Five-Year Review Report

Third Five-Year Review Report
for
Iron Mountain Mine Superfund Site
Redding, California

September 2003

Prepared By:
United States Protection Agency
Region 9
San Francisco, CA

Approved by: **Date:**

Elizabeth J Adams   September 30, 2003

Elizabeth J. Adams
Chief, Site Clean-up Branch
Superfund Division
U.S. EPA Region 9

Table of Contents

Executive Summary

The interim remedy for the Iron Mountain Mine Superfund site near Redding, California consists of a combination of source control, acid mine drainage treatment and water management components including water diversions and coordinated releases of contaminated surface water from Spring Creek Debris dam into releases of dilution flows from Shasta Dam. The remedies selected in the 1986, 1992 and 1993 Records of Decision have been implemented and are operating as intended. The remedy for the 1997 Record of Decision is currently under construction and is anticipated to be completed in December 2003. The final two operable units at the site, for the sediments and for Boulder Creek area-wide sources, are currently in the Remedial Investigation and Feasibility Study phase of the process. They are expected to have a Record of Decision by December 2004 and September 2005, respectively.

This is the third Five-Year review for the Iron Mountain Mine site. The trigger for the first five-year review was the start of construction of the “partial cap” in September 1988. The first five-year review was completed September 30, 1993 and the second five-year review was completed October 8, 1998.

The assessment of this Five-Year review found that the three remedies are operating as intended and the operation and maintenance at the site have been satisfactory over the past five years. The actions to date have resulted in over an 88% reduction in copper loading discharges and a 95% reduction in zinc loading discharges. It is expected that after the remedy from the 1997 Record of Decision is complete, the metal loading discharges from the site will be reduced by more than 95%.

Because the three interim response actions implemented to date do not fully address all the discharges of acidity, copper, cadmium and zinc at the Iron Mountain Mine site, the interim remedy is fully protective of human health but not the environment at this time.

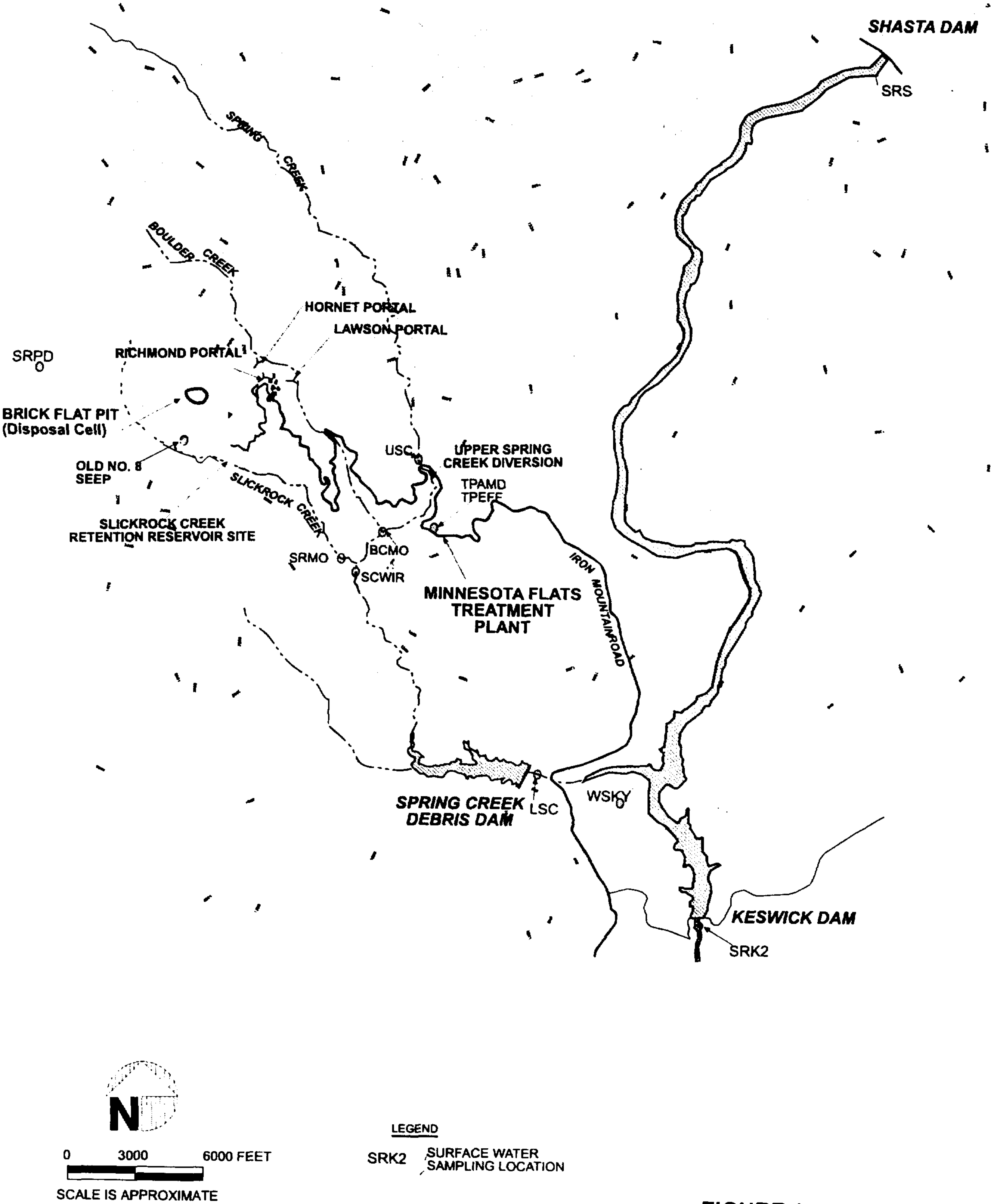


FIGURE 1
LOCATION MAP
IRON MOUNTAIN MINE FIVE YEAR REVIEW

IMMMAP - 5 Yr Review.FH8

List of Involved Parties at Iron Mountain Mine

EPA	United States Environmental Protection Agency is the lead governmental agency for the clean-up at Iron Mountain Mine
CH2M Hill	EPA's technical contractor
State of California (DTSC & RWQCB)	The State of California, through its Department of Toxic Substances Control (DTSC) and its Regional Water Quality Control Board (RWQCB), acts as the supporting governmental agency at Iron Mountain Mine.
USBR	The U.S. Bureau of Reclamation has acted as EPA technical advisor at the site and is the federal land manager responsible for operating the Central Valley Project which includes Shasta, Keswick and Spring Creek Debris dams which are part of the remedy for the site.
DFG	Department of Fish and Game has served on the technical advisory committee as trustee for the fishery resources.
NOAA	National Oceanic and Atmospheric Administration has served on the technical advisory committee as the federal trustee for the anadramous fishery resources in the Sacramento River (i.e. salmon and steelhead trout) and their critical habitat.
Aventis Crop Sciences, Inc.	Responsible company for clean-up. Aventis Crop Sciences (or companies acting on its behalf) conducted various investigations and remedy construction until a final settlement was reached in Dec. 1999. Aventis Crop Sciences left the site in Dec. 2000
Rhone-Poulenc	Former name of Aventis Crop Sciences, Inc.
Stauffer Chemical Co.	Former owner/operator of Iron Mountain Mine who was bought out by Rhone-Poulenc
AIG Consultants, Inc.	Company responsible for performing Site Operator responsibilities since Dec. 2000.

List of Acronyms

AMD	Acid mine drainage
cfs	cubic feet per second
CTR	California Toxics Regulation
DFG	Department of Fish and Game
EPA	Environmental Protection Agency
IMM	Iron Mountain Mine
NOAA	National Oceanic and Atmospheric Administration
O&M	Operation and Maintenance
OU	Operable Unit
ppb	parts per billion
ROD	Record of Decision
RWQCB	Regional Water Quality Control Board
USBR	U.S. Bureau of Reclamation

List of Attachments

1) "Previous Five-Year Review Recommendations," John Spitzley (CH2M Hill) September 23, 2003

2) "Interview Summaries for IMM 5-Year Review Interviews," Valentina Cabrera-Stagno (EPA), July-August 2003

3) "Minnesota Flats Treatment Plant Audit," Jim Stefanoff, Bill Murdock (CH2M Hill) September 22, 2003

4) "Minnesota Flats Treatment Plant Effluent Discharge" John Spitzley, Tony Jaegel (CH2M Hill) September 18, 2003

5) "Site Evaluation and Compliance at Keswick Dam, Iron Mountain Mine Five-year review," John Spitzley (CH2M Hill), September 15, 2003

6) "Site Inspection" Dale Cannon, Dave Bunte, and John Spitzley (CH2M Hill), September 22, 2003

Iron Mountain Mine
Redding, California
Third Five-Year Review Report

I. Introduction

The purpose of this five-year review is to determine whether the remedial actions implemented at the Iron Mountain Mine site are protective of human health and the environment. The methods, findings, and conclusions of the review are documented here. In addition, this Five-Year Review report identifies issues found during the review, if any, and recommendations to address them.

The Agency is preparing this five-year review pursuant to CERCLA Section 121 and the National Contingency Plan. CERCLA Section 121 states:

> "If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgement of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews."

The agency interpreted this requirement further in the National Continency Plan; 40 FAR Section 300.400(f)(4)(ii) states:

> "If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action."

The United States Environmental Protection Agency (EPA) Region 9 has conducted a five-year review of the remedial actions implemented at the Iron Mountain Mine site near Redding, CA. This review was conducted from May 2003 through September 2003. This report documents the results of the review.

This is the third Five-Year review for the Iron Mountain Mine site. The triggering action for the first Five-Year review was the date of the start of construction of the "partial cap" in September 1988. Response is still ongoing at this site, and all hazardous materials, pollutants or contaminants have not been removed. The first five-year review was completed September 30, 1993 and the second five-year review was completed October 8, 1998.

I. Site Chronology

Table 1 - Site Chronology

Event	**Date**
Iron Mountain Mine listed on the National Priority Listing "Superfund List"	1983
Operable Unit (OU) 1 – "Site-wide": Richmond partial cap, Brick Flat Pit cap, Slickrock Creek diversion, Upper Spring Creek diversion	
Remedial Investigation and Feasibility Study of options completed	1985
Additional feasibility study completed	1986
Record of Decision selecting remedy signed	1986
Upper Spring Creek Diversion completed (final required component of remedy)	1991
OU2 – "Boulder Creek": Richmond and Lawson adits AMD treatment, consolidation of seven waste piles and capping, construction of sludge disposal cell	
Remedial Investigation and Feasibility Study of options completed	1992
Record of Decision selecting remedy signed	1992
Aerated Simple Mix component of treatment plant completed	1994
High Density Sludge component of treatment plant completed	1997
Emergency Storage Facility for treatment plant completed (final required component of remedy)	2000
First Five-Year Review	1993
OU3 – "Old Mine/No. 8 Seep OU": seep discharge treatment	
Remedial Investigation and Feasibility Study of options completed	1993
Record of Decision selecting remedy signed	1993
Emergency Storage Facility for treatment plant completed (final required component of remedy)	2000
OU4 – "Water Management OU": Dam and treat runoff from Slickrock Creek	
Remedial Investigation and Feasibility Study of options completed	1994
Additional feasibility study completed	1996
Record of Decision selecting remedy signed	1997

Slickrock Creek Retention Reservoir projected completion	Mar 2004
Second Five-Year Review	1998
Third Five-Year Review	2003
OU5 – Sediments	
Projected completion of the Remedial Investigation and Feasibility Study	Mar 2004
Projected completion of the Record of Decision selecting remedy	Dec 2004
OU6 – Boulder Creek Area Sources	
Projected completion of the Remedial Investigation and Feasibility Study	Mar 2005
Projected completion of the Record of Decision selecting remedy	Sept 2005

III. Background

Iron Mountain is located in Shasta County, California, approximately 9 miles northwest of the City of Redding. The collection of mines on Iron Mountain is known as Iron Mountain Mine (IMM). They are the southernmost mines in the West Shasta Mining District and have been periodically worked for production of silver, gold, copper, zinc, and pyrite. The mine area includes extensive underground workings, side hill and open pit mining areas, waste rock dumps and tailings piles.

The IMM site includes approximately 4,400 acres of land that includes the mining property on Iron Mountain, several inactive underground mines, an open pit mine, areas that were mined by side hill mining activities, other areas disturbed by mining or mineral processing activities, numerous waste dumps, process tailings piles, abandoned mining facilities, mine drainage conveyance and treatment facilities, and the downstream reaches of Boulder Creek, Slickrock Creek, Spring Creek, Spring Creek Reservoir, Keswick Reservoir, and the Sacramento River affected by drainage from Iron Mountain Mine.

Several, and possibly all, of the mines and the waste rock and tailings piles are discharging acidic waters, typically with a high content of heavy metals. These discharges are herein referred to collectively as acid mine drainage, or AMD. The largest source of heavy metal laden AMD is the Richmond Mine, and the second largest is the Hornet Mine, both of which drain into Boulder Creek. The third largest source, Old/No. 8 Mine Seep, drains into Slickrock Creek. These severe AMD discharges derive from hydro-geochemical reactions in the inactive underground mine workings and are the direct result of the mining activity that took place in these deposits over many decades.

The remaining IMM heavy metal discharges derive from widely dispersed area-wide sources. The discharges from these sources are closely associated with heavy rainfall and high runoff storm events. The IMM area discharges derive from waste piles, process tailings, sidecast spoils, ground disturbed by mining-related activities, discharges from buried workings or partially accessible workings, contaminated soil and debris, seeps, contaminated interflow and groundwater, and contaminated sediments in the Slickrock Creek, Boulder Creek and Spring Creek watersheds at IMM.

The IMM site was listed on the National Priorities List in September of 1983. Since that time, EPA , with State support, conducted its remedial investigation to characterize the nature and extent of contamination at the Site. EPA has issued four Feasibility Studies and two Feasibility Study Addenda to support four Records of Decision (RODs) for the IMM site.

In 1989, EPA identified Aventis Crop Sciences, Inc. (formerly known as Rhone-Poulenc, Inc.) as the successor to Stauffer Chemical Company, a former owner/operator of the IMM site. Stauffer Management Company, on behalf of Aventis Crop Sciences, Inc. performed certain cleanup work at IMM in response to seven EPA unilateral administrative orders. EPA and the State settled our cost recovery litigation with Aventis Crop Sciences, Inc. in December 2000. Pursuant to the settlement, AIG Consultants, Inc., on behalf of Aventis Crop Sciences, Inc., will perform the operations and maintenance of the remedial actions implemented pursuant to the four IMM RODs for thirty years.

Basis for Taking Action

The fishery resources, other aquatic species and the ecosystem of Keswick Reservoir and the Sacramento River below Keswick Dam are the primary natural resources at risk to uncontrolled IMM heavy metal discharges. The contaminants of concern identified by EPA are acidity and toxic metals, which include copper, cadmium and zinc. All of these contaminants are present in the AMD discharges from the underground, sidehill and open pit mine workings at IMM, and the AMD discharges from area sources in the Slickrock Creek and Boulder Creek watersheds at IMM. Both the exceedances of water quality standards and the accumulation of toxic sediments downstream of IMM contribute to the unacceptable risks to species in the areas impacted by IMM releases.

The National Oceanic and Atmospheric Administration has listed the Upper Sacramento River as the most important salmon spawning ground in California. Four species of chinook salmon, steelhead trout and other aquatic species depend on the Upper Sacramento River as critical habitat. The Winter Run Chinook Salmon has been listed as an endangered species. The Late Fall and Spring Run Chinook Salmon have been listed as threatened species. The Steelhead are also listed as threatened species.

IV. Remedial Actions

Remedial Action Objectives

The overall objective of EPA's IMM Superfund cleanup program is to eliminate the AMD discharges that are harmful to public health and the environment. EPA has identified three primary goals for the IMM Superfund remedial action:

- Comply with water quality criteria established under the Clean Water Act and the California Porter-Cologne Water Quality Act (standards are set forth in the Basin Plan and statewide plans). These standards were established to protect the valuable Sacramento fishery and aquatic ecosystems. Prior to signing of the 1997 ROD, the Basin Plan called for a water quality standard of 5.6 ppb dissolved copper as an instantaneous maximum exposure. After the 1997 ROD was signed, the State's Inland Surface Water Plan was vacated by the court and EPA promulgated the California Toxics Rule (CTR) standards to replace the standards in that plan. The CTR left site specific standards in place for the Sacramento River above Hamilton City, but promulgated new criteria for chronic exposures for this same reach of the Sacramento River. The standards for dissolved copper that are currently applicable in the Sacramento River above Hamilton City are 5.6 ppb as a maximum exposure and 4.1 ppb as a 96-hour, chronic average standard.
- Reduce the mass discharge of toxic heavy metals through application of appropriate control technologies.
- Minimize the need to rely on special releases of valuable water resources to dilute continuing IMM contaminant discharges in order to assure attainment of protective water quality criteria.

EPA has concluded that a combination of source control, treatment, and water management components are needed to assure an effective, implementable and cost-effective cleanup program for the IMM AMD discharges.

<u>1986 Record of Decision, Site-wide</u>

Remedy Selection

The 1986 ROD selected an interim remedy that identified a number of specific projects. These projects included the construction of a partial cap over the Richmond mineralized zone, including capping Brick Flat Pit (the open pit mine on top of Iron Mountain), and several subsidence areas; construction of a diversion of Slickrock Creek to avoid a mining waste slide; construction of a diversion of the Upper Spring Creek to avoid polluting its cleaner water and filling Spring Creek Reservoir; construction of a diversion of the South Fork of Spring Creek for a similar purpose; a study of the feasibility of filling mine passages with low-density Cellular Concrete; and an enlargement of Spring Creek Debris Dam, the exact size of which would be selected after a determination of the effectiveness of the other remedies.

Remedy Implementation

On July 19, 1988, EPA initiated construction of the partial cap in seven subsidence areas over the Richmond mineralized zone. EPA also capped the lower portion of Brick Flat Pit, the open pit mine on top of Iron Mountain. As part of that construction, EPA used tailings materials from the Minnesota Flat area, as well as select other tailings piles that contained relatively high concentrations of copper, cadmium, and zinc. EPA completed construction of the partial cap in July 1989.

EPA, through an interagency agreement with the USBR, began construction of the Slickrock Creek diversion in July 1989 and completed construction in January 1990. The diversion consists of a small stilling pool and diversion dam, a 36-inch diameter, urethane-lined, concrete pipeline approximately one mile in length and an energy dissipation structure to remove the kinetic energy of the diverted flows prior to their return to lower Slickrock Creek.

Under Order from EPA, Aventis Crop Sciences began construction of the Upper Spring Creek diversion in July 1990 and it was operational in January 1991. The Upper Spring Creek Diversion consists of a large grated drop inlet structure (that prevents large rocks and debris from entering the diversion while allowing the creek flows to drop into a rock trap and then into a short tunnel), a 54-inch diameter, urethane-lined concrete pipeline several thousand feet in length, and an impact structure to dissipate the kinetic energy of the diverted flows prior to discharging them to Flat Creek.

EPA is not proposing implementation of the South Fork of Spring Creek Diversion nor to enlarge the Spring Creek Debris Dam at this time. In EPA's 1997 ROD for the IMM site, EPA determined that a "dam and treat" remedial approach is technically practicable for the Slickrock Creek area source AMD discharges and that similar controls are available for the discharges from the Boulder Creek watershed at IMM. EPA determined that the significant additional reduction in IMM heavy metal discharges, at potentially reduced cost from the proposed South Fork of Spring Creek Diversion or enlargement of the Spring Creek Debris Dam, is preferable to water management alternatives.

Operation and Maintenance

The components of this remedial action, and all subsequent ones, are currently operated and maintained by AIG Consultants, Inc., pursuant to the settlement of EPA's and the State's cost recovery litigation for the IMM Superfund cleanup on December 18, 2000. Routine inspection and maintenance activities are ongoing. Under the terms of a memorandum of understanding with the State of California, EPA is currently performing oversight of the performance of O&M activities by AIG Consultants, Inc. EPA's contractor, CH2M Hill, regularly performs site inspections, and performs a comprehensive site inspection at least annually. CH2M Hill collects water quality data to assess the ongoing performance of the remedy on a weekly basis during the winter rainy season and on a monthly basis during the dry summer season.

No significant or special operations and maintenance efforts were required subsequent to completion of removal of the Minnesota Flats tailing pile; the construction of the Brick Flat Pit cap, the subsidence area partial caps, and related surface water controls; and the construction of the Slickrock Creek Clean Water Diversion.

The Upper Spring Creek Diversion has functioned as designed to effectively divert up to 800 cfs of clean water into Flat Creek, providing additional storage of contaminated water in the downgradient Spring Creek Reservoir. However, the urethane pipeline lining system has deteriorated over the past 12 years since it was constructed. A stilling basin was excavated in the creek bed upstream of the diversion inlet trashrack in 2000 to settle out small rocks and gravels to reduce the erosion of the lining system. This stilling basin has been very effective in reducing the erosion of the lining system. EPA is currently reviewing the need to repair or replace the urethane lining system to assure the long-term effectiveness and reliability of the Upper Spring Creek Diversion pipeline.

The Brick Flat Pit cap was subsequently modified to permit EPA to incorporate the cap into the landfill liner system selected in EPA's 1992 ROD, as discussed below. The Slickrock Creek diversion is in the process of being modified to incorporate the diversion into the Slickrock Creek Retention Reservoir clean water diversion selected in EPA's 1997 ROD.

1992 Record of Decision, Boulder Creek

Remedy Selection

The 1992 ROD selected treatment of the AMD discharges from the Richmond and Lawson adits in a lime neutralization treatment plant. EPA's 1992 ROD also selected the consolidation and capping of seven waste piles in a landfill to be located on the site. The 1992 ROD provided for disposal of the IMM treatment plant sludges in a landfill to be constructed in the inactive open pit mine, Brick Flat Pit, to meet regulatory requirements for this use.

Remedy Implementation

EPA constructed the treatment plant (which includes an aerated simple mix and a high density sludge components) through a combination of an enforcement action and fund-lead design and construction. Aventis Crop Sciences began construction of the aerated simple mix components of the treatment plant in the late summer of 1993 and completed the construction of it in September 1994. Aventis Crop Sciences also constructed the associated support facilities, including the AMD collection and conveyance system, the sludge drying beds, roadway improvements and the sludge landfill in Brick Flat Pit. Aventis Crop Sciences did not complete the construction of required emergency storage facilities until September 2000. EPA designed the high density sludge modifications to the treatment plant, and constructed them from the spring of 1996 to January 1997. In 2002, the Brick Flat Pit dam was raised which provided an additional 25 to 30 years of storage capacity for treatment sludge.

Under order from EPA, Aventis Crop Sciences excavated, consolidated and capped seven largely pyritic waste piles in a disposal cell located on site at IMM. The landfill was designed to comply with California mining waste requirements.

Operation and Maintenance

The treatment plant operation and maintenance has been performed by representatives of Aventis Crop Sciences until December 2000. Under the terms of the settlement, AIG Consultants, Inc. has assumed responsibility for performing operation and maintenance of the treatment plant for thirty years. Under the terms of a Memorandum of Understanding with the State of California, EPA is responsible for oversight of AIG Consultants, Inc.'s ongoing O&M activities. EPA regularly monitors several aspects of treatment plant operation, including process parameters and influent and effluent flow rate and water quality. EPA also conducts periodic inspections of the physical condition of the treatment plant. Routine maintenance activities are ongoing.

The treatment plant has been very effective in reducing the IMM heavy metal discharge. The treatment process removes more than 99.9 percent of all metals from the AMD flows that are delivered to the treatment plant for treatment. With the operation of the full scale IMM treatment plant since September 1994, the IMM copper discharge is reduced by greater than 80 percent and the zinc and cadmium discharges are reduced by greater than 90 percent from historic levels on an overall basis. During the period from 1999 through 2003 EPA's remedial action at IMM prevented the discharge of approximately 640,000 pounds of copper and approximately 2,350,000 pounds of zinc by treating approximately 570 million gallons of concentrated acid mine drainage.

During the past five years, the treatment plant has had the following major work done:

- The thickener was re-coated and cathodic protection was installed.
- The million gallon Emergency Storage Tank was added
- The hydraulic capacity of the treatment plant was upgraded to handle the incoming flows from the future Slickrock Retention Reservoir

The collection and conveyance system has in general operated effectively over this time period.

1993 Record of Decision, Old Mine/No. 8 Seep

Remedy Selection

In the 1993 ROD, EPA selected treatment of the AMD discharges from the Old/No. 8 Mine Seep at the IMM treatment plant, as appropriately modified.

Remedy Implementation

Under Order from EPA, Aventis Crop Sciences designed and constructed the facilities to collect and convey AMD from Old Mine/No 8 to the treatment plant. Aventis Crop Sciences also constructed the necessary aerated simple mix components to the treatment plant by September 1994. EPA constructed the high density sludge modifications to the treatment plant, which became effective in January 1997. Aventis Crop Sciences did not complete the construction of required emergency storage facilities until September 2000.

Operation and Maintenance

See Operation and Maintenance section under 1992 ROD above for further analysis of the operations and maintenance of the treatment of these flows.

1997 Record of Decision, Water Management

Remedy Selection

The remedial alternative selected in the 1997 ROD includes the construction of a small dam in Slickrock Creek, clean water diversions, upgrades to the AMD conveyance pipeline, upgrades to the treatment plant, and a short tunnel to discharge the high volumes of treated water to Spring Creek.

Remedy Implementation

Under an enforcement action, Aventis Crop Sciences designed a 150-foot, earthen dam in the Slickrock Creek Watershed, just downstream of the largest hematite pile. The design was completed in June 2000. As part of the settlement of EPA's and the State's cost recovery litigation in December 2000, EPA and the State agreed to assume responsibility for construction of the Slickrock Creek Retention Reservoir and other remaining components of the 1997 ROD. EPA started construction in June 2001. A major landslide above the right abutment of the dam during the winter of 2002 delayed the expected completion of the construction until December 2003 to allow for work to stabilize the landslide. The construction is currently on schedule to be completed by December 2003 and testing completed by March 2004.

The hydraulic upgrades to the treatment plant, the AMD conveyance pipelines from the Slickrock Retention Reservoir; the Iron Mountain roadway and culvert upgrades, and the discharge tunnel from the treatment plant to Spring Creek were completed by Aventis Crop Sciences by September 2000.

Operation and Maintenance

Once start-up and shakedown testing is complete, operation and maintenance of the remedy will be assumed by AIG Consultants, Inc. with oversight provided by EPA.

V. Progress Since Last Report

At the time of the last Five-Year review, the interim response actions had not addressed all sources of contamination at Iron Mountain Mine and discharges, though partially controlled, were continuing. Therefore, the previous team concluded that the remedy was not fully protective at that time.

During the past five-year period, through a combination of enforcement and fund-lead approaches, EPA designed and initiated construction of the remedy selected in EPA's 1997 ROD. As discussed above, EPA expects to complete construction of the major remaining component of this remedy, the Slickrock Creek Retention Reservoir, in December 2003. This remedy is expected to come on-line this wet season, and will provide for 95 percent control, on an overall basis, of the historic IMM AMD discharges.

EPA and the State reached a settlement of the ongoing IMM cost recovery litigation in December 2000. The settlement assures that the remedial actions selected in EPA's 1986, 1992, 1993 and 1997 RODs will be operated and maintained in perpetuity. Under the terms of the settlement, Aventis Crop Sciences arranged for AIG Consultants, Inc. to perform operations and maintenance activities at IMM for 30 years. Aventis Crop Sciences also entered into a Guaranteed Investment Contract with AIG, the parent corporation of AIG Consultants, Inc,. to provide for a payment of $514 million to the Governments at year 30 to fund operation and maintenance activities beyond the initial 30 year period. Under the terms of a Memorandum of Understanding with the State of California, EPA will perform oversight of AIG Consultants, Inc. operation and maintenance activities.

The settlement also provides funding for several site improvements, including rehabilitation of the underground workings in the Richmond Adit, the construction of the Phase II Brick Flat Pit Dam Raise to provide additional landfill capacity for treatment plant sludge, construction of a muck disposal cell for mine wastes generated by water flow through the mines, re-lining and installation of cathodic protection for the thickener tank, and the construction of improvements to the Boulder Creek Tailings Dam.

The State of California was the lead for the design and construction of the Richmond Adit and Drifts Rehabilitation that will assure safe access for workers and equipment to regularly maintain the workings and assure AMD collection. This work started in September 2001 and was completed in September 2003. The completion of this project eliminates the largest identified risk for an uncontrolled spill at the site, by ensuring the AMD collection system at the Richmond Mine is reliable.

The Brick Flat Pit Phase II Dam Raise, the construction of the Muck Cell and the re-lining and installation of cathodic protection for the thickener tank were completed in 2003 under EPA oversight. The design of the improvements to the Boulder Creek Tailings Dam is nearing completion with construction expected to be completed in 2003.

Status of Recommendations

CH2M Hill prepared a technical memo on the status of the recommendations from the previous five-year review, "Previous Five-Year Review Recommendations" dated September 23, 2003 which is attached. Each recommendation has been addressed. The ongoing inspection and maintenance requirements recommended in the last five-year review were completed as recommended and were codified for future years in the settlement agreement in December 2000. The recommended upgrades to the treatment plant to handle increased flows have been made and the upgraded system passed the operation test in August 2003.

The last five-year review recommended that EPA closely coordinate our ongoing work with Mr. T.W. Arman, the current property owner to assure the reliability of EPA's ongoing operation and maintenance activities. Operating under an existing Court order, EPA has been successful in assuring access for EPA representatives to reliably perform site operations and maintenance activities, and to assure that activities being performed by Mr. Arman or his representatives did not interfere with EPA's work.

The last recommendation suggested that EPA evaluate promising technologies for AMD reduction. Over the past five years, EPA has been contacted by numerous vendors and the current property owner regarding proposals for implementing innovative control, treatment and resource recovery technologies at IMM. EPA has carefully reviewed the proposals. However, EPA has concluded that, to date, none of the proposed new AMD control, treatment or resource recovery options would be appropriate for the IMM discharges. EPA will continue to explore potential options to long-term treatment.

Status of any other prior issues

The IMM remedial actions selected and implemented to date collectively constitute an interim remedial action and do not address all of the AMD discharges from the Site.

Sediments - EPA is currently studying the contaminated sediments down gradient from IMM located in Spring Creek Reservoir, the Spring Creek arm of Keswick Reservoir and the main channel of Keswick Reservoir. Based upon EPA's remedial investigation, it is clear that these contaminated sediments pose a threat to the environment. These contaminated areas are devoid of benthic communities or the benthic communities are severely impaired. Additionally, the fine-grained sediments located in the Spring Creek arm of Keswick Reservoir could become entrained in flood waters, spills from the Spring Creek Debris Dam, or power plant discharges. The release of these sediments may pose a threat to the valuable salmon spawning grounds of the upper Sacramento River. EPA expects to complete the Remedial Investigation and the Feasibility Study and ROD in March 2004 and December 2004, respectively.

Boulder Creek Area Sources - EPA continues to study the discharges from the area sources in the Boulder Creek watershed. These discharges constitute approximately 5 percent, overall, of the historic IMM discharges of copper and zinc. EPA expects to complete the Remedial Investigation and the Feasibility Study in September 2005.

Matheson Waste Pile - EPA is proceeding with the design for the removal action at the Matheson Waste Piles to excavate and properly dispose of the waste on-site. EPA expects the removal action will be completed by 2005.

VI. Five-Year Review Process

Administrative Components

Stakeholders and members of the community were notified of the initiation of the five-year review process in the fact sheet dated August 2003.

The Iron Mountain Mine five-year review was conducted by an EPA team of Cynthia Wetmore, Rick Sugarek, and Valentina Cabrera-Stagno, along with a CH2M Hill team of Caroline Ziegler, John Spitzley, Bill Murdock, Jim Stefanoff, Dale Cannon, Dave Bunte, Doris Powers and Tony Jaegel. The State of California reviewed and provided comments on this report. A site inspection, independent audit of the treatment plant, water quality analysis, review of status of previous five-year review, and interviews were conducted for this five-year review.

Community Involvement

Telephone interviews were conducted during the months of July and August with the following people: Annette Rardin (neighbor), Laurie Sullivan (NOAA), Jim Pedri (RWQCB), Dianne Wisniewski (USBR), and Harry Rectenwald (DFG). A summary of the questions and responses are attached. Generally, most interviews were positive about the work at the site and the communication. Ms. Rardin has been concerned about the traffic associated with the work at the site, and the physical changes in the creek in her backyard due to the work at the site.

Ms. Sullivan, Mr. Pedri, Ms. Wisniewski and Mr. Rectenwald were asked to address the appropriateness of the current water quality standards at Keswick and the potential application of the lower California Toxics Rule 96-hour chronic average standard once EPA's 1997 ROD's remedial action is completed. These agency representatives believe that the water quality standards are protective and appropriate, and expect to be involved in negotiating a revised agreement to set out operating procedures for Keswick, Shasta and Spring Creek dams related to management of ongoing IMM discharges. The agency representatives also expressed concern regarding the higher than expected metal loading in the Shasta Dam water releases which are relied on to dilute the metal discharges from Spring Creek Debris Dam. Ms. Wisniewski and Mr. Pedri discussed the water management difficulties in achieving the water quality standards due to upgradient conditions. Ms. Sullivan and Ms. Rectenwald reiterated the appropriateness of these standards as protective for the winter-run chinook salmon.

Data Review

This five-year review consisted of a review of relevant documents including O&M records and monitoring data. The relevant technical memoranda are identified in this review where applicable and are attached in full.

<u>Treatment Plant Audit</u>

CH2M Hill personnel familiar with the operations of the treatment plant performed an audit on the treatment plant operations and maintenance program on August 27th and 28th, 2003. The technical memorandum documenting their findings, "Minnesota Flats Treatment Plant Audit" dated September 22, 2003, is attached.

Pursuant to the settlement agreement, EPA set dissolved copper, zinc, and cadmium water quality standards for the effluent that were intended to reflect proper operations of the high density sludge treatment plant. EPA recognized at that time that there were limited data and agreed to revisit the standard once operational experience was gained.   One significant finding of the audit is that the effluent often appears not meet the maximum concentration limits, and the rolling seven-day and thirty-day averages for dissolved copper and dissolved zinc even though the plant is properly operated. EPA and the Site Operator have previously identified this issue for review. The data collected by the Site Operator indicates that the effluent appears not to consistently meet the effluent standards, while data acquired by EPA's contractor indicate that plant performance was much better. The results of EPA's investigation are documented in the technical memo, "Minnesota Flats Treatment Plant Effluent Discharge", dated September 18, 2003, which is attached.

The investigation concludes that the treatment plant is capable of meeting the current dissolved copper effluent standards, and that the reported copper exceedances indicated by the Site Operator's data are in error. This error is likely attributable to the use of inappropriate laboratory testing methodologies for the dissolved copper. Comparative sampling with more appropriate analytical methods with lower detection limits indicate that the plant is operating properly and that the plant effluent meets the dissolved copper standard.

The investigation also indicates that the analytical method currently employed by Site Operator may be unable to accurately report at the low levels of dissolved zinc in the treatment plant effluent. Comparative sampling with appropriate analytical methods with lower detection limits indicates that the plant is discharging significantly less dissolved zinc than reported by the Site Operator. However, this improved data indicate that the plant effluent, though being operated properly, may not be able to meet the dissolved zinc standards set by EPA. The investigation suggests that the exceedances of the dissolved zinc standards may be, at least in part, attributable to the zinc anodes that were recently installed to provide cathodic protection for the thickener tank. Additional data are required to determine the impact of the removal of the zinc anodes on the quality of the plant effluent. This is being further investigated by CH2M Hill. Based upon the results of the further study, EPA may consider revising the zinc effluent standards to more accurately reflect the best available technology standards for the high density sludge treatment plant.

The auditors identified a few areas for improvement. They recommended updating the O&M manual in anticipation of when the more dilute Slickrock Creek Retention Reservoir water is added to the current AMD for treatment. They also recommended a stand-alone Emergency Response Plan and computerized maintenance tracking system be installed.

Water Quality at Sacramento River below Keswick Dam

The U.S. Bureau of Reclamation (USBR) routinely samples the water releases from the Spring Creek Debris Dam, Shasta Dam and Keswick Dam. Sampling is conducted on a weekly basis, and more frequently during storm events or uncontrolled releases from Spring Creek Debris Dam. During the past five years, the dissolved copper concentrations in the Sacramento River below Keswick exceeded the 5.6 ppb instantaneous maximum limit for 15 days out of the 256 days when samples were collected. CH2M Hill reviewed and summarized the data in the technical memorandum “Site Evaluation and Compliance at Keswick Dam, Iron Mountain Mine Five-year review” dated September 15, 2003, which is attached.

EPA does not believe that it would be appropriate or protective to operate Shasta Dam, Keswick Dam and Spring Creek Debris Dam to attempt to meet the chronic, 96-hour, chronic average standard (4.1 ppb for copper) until the remedy selected in the 1997 ROD becomes operational. The USBR has not altered its operations to attempt to meet the 4.1 ppb dissolved chronic copper standard. Once the 1997 ROD’s remedy is in operation, EPA expects the 1980 Memorandum of Understanding between the State and the USBR to be renegotiated to define the manner in which dams will be operated to meet water quality standards in the upper Sacramento River. Over the past five years, with USBR operations focused on meeting the 5.6 ppb maximum copper standard, there were more than 72 days when the dissolved copper exceeded the chronic exposure limit of 4.1 ppb below Keswick. Sampling frequency was not increased to determine the number of exceedances on a 96-hour basis.

CH2M Hill performed a statistical analysis to estimate the contribution of the copper concentration from Shasta Dam water releases to the copper concentration in waters below Keswick Dam. The analysis indicates that during peaks in copper concentrations, approximately 65% of the copper below Keswick Dam was attributable to copper concentration from the Shasta Dam releases.

Recent work done by the Central Valley Regional Water Quality Control Board (RWQCB) on metals distribution within Shasta Lake indicates copper and zinc are not uniformly distributed throughout the water column. Data presented in the staff report titled *Interim Report, Metals Distribution Within Shasta Lake, Shasta County, California*, May 2003, suggest that copper and zinc concentrations are higher in the upper portion of the water column in the winter period. The RWQCB anticipates gathering additional data to further characterize the presence of metal concentrations in Shasta Lake. The data will be useful in evaluating the possibility of discharging waters from selected depths in the water column containing metals using the temperature control device on the upstream face of the dam during critical periods, while having minimal impact on preservation of the deep cold water pool necessary for summer operations.

The RWQCB is also working with the owners of the abandoned copper mines, Mining Remedial Recovery Company, which discharge metals into Shasta Lake. Significant reductions have occurred in the metal loading from West Squaw Creek to Shasta Lake. The RWQCB has requested Mining Remedial Recovery Company begin to focus efforts on discharges of AMD to Little Backbone Creek, where a significant percentage of the metal loading to Shasta Lake occurs.

Site Inspection

CH2M Hill conducted an overall site inspection on July 29, 2003. The technical memorandum “Site Inspection” dated September 22, 2003, is attached. This inspection included site roads, slopes, tanks, discharge works, sludge drying beds, the AMD Collection and Treatment system, Brick Flat Pit, Upper Spring Creek Diversion, and Boulder Creek Tailing Dam. The treatment plant inspection was performed separately. It was concluded that the site was generally well-maintained, but there were a few items that need to be addressed to improve the operation of the site. These are as follows:

- Continue follow-up with Shasta County for the repair of Iron Mountain Road between Flat Creek bridge and the entrance gate.
- Seal the pavement cracks (alligatoring) occurring along and on the plant road between the entrance gate to a location below drying bed number 4. This is planned to occur after the sludge haul.
- Fill the gullying that is occurring on the uphill slopes of drying bed numbers 1 and 2 and on the downslopes of sludge drying bed numbers 3 and 4 and seed the bare areas. Improve the drainage in these areas to reduce the reoccurrence of the gullying.
- Complete the removal of the scale material in the AMD conveyance pipelines.
- Review the temporary drainage plan for the clean water diversion from the upper Slick Rock Creek basin. Provide temporary diversions to avoid damage to the access road and downstream construction particularly if the construction is not complete prior to the rainy season.
- Review the temporary drainage plans around the borrow and storage sites (near markers 12 and 18) along Iron Mountain Road. Clean culverts and construct drainage ditches.
- Complete the Boulder creek tailings dam protection project
- Continue the study and demonstration of alternative repair materials for lining the Spring Creek diversion pipeline.
- Complete the scour protection on the Spring Creek Diversion impact structure.
- Consider installing the remaining horizontal drains in the Boulder Creek slide area.
- Replace the exposed PVC pipe at the ends of the horizontal drains with non-UV sensitive pipe.
- Determine the contents of the fluid in the chemical storage tanks across the road from the cementation plant and provide proper containment if required or properly dispose of the contents.
- Remove sediments above the Boulder Creek sampling station and above the Spring Creek diversion. These are routine planned activities.

VII. Technical Assessment

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

The review of site documents and water quality data, and the results of site inspection and treatment plant audit indicate that the remedy is functioning as envisioned in the decision documents.

The objective of the remedial actions selected in EPA’s four Records of Decision is to protect the fishery resources and ecosystem of the Sacramento River from copper, zinc and cadmium discharges from IMM, by a combination of source control, treatment and water management. The analysis in the decision documents estimated that these standards will be met except in rare wet years (estimated to be one in every thirty years after the remedy in the fourth Record of Decision is implemented.)

The collection and treatment of the AMD from the Richmond, Lawson and Old Mine/No 8 adits has reduced the metal loading discharge over the past five years by 88% for copper and 95% for zinc. The clean water diversions at Spring Creek and Slickrock Creek have been effective: controlling discharges from sources in the Slickrock Creek watershed, and minimizing the volume of contaminated water in the Spring Creek Reservoir, increasing the effectiveness of USBR water management operations. The improved effectiveness of water management by USBR at Spring Creek Debris dam resulted in only 15 days in the past five years when the dissolved copper instantaneous maximum standard was exceeded.

Question B: Are the exposure assumptions, toxicity data, clean-up levels, and remedial action objectives used at the time of the remedy selection still valid?

The exposure assumptions remain the same. There is no new toxicity data. The instantaneous maximum metal standards remain the same. However, cleanup standards were expanded by EPA's promulgation of the California Toxics Rule to include a chronic standard in addition to the instantaneous maximum standards that are included in the Basin Plan. At the time of the 1997 ROD, the chronic exposure limits had been proposed and the impact of these lower limits on was discussed in the 1997 ROD.

EPA's four Records of Decision rely on toxicity data developed by the State of California that formed the basis for the protective water quality standards adopted by the State of California in the Basin Plan. Due to a court decision vacating the State's Inland Surface Water Plan, EPA has promulgated the California Toxics Rule that now sets chronic standards for the dissolved metals in the Sacramento River above Hamilton City. The addition of the 96-hour, chronic average standard was determined through a calculational methodology from the instantaneous maximum standard already in use at IMM, and, therefore, was based on the toxicity data which was used to set the instantaneous maximum levels.

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

Since the time of the last five-year review species present in the Sacramento River have been newly listed as threatened or candidate species. Central Valley spring run chinook was listed as a federal threatened species (Nov. 15, 1999), Steelhead was listed as a federal threatened species (Aug. 7, 2000), and Green Sturgeon was listed as a federal candidate species. These species are all present below Keswick Dam. An interview was conducted with Harry Rectenwald from the California Department Fish and Game. He states that the water quality criteria developed for IMM using winter run chinook salmon as the ecological receptor are protective of these newly listed species as well because salmon is known to be the most sensitive of these receptors. When fully enacted the remedy for IMM will be protective of all sensitive species living downstream of Keswick Dam.

VIII. Issues

1) The Contribution of the Upstream Water Copper Concentration

California Toxics Rule promulgated a standard of 4.1 ppb dissolved copper as a 96-hour chronic average standard to be met at the Sacramento River below Keswick Dam. The upgradient water from Shasta Dam has a dissolved copper content of under 1 ppb to 4 ppb. This upgradient water quality will make the water management component of the selected remedy difficult to achieve.

2) Miscellaneous Site Maintenance Issues

CH2M Hill identified twelve minor items to be repaired at the site (see Site Inspection, page 20). In general, the treatment plant and related facilities are properly operated and maintained with no major issues.

3) Treatment Plant Audit Recommendations

CH2M Hill has been working with AIG Consultants, Inc. to investigate the reported water quality exceedances for dissolved copper and zinc from the treatment plant effluent. Our review indicates that the Site Operator is properly operating the treatment plant, that the treatment plant effluent is meeting the discharge requirements for dissolved copper, and that further study is required to assess whether the performance standard should be revised for dissolved zinc. Our review indicates that the analytical methodology being used by the Site Operator does not accurately measure the low copper concentrations in the treatment plant effluent. Our review also indicates that the methodology used by the Site Operator reports higher concentrations of zinc than other more accurate methodologies, but the discharges may not be able to meet the standard set by EPA. The investigation found that the zinc anodes may have been contributing to the high zinc discharges. EPA will continue its investigation of the zinc discharges to determine an appropriate response to the reported zinc water quality effluent exceedances from the treatment plant.

CH2M Hill also made recommendations in regards to updating the O&M manual, maintenance tracking program, and emergency response program.

IX. Recommendations and Follow-up Actions

1) The Exceedances of the Chronic Copper Standard at Keswick.

After the remedy is implemented at Slickrock Creek, the water quality leaving the site will improve. This improved quality may be enough to meet protective water quality standards and to overcome the water management difficulties at Spring Creek Debris dam due, in part, to the upgradient quality of the Shasta Dam water and current Shasta Dam operations. EPA should obtain data surface water quality data that is necessary to characterize the performance of the remedy once the Slickrock Creek Retention Dam is completed.

EPA should also continue to work with the RWQCB and USBR to obtain additional data to characterize the sources and locations of metal concentrations in Shasta Lake and to evaluate operational options that could manage the metal discharges from Shasta Dam. The RWQCB expects to continue to work with the Mining Remedial Recovery Company to reduce the metal discharges from several mines in the West Shasta Mining District. EPA should monitor the progress of this work.

The Records of Decision anticipated an uncontrolled release from the site once in approximately every 30 years while meeting the instantaneous maximum copper standard in the Sacramento River. EPA should rely on the data obtained after the remedy at Slickrock Creek is operational to perform an analysis to estimate the frequency of an uncontrolled release under operations to meet both an instantaneous maximum standard and a 96-hour average chronic standard. The impact on the fishery resource in the Sacramento River from the uncontrolled releases should be discussed among the regulatory stakeholders at Iron Mountain Mine - U.S. EPA, the State of California, the Department of Fish & Game, the National Oceanic and Atmospheric Administration, the Fish and Wildlife Service and the Bureau of Reclamation. Based upon these discussions, a new Memorandum of Understanding should be developed to resolve the problem of heavy metal loading from Shasta Dam and the water management efficiency of Spring Creek Debris Dam. It is estimated that two to three years of wet season data will be needed after the 1997 ROD remedy becomes operational before the exceedence issue can be fully addressed.

2) Miscellaneous Site Maintenance Issues

EPA should provide the list of maintenance issues to the Site Operator and develop a time frame for the work to be completed. The site maintenance items should be completed prior to the start of the wet season. EPA should continue the O&M oversight program and provide annual inspections and a follow-up program to ensure the recommendations are completed satisfactorily.

3) Treatment Plant Audit Recommendations

EPA should continue to investigate the reasons and resolve in the near-term for the reported water quality exceedances from the treatment plant. Any recommendations from the investigation should be implemented and follow-up to ensure that the water quality standards leaving the treatment plant are met. The Site Operator will be directed to revise the analytical methodology used to monitor plant performance, as currently recommended. EPA should provide the list of documents that need updating to AIG Consultants, Inc. and develop a time frame for the work to be completed.

X. Protectiveness Statements

Because the three interim response actions implemented to date do not fully address all of the discharges of acidity, copper, cadmium and zinc at the Iron Mountain Mine site, the interim remedy is fully protective of human health but not the environment. EPA has made substantial progress and the remedial actions implemented to date have afforded substantial protection to the valuable Sacramento River ecosystem and water supply.

EPA is currently in the process of constructing the remedial action selected in the 1997 Record of Decision for the Iron Mountain Mine site. When implemented, this remedy will provide substantial additional protection to the Sacramento River ecosystem and water supply.

EPA also continues to conduct an RI/FS to address the area source AMD discharges from the Boulder Creek watershed at IMM and the contaminated sediments down gradient from IMM. EPA expects to develop and evaluate potential remedial actions to address these areas for future decision making.

The IMM interim remedy continues to rely on USBR water management actions, on an interim basis and in accordance with the 1980 agreement, to provide for the safe release of the continuing IMM contaminant discharges from the Spring Creek Reservoir (to the extent technically feasible without implementation of further response actions at IMM). The interim water management actions are necessary to reduce the likelihood of uncontrolled spills and meet the standards for water quality.

XI. Next Review

This site has yet to reach construction complete and still has contamination remaining onsite; another five-year review is scheduled for September of 2008.

Attachments

Previous Five-Year Review Recommendations Iron Mountain Mine Five-Year Review

PREPARED FOR: Cynthia Wetmore/EPA Region IX
Rick Sugarek/EPA Region IX

PREPARED BY: John Spitzley/CH2M HILL

DATE: September 23, 2003

This memorandum reviews the recommendations provided in U.S. EPA's September 1998 five-year review for the Iron Mountain Mine (IMM) Superfund Site.

1. **Recommendation:** Coordinate closely with Mr. T. W. Arman and Iron Mountain Mines, Inc., to assure that any proposed mining venture would not hinder EPA access to operate and maintain the remedial actions at IMM, nor otherwise interfere with the effectiveness of the remedy.

   Status: U.S. EPA is coordinating with Mr. Arman and Iron Mountain Mines, Inc., to coordinate access to the site. In general, EPA's coordination efforts have successfully permitted EPA access to the site for operation and maintenance of remedial actions. Problems have arisen with respect to Mr. Arman and IMM, Inc., conducting operations at the site without submittal of adequate work plans or site safety plans.

   Mr. Arman has not submitted adequate work plans or submitted site safety plans for work conducted on IMM, Inc.'s proposed AG-Gel process. Concerns regarding IMM, Inc.'s site activities by the State of California Regional Water Quality Control Board resulted in enforcement action conducted by the Department of Toxic Substances Control (DTSC).

   Problems have arisen in regard to Mr. Arman and personnel authorized by IMM, Inc., not following safety guidelines established by the Site Operator regarding site access and travel on the site roads. This has resulted in unsafe road conditions at the site. Specifically, all vehicles passing the Minnesota Flats Treatment Plant are required by Iron Mountain Operations (IMO) to communicate roadway positions by a CB radio so that vehicles are able to use turnouts and pass safely on the one-way road. IMO staff and site subcontractors have repeatedly requested that Mr. Arman and Iron Mountain Mines, Inc., follow this safety guideline.

2. **Recommendation**: Continue to perform inspections and monitor the condition of the USC Diversion and the SRC Diversion. Perform maintenance when required.

   Status: CH2M HILL has conducted annual inspections of the USC Diversion. Memorandums have been submitted to EPA. The most recent inspection of the USC Diversion by CH2M HILL was conducted on June 19, 2003. An inspection memorandum was submitted by the Site Operator on September 5, 2003.

EPA has ensured long-term inspection and maintenance of the USC Diversion and SRC Diversion by its *Statement of Work, Site Operations and Maintenance, Iron Mountain Mine, Shasta County, California* (SOW) (settlement date December 18, 2000). Sections 8.11.1 and 8.11.2 of the SOW require the following:

> "The Site Operator shall operate and maintain the Upper Spring Creek Diversion in a manner that diverts stream flow, up to the maximum hydraulic capacity of the diversion, from Upper Spring Creek to Flat Creek at all times, except as authorized or directed by the Oversight Agency. The maximum hydraulic capacity of the diversion currently equals approximately 850 cfs.
>
> The Site Operator shall operate and maintain the Upper Spring Creek Diversion stilling basin in a manner to settle out sediment particles 1/4 inch or greater in cross section at all stream flow less than or equal to 1,000 cfs.
>
> The Site Operator shall operate and maintain the ROD1 Upper Slickrock Creek Diversion in a manner that diverts stream flow, up to the maximum hydraulic capacity of the diversion, from Upper Slickrock Creek around the Slickrock Creek Basin to Lower Slickrock Creek at all times, except as authorized or directed by the Oversight Agency. The maximum hydraulic capacity of the diversion currently equals approximately 80 cfs.
>
> The Site Operator shall maintain and operate the Upper Slickrock Creek Diversion stilling basin in a manner that settles out sediment particles 1/4 inch or greater in cross section."

Inspections of the Upper Spring Creek Diversion and Upper Slickrock Creek Diversion indicate that the diversions have been properly maintained and operated by the Site Operator.

Sections 9.10.2.3.3 and 9.10.2.3.4 of the SOW state:

> " Over the next 3 years, the Site Operator shall perform necessary studies and implement a satisfactory repair program to restore the RCCP lining system or, as necessary, replace the RCCP lining system by December 2003. The Site Operator shall prepare an annual written report and perform RD and RA to complete the required structural repair of the facility.
>
> Over the next 3-years the Site Operator shall perform necessary studies and implement satisfactory repairs to ensure the long-term performance of the impact wall (by December 2003). If necessary, the Site Operator shall perform RD and RA to repair the facility, and install a cover constructed for long-term protection of the wall."

The Site Operator has initiated design studies for repair of the RCCP lining system.

As a result of the extended construction period for the Slickrock Creek Retention Reservoir (SCRR) project selected by EPA in the 1997 ROD, inspections of the Upper Slickrock Creek Diversion pipeline have not been conducted for the last 2 years. Routine inspections and maintenance have been conducted of the intake and discharge structures. The structures and pipeline have performed satisfactorily through the summer of 2003. Most of the pipeline will be abandoned and replaced in December 2003, following completion of the Slickrock Creek Clean Water Diversion, now under construction.

3. **Recommendation:** Continue to perform inspections and monitor the condition of roadways, capped areas, mining waste disposal cells, the Brick Flat Pit sludge landfill, and surface water controls. Provide maintenance or upgrade as required.

   Status: These facilities have been routinely inspected and maintained by the Site Operator. Sections 8 and 9 of the *Statement of Work, Site Operations and Maintenance, Iron Mountain Mine, Shasta County, California* (SOW) (settlement date December 18, 2000) require the Site Operator to inspect and maintain these facilities to meet specific performance standards. Operation and maintenance activities completed by the Site Operator are detailed in the Site Operator's Monthly Progress Reports. Detailed records pertaining to operation and maintenance of the Brick Flat Pit Landfill are provided by the Site Operator's report *Landfill Management Report and Plan*, last submitted to EPA on January 17, 2003.

   At EPA's request, CH2M HILL routinely performed site inspections of existing facilities and in-progress construction projects. The most recent CH2M HILL memorandum providing a comprehensive review of these site facilities was completed on July 29, 2003. (see Technical Memorandum re *Site Inspection, Iron Mountain Mine.*)

   Upgrades to these facilities were completed during the performance period in accordance with the requirements of the remedies selected by EPA in the 1997 ROD. Major upgrades have included the following:

   (a) Culverts were upgraded on Iron Mountain Road at Boulder Creek Crossing and Spring Creek Crossing to ensure continuous site access during 100-year storm events. These locations were both flooded during the January 1997 New Year's Day 15-year storm.

   (b) A tie-back retaining wall was constructed near Boulder Creek Crossing at a critical location identified by the Site Operator and EPA. The location was subject to slope instability that threatened site access and the installed acid mine drainage (AMD) pipeline.

   (c) Construction of the second phase enlargement of the Brick Flat Pit Containment Dam was completed in the summer of 2002. With this raise (the second of three stages of full buildout of the containment dam), the capacity of the Brick Flat Pit disposal cell was increased from 403,250 to 1,177,490 cubic yards. At an average treatment production rate of 25,000 cubic yards per year, the completed dam raise will allow approximately 30 years of landfill operation, prior to the final dam buildout.

   (d) In accordance with EPA's selected remedies provided in the 1997 ROD, major upgrades have been implemented to the surface-water control systems in the Slickrock Creek Basin. Construction includes clean water diversions, roadways, pipelines, a retention reservoir (SCRR) for capture of contaminant area discharges, and appurtenant structures. Completion of construction is scheduled for December 2003.

4. **Recommendation**: Assure completion of all necessary upgrades to the AMD collection and conveyance system to assure collection and conveyance of all of these concentrated AMD discharges to MFTP for treatment. Provide maintenance or additional upgrades as required.

   Status: The 1997 ROD provided for increasing the hydraulic inflow capacity of the MFTP treatment plant from approximately 2,500 gallons per minute (gpm) to 6,500 gpm. Hydraulic upgrades to the Minnesota Flats Treatment Plant (MFTP) were completed in September 2000. The purpose of the upgrade was to allow treatment of the contaminant flows collected by the SCRR, now scheduled for completion in December 2003.

   To confirm the hydraulic capacity of the MFTP, CH2M HILL process engineers and IMO staff conducted a flow test of the plant on August 12, 2003. Testing was conducted on the AMD piping from the 1-million-gallon emergency storage tank (TK-14), through the reactors (TK-1 and TK-2), through the thickener, and the effluent discharge system. The CH2M HILL Technical Memorandum to EPA re *Hydraulic Flow Test, Minnesota Flats Treatment Plant, Iron Mountain Mine,* dated September 4, 2003, provides a detailed description of the test procedures, test data, and observations pertaining to the performance of the system. The testing demonstrated that the treatment plant was able to pass in excess of 7,000 gpm from the emergency holding tank, through the reactors, into the thickener. The thickener and effluent discharge system are designed to allow a discharge of greater than 10,000 gpm.

   The testing conducted on August 12, 2003, was performed using very dilute AMD influent made up of contaminant flow from the Richmond and Lawson portals and Old/ No. 8 Mine seep, mixed with Upper Spring Creek water. Additional testing of the system is required during startup of the SCRR to evaluate how the increased flows, together with higher solids density in the reactors, will affect the hydraulic capacity and performance of the system.

5. **Recommendation:** Assure the reliability and redundancy of critical treatment plant systems, including the water supply, electrical, dry lime storage and feed, lime slurry, reactor mixing, and aeration.

   Status: Section 9.3.2.10 of the SOW requires the following:

   > " The Site Operator shall store onsite at all times spare parts and special tools recommended by the equipment manufacturers for routine operation and maintenance, except to the extent that the Oversight Agency has pre-approved in writing deviation from the manufacturer's recommendation. The requirement in the prior sentence does not apply to office equipment. Additionally, the Site Operator shall maintain onsite at all times any ordinary tools and equipment expected to be on hand for operation and maintenance (including but not limited to cosmetic upkeep) of this facility. Upon request from the Oversight Agency, the Site Operator shall allow for an immediate inspection to identify the tools and spare parts in inventory."

The basis of design of the MFTP included 'firm capacity' for all treatment plant components, except for the thickener. This means that, except for the thickener, all components have redundant backup systems. Examples include the following:

(a) The water supply system has been upgraded at the Spring Creek Intake Structure to provide greater reliability and access during storm events to ensure continued availability of lime slurry make-up water for treatment plant operations. The upgrades include construction of a protective intake structure, gabion walls providing stream bank protection, and construction of a settlement basin adjacent to the intake structure.

(b) Two emergency generators provide backup power to the PG&E power supplied to the plant via 12 KV transmission lines. One generator is able to provide power for full treatment plant operations, and the other generator is able to provide power for critical component operations.

(c) The MFTP provides a redundant lime delivery system based on firm-capacity availability of all components. This includes two 500-ton lime silos; a 4-inch and 2-inch continuous lime circuit, three lime slakers, and two lime-slurry mix tanks. During maximum inflow events, the treatment plant uses approximately 175 tons of quicklime per day. The treatment plant operations are therefore dependent on offsite delivery of lime via a rail and trucking delivery system.

(d) Two reactors are used for mixing, neutralizing, and aerating the influent AMD during high influent flow conditions. While complete aeration will not be possible using one reactor at maximum influent flow, only one reactor is necessary for mixing and neutralizing the maximum influent flow.

Relatively low-cost spare parts are stored onsite or are immediately available from nearby suppliers located in Sacramento or the San Francisco Bay area. Relatively high-cost spare parts are not stored onsite and are not available immediately from suppliers. These include (1) two sludge return pumps installed in the thickener centerwell to pump thickener sludge to the sludge conditioning tank, (2) one reactor mixer gear drive installed at each of the two mixer tanks, and (3) thickener rake arms and gear drives.

With respect to the submersible sludge return pumps, the two pumps were recently replaced, one in July 2002 and the other in July 2003. One of the used pumps has been retained onsite as a spare, and the Site Operator has a rebuild kit onsite for rebuilding the two new pumps. The Site Operator intends to purchase an additional new submersible pump in 2004 that will provide an onsite spare. The new pumps have a 3-year warranty. Only one pump is required for all operating conditions.

With respect to the reactor mixer gear drives, one gear drive was replaced in November 2002, and one was replaced in January 2003. Each of the new drives has a 3-year warranty. The lead time for replacement is 4 to 6 weeks.

With respect to the thickener rake arms and gear drives, spare parts are not available for these components. Failure of these parts would likely require several months of using the simple mix operation mode, resulting in production of double the quantity of sludge at double the water content.

6. **Recommendation:** Assure the construction of adequate emergency and operating storage capacity to assure full treatment of all AMD discharges collected and conveyed to the MFTP for treatment.

   Status: In 1999, a 1-million-gallon emergency storage tank and associated piping systems were construted adjacent to the MFTP. The use of the tank includes temporary AMD storage during plant shutdowns for maintenance and backup emergency storage. In addition to the 1-million-gallon emergency storage tank, a 435,000-gallon Modutank is available for operating and emergency storage. The adequacy of these two tanks for emergency storage is dependent on the influent flow rate and the amount of time required for storage. Table 1 lists the number of hours and days of temporary and emergency storage that is available at various flow rates using the 1,435,000 gallons of available storage.

TABLE 1
Emergency and Temporary Storage Capacity
Iron Mountain Mine Five-Year Review

Influent Flow Rate (gpm)	Hours Storage	Days Storage
100	239	9.97
500	48	1.99
1,000	24	1.00
2,000	12	0.50

MFTP daily flow records are available from Iron Mountain Mine Operations (IMO) for the period from October 1994 through July 2003. Review of these records demonstrates the following:

- The MFTP influent flow rate has equaled or exceeded 100 gpm for 2,645 days, approximately 85 percent of the time during the period.
- The MFTP influent flow rate has equaled or exceeded 500 gpm for 337 days, approximately 11 percent of the time during the period.
- The MFTP influent flow rate has equaled or exceeded 1,000 gpm for 50 days, approximately 1.6 percent of the time during the period.
- The MFTP influent flow rate exceeded 2,000 gpm on three days (February 6, 1998, – 2,004 gpm; February 7, 1998, – 2,293 gpm; and February 8, 1998, – 2,403 gpm); approxiamtely 0.10 percent of the time during the period.

In addition to the 1,435,000 gallons of emergency storage located adjacent to the MFTP, two storage locations are avaliable in the Slickrock Creek Basin. The Old/No. 8 Mine workings are capable of holding in excess of 100,000 gallons of storage from the Old/No. 8 Mine Seep discharge with shutdown of the pump stations used to pump contaminant flow from the Old/No. 8 Mine workings. The amount of underflow (flow from the mine workings to Slickrock Creek by way of subsurface movement) during periods that the pumps are shut down is not known. Typical flow from the Old/No. 8 Mine Seep to the MFTP ranges from 100 gpm to over 300 gpm during storm conditions.

The second storage location in the Slickrock Creek Basin is the Slickrock Creek Retention Reservoir (SCRR), now under construction. The SCRR is planned to collect contaminant flow from area-wide sources located in the basin. The SCRR is planned to have a storage capacity equal to 220 acre-feet and isdesigned to discharge 3,250 gpm to the MFTP for treatment during heavy storm conditions. The SCRR is designed to spill during a 3-day, 100-year storm event with 25 acre-feet emergency storage capacity. Assuming an in inflow into the SCRR equal to 3,250 gpm, the 25 acre-feet of emergency storage will take 41 hours, or just under two days, to fill.

Interview Summaries for IMM 5-year review interviews
Conducted by Valentina Cabrera-Stagno, EPA

Resident - Annette Rardin Tuesday July 29, 2003 9:00 AM

1) What is your overall impression of the project?
   It is a complicated situation politically and environmentally. EPA is doing something for the environment; things have progressed in a positive direction.
2) What effects have site operations had on you?
   It has altered their property. They used to have a natural creek but now it's a storm drain. It's a loss to them. The water is cleaner. They were highly distressed when they were threatened with imminent domain and had trouble reaching an agreement with the company that was implementing the remedy.
   Their house is not on city or well water, they have creek water. The water problems threatened their existence on the land. After a number of years EPA decided to address their water system and made the company address it. They did a good job and moved their water pick up to a safer location. It took years to get through to them. Relationship has been very good in the last number of years.
3) Do you have any concerns regarding the site or its operation and administration?
   She is concerned that when the site gets turned over to the State, they will get lost in another shuffle. The creek has dug down 12 feet since the new diversion of water through their backyard, concern for this deeper water channel and potential erosion. In big storm events someone could drown.
   She has seen huge increases in traffic because the road to Shasta Dam has been closed since 9/11/01. Instead people go up Iron Mountain Road. The huge trucks carrying lime cannot stay in their lane around the curves. There have been a couple of accidents in the last couple of years (a friend of hers was hit by the wide curve by Spring Creek Dam). She suggests improving the road at the S curve right below the Matheson turn off; this is the worst spot.
4) Are you aware of any events, incidents or activities at the site such as vandalism, trespassing, or emergency responses from local authorities?
   There were a few accidents and fires at the site. Earlier on (5 years ago), guys would get off work and stop at the turn around by their house and drink beer. The workers drive really fast at shift change. She also noticed people swimming in a swimming hole that has developed by the road bank up by the mine.
   Management has been wonderful friendly and helpful.
5) Do you feel well informed about the site's activities and progress?
   She hasn't really heard very much lately, but feels well informed. Things have gone from very bad to good. The community involvement coordinator was a very good person to talk to in EPA. They really appreciated him.

6) Do you have any comments, suggestions, or recommendations regarding the site's management or operation?
It's complicated environmentally, as well as politically. It is important not to forget that individual human beings are affected. She understands her concerns were not as important as the bigger issues, but a different tone would have been better. Some local people badmouth EPA for getting involved at all, but she supports what EPA is doing.

NOAA - Laurie Sullivan (415) 972-3210 Wednesday July 30, 2002 3:00 PM

1) Have any new salmon studies been performed that are relevant to establishing the protective standards for the Sacramento River salmon fishery?
Don't think so.
2) Do the continuing discharges from IMM pose a risk to aquatic life downstream?
Yes, salmon are very sensitive to copper and below Keswick Dam is the last of the spawning beds for winter run salmon.
3) What are your thoughts on the need for/protectiveness of the 4.1 ppb Cu 96-hour copper standard versus the 5.6 ppb instantaneous maximum standard?
She is more comfortable with a 96-hour standard because an instantaneous value could be taken at the tail end of a high peak. She thinks the 4.1 ppb 96-hour standard is protective of salmon.
4) For my own edification: explain how salmon/wildlife considerations were incorporated into the Basin Plan and the setting of the regulatory numbers.
The Basin Plan was thrown out in court and as a result EPA promulgated standards – the CA Toxics Rule.

DFG - Harry Rectenwald Thursday July 31, 2003 10:00 AM

1) Have their been any new listings of "Species of Special Concern" in the area?
Yes there have been:
    Central Valley Spring Run Chinook were listed Federally Threatened Nov 15, 1999. Listed as by the State as Threatened on Feb. 5, 1999.
    Steelhead – Federally listed as threatened Aug. 7, 2000.
    Green Sturgeon – Federal Candidate Species.

These species are all present below Keswick Dam. The 4.1 ppb 96 hour average is protective of these species as well, because they have the same tolerance as the winter run salmon upon which the standard was developed.
2) Have any new salmon studies been performed that are relevant to establishing the protective standards for the Sacramento River salmon fishery?
No knew studies have occurred that are relevant to the Sacramento River. The standards were based on site specific studies and are still appropriate for the area.
3) Do the continuing discharges from IMM pose a risk to aquatic life downstream?
Yes, IMM still poses a risk, especially because they are dependent on Shasta Dam for clean water to dilute their discharges. Future water development will accentuate this risk as water for dilution becomes more scarce.
4) What are you thoughts on the need for/protectiveness of the 4.1 ppb Cu 96-hour copper standard versus the 5.6 ppb instantaneous maximum standard?

There is general agreement on 5.6 as an instantaneous maximum. If 5.6 were a 96-hour standard there would be potential for copper to peak to levels that exceeded a 24 hour lethal level for salmon.

USBR - Dianne Wisniewski Thursday July 31, 2003 3:00 PM

1) What is your overall impression of EPA's IMM cleanup project?
   Good. The problems that have arisen are not EPA's fault and they are moving forward as best they can.
2) Have there been routine communications or activities (site visits, inspections, reporting activities, etc) conducted by your office regarding the site? If so, please give purpose and results.
   She tests the water coming out of SCDD. They also usually hold a yearly meeting with CH2MHILL as EPA's representative. Did not have one this last year. She has visited the site 2-3 times in the last 5 years.
3) Have there been any complaints, violations, or other incidents related to the site requiring a response by your office? If so, please give details of the events and results of the responses.
   USBR responds when the dam spills. It spills about once a year for a 2-3 day period. They then have to analyze the water more frequently and may or may not have to release water to dilute the spilled water. Usually sample 1 time per week, but upt o 5 times per week or 2 times a day when it spills.
4) Do you feel well informed about the site's activities and progress?
   yes
5) Do you have any comments, suggestions, or recommendations regarding the site's management or operation?
   No. Keep up the good work. Build the dam. The on-site staff are doing a good job and have good communication with USBR.
6) Has it been difficult operationally to efficiently attain 5.6 ppb in the Sacramento River while minimizing storage in Spring Creek Reservoir?
   Sometimes difficult because dilution water is high in copper. USBR would like to never use dilution water, because that water could be used for other projects. USBR's other concern is that the sediment in the Spring Creek arm of Keswick Reservoir means the power plant can't run as efficiently as they would like it to, or it would throw sediment downstream.
7) Over the past five years have there been spills from the Spring Creek Reservoir? How often? What factors contribute to or cause the spills? Have you exceeded standards during the spills?
   Yes – Dec 02, Jan 03, Jan 02, Mar 01, 96 & 97. They last 3 days or so. Rain and ground saturation affect whether it spills. It doesn't usually exceed 5.6 in a 48 hour window. Sometimes exceeds it instantaneously. The copper levels leaving SCDD are between 540 and 170 (winter to summer).
8) Over the past five years, has water needed to be released from Shasta or Whiskeytown in order to compensate for IMM discharges? How often?

The first 2-3 years of the last 5 year window were pretty good. In the last 2 years things have been worse. Tom Patton of CVO-Central Valley Operations out of Sacramento makes the decision whether to dilute from Shasta. 916-979-2185.

9) How does the USBR intend to address the elevated Shasta Lake copper and zinc levels seen over the past several winters?
RWQCB has just done some studies and found elevated levels in Squaw Creek, they are going to present it for public comment. USBR may do some sampling. The contamination is probably from other mines in the Shasta area and USBR would prefer the mine sources were controlled. USBR is looking into whether it was the temperature control device change in Shasta Dam that caused the increase in metals. The temperature control device helps save the cold water for salmon in the summer time.

RWQCB - Jim Pedri Wednesday, August 20, 2003, 9:30 AM

1) What is your overall impression of EPA's IMM cleanup project?
Excellent, he is impressed with EPA's ability to pursue past owners. IMM was the worst mine in his region and thanks to EPA's efforts the remedy is 95% of the way done.

2) Have there been routine communications or activities (site visits, inspections, reporting activities, etc) conducted by your office regarding the site? If so, please give purpose and results.
RWQCB is the state oversite agency for O & M. They have site visits a little less than once a month. They also do work associated with the mine but not at the mine site, such as sampling in Sacramento River or at Shasta Dam. This sampling is weekly.

3) Have there been any complaints, violations, or other incidents related to the site requiring a response by your office? If so, please give details of the events and results of the responses.
In the past, they have had to respond against the property owner. More than five years ago they ordered the property owner to operate an interim treatment. A year and a half ago they shut down illegal treatment that the owner was operating, not related to the superfund remedy. He was handling hazardous materials illegally, and he would need to get a permit from RWQCB to do so legally.

4) Do you feel well informed about the site's activities and progress?
He has been informed adequately. There are currently two state agencies involved. DTSC has a 10% cost share for the Slickrock dam project, and RWQCB is in charge of O&M. He feels that DTSC is kept in the loop better than the RWQCB.

5) Do you have any comments, suggestions, or recommendations regarding the site's management or operation?
He would like to be kept abreast of all activities that affect operations and maintenance of the existing remedy. Also, in order to investigate the high level of copper and zinc in Shasta Lake they have taken many samples and will need to take

many more. They have enough manpower but they lack the laboratory budget. Could they use EPA's lab for some of the samples. Rick is good to work with and tough, which is good. He has gotten the PRP's to implement the remedy.

6) <u>How does the RWQCB believe that the elevated Shasta Dam copper and zinc levels should be addressed?</u>
They are going to enforce the permits which they have. Also there are two creeks that are being improved, West Squaw and Little Backbone. West Squaw Creek is approaching 95% removal of AMD from discharge, Little Backbone Creek is having problems but should improve. They also need to investigate where the metals are coming from, there is the possibility that they are seeping up from the copper smelters under the dam. If after implementing their clean-up plans there are still significant metals in the water column they will have to coordinate with USBR about spilling clean water when it is needed to dilute IMM discharges. This hasn't been coordinated yet. Another option would be to require better mixing of metals by putting in a curtain or aeration.

7) <u>Does the RWQCB believe that additional controls can be implemented on the mines in the West Shasta Mining District? Significant controls?</u>
Additional control could be imposed but they would be costly. They will need to be a different approach than that used at IMM because other mines don't have electrical power or as much money. The RWQCB is going to keep on until they reduce the level of metals, through enforcement, Cease and Desist Orders and NPDES permits. In one of the creeks where removal of metals to water quality objectives is not possible, they are looking into changing the beneficial uses of those waterways so the PRP can avoid third-party lawsuits. In this way they would be free to remove as many metals as they can.

8) <u>Does the RWQCB believe that the USBR could alter the manner in which it operates the temperature control device to withdraw water from depth to avoid high concentrations of metals?</u>
Typically, IMM spills in winter when USBR would have the most flexibility to use colder temperature water without jeopardizing the total cold water supply. This could help resolve the problem.

Minnesota Flats Treatment Plant Audit Iron Mountain Mine Five-Year Review

PREPARED FOR: Rick Sugarek/EPA Region IX
Cynthia Wetmore/EPA Region IX

PREPARED BY: Jim Stefanoff/CH2M HILL
Bill Murdock/CH2M HILL

DATE: September 22, 2003

Introduction

At request of U.S. EPA, CH2M HILL performed an audit of Operations and Maintenance (O&M) activities at the Minnesota Flats Treatment Plant (MFTP) at the Iron Mountain Mine Superfund Site (IMM) on August 27 and 28, 2003. This audit was conducted in support of the 2003 five-year review for the IMM Superfund Site and to determine if the facility is being operated and maintained in conformance with the Iron Mountain Mine Scope of Work (SOW), dated October 2, 2000.

At the time of the August 2003 audit, the MFTP was shut down for maintenance, and acid mine drainage (AMD) was being stored in the emergency storage tank (TK-14). However, both authors are familiar with the plant operations and the shutdown did not effect the capability to complete an thorough review. Bill Murdock was recently onsite in August 2003 to observe normal plant operations and a plant test to evaluate throughput flow capacity of the treatment plant. The results of that testing is provided in a separate memorandum (*Hydraulic Flow Test, Minnesota Flats Treatment Plant, Iron Mountain Mine.* CH2M HILL. September 4, 2003) .

Personnel Involved in the Audit

The O&M audit was conducted by two process engineers from CH2M HILL – Mr. Jim Stefanoff and Mr. Bill Murdock. Both auditors are familiar with the history and development of the IMM remedy, the installation of the various facilities being operated to collect and treat AMD at IMM, previous O&M performance issues, and the operating principles of the HDS process.

Mr. Jim Stefanoff is from CH2M HILL's Spokane, Washington, office. He has been involved in the design and operations of IMM since 1990. He has participated in the following design and construction elements at the MFTP: (1) Task Manager for Treatability study of the High Density Sludge (HDS) process; (2) Senior Reviewer for the Aerated Simple Mix (ASM) process installed at IMM prior to the modification of the plant for HDS operation; and (3) Lead process engineer on the modification of the MFTP to incorporate the HDS process. He reviews the IMO monthly reports in support of the Environmental Protection Agency's (EPA's) activities on this site.

Mr. Bill Murdock is a senior mechanical engineer from CH2M HILL's Portland, Oregon, office. He has been involved at the IMM site for over 10 years. He has been a senior reviewer for design of both the ASM simple mix plant and the HDS design. He Bill was onsite during the August 2003 high influent flow rate test, and witnessed the operation of the MFTP systems at influent flow rates in excess of 6,500 gallons per minute (gpm).

Background

The background of the IMM site and the development of the remedy at IMM are described in detail in other documents associated with the site. Detailed background information is provided by the *Statement of Work, Site Operations and Maintenance, Iron Mountain Mine, Shasta County, California* (SOW) (settlement date December 18, 2000) and other documents associated with the four Records of Decision (RODs) that have been issued for the site.

Brief Description of the IMM Process

AMD is collected from various portals and other sources on Iron Mountain and routed to the MFTP by two HDPE (high density polyethylene) pipelines buried in Iron Mountain Road. The pipelines discharge into a 1-million-gallon stainless-steel holding tank located upstream of the MFTP. The flow is typically routed through the tank to the MFTP. The site is also able to divert flow into a 435,000-gallon-capacity Modutank for emergency or temporary storage.

After the AMD enters the MFTP, it is contacted with "conditioned sludge" (recycled HDS sludge coated with lime slurry) to raise the pH of the mixture and to precipitate the metals present in the AMD. The resulting slurry of neutralized and treated AMD and sludge is routed to a thickener where the sludge settles and the treated water overflows the thickener launder and is discharged to surface waters (Spring Creek) via the effluent tunnel. The HDS sludge in the thickener is wasted to the sludge drying beds. Filtrate from the drying beds is pumped to Spring Creek, and the dried sludge is hauled to the Brick Flat Pit disposal cell on an annual basis, typically during September and October of each year.

Modifications to MFTP since 1998

The MFTP was converted from an ASM process treatment plant to an HDS process treatment plant with startup in January 1997. The evaluation of the MFTP process performance for the first 18 months was provided in the technical memorandum *Site Evaluation, Iron Mountain Mine*. CH2M HILL. September 25, 1998. The treatment plant process has not changed from that time. The following changes or upgrades have been completed to the plant during the audit period:

1. Between 1999 and 2002 the thickener was re-coated internally and cathodic protection was installed to protect the steel shell from corrosion. During 2003 the zinc anodes were removed from the thickener after confirmation that the impressed current corrosion prevention system was sufficient.

2. In 1999 the 1-million-gallon emergency storage tank and associated piping systems were installed. The use of the tank includes temporary AMD storage during plant shutdowns for maintenance.

3. By September 2000, the hydraulic capacity through the neutralization reactors and the thickener was upgraded to allow an influent capacity of 6,500 gpm to accommodate the addition of the Slickrock Creek Retention Reservoir (SCRR) flows to the treatment plant. The hydraulic capacity of the MFTP was confirmed in early August 2003.

Description of the Audit Process

Because of the auditors' familiarity and ongoing involvement with the facility, minimal time was spent reviewing data and documents. Interviews were conducted with the Iron Mountain Operations (IMO) managers, General Manager (Mr. Rudy Carver) and the MFTP Lead Operator (Mr. Robert Lindskog). Both of these men spent most of the two days the auditors were onsite being interviewed or accompanying the auditors on tours of the facility.

On Wednesday, August 27th, the auditors inspected the MFTP facility and ancillary facilities with the IMO managers. Facilities visited and inspected included:

1. Lime Receiving and Storage
2. Reactor Tanks and associated equipment
3. Thickener
4. Sludge Drying Beds
5. Filtrate Pumping Station
6. Effluent Tunnel
7. Spring Creek Diversion including structure at tunnel outlet in Flat Creek
8. Modutank
9. AMD Emergency Storage Tank
10. Brick Flat Pit

Following the facility inspection, the requirements of the SOW were discussed with IMO. On Thursday, August 28th, the auditors again met with the IMO managers and reviewed the requirements of the Performance Standards Verification Plan (PSVP), which are primarily related to effluent water quality and sludge quality. Also discussed were the status of each of the major plans which are in place at the facility including:

1. O&M Plan
2. Sludge Management Plan
3. Health and Safety Plan
4. Emergency Response Plan

After reviewing the status of the plans and the effluent and sludge analytical information, additional inspections were conducted of the more outlying facilities at IMM, including the following:

1. The Richmond Portal rehabilitation project. Mr. Carver arranged for us to enter the Richmond Adit and to view the progress being made on the rehabilitation work. Mr. Terry Johnson of North Pacific Research led the tour and provided information on the progress of the work.

2. Brick Flat Pit

3. Slickrock Creek Retention Reservoir

4. Various roads between these locations

The next section covers the detailed findings of the audit and presents recommendations of the auditors.

Audit Findings and Recommendations

Audit findings are referenced to the requirements of the statement of work and the Performance Standards Verification Plan. Findings are presented separately for O&M and for Performance (effluent and sludge quality). Each category of finding is presented in a separate section below.

Audit Findings Regarding O&M

Audit findings are presented in the table below as responses to the requirements listed in the Statement of Work. The requirement numbers below match the section numbers in the Statement of Work.

TABLE 1
MFTP Audit Finding Relative to O&M Requirements

No.	Requirement	Audit Finding
Routine O&M Requirements for the Minnesota Flats Treatment Plant		
1	Operate, inspect, maintain, repair, replace, and upgrade the MFTP in a manner that conforms to the *Operations and Maintenance Instructions, High Density Sludge Treatment Plant, Iron Mountain Mine-Redding, CA*, dated April 2001.	Yes, site operator has an excellent attitude toward meeting all requirements of the O&M Instructions and maintains equipment well.
2	Operate Facility so as to produce maximum density sludge including sludge wasting practice prescribed in the SOW.	Yes, operator has been operating the facility to produce optimum density sludge.
3	Operate the Facility to fully oxidize the sludge being discharged to the sludge drying beds.	Yes, the facility is operated to fully oxidize the sludge as evidenced by color.
4	Operate the HDS plant in accordance with the pH control practice and maintain minimum of 8.4 pH at all times.	Yes, operator using 8.6 pH setpoint for process.
5	Notification regarding necessity to reduce sludge density target during maintenance.	Operator has notified and has endeavored to minimize periods of low sludge density.
6	Operator maintains utility systems and process systems for optimum performance.	Yes, plant staff have a continuous improvement mindset.
7	Periodic inspection, cleaning, and touch-up painting of structures and tanks to maintain appearance and functionality.	Operator inspects and touches up continuously where possible and annually during outages.
8	Operator to support transition to ROD4 conditions including treating of SCRR flows. SOW requires operator to update the O&M instructions.	This is a work in progress. Operator has assisted in the transition but has not yet updated the O&M instructions as required. Recently completed high flow test of MFTP.
9	Operator is properly handling debris and trash and practicing good housekeeping.	Yes, site is clean and debris is managed well.
10	Spare parts inventory and special tools.	Operator maintains some spare parts and special tools and rents or buys locally tools and parts on an as-needed basis. No consolidated list of spare parts or minimum inventory list exists.

TABLE 1
MFTP Audit Finding Relative to O&M Requirements

No.	Requirement	Audit Finding
Non-routine O&M Requirements for the Minnesota Flats Treatment Plant		
1	Introductory language without specific O&M requirements.	No audit findings for this item in the SOW.
2	Operation during utility outages.	Operator maintains operations when possible.
3	Replacement of sludge recycle system components including piping and pumps.	Operator has replaced both sludge recycle pumps during the audit period and is replacing sludge recycle piping with stainless steel when components fail.
4	Replacement of components around reactors including mixers and associated piping.	Operator replaces components as needed. Currently purchasing motor operator for TK-2 bypass valve (36").
5	Thickener repairs and re-lining.	Yes, operator has complied with requirements. Currently using impressed current cathodic protection system.
6	Hillslope benches and erosion control in the thickener area.	Operator controls erosion and maintains hillslopes.
7	Minimizing wet sludge hauls.	No wet sludge hauls were made during the audit period.
Routine O&M Requirements for Treatment Plant Ancillary Facilities		
1	Inspect, operate, maintain, and upgrade MFTP Ancillary Facilities in accordance with the *Operations and Maintenance Instructions, High Density Sludge Treatment Plant, Iron Mountain Mine-Redding, CA,* dated April 2001.	Yes, all ancillary facilities are in good working order and are being maintained.
2	Proper handling of MFTP ancillary facilities O&M unit components.	Yes, to the best of our ability to ascertain.
3	Cleaning of exterior surfaces and washdown of discoloration.	Yes, but not necessarily weekly. Operator does housekeeping and washdown as needed.
4	O&M to maintain Modutank in good operating condition.	Yes, re-lined the Modutank in 2002. No formal leak test or certified inspection was completed.
5	Keeping Modutank empty during normal operation and metering flow to MFTP when Modutank is used. Use of Modutank when 1 million gallon tank is full.	Operator keeps 6" of AMD or filtrate in the Modutank during summer months to reduce UV damage to liner. 1 million gallon tank has never been filled during this audit period.
Non-routine O&M Requirements for Treatment Plant Ancillary Facilities		
1	Maintenance of hillslopes and ditches below MFTP to prevent erosion.	Yes, only minor erosion was observed. Ditches are well maintained.
2	Maintenance of the sludge drying beds.	Yes, operator maintains beds after each annual sludge haul.
3	Modutank liner inspection and leak test.	No formal liner inspection, leak test, and report have been completed. Informal inspection and leak test were completed last year.
4	Maintenance and repair of the protective dike at the outlet of the effluent tunnel.	Protective dike appears in good repair.

TABLE 1
MFTP Audit Finding Relative to O&M Requirements

No.	Requirement	Audit Finding
5	Maintenance of Flat Creek stream channel down-stream of the Spring Creek Diversion impact structure.	Had some significant erosion just down-stream of the concrete channel liner down-stream of the Spring Creek Diversion. Repaired in a timely manner.
5	The SOW states that the site operator shall perform necessary studies and implement a satisfactory repair program to restore the Upper Spring Creek Diversion RCCP lining system or, as necessary, replace the RCCP lining system by December 2003.	IMO has initiated an evaluation of the lining system. A design has not been submitted for the repair, and repairs will not likely be completed by December 2003.

This concludes the audit findings relative to the O&M requirements. The next section reports on audit findings relative to the Performance Standards and Verification Plan for the facility.

Audit Findings Regarding Plant Performance

This section reports on the audit findings regarding MFTP performance with respect to the standards contained in the Performance Standard and Verification Plan (PSVP), included in Section 14 of the SOW. Performance with respect to effluent water quality standards and sludge solids content is the focus of this section. Other performance standards will be commented on as appropriate or as observed.

Performance standards for the treatment plant effluent are set by the ARARs. The ARARs include maximizing the removal of metals and attaining the metal removal performance achieved by the HDS treatment process during the previous 5 years.

The effluent from the MFTP includes thickener overflow and filtrate derived from the sludge placed in the sludge drying beds. The thickener overflow is discharged through the Treated Water Discharge System Tunnel into Spring Creek. The sludge drying bed filtrate is gravity-drained to the filtrate pump station and pumped to Spring Creek below the Upper Spring Creek Diversion.

Discussion of the MFTP performance with respect to meeting the effluent discharge requirements is provided in the technical memorandum *Minnesota Flats Treatment Plant Effluent Discharge; Iron Mountain Mine, Five -Year Performance Review*. CH2M HILL. September 18, 2003.

Audit findings with respect to effluent quality and other performance standards are contained in Table 2 below. Table 2 also documents review of the site documents for compliance with the SOW requirements.

TABLE 2
MFTP Audit Finding Relative to Performance Requirements

No.	Requirement	Audit Finding
Performance Requirements (Effluent, Storm Water, Receiving Waters)		
1	Dissolved metals in effluent from thickener and sludge drying ponds (filtrate)	Plant is meeting requirements with the exception of dissolved copper and zinc. An evaluation of the results is provided in a separate memorandum. The outcomes of the evaluation are not expected to affect plant operations, except for analytical testing.
2	Solids content of sludge being wasted from the thickener to the sludge drying beds.	Operators waste sludge within the requirements provided by the SOW. Filter leaf tests confirm that sludge density is consistently better than required (70 percent solids vs. 50 percent required).
3	Facility shall be operated in accordance with an approved Storm Water Pollution Prevention Plan (SWPPP).	Auditors observed no indication of unreported violations of the SWPPP for the site.
4	Facility shall monitor receiving water quality at the mouth of Boulder Creek and Slickrock Creek (BCMO and SRMO, respectively) for high dissolved metals.	A high dissolved metals event at BCMO this year was attributed to a "first flush" of accumulated AMD following a storm.
5	IMO is obligated to report performance to EPA on a monthly basis and to identify any performance issues.	Compliance with reporting requirements appears to be adequate.
Document Review		
1	Operations and Maintenance Plan	The latest revision of the O&M plan is dated April 2001 and needs to be updated for the changes to the MFTP since 2001. No electronic copy of this large document is available.
2	Sludge Management Plan	IMO indicated that it cannot meet the currently mandated date for submitting the Sludge Management Plan because of the timing of the sludge haul and availability of survey and analytical data after the haul. IMO requested that the required submission date be delayed until January 15 of the year following the sludge haul. Brick Flat Pit appears to be maintained according to the Sludge Management Plan.
3	Health and Safety Plan	Administrative updates need to be completed to the Health and Safety Plan. Locations of emergency responders have changed since the plan was last updated.
4	Emergency Response Plan	No stand-alone Emergency Response Plan exists at the site. Emergency response requirements are spread throughout the O&M Plan and other plans. The audit team suggests that a consolidated stand-alone plan be assembled for quick reference.

The sections below document the issues identified by the audit team, anticipated changes to the site remedy that need to be addressed, and the recommendations of the audit team.

Issues

In general, the facility was being operated in compliance with the O&M and performance requirements contained in the SOW. The staff are dedicated to operating, inspecting, maintaining, repairing, and upgrading the facility to maintain the effectiveness of the remedy. Several issues were observed that warrant additional consideration. These include the following:

1. The operations and maintenance staff have been through a series of management changes that have left them isolated from the kind of infrastructure and support offered by a large corporation. This leaves the facility vulnerable to the loss of even a single individual. Specific recommendations for minimizing this vulnerability are contained in the Recommendations section below.
2. The O&M Plan and the Health and Safety Plan are out of date and need to be updated.

Anticipated Changes

The major change anticipated in plant operations in the near future is the addition of the flows from the SCRR later this year or early next year. The addition of these flows will increase the hydraulic loading on the MFTP and will reduce the strength of the AMD being treated by the facility. The MFTP and conveyance systems need to be reviewed and tested at the increased flow rates to verify adequacy of these systems.

A recent flow test conducted at the MFTP confirmed that flows in excess of 6,500 gallons/minute (gpm) of AMD feed could be passed through the plant. The 6,500-gpm feed rate is the design influent rate after SCRR flows are added to the MFTP. Additional tests need to be run to verify that the treatment plant can pass the required flows with various reactor tank configurations.

Recommendations

Based on the audit findings detailed in the Tables 1 and 2, the following recommendations have been developed:

1. Update the O&M Plan and the Health and Safety Plan to reflect current operations and updated emergency contact information and procedures.
2. Create a readily accessible Emergency Response Plan (Cardex or equal system) that provides concise instructions to operators on how to respond to plant or other emergencies. This information is currently located in various sections of the O&M Plan and other documents and is not readily accessible to operators during an emergency. The plan should be kept in the control room, and all plant personnel should be familiar with the contents of the plan.
3. Install a computerized maintenance system that interfaces with the operations computer. This system would track run hours as well as maintenance completed on each

piece of equipment and maintain a spare parts inventory. Implementing this type of system would decrease the facility's vulnerability to the loss of one or more personnel.

4. Perform additional flow testing of the MFTP at a 6,500-gpm AMD influent rate to verify that the plant can process design flows after SCRR flows are added. The previous test routed AMD through both reactors to the thickener. An additional test should be conducted to route the flow from Reactor TK-1 to the thickener. The previous flow testing was conducted using very dilute AMD with the reactors at low solids content. Additional testing should be conducted with influent from the SCRR with the reactors at the operational solids content.

Minnesota Flats Treatment Plant Effluent Discharge Iron Mountain Mine Five-Year Review

PREPARED FOR: Rick Sugarek/EPA Region IX
Cynthia Wetmore/EPA Region IX

PREPARED BY: John Spitzley/CH2M HILL
Tony Jaegel/CH2M HILL

DATE: September 18, 2003

Introduction

This memorandum provides an evaluation of the operational performance of the Minnesota Flats Treatment Plant (MFTP) at Iron Mountain Mine (IMM) in meeting the Performance Standards for treatment plant effluent discharge. The evaluation focuses on the plant's performance in meeting the discharge limitations contained in the Iron Mountain Mine Scope of Work (SOW), dated October 2, 2000.

The SOW includes the requirements necessary to operate and maintain the selected CERCLA remedy at the IMM site. The IMM Remedy includes the collection, conveyance, and treatment of all acid mine drainage (AMD) from the Richmond Mine workings, the Lawson Mine workings, the Old/No. 8 Mine workings and, anticipated for completion in the SOW by 2001 or 2002, the disturbed portion of the Slickrock Creek watershed that would be collected behind the Slickrock Creek Retention Reservoir (SCRR).

The IMM Remedy requires treatment of these flows at a high density sludge (HDS) treatment plant and the long-term onsite storage of sludge generated from the treatment process. Figure 1 presents a plot of the monthly AMD treated at the MFTP from October 1998 through July 2003. All figure are provided at the end of the text. For this period, approximately 568 million gallons of AMD were treated at the MFTP. Figure 2 presents the approximate monthly copper and zinc loads removed at the MFTP from October 1998 through July 2003. During this period, approximately 640,000 pounds of copper and 2,360,000 pounds of zinc were removed from the site contaminant discharges.

Effluent Discharge Requirements

Sections 8 and 14 of the SOW state the Performance Standards required for operation of the treatment plant. These sections include the following requirements:

- The ARARs specify that the AMD neutralization facility shall be designed and operated to maximize the removal of metals through the use of the HDS treatment process and, as a minimum, meet the Clean Water Act (CWA) Effluent Guidelines and Standards for Ore Mining and Dressing at 40 CFR 440.102(a) and 440.103(a) as specified in Table 1. (14.2.2.6)

TABLE 1
CWA Effluent Guidelines and Standards

Parameter	30-Day Average [a] (mg/L)	Daily Maximum [b] (mg/L)
Copper (Total)	0.15	0.30
Cadmium Total)	0.05	0.10
Zinc (Total)	0.75	1.5
Lead (Total)	0.3	0.6
TSS [c,d]	20	30
pH [d]	6.0 to 9.0	6.0 to 9.0

[a] Average of daily concentration values for 30 consecutive days.
[b] Maximum allowable concentration measured for any one day.
[c] TSS = Total Suspended Solids.
[d] Applicable for discharge to Flat Creek

Note: Effluent limitations are from 40 CFR 440.102(a) and 440.103(a).
From Table 14-1; Statement of Work, Site Operations and Maintenance,
Iron Mountain Mine, October 2, 2000.

- The Clean Water Act system of technology-based effluent controls requires discharges to achieve the best practicable control technology (BPT) and the best available technology economically achievable (BAT). The existing HDS AMD neutralization facility has demonstrated metal discharge levels during the past 3 years that are substantially below the limits specified in Table 2. The HDS control technology currently employed at the facility constitutes BAT for the purpose of the SOW. The BAT effluent limitations based upon metal removal levels currently achieved at the IMM treatment plant are specified in Table 2 as daily maximum, 7-day, and 30-day average concentrations.

TABLE 2
BAT Control Technology Limits

Parameter	30-Day Average [a] (µg/L)	7-Day Average [b] (µg/L)	Daily Maximum [c] (µg/L)
Copper (dissolved)	5	10	15
Cadmium (dissolved)	1	2	3
Zinc (dissolved)	10	20	30

[a] Running average of daily values for 30 consecutive days.
[b] Running average of daily values for 7 consecutive days (2 x 30 day average).
[c] Maximum allowable for any one day (3 x 30-day average)

Source: Table 14-2, *Statement of Work, Site Operations and Maintenance, Iron Mountain Mine*, October 2, 2000.

EPA provided the following exceptions for compliance with the effluent limitations given in Tables 1 and 2.

- The SOW required effluent discharged to lower Spring Creek to comply with the effluent limitations specified in Tables 1 and 2, except for pH and TSS level. As stated in ROD2 and ROD3, EPA determined that for the effluent discharged to lower Spring Creek, it would not be necessary to adjust the effluent pH because of the acidic nature and buffering capacity of this creek. Treatment to TSS levels proscribed in the Clean Water Act is not necessary because of the high TSS levels in Spring Creek.

- The Site Operator would not be responsible for exceeding effluent requirements during high wind conditions that could cause a carryover of solids in the thickener overflow and related exceedences of the total or dissolved metal concentrations.
- EPA intended to reevaluate the effluent limitations in 2001 or 2002, following the anticipated completion of the ROD 4 Slickrock Creek Retention Reservoir Project. Because of delays in completing the SCRR project, this evaluation has not yet been completed. Completion is scheduled for December 2003.

Compliance Monitoring Data

The data used to conduct this review are maintained by CH2M HILL in electronic databases. Most of the data used to assess compliance with the SOW requirements was supplied directly by the Site Operator, Iron Mountain Operations (IMO). Additional data used for this review were collected by CH2M HILL for EPA. While the database provides a substantially complete record of analytical data collected over the past 5 years, there are some limitations to its use, including:

1. The effect of operations (i.e., plant shutdowns) or natural conditions (wind) on effluent quality are not described.
2. Prior to January 2001 the quantity and quality of dissolved metals data are not sufficient to demonstrate compliance with the SOW limitations. Operations under the SOW were not in effect until late 2000, and a sufficient number of samples were not collected.

A summary of the compliance data on record reported by IMO during the past 5 years and used as the basis of this review is provided in Table 3.

TABLE 3
Summary of IMO Effluent Monitoring Data
September 30, 1998, through July 31, 2003

Parameter	No. of Results	No. of Non-detects (ND)	Percent ND	Median ND Value
Cadmium, Dissolved	841	159	19	1.00
Cadmium, Total	1,524	340	22	5.0
Copper, Dissolved	841	82	10	5.0
Copper, Total	1,518	22	1	20
Zinc, Dissolved	841	39	5	10
Zinc, Total	1,522	2	0.1	73[a]
Daily pH	1,528	N/A	N/A	N/A
Daily Flow	1,765	N/A	N/A	N/A

[a] Result is elevated due to one sample with an ND result of 136 ppm. Typical detection limit for total zinc is 10.

Analytical detection limits were used in calculations of 7-day and 30-day averages. In most cases, the analytical reporting levels were sufficient to demonstrate compliance. However, the number of exceedences may be overstated due to high reporting limits.

CWA Limit Compliance Summary

pH

Figure 3 provides a plot of MFTP effluent pH from the period October 1998 through July 2003. No exceedences of the daily or monthly CWA limits for pH were observed for the MFTP plant effluent during the period.

Total Cadmium

No exceedences of the daily or monthly CWA limits for total cadmium occurred during the performance period. The average of all data equaled 4.0 µg/L, with a maximum of 96 µg/L. Figure 4 provides a plot of MFTP effluent total cadmium for the period October 1998 through July 2003. The maximum result of 96µg/L occurred on December 24, 2000. Total cadmium results and total zinc results were also elevated during that entire week. The December 2000 monthly average of 12.8 µg/L was the highest monthly average during the five-year review period, but less than the CWA monthly average limit of 50 µg/L.

Total Copper

The MFTP achieved the CWA requirements for total copper for more than 99 percent of the days reported for the five-year period. Thirteen days (0.86 percent) exceeded the daily CWA limit for total copper from January 2001 through October 2003. Eight of the results over the daily limit were reported during the 2-week period from February 23, 2001, through March 9, 2001. Figure 5 provides a plot of MFTP effluent total copper for the period October 1998 through July 2003.

The monthly average exceeded the CWA limit for total copper (150 µg/L) on two occasions; February 2001 (159 µg/L) and March 2001 (221 µg/L). These monthly exceedences coincide with the majority of daily exceedences.

Total Zinc

The MFTP achieved the CWA requirements for total zinc (1,500 µg/L) for more than 99 percent of the days reported. Five days (0.33 percent) exceeded the daily CWA limit for total zinc during the five-year period. The CWA requirements for zinc were exceeded on only one day (February 23, 2001), since operations were implemented under the SOW. Figure 6 provides a plot of MFTP effluent total zinc for the period October 1998 through July 2003.

The monthly average exceeded the CWA limit for total zinc on two occasions; August 1999 and December 1999, prior to operations under the SOW.

Total Lead

The SOW does not require IMO to collect samples to demonstrate compliance with the CWA limits for lead. However, CH2M HILL (for EPA) periodically analyzes effluent grab samples for lead as part of its oversight monitoring program. The CH2M HILL dataset was used to provide the information for this section. During the past 5 years, CH2M HILL collected 113 effluent samples for lead analysis. Most of these samples were collected weekly during the winter months. The average for all the samples equaled 2.7 µg/L, and the maximum result equaled 82.2 µg/L. The maximum lead result of 82.2 µg/L occurred on December 7, 1999, which coincides with a high result for total zinc on that day. The next highest result for total lead equaled 15.6 µg/L. None of the test results exceeded the CWA daily or monthly limits for total lead.

BAT Limit Compliance

Dissolved Cadmium

CH2M HILL and IMO data demonstrate compliance with the BAT requirements for maximum daily dissolved cadmium (3 μg/L) from January 2001 through July 2003. For 67 treatment plant effluent samples collected by CH2M HILL at the MFTP, the reported concentrations were less than 3 μg/L for all samples; 4 sample results exceeded 2.0 μg/L, and 14 sample results exceeded 1.0 μg/L. Because the CH2M HILL data were collected weekly during the winter months (with no collection the remaining portion of the year), the data are not sufficient for evaluating compliance with 7-day and 30-day BAT averages.

The IMO data demonstrate similar compliance with the daily maximum requirements for effluent maximum dissolved cadmium concentrations. From the period from January 2001 though July 2003, review of IMO data indicated no exceedences for dissolved cadmium.

Dissolved Copper

CH2M HILL data demonstrate substantial compliance with the BAT requirements for maximum daily dissolved copper (5 μg/L) from January 2001 through July 2003. For 67 samples of the treatment plant effluent collected by CH2M HILL at the MFTP, the reported concentrations were less than 5 μg/L for 62 samples; 4 sample results ranged from 5.1 μg/L to 5.5 μg/L. Because the CH2M HILL data were collected weekly during the winter months (with no collection the remaining portion of the year), the data are not sufficient for evaluating compliance with average 7-day and 30-day BAT requirements.

Analysis of the IMO data demonstrates that data for dissolved copper are not adequate for demonstrating compliance with the BAT requirements. Problems with the dataset exist pertaining to the detection limits reported and the methodology of the IMO contract laboratory. Evaluation of the detection limits and laboratory methodology are provided under a separate memorandum.

Dissolved Zinc

CH2M HILL data do not demonstrate compliance with the BAT requirements for maximum daily dissolved zinc (30 μg/L) from January 2001 through July 2003. For 67 samples of the treatment plant effluent collected by CH2M HILL at the MFTP, the reported concentrations were less than 30 μg/L for 52 samples; the reported results ranged from 30 to 50 for 10 samples; the reported concentrations exceeded 50 μg/L for 5 samples.

Analysis of the IMO data demonstrates similar exceedences of the IMO requirements for dissolved zinc. IMO reported exceeding the daily, weekly, and monthly limits 45 percent, 79 percent, and >99 percent, respectively, for dissolved zinc. Additional analysis is required to determine whether modification of the BAT requirements is appropriate. One possible reason for these exceedences is the use of zinc sacrificial anodes as part of the cathodic protection system, installed in the summer of 2001. Removal of the zinc anodes, completed in the summer of 2003, may result in a reduction in the dissolved zinc concentrations.

Conclusions and Five-Year Review Recommendations

Based on our review of the treatment plant effluent data collected over the past 5 years, we have developed the following conclusions and recommendations:

CWA Effluent Limitations

Conclusion: The treatment plant is in substantial compliance with the CWA effluent limitations for total cadmium, total copper, total zinc, and total lead. The instances where daily or monthly exceedences occurred were rare and can likely be attributed to operational conditions or other known factors.

Recommendation: No change in the CWA effluent limitations is recommended.

BAT Effluent Limitations

Conclusion: EPA demonstrated MFTP substantially complies with the daily BAT effluent limitations for dissolved cadmium and dissolved copper. The data do not demonstrate compliance with the BAT requirements for dissolved zinc. The IMO contract laboratory's methodology for analysis of dissolved metals and associated detection limits does not permit evaluation of compliance with BAT requirements.

Recommendation: Modification of the IMO's contract laboratory's methodology and detection limits should be considered. Following startup of the Slickrock Creek Retention Reservoir project in January 2004, the data should be reevaluated to determine whether modification of the BAT requirements is warranted.

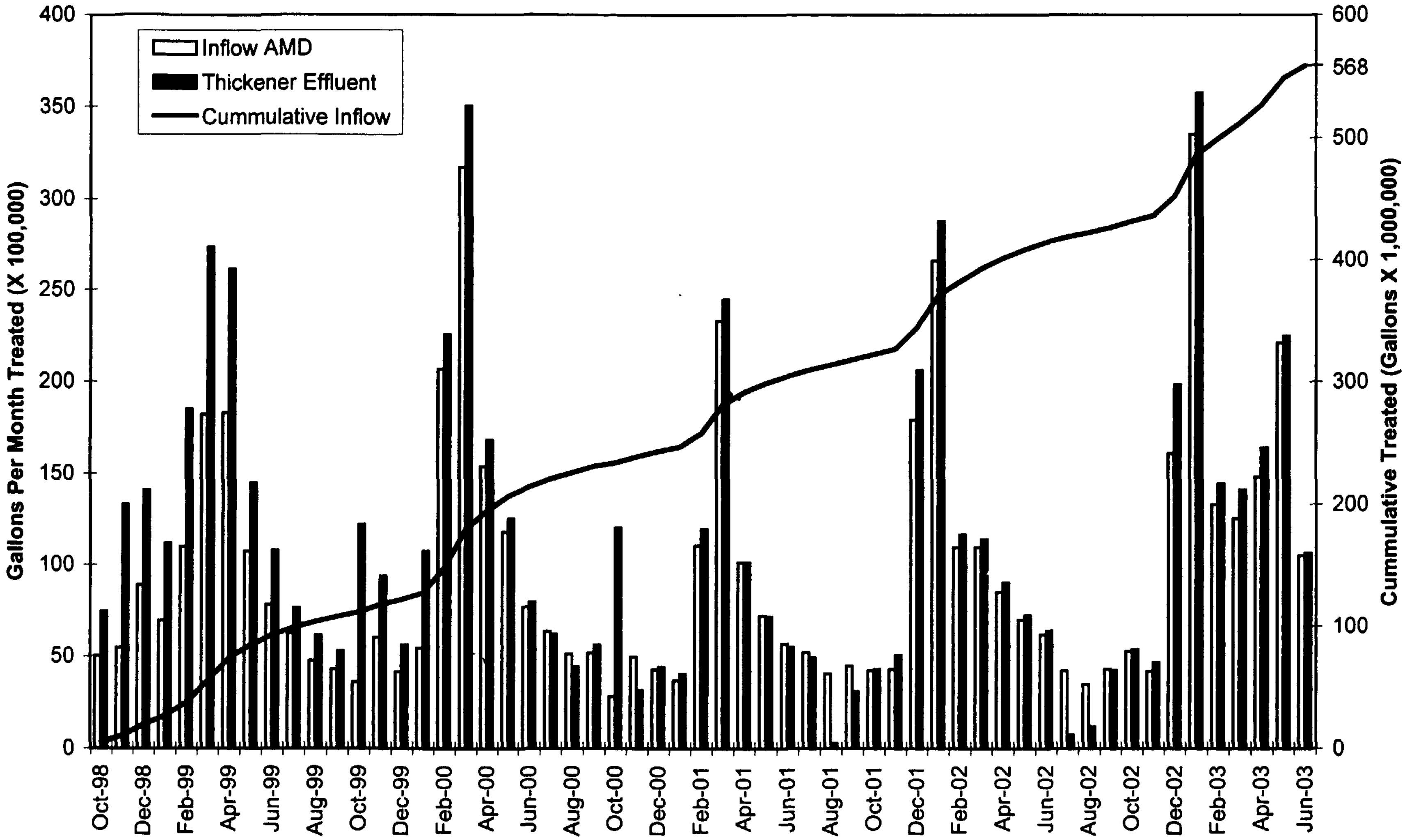


FIGURE 1
MFTP TREATMENT SUMMARY
IRON MOUNTAIN MINE 5-YEAR REVIEW

MFTP Effluent_5 Yr Review.xls: FIGURE 1

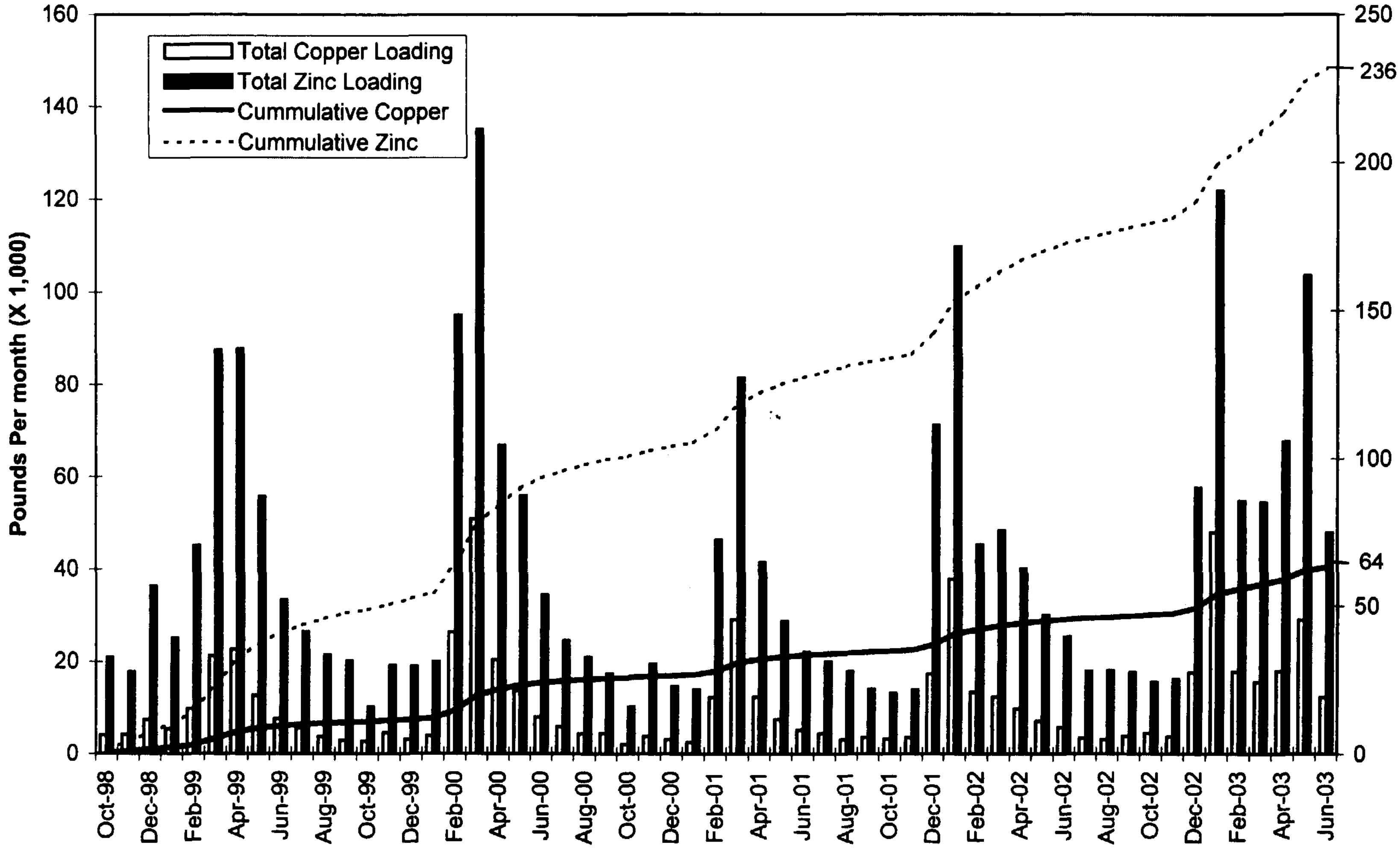


FIGURE 2
MFTP METALS LOAD REMOVAL
IRON MOUNTAIN MINE 5-YEAR REVIEW

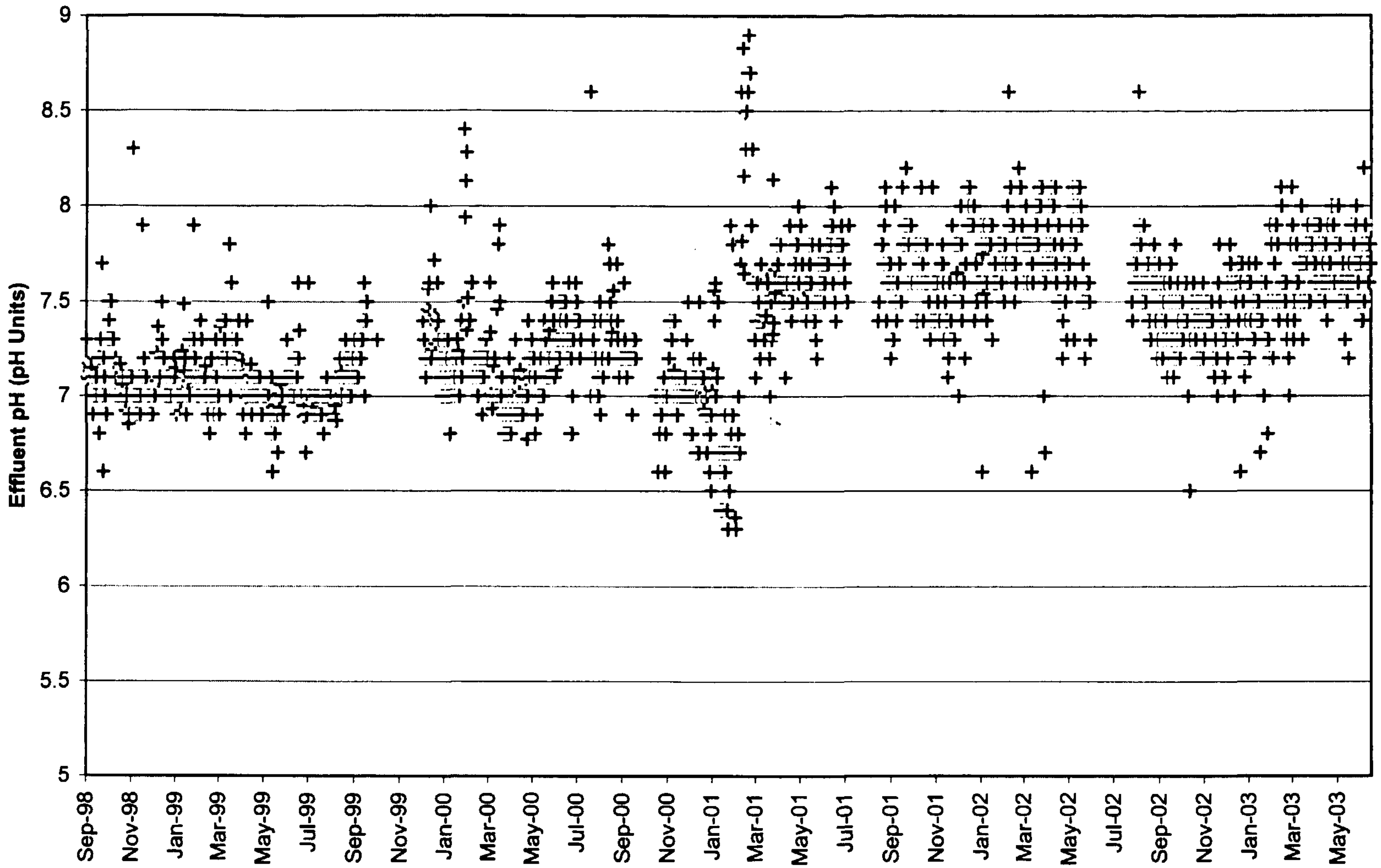


FIGURE 3
MTFP EFFLUENT- DAILY pH
IRON MOUNTAIN MINE 5-YEAR REVIEW

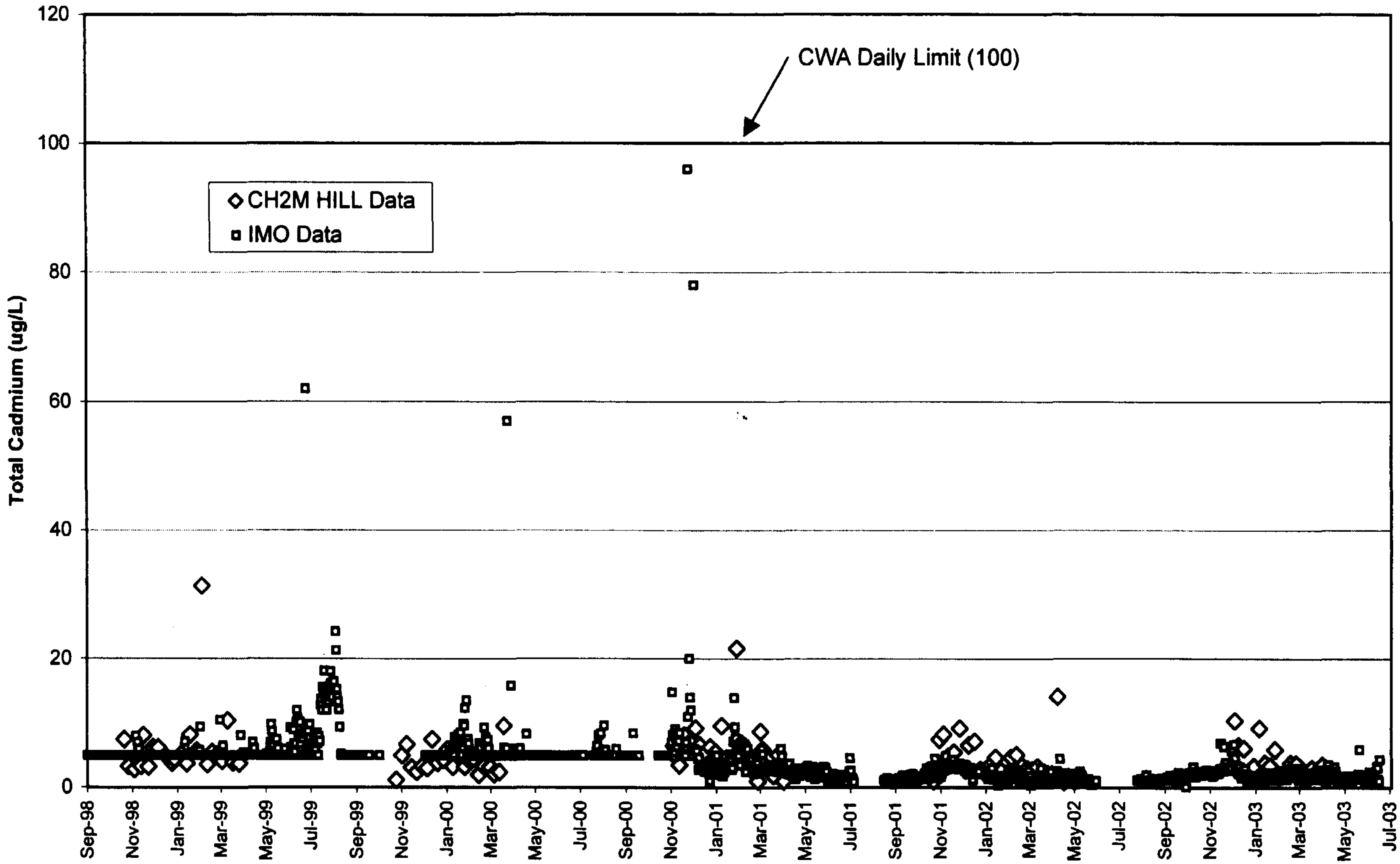
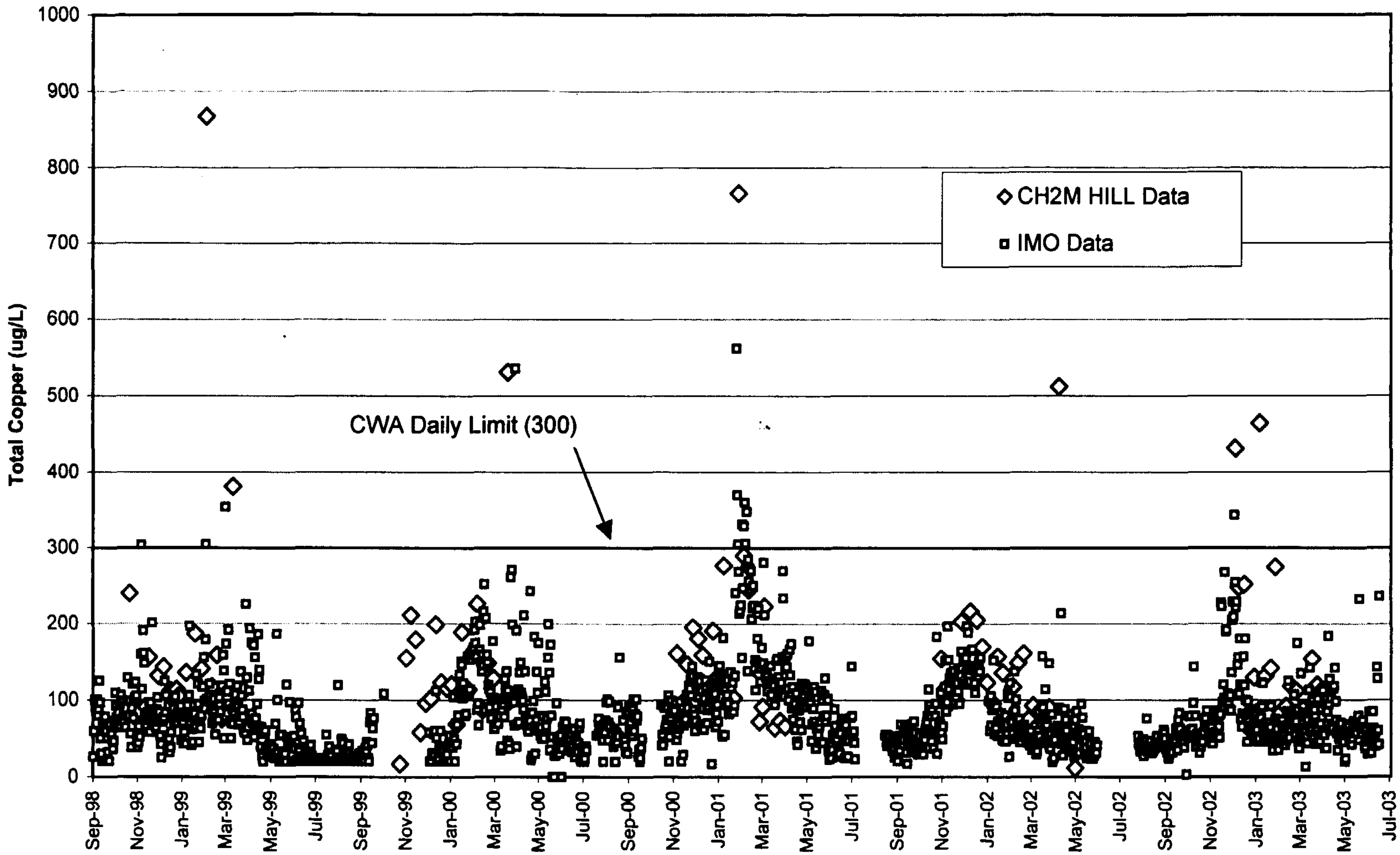
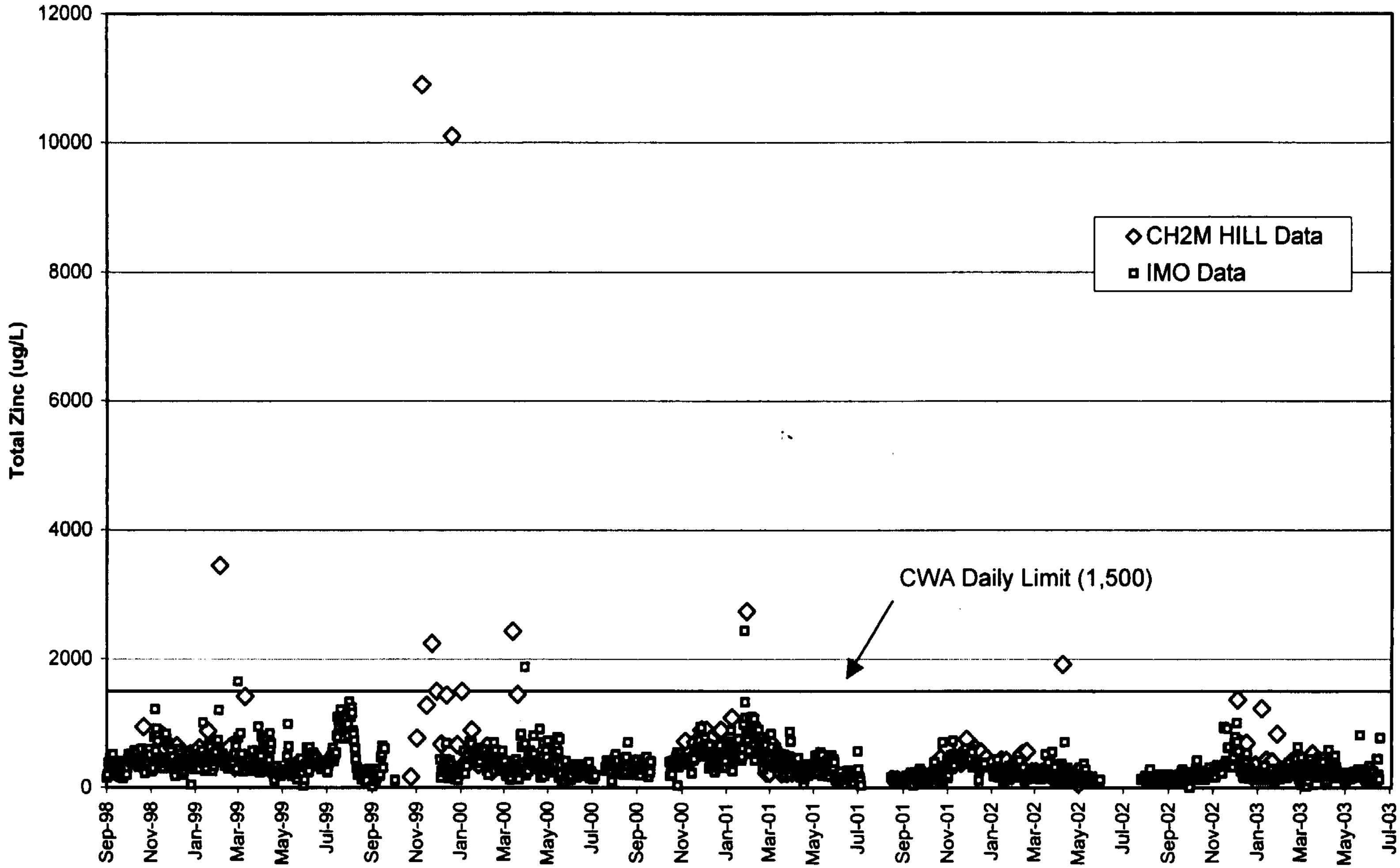


FIGURE 4
MFTP EFFLUENT
DAILY TOTAL CADMIUM
IRON MOUNTAIN MINE 5-YEAR REVIEW



MFTP Effluent_5 Yr Review.xls: FIGURE 5

FIGURE 5
MFTP EFFLUENT
DAILY TOTAL COPPER
IRON MOUNTAIN MINE 5-YEAR REVIEW



MFTP Effluent_5 Yr Review.xls: FIGURE 6

FIGURE 6
MFTP EFFLUENT
DAILY TOTAL ZINC
IRON MOUNTAIN MINE 5-YEAR REVIEW

Site Evaluation and Compliance at Keswick Dam Iron Mountain Mine Five-Year Review

PREPARED FOR: Rick Sugarek/EPA Region IX
Cynthia Wetmore/EPA Region IX

PREPARED BY: John Spitzley/CH2M HILL

DATE: September 15, 2003

Introduction

This technical memorandum evaluates the effectiveness of remedial actions in reducing copper and zinc discharges from the Iron Mountain Mine (IMM) site during the period from 1999 through 2003. Effectiveness is evaluated on the basis of the observed copper and zinc load removed from the contaminant discharges at the IMM site and the reduction in the copper and zinc discharges from Spring Creek Debris Dam (SCDD), located downstream from the IMM site.

Background

Iron Mountain is located approximately 9 miles northwest of Redding, California. The mountain is bordered to the south/southwest by Slickrock Creek and to the north/north-west by Boulder Creek, as shown on Figure 1. Acid mine drainage (AMD) from abandoned mine workings, waste piles, and other area sources discharges and contaminates Boulder and Slickrock creeks. These creeks flow into Spring Creek, which subsequently flows into Spring Creek Reservoir, Keswick Reservoir, and the Sacramento River.

The U.S. Bureau of Reclamation (USBR) constructed the SCDD, which dams the Spring Creek Reservoir, in the early 1960s to meter the contaminated discharge from Spring Creek into Keswick Reservoir and the Sacramento River. The USBR monitors the daily flow from SCDD and routinely completes analytical testing on the discharge waters to determine the metal concentrations of copper and zinc.

Remedial Actions

The U.S. Environmental Protection Agency (EPA) has selected and implemented several major remedial actions at the IMM site. During the period from 1985 through 1990, EPA evaluated, designed, and constructed the following remedial actions selected in the first Record of Decision for the IMM site (ROD1):

- Clean water diversions to route clean water around contaminated waste areas
- Tailings and waste pile removal

- Capping of an open-pit mine and subsidence areas to halt rainwater infiltration into the mine workings

Prior to implementation of these actions, site discharges of copper had been partially remedied by treating portal discharges in Slickrock and Boulder creeks using a copper cementation process. The process involves running AMD discharges through tanks containing shredded tin cans. The AMD copper replaces the iron exposed in the tin cans. Cementation plants have been operated intermittently at Iron Mountain since the 1920s.

In 1989 EPA constructed a 60-gallon-per-minute (gpm) emergency treatment plant to treat a portion of the winter discharges from the Richmond portal. The plant was upgraded to treat a maximum of 140 gpm and operated during the winter months during water years 1992 through 1994. The emergency treatment plant was in operation for the following periods:

- December 1989 to March 1990
- November 1990 to April 1991
- December 1991 to May 1992
- November 1992 to May 1993
- December 1993 to September 1994

In 1992 EPA selected the construction of a high density sludge (HDS) treatment plant and ancillary facilities to collect and treat all discharges from the Richmond and Lawson portals (ROD 2). In 1993 EPA selected the collection and treatment of AMD discharges from the Old/No. 8 Mine Seep (ROD 3).

In 1997 EPA selected collection and treatment of the releases of contaminant discharges from widespread area sources in the Slickrock Creek watershed at Iron Mountain Mine. This project includes construction of a clean water diversion, a retention reservoir, roadways, and capping arsenic-laden main tailings. Substantial completion of the ROD 4 remedies is scheduled for December 2003.

In response to ROD2 and ROD 3, the Responsible Party (RP) constructed an aerated simple mix (ASM) plant at Minnesota Flats (MFTP) in 1993 and 1994. Because of excessive sludge volumes and poor handling characteristics of the ASM sludge, EPA constructed the HDS treatment plant at the MFTP, with startup in January 1997. The HDS treatment process was selected by EPA to improve the cost-effectiveness of IMM treatment operations and to achieve the following improvements in plant and process operations:

1. Decrease the amount of sludge generated by the ASM treatment process. The HDS process has been found to reduce the amount of sludge by over 50 percent compared to the ASM process.

2. Improve process performance of the sludge drying beds. Because of superior dewatering characteristics, the HDS sludge drains quicker and decreases the plugging of the filter sand observed under the ASM process.

3. Improve sludge handling characteristics. The HDS sludge has proved to be easier to excavate and haul to the disposal location than the ASM sludge. The HDS sludge behaves more like a sandy silt than the ASM sludge that behaved like a thixotropic or "quick" clay.

4. Permit the operation of Brick Flat Pit (BFP) as an engineered landfill. Annual sludge hauls are conducted to carry the sludge from the treatment plant to the BFP disposal cell location at the old open pit mine. The sludge is near optimum moisture content at the time of the sludge hauls in September and October of each year. This enables sludge placement in the disposal cell in a controlled manner, allowing compaction and shaping of the fill to allow drainage and access.

Site operations have demonstrated that all intended benefits to site operations from utilizing the HDS process have been realized or exceeded.

Treatment Plant Operations

The MFTP began operation in September 1994 and has continued round-the-clock operations through September 2003. Except for short down-time periods during heavy storm events, the plant has run continuously 24 hours per day, 7 days per week for the period. The site operator reports daily inflow and metal concentrations that are used to compute the total copper and zinc loads collected for treatment. Comparison of influent and effluent data shows that the treatment process is greater than 99.9 percent effective in removing dissolved metals from the AMD.

Table 1 lists the copper and zinc loads collected from AMD discharges at the IMM treatment plants for Water Years 1999 through 2003. During the period from 1999 through 2003, EPA's remedial action at IMM prevented the discharge of approximately 640,000 pounds of copper and approximately 2,350,000 pounds of zinc by treating approximately 570 million gallons of concentrated AMD.

TABLE 1
Copper and Zinc Discharges Collected by Iron Mountain Mine Treatment Plants
Water Years 1999 through 2003

Water Year	Plant Inflow (gal)	Influent Copper (lb)	Influent Zinc (lb)
1999	107,790,000	110,000	480,000
2000	123,220,000	150,000	520,000
2001	86,940,000	90,000	330,000
2002	108,700,000	120,000	450,000
2003	141,970,000	180,000	580,000
Total	**568,620,000**	**640,000**	**2,360,000**

Spring Creek Debris Dam Discharges

Contaminants from Boulder and Slickrock creeks discharge through SCDD into Keswick Reservoir, as depicted in Figure 1. As reported in the previous five-year review memorandum (*Site Evaluation, Iron Mountain Mine*, September 25, 1998), the State of California Regional Water Quality Control Board, EPA, and the USBR have routinely collected samples at SCDD to monitor pH, total copper, total zinc, and total cadmium in the reservoir discharge.

During the period 1983 through 1994, the pH of the water retained in Spring Creek Reservoir typically ranged from pH 2 to pH 3, with an average pH value of 2.8 computed for the

264 samples collected. During the period from November 1996 through May 1998, the pH of the water ranged from 3.75 to 5.2, with an average pH value of 4.5 computed for the 46 samples collected. The increase in the pH of the SCDD discharge was also observed during the five-year review period. From September 1999 through July 2003, the pH of the SCDD discharge ranged from 3.00 to 5.45 with an average pH value of 4.2 computed for the 356 samples collected. A plot of the variation of the SCDD discharge pH is provided in Figure 2.

SCDD Discharge Loads

The USBR computes the average daily discharge from SCDD using the SCDD outlet gate settings. Flows measured using the outlet gate discharge curves have been favorably compared to flows estimated using the standard broad-crested weir located just downstream of the outlet gates. The USBR typically samples SCDD discharges on a weekly or biweekly basis, and more often during high flow conditions or when the reservoir is within 75 percent of reservoir capacity. The historical concentrations fluctuate as a function of inflow and treatment at the site.

For the calculations presented in this technical memorandum, a linear variation between the actual reported values of daily copper and zinc concentrations was assumed.

Average daily copper and zinc discharge loads from SCDD were calculated using the computed concentrations and the USBR average daily discharges for the period October 1, 1969, through August 2003. The annual and cumulative copper and zinc discharges for the period are presented in Figures 3 and 4, respectively. Appendix Tables A-1, A-2, and A-3 list the datasets illustrated in Figures 3 and 4. For this period, approximately 5.1 million pounds of copper and 22.6 million pounds of zinc were discharged from SCDD into Keswick Reservoir and the Sacramento River.

Table 2 lists the copper and zinc loads (in pounds) discharged from SCDD for water years 1999 through 2003. (The water year extends from October 1 of the year proceeding the water year through September 30 of the water year; the data set includes data through July 2003.) For this period approximately 90,000 pounds of copper and 137,000 pounds of zinc were discharged from SCDD into Keswick Reservoir and the Sacramento River.

TABLE 2
Copper and Zinc Discharge from Spring Creek Debris Dam
Water Years 1999 through 2003

Water Year	SCDD Discharge (acre-ft)	Annual Copper (lb)	Annual Zinc (lb)
1999	26,000	20,000	31,000
2000	34,000	28,000	39,000
2001	16,000	13,000	18,000
2002	18,000	12,000	17,000
2003	31,000	17,000	31,000
Total	**125,000**	**90,000**	**137,000**

Total Copper and Zinc Loads Discharged from IMM

Table 3 lists the total copper and zinc loads discharged from IMM for Water Years 1999 through 2003 (the dataset includes data through July 2003).The total load includes IMM contaminant flows (now collected for treatment) and the SCDD discharge loads. For this period IMM discharged approximately 734,000 pounds of copper and 2.5 million pounds of zinc.

Table 3 also shows the percent reduction in copper and zinc discharges from IMM for the period as a result of EPA's treatment remedial action. The percent reduction is calculated as the load removed by treatment divided by the total load. These calculated values do not take into account the reduction in copper and zinc contaminant loads as a result of other remedial actions, including the construction of the Slickrock Creek clean water diversion, capping of BFP and subsidence areas, and removal of sulfide tailings and waste piles in Boulder Creek. For this five-year period, collection and treatment of portal discharges have resulted in an average reduction in copper discharges of 88 percent and an average reduction in zinc discharges of 95 percent.

TABLE 3
Total Iron Mountain Copper and Zinc Discharges and Reduction in Site Discharge
Water Years 1999 through 2003

Water Year	SCDD Discharge (acre-ft)	Total IMM Copper (lb)	Total IMM Zinc (lb)	Discharge Reduction Copper (%)	Discharge Reduction Zinc (%)
1999	26,000	127,000	509,000	84	94
2000	34,000	177,000	558,000	84	93
2001	16,000	103,000	349,000	87	95
2002	18,000	133,000	469,000	91	96
2003	31,000	194,000	614,000	91	95
Total	125,000	734,000	2,498,000	88	95

Water Quality Compliance at Keswick Reservoir

During the five-year review period, the USBR conducted routine sampling of SCDD (LSC), Shasta Dam (SRS) and Keswick Dam discharges (SRK2). Sampling and testing was conducted weekly during normal operations and more frequently during changes in releases, storm events, or overtopping of SCDD. The purpose of the sampling was to assist the USBR in regulating discharges from SCDD to meet water quality objectives for the Sacramento River downstream of Keswick Dam. The sampling locations are shown on Figure 1.

The State Basin Plan standard water quality objectives for the Sacramento River at Keswick Dam are 5.6 μg/L for copper, 16 μg/L for zinc, and 0.22 μg/L for cadmium (*The Water Quality Control Plan (Basin Plan)* California Regional Water Quality Control Board. Fourth Edition, 1998).

During the period from October 1999 through July 2003, the USBR conducted sampling and testing on approximately 256 days at the sampling location just downstream from Keswick

Dam (SRK2). The reported total and dissolved copper concentrations are shown on Figure 5. Of these 256 days, the reported copper concentration exceeded 5.6 μg/L on 15 of the days reported.

Figure 6 compares the dissolved copper concentrations reported by the USBR for Keswick Dam and Shasta Dam. Review of the data for the period October 1999 through July 2003 demonstrates that for those days when the dissolved copper concentration at the Keswick Dam discharge equaled or exceeded 4.0 μg/L, the average ratio of the dissolved copper concentration recorded at Keswick Dam and Shasta Dam equaled 65 percent. The ratios ranged from 21 percent to 96 percent with a standard deviation equal to 15 percent.

The ratio of the concentrations provides a very approximate indicator of the relative copper load contributions from Shasta Dam to the Keswick Dam discharges. A more comprehensive sampling program and mass balance analysis would be required to more accurately evaluate the actual load contributions. The mass balance analysis would need to evaluate travel time from Shasta Dam to Keswick Dam, dilution from Whiskeytown Reservoir through the Spring Creek Powerhouse, accretion flows, precipitation, and load contribution from SCDD.

Implementation of the ROD 4 remedies is projected to provide a 60 to 70 percent reduction in the remaining contaminant discharge from the Iron Mountain Mine site. Subsequent to implementation of the ROD 4 remedy, an additional evaluation should be conducted to reevaluate the controlled releases from SCDD into Keswick Reservoir and operational requirements for SCDD, Shasta, and Keswick Dam.

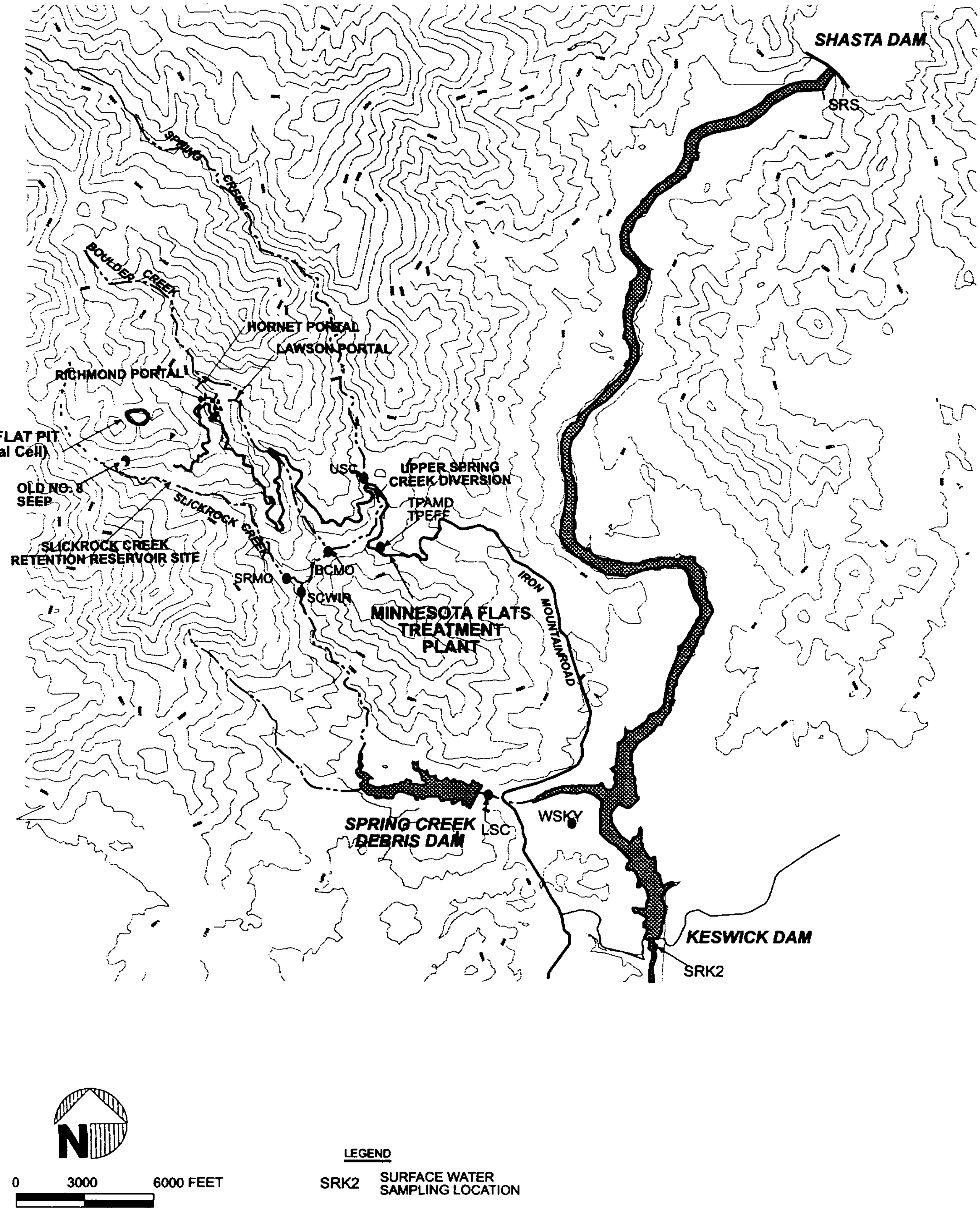


FIGURE 1
LOCATION MAP
IRON MOUNTAIN MINE FIVE YEAR REVIEW

IMMAP - 5 Yr Review.FH8

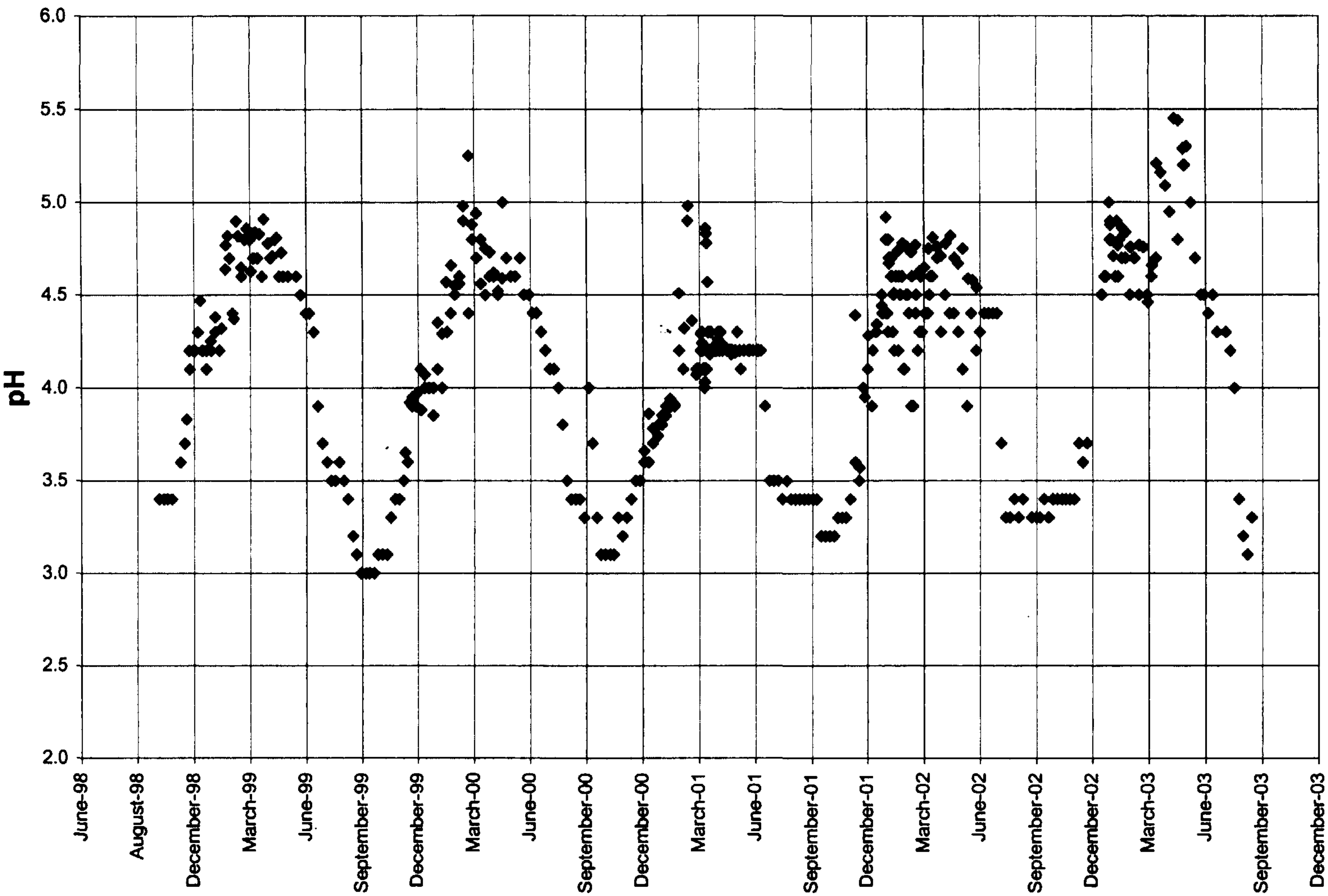


FIGURE 2
pH MEASUREMENTS
SPRING CREEK DEBRIS DAM DISCHARGE
IRON MOUNTAIN MINE FIVE-YEAR REVIEW

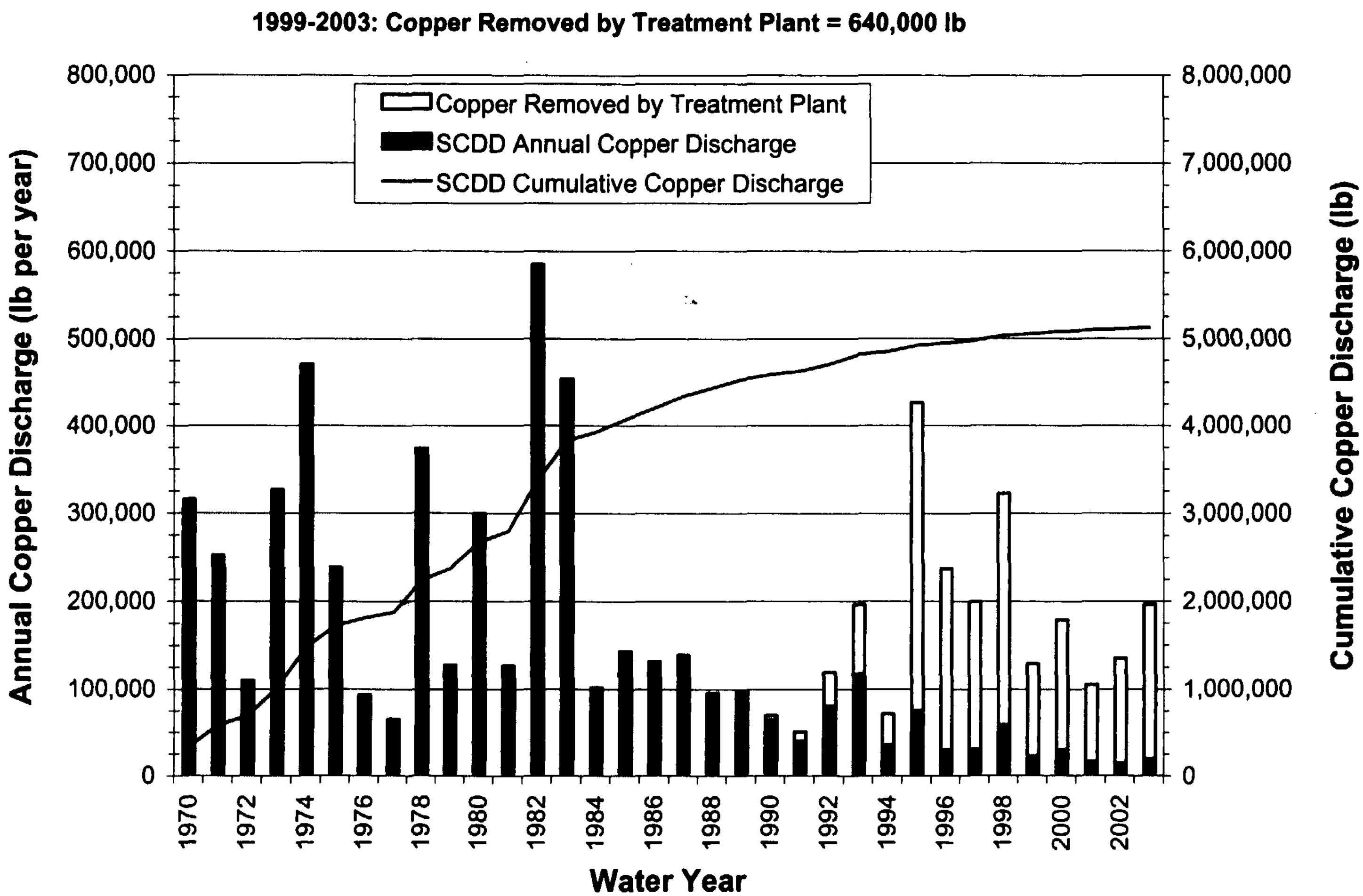


FIGURE 3
IMM COPPER DISCHARGE
IRON MOUNTAIN MINE FIVE-YEAR REVIEW

1999-2003: Zinc Removed by Treatment Plant = 2,350,000 lb

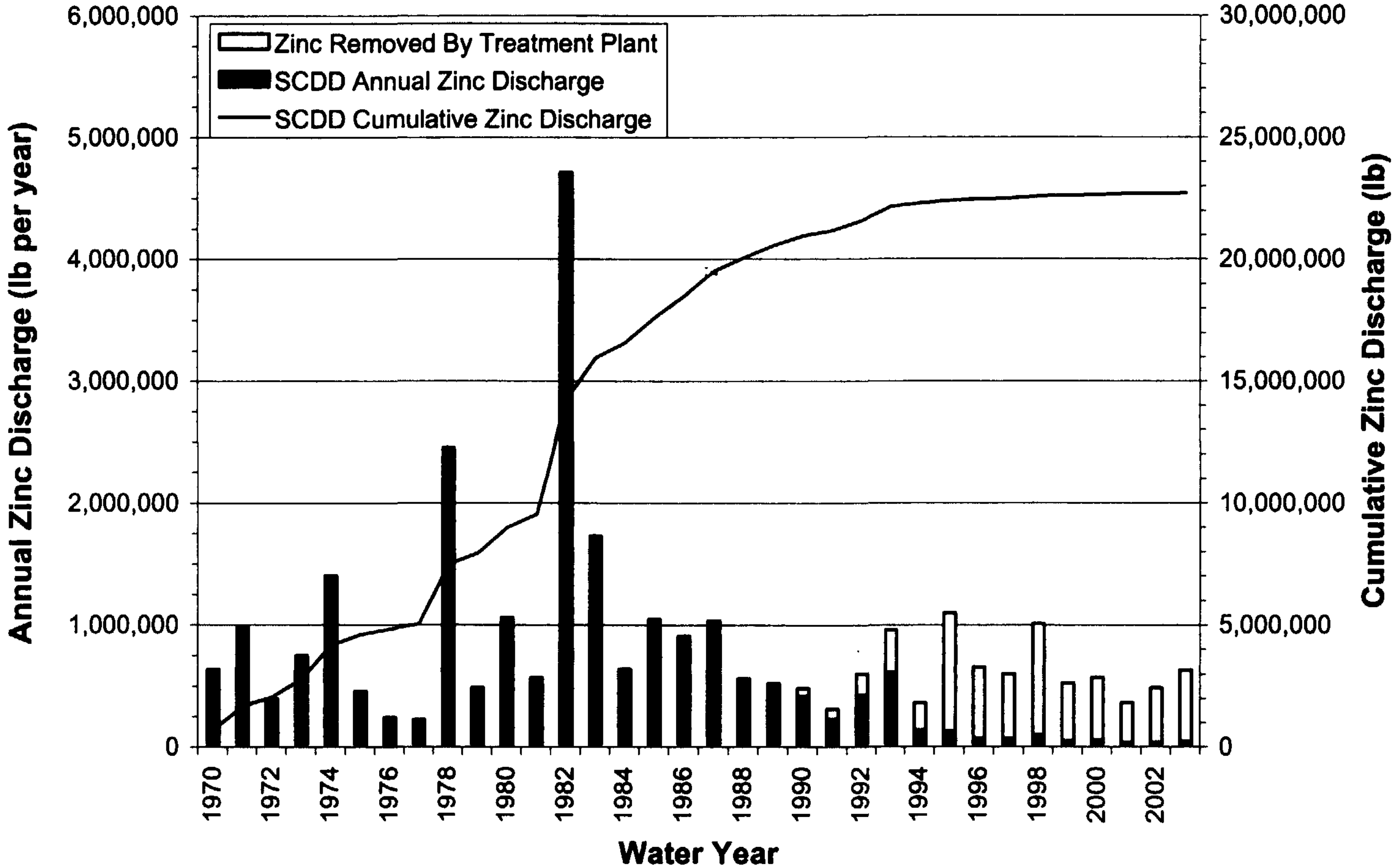


FIGURE 4
IMM ZINC DISCHARGE
IRON MOUNTAIN MINE FIVE-YEAR REVIEW

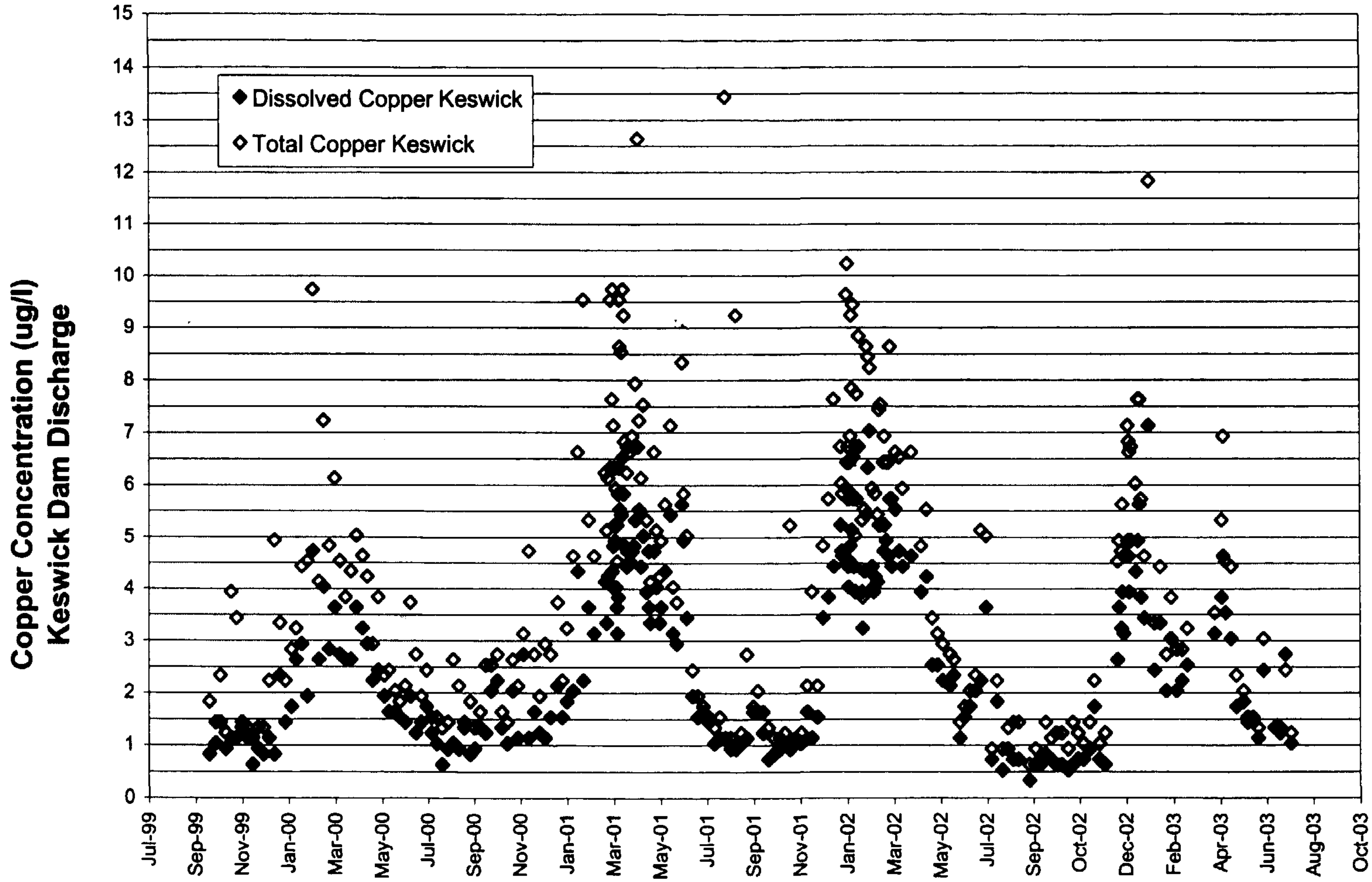


FIGURE 5
TOTAL AND DISSOLVED COPPER CONCENTRATION
KESWICK DAM DISCHARGE
IRON MOUNTAIN MINE FIVE-YEAR REVIEW

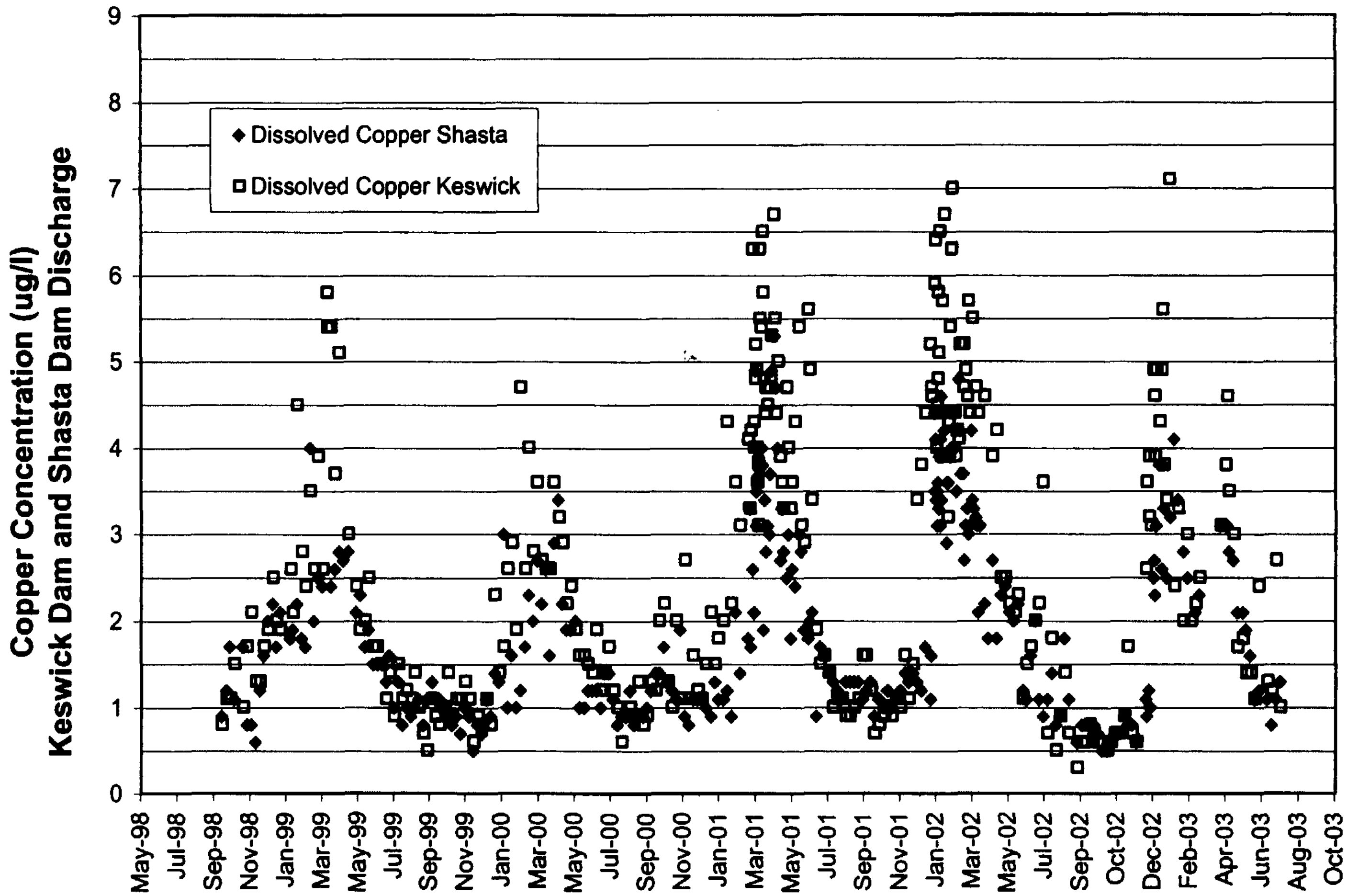


FIGURE 6
DISSOLVED COPPER CONCENTRATION
SHASTA DAM AND KESWICK DAM DISCHARGE
IRON MOUNTAIN MINE FIVE-YEAR REVIEW

Five Year Review Shasta_Keswick.xls: Shasta_Keswick Chart

Table A-1
SCDD Copper and Zinc Discharge: 1970 -2003 Water years
Iron Mountain Mine Five-Year Review

Water Year	SCDD Discharge (Acre-ft)	Annual Copper (lb)	Cumulative Copper (lb)	Annual Zinc (lb)	Cumulative Zinc (lb)
1970	39,248	313,471	313,471	620,080	620,080
1971	32,334	249,828	563,298	967,460	1,587,539
1972	10,236	107,645	670,943	377,701	1,965,241
1973	38,853	324,551	995,494	733,315	2,698,556
1974	62,806	468,516	1,464,010	1,386,576	4,085,133
1975	31,213	236,319	1,700,329	440,408	4,525,540
1976	7,495	91,300	1,791,629	225,771	4,751,311
1977	2,955	63,044	1,854,674	208,976	4,960,288
1978	57,180	371,769	2,226,443	2,437,129	7,397,417
1979	15,156	125,212	2,351,655	468,785	7,866,202
1980	32,820	297,479	2,649,133	1,045,093	8,911,295
1981	24,276	124,935	2,774,068	554,420	9,465,715
1982	52,290	582,541	3,356,609	4,695,683	14,161,398
1983	83,856	451,591	3,808,199	1,714,696	15,876,094
1984	29,441	99,875	3,908,075	619,616	16,495,710
1985	19,680	141,365	4,049,439	1,028,050	17,523,760
1986	38,364	129,532	4,178,971	892,608	18,416,368
1987	16,813	136,958	4,315,929	1,019,126	19,435,495
1988	16,964	93,301	4,409,230	544,878	19,980,372
1989	19,579	95,706	4,504,936	504,504	20,484,876
1990	13,709	61,750	4,566,687	401,006	20,885,882
1991	4,730	36,728	4,603,414	209,692	21,095,574
1992	14,671	77,884	4,681,298	406,776	21,502,350
1993	23,240	114,970	4,796,268	591,205	22,093,556
1994	4,191	32,739	4,829,006	118,666	22,212,222
1995	40,952	72,601	4,901,607	110,379	22,322,601
1996	18,669	28,170	4,929,777	52,568	22,375,169
1997	28,856	27,851	4,957,628	47,313	22,422,483
1998	74,989	55,993	5,013,621	78,674	22,501,157
1999	25,769	19,957	5,033,578	31,465	22,532,622
2000	34,495	27,819	5,061,397	38,703	22,571,325
2001	15,831	13,445	5,074,842	18,104	22,589,429
2002	18,140	11,931	5,086,773	17,464	22,606,893
2003	30,569	17,100	5,103,873	30,936	22,637,829
Total	949,797	5,103,873		22,637,829	
Five Year	124,803	90,252		136,672	
1999	26,000	20,000		31,000	
2000	34,000	28,000		39,000	
2001	16,000	13,000		18,000	
2002	18,000	12,000		17,000	
2003	31,000	17,000		31,000	
Five Year	125,000	90,000		137,000	

Table A-2
Copper and Zinc Load Collected by IMM Treatment plant
Iron Mountain Mine Five-Year Review

Water Year	Plant Inflow (gal)	Influent Copper (lb)	Influent Zinc (lb)
1970			
1971			
1972			
1973			
1974			
1975			
1976			
1977			
1978			
1979			
1980			
1981			
1982			
1983			
1984			
1985			
1986			
1987			
1988			
1989			
1990	4,352,979	5,849	64,682
1991	5,380,272	11,658	85,316
1992	10,467,006	38,920	176,265
1993	25,305,355	79,182	351,492
1994	22,098,293	36,302	226,877
1995	162,372,924	351,478	972,529
1996	108,883,298	206,954	585,914
1997	107,146,938	169,516	537,979
1998	192,784,060	264,375	917,420
1999	107,791,992	107,154	477,614
2000	123,216,791	148,803	518,829
2001	86,938,235	89,408	330,862
2002	108,703,282	121,023	451,705
2003	141,965,410	177,106	582,758
Total	1,207,406,836	1,807,727	6,280,242
Five Year	568,615,710	643,493	2,361,768
1999	107,790,000	110,000	480,000
2000	123,220,000	150,000	520,000
2001	86,940,000	90,000	330,000
2002	108,700,000	120,000	450,000
2003	141,970,000	180,000	580,000
Five Year	568,620,000	640,000	2,360,000

Table A-3
Total Iron Mountain Load: SCDD Discharge + Treatment Plant Load
Iron Mountain Mine Five-Year Review

Water Year	SCDD Discharge (Acre-ft)	Annual Copper (lb)	Annual Zinc (lb)	Percent Reduction Water Year	Copper (%)	Zinc (%)
1970	39,248	313,471	620,080			
1971	32,334	249,828	967,460			
1972	10,236	107,645	377,701			
1973	38,853	324,551	733,315			
1974	62,806	468,516	1,386,576			
1975	31,213	236,319	440,408			
1976	7,495	91,300	225,771			
1977	2,955	63,044	208,976			
1978	57,180	371,769	2,437,129			
1979	15,156	125,212	468,785			
1980	32,820	297,479	1,045,093			
1981	24,276	124,935	554,420			
1982	52,290	582,541	4,695,683			
1983	83,856	451,591	1,714,696			
1984	29,441	99,875	619,616			
1985	19,680	141,365	1,028,050			
1986	38,364	129,532	892,608			
1987	16,813	136,958	1,019,126			
1988	16,964	93,301	544,878			
1989	19,579	95,706	504,504			
1990	13,709	67,600	465,688	1990	9%	14%
1991	4,730	48,385	295,008	1991	24%	29%
1992	14,671	116,804	583,041	1992	33%	30%
1993	23,240	194,152	942,698	1993	41%	37%
1994	4,191	69,040	345,543	1994	53%	66%
1995	40,952	424,078	1,082,908	1995	83%	90%
1996	18,669	235,124	638,483	1996	88%	92%
1997	28,856	197,367	585,292	1997	86%	92%
1998	74,989	320,368	996,094	1998	83%	92%
1999	25,769	127,111	509,079	1999	84%	94%
2000	34,495	176,622	557,532	2000	84%	93%
2001	15,831	102,853	348,966	2001	87%	95%
2002	18,140	132,954	469,170	2002	91%	96%
2003	30,569	194,205	613,694	2003	91%	95%
Total	949,797	6,911,600	28,918,072	Total	26%	22%
	124,803	733,745	2,498,440		88%	95%
1999	26,000	127,000	509,000			
2000	34,000	177,000	558,000			
2001	16,000	103,000	349,000			
2002	18,000	133,000	469,000			
2003	31,000	194,000	614,000			
Five Year	125,000	734,000	2,498,000			

Site Inspection
Iron Mountain Mine Five-Year Review

PREPARED FOR: Rick Sugarek/EPA Region IX
Cynthia Wetmore/EPA Region IX

PREPARED BY: Dale Cannon/CH2M HILL
Dave Bunte/CH2M HILL
John Spitzley/CH2M HILL

DATE: September 22, 2003

As requested by EPA, CH2M HILL personnel visited the Iron Mountain Mine site to observe site conditions and provide a general overview of the current condition of the civil/site facilities. Portions of the *Site Operations and Maintenance Statement of Work* (SOW), dated October 2, 2000, including Article 8, Performance Standards, and Article 9, Routine and Non-routine O&M, were used as a guide. The focus of the site visits was on the site/civil facilities and the Richmond Adit Rehabilitation. The treatment plant and the other onsite mines were not included; neither was a detailed review of the Slickrock Creek Retention Reservoir construction project.

Treatment Plant

Reviews of the current condition of the Minnesota Flats Treatment Plant (MFTP) can be found in separate memorandums:

- *Hydraulic Flow Test, Minnesota Flats Treatment Plant, Iron Mountain Mine*. CH2M HILL. September 4, 2003
- *Site Evaluation and Compliance at Keswick Dam, Iron Mountain Mine Five-Year Review*. September 15, 2003.
- *Minnesota Flats Treatment Plant Effluent Discharge, Iron Mountain Mine Five-Year Performance Review*. September 18, 2003.
- *Minnesota Flats Treatment Plant Audit, Iron Mountain Mine Five-Year Review*. September 22, 2003.

Site Drainage

There were significant periods of rain in the winter of 2002-2003 that should have tested the drainage facilities. All seem to have performed as intended except for a ditch around the sludge drying basins that overtopped. This ditch was cleaned of willows and sediments.

General Comments

In general, based on our brief observations, we believe that the site is well maintained. The following are our recommendations:

- Continue follow-up with Shasta County for the repair of Iron Mountain Road between Flat Creek Bridge and the entrance gate.
- Seal the pavement cracks (alligatoring) that is occurring along and on the plant road from the entrance gate to a location below Drying Bed No. 4. The Iron Mountain Mine Operations staff (IMO) plan to complete this repair after the sludge haul in October.
- Fill the gullying that is occurring on the uphill slopes of Drying Beds No. 1 and 2 and on the downslopes of Sludge Drying Beds No. 3 and 4, and seed the bare areas. Improve the drainage in these areas to reduce the reoccurrence of the gullying.
- Complete the removal of the scale material in the AMD conveyance pipelines.
- Review the temporary drainage plan for the Clean Water Diversion from the upper Slickrock Creek Basin. Provide temporary diversions to avoid damage to the access road and downstream construction, particularly if the SCRR construction is not complete prior to the rainy season.
- Review the temporary drainage plans around the borrow and storage sites (near Markers 12 and 18) along Iron Mountain Road. Clean culverts and construct drainage ditches.
- Continue the study and demonstration of alternative repair materials for lining the Spring Creek Diversion pipeline.
- Complete the scour protection on the Spring Creek Diversion impact structure.
- Consider installing the remaining horizontal drains in the Boulder Creek slide area.
- Replace the exposed PVC pipe at the ends of the horizontal drains with non-UV-sensitive pipe.
- Determine the contents of the fluid in the chemical storage tanks across the road from the cementation plant and provide proper containment if required or properly dispose of the contents.
- Remove sediments above the Boulder Creek sampling station and above the Spring Creek Diversion. These are routine planned activities.

Specific Comments on Civil/Site Facilities

Dale Cannon met Wes Franks, Iron Mountain Operations (IMO) Construction Manager, at his office at the Minnesota Flats Treatment Plant at approximately 8:45 a.m. on Tuesday, July 29, 2003. It was sunny and hot. Dale and Wes completed the inspection tour about 12:30 p.m. The following are Dale's specific comments. The numbers shown refer to the SOW article number.

8.5.1 Plant Roads

This includes the plant road from the entrance gate to the end of the paving – just beyond the gate at the Minnesota Flats area. The ditches were clean of sediment. The shotcrete-lined "v" ditch and the stilling basin at the end of the ditch were clean. Minor raveling of the pavement reported during the November 2002 inspection has been repaired. The edge of the pavement was paved with concrete. The cracks in the pavement (alligatored pattern) along a reach of roadway below Drying Basin No. 4 that were reported in the November 2002 inspection report have not yet been repaired. Wes reported that IMO is planning to place a seal coat over the pavement after this year's sludge haul.

At least two locations along the county road between Flat Creek Bridge and the entrance gate were badly deteriorated and have been repaired by Shasta County public works. The performance of these locations should be reviewed during the next winter.

Dale Cannon had inspected the culvert that crosses underneath the road just outside of the entrance gate on a previous field trip about one month earlier – it was clear of gravel, rocks, and debris, and the plates in the bottom of the culvert were holding up well.

8.5.2 Hillslopes

Gullying continues to occur uphill from the sludge drying beds and also on the sludge drying bed banks below Drying Beds No. 3 and 4. Most of the gullying appears to be minor, but some are deeper. Vegetation is filling in the bare spots, and the gullying is not as noticeable as during the November 2002 inspection. Wes commented that the gullies would be filled just before the rainy season so that vegetation can be reestablished. Without the vegetation, the gullying will reoccur. Drainage should be evaluated and perhaps redirected in properly constructed drainage channels to prevent future gullying. The hillside around the 1-million-gallon tank looks good. The vegetation has been reestablished and held up well during the rain storms in winter 2002-2003. The hillside above the effluent discharge outlet tunnel also looks good.

8.5.3 Effluent Discharge Works

The outlet of the discharge tunnel was free of debris and free-flowing. The dike separating the outlet from Spring Creek was in good condition. The berm built when the discharge tunnel was built has not changed except for vegetation growth.

8.5.4 Modutank

A new liner was installed in summer 2002. The modutank is currently in use, while the thickener tank is down for inspection. There are no signs of leakage. The tank was nearly full at the time of inspection. No defects were noted in the piping or valves. All valves are periodically exercised in accordance with the annual O&M program. Valves were not exercised during the July 29 site visit.

8.5.5 AMD Tank

Dale and Wes did not inspect the inside of the AMD tank on this site visit – the tank was recently cleaned and inspected according to Wes Franks/IMO, and no defects were found.

8.5.6 Clean Water System for Lime Slurry Makeup

Not inspected.

8.5.7 Sludge Drying Beds

The ditches around the drying beds were clean of sediment. Sludge Drying Beds No. 1 and 4 will be emptied this year. The beds are wet from the spring rains. No defects were noted.

8.5.8 Boulder Creek Cementation Plant

The plant has not been used for a few years but appeared to be ready for use. The three unused transformers reported during the November site visit have been removed.

8.6 Site Roads

Iron Mountain Road and the Jeep Road, as well as access roads to the Lawson and Richmond, were in good condition. The roads were well graded. The ditches and the culvert openings were clear of debris and sediment except around Markers 12 and 18. These are borrow and storage locations for the Spring Creek Diversion Dam fill. Care should be taken during the construction of the Slickrock Creek Diversion Dam to ensure proper drainage, particularly prior to a rain storm. Culverts need to be cleaned and roadside ditches restored.

The Hilfiker retaining walls looked good. Gabbion walls were installed at two locations along the Lawson Road to protect the downhill slopes. They looked good.

Some PVC pipe was used for culverts crossing Lawson Road. The exposed ends of these pipes should eventually be replaced with HDPE or ABS pipe.

Dale and Wes went part way up Slug Gulch Road, and it was found to be in good condition.

8.7 AMD Collection and Conveyance System

A section of the AMD conveyance pipeline immediately upstream from the Boulder Creek Crossing of Iron Mountain Road was recently replaced. A section of the pipeline was removed and was lying alongside the road. It was completely full of scale. The scale buildup still remains in the AMD conveyance pipeline upsteam from the replaced section as well as in a short section of pipe between the end of the replaced pipe and the intersection of the AMD pipe from Old\No. 8 to the Lawson AMD pipeline. IMO will continue to work at the removal of the scale so that the pipeline will be ready this winter. The scale will be removed at 500-foot intervals. A water jet and "pig" will be used. The scale will be vacuumed out of the pipeline.

The Lawson grit chamber was clean and functioning. A cast iron blind flange on the Lawson grit chamber discharge pipeline is rusting and should be replaced with an SS blind flange.

The Richmond grit chamber was murky and had an oil layer on top. The water from the main was gray. The pipes from the mine and the grit chamber need to be cleaned as part of the final cleanup of the Richmond work. Richmond work will be complete in about one month. Wes said that they IMO will have a company with vacuum capability clean the chamber. The equipment is all stainless steel. A cast iron blind flange on the Richmond grit chamber discharge pipeline is rusting and should be replaced with an SS blind flange.

The Old\No. 8 grit chamber was not operating because of the construction and the inspection of the thickener tank.

8.8 Brick Flat Pit

Nothing special noted. Vents had been raised.

8.11.1 Upper Spring Creek Diversion

The pool above the diversion intake was clear and free of debris. Wes said IMO intends to clean silt in the bottom of the pool prior to the rainy season.

The sediment basin was relatively clean when the Spring Creek Diversion pipeline was inspected on June 19th. The detailed report of that inspection will be submitted shortly by IMO.

No visual movement of the impact structure and no bank erosion downstream from the impact structure were noted. Vegetation has been re-established along the banks. Wes noted that the impact structure basin no longer fills with gravel during the winter. The construction of the stilling pool in front of the diversion has been successful in eliminating the grit and gravel being diverted through the diversion pipeline. Stainless steel (SS) plate protection has been added to the impact structure, but the work is not yet complete. A center plate still needs to be installed (it is onsite) and the bottom repaired and protected with an SS plate. The scoured concrete and rebar area will be sand-blasted, non-shrink grout will be placed in the scoured area, and an SS plate will be bolted over the floor area of scour. The bolts will be protected by welding a stainless steel angle iron over them.

8.11.2 ROD 1 Upper Slickrock Creek Clean Water Diversion

The stilling basin and the intake bar screen were clear of debris. The gate, however, was closed for the construction of the Slickrock Creek Diversion and Retention Reservoir downstream. Heavy rains will cause the water to pool behind the Reclamation Dam and eventually overflow into Catfish Pond. There is no outlet from Catfish Pond except by overtopping the weir. The construction of the water diversion intake structure is complete. The Clean Water Diversion pipeline is being constructed. Alternative means of diverting the water from Slickrock Creek need to be considered if the Clean Water Diversion is not operational by the start of the rainy season.

8.11.4 Left Side Water Diversions

These are part of the current construction project and were not specifically inspected. Wes is concerned that these will be a constant maintenance problem. He is also concerned that the size of the area above the stilling basin may be inadequate for the amount of material that may come down from the mountain. He is also concerned about the adequacy of the disposal area – which is essentially filled with material stockpiled from the dam construction.

8.12 Boulder Creek Tailing Dam

It is our understanding that the concept for the work at the Boulder Creek Tailing Dam has been accepted and that construction will start after completion of the sludge haul. The weir and the pool upstream from the dam were clear of debris. A temporary culvert and road across Boulder Creek will be removed prior to the rainy season.

8.13 Slickrock Creek Basin

This area is under construction and not inspected during the site visit.

8.14 Boulder Creek Slide Area

The horizontal drains appeared to be working well. It is our understanding that the number of drains that were initially installed was less than the planned number. The initial drains were installed to determine the effectiveness of the horizontal drainage system with the thought that additional drains would be installed later if found to be effective. Consideration should be given to installing these additional drains. Wes reported that Pace annually surveys the area of the slide and has found no movement in the slide or the Lawson portal.

The horizontal drains were constructed using PVC pipe and valves. The PVC pipe is exposed where it comes out of the hillside. PVC pipe becomes brittle with continuous exposure to ultra-violet (UV) light. Consideration should be given to replacing the exposed sections of PVC with non-UV-sensitive pipe.

8.15 Boulder Creek Sampling Station

The sampling station (BCMO) was clear of debris and ready for sampling. However, the water level in the creek is below the bottom of the sampling station. About 3 or 4 feet of sediment has settled in the bottom of the pool above the weir. The sediment has to be removed between storms during the winter. The disposal area is next to and uphill from Boulder Creek and Spring Creek. The disposal area slopes toward the creeks. Gravel, silt, and rocks from the disposal pile could easily be washed down into Spring Creek during rainstorms. Other sites should be considered, although no close site was readily apparent.

Chemical Storage Tanks

There are three chemical storage tanks near the shed across the road from the cementation plant. These tanks have an estimated volume of 4,000 to 5,000 gallons. They are about 1/2, 2/3, and 1/8 full. The fluid in the tanks is unknown. Pipes from the tanks enter into the metal storage building. The tanks appear to be polypropylene, but the pipes are PVC. While there is no sign of leakage, any leakage from the tanks could drain into Boulder Creek. It is recommended that the contents of the tanks be determined and an appropriate containment protection system be provided or, if the chemicals are no longer used, that they be properly disposed of.

Specific Comments on Richmond Adit Rehabilitation

The rehabilitation of the Richmond Adit is a Remedial Action (RA) being performed by the Site Operator, IMO, and its subcontractor, North Pacific Research. The Site Operator was directed to perform this RA in Section 9.9.2.2, *Non-routine O&M Requirements for the Richmond Adit,* of the SOW. The Richmond Adit and Drifts rehabilitation includes:

- Providing machine access or alternate method of muck removal
- Relocating utilities and the AMD conveyance piping
- Installing a new ventilation system
- Removing muck from the drifts and placing it in a newly created disposal cell
- Providing stability to the chutes
- Installing an active support system in the 5-way area
- Constructing a 700-foot-long bypass drift, a new cross-cut, muck check dams, AMD stilling basins, and collection systems.

As of September 19, 2003, all of these items have been completed, with the following exceptions:

- Paragraph 1h of Section 9.9.2.2 requires that the chutes in the A, B, and C Drifts be stabilized. There are several chutes (2E, 5C, 9C, and 4E) that have plugged drain pipes or have potential for plugging based on the presence of salts that have been observed in the discharge piping. A more thorough evaluation of these chutes and their associated drainage is required. Based on those evaluations, additional actions may be required.
- A failure of the shotcrete occurred in the B Drift near Chute 5C on September 10, 2003. The potential for future shotcrete failures in the haulage drifts and required follow-up actions should be determined. This issue must be addressed to allow access to the haulage drifts for maintenance and inspections to proceed safely.
- Construction documentation, including initial conditions, as-built drawings, and an O&M Plan for the Richmond are in the initial stages of development and need to be completed.
- Site cleanup activities in the area near the Richmond portal have not been completed. This includes removal of contaminated material on the road between the portal and the temporary construction facilities, grading the road for proper drainage, disposing of the material in the muck disposal cell, and temporarily closing the muck disposal cell for the winter.