

Five-Year Review Report

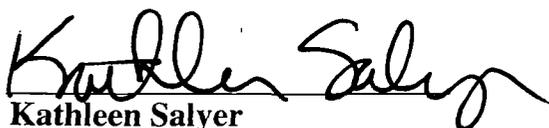
Fourth Five-Year Review Report
for
Iron Mountain Mine Superfund Site
Redding, California

July 2008

Prepared for:
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U.S. Environmental Protection Agency
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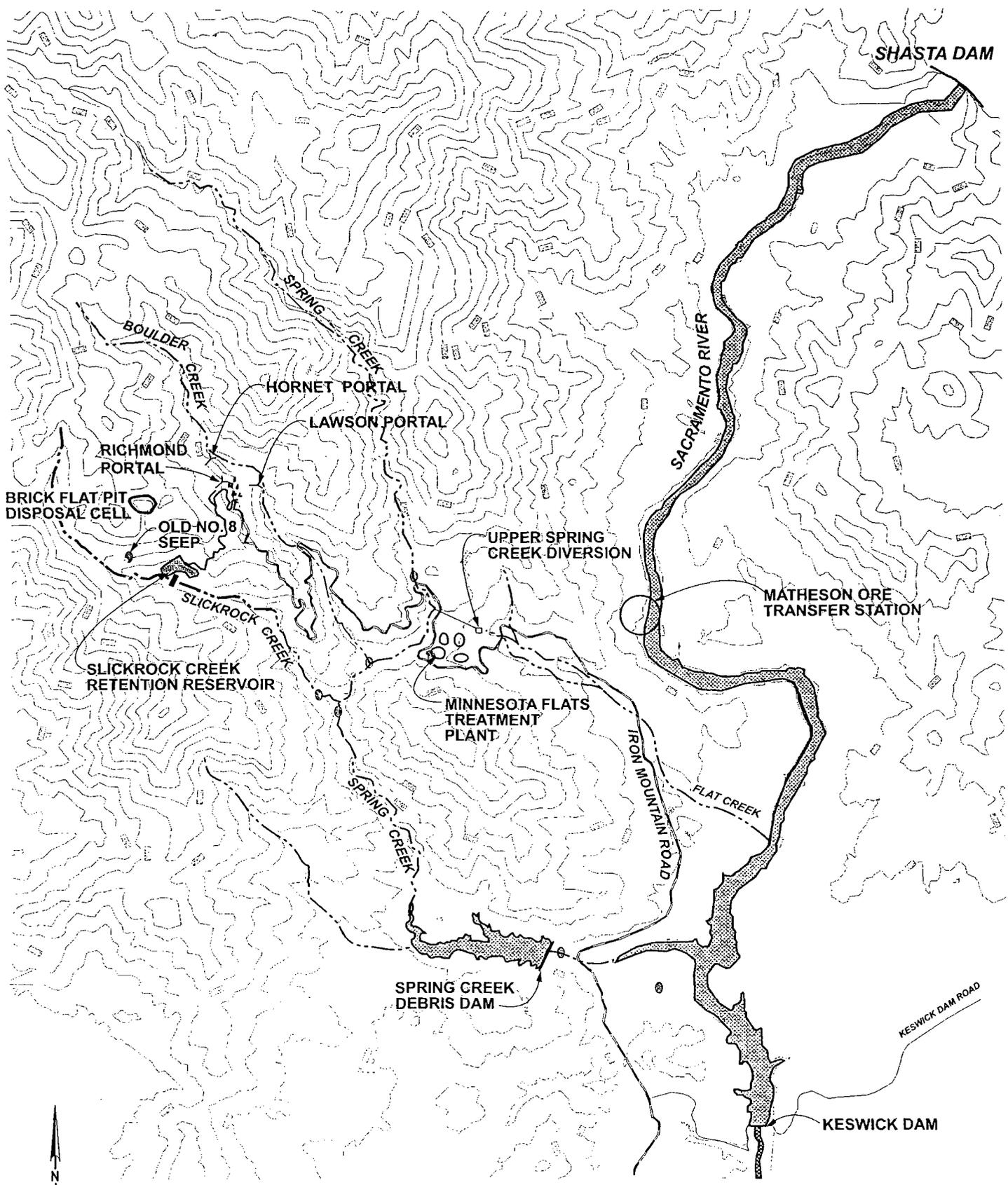
Executive Summary

The interim remedies for the Iron Mountain Mine Superfund site near Redding, California, consist of a combination of source control, acid mine drainage collection and 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. Figure 1 provides a location map for the Iron Mountain Mine site. The remedies selected in the 1986, 1992, 1993, and 1997 Records of Decision (EPA, 1986 [ROD 1]; EPA, 1992 [ROD 2]; EPA, 1993 [ROD 3]; EPA, 1997 [ROD 4]) have been implemented and are operating as intended.

The Spring Creek Arm of Keswick Reservoir sediment interim remedial action was selected in the 2004 Record of Decision (EPA, 2004 [ROD 5]), and the remedial design was completed in September 2007. Construction of the interim remedy components could begin as early as the fall of 2008. The last operable unit at the site, the Boulder Creek area-wide acid mine drainage sources, is currently in the Remedial Investigation and Feasibility Study phase of the process. EPA expects to complete the Remedial Investigation and the Feasibility Study in 2009.

This is the fourth 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; the second five-year review was completed October 8, 1998; and the third five-year review was completed September 30, 2003.

The assessment of this five-year review found that the remedies implemented under RODs 1 through 4 are operating as intended, and the operation and maintenance at the site has been satisfactory over the past five years. The actions to date have resulted in over 95 percent reduction in metal loading discharges from the site.



0 2,500 5,000 FEET
 SCALE IS APPROXIMATE

FIGURE 1
LOCATION MAP
 2008 FIVE-YEAR REVIEW
 IRON MOUNTAIN MINE

Five-Year Review Summary Form, cont'd.

Issues:

The IMM site is generally well-maintained. No operation and maintenance issue was identified during the site inspection that is expected to impact the effectiveness or protectiveness of the interim IMM remedial actions. However, CH2M HILL identified several issues related to the ongoing operation and maintenance program that require follow up actions, as summarized in Section VI "Site Inspections and Interviews."

Recommendations and Follow-up Actions:

Recommendations regarding IMM operation and maintenance should be implemented by the Site Operator or EPA as summarized in Section VI "Site Inspections and Interviews."

Protectiveness Statement(s):

The interim remedial actions implemented at IMM (selected in RODs 1-4) are protective of human health and the environment, and are consistent with the anticipated final remedy for the Site. The selected interim remedial actions have essentially eliminated the potential exposure and resultant threats to human health and the environment from acid mine drainage (AMD) discharges from contaminant sources addressed by the interim remedial actions. The IMM interim remedial actions do not address all sources of discharges from the Site. Further remedial actions are required.

The interim actions have afforded substantial protection to the valuable Sacramento River ecosystem and water supply by eliminating greater than 95 percent of the historic metal discharges from the IMM site.

During this five-year review period, the copper concentrations in the Sacramento River below Keswick Dam met the protective ambient water quality standard identified in RODs 1-4: the Basin Plan standard of 5.6 ppb for the maximum allowable dissolved copper concentration.

List of Involved Parties at Iron Mountain Mine

EPA	United States Environmental Protection Agency is the lead governmental agency for the cleanup at Iron Mountain Mine
CH2M HILL	EPA's technical contractor
State of California (DTSC and Water Board)	The State of California, through Department of Toxic Substances Control (DTSC) and Regional Water Quality Control Board (Water Board), acts as the supporting governmental agency at Iron Mountain Mine.
Reclamation	The 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.
CDFG	The California Department of Fish and Game has served on the technical advisory committee as trustee for the fishery resources.
NOAA	The National Oceanic and Atmospheric Administration has served on the technical advisory committee as the federal trustee for the anadromous fishery resources in the Sacramento River (i.e. salmon and steelhead trout) and their critical habitat.
Aventis CropScience	Responsible company for cleanup. Aventis CropScience (or companies acting on its behalf) conducted various investigations and constructed some of the interim remedies until a final settlement was reached in December 2000. Aventis CropScience left the site in December 2000.
Rhone-Poulenc	Former name of Aventis CropScience
Stauffer Chemical Co.	Former owner/operator of Iron Mountain Mine who was bought by Rhone-Poulenc
AIG	Company responsible for performing Statement of Work under December 2000 IMM Consent Decree
IMO	Site Operator, under AIG
Iron Mountain Mines, Inc.	Current owner of the inactive mine property

List of Acronyms

ac-ft	acre-foot
AMD	acid mine drainage
Basin Plan	<i>Water Quality Control Plan for the Sacramento River Basin and San Joaquin River Basin</i>
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
cfs	cubic feet per second
CTR	California Toxics Rule
CDFG	California Department of Fish and Game
CVP	Central Valley Project
EPA	U.S. Environmental Protection Agency
gpm	gallons per minute
IMM	Iron Mountain Mine
IMMI	Iron Mountain Mines, Inc.
IMO	Iron Mountain Operations
Matheson	Matheson Ore Transfer Station
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	National Oceanic and Atmospheric Administration Marine Fisheries Service
O&M	operation and maintenance
OU	Operable Unit
ppb	parts per billion
Reclamation	Bureau of Reclamation
ROD	Record of Decision
SOW	<i>October 2000 Statement of Work Site Operations and Maintenance, Iron Mountain Mine, Shasta County, California</i>
Spring Creek Arm	Spring Creek Arm of Keswick Reservoir
State	State of California

TMDL

total maximum daily load

UAA

Use Attainability Analysis for the Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for Beneficial Uses at West Squaw Creek, Shasta County

Water Board

Central Valley Regional Water Quality Control Board

List of Attachments

1. "Previous Five-Year Review Recommendations," John Spitzley and Sandra Shearer (CH2M HILL).
2. "List of Documents Reviewed," Sandra Shearer (CH2M HILL).
3. "Minnesota Flats Treatment Plant Effluent Discharge," John Spitzley, Eric Halpenny, and Sandra Shearer (CH2M HILL).
4. "Site Evaluation and Compliance at Keswick Dam," John Spitzley, Eric Halpenny, and Sandra Shearer (CH2M HILL).
5. "Site Inspection Checklist," John Spitzley and Sandra Shearer (CH2M HILL).
6. "Site Inspection Summary," John Spitzley, Sandra Shearer, Dave Bunte, and Eric Halpenny (CH2M HILL).
7. "Institutional Control Assessment," Sandra Shearer and Caroline Ziegler (CH2M HILL).
8. "Applicable or Relevant and Appropriate Requirement Analysis," Sandra Shearer and John Blasco (CH2M HILL).

Iron Mountain Mine, Redding, California

Fourth Five-Year Review Report

I. Introduction

The purpose of this five-year review is to determine whether the interim remedial actions implemented at the Iron Mountain Mine (IMM) Superfund 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 U.S. Environmental Protection Agency (EPA) is preparing this five-year review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (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 judgment 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."

EPA interpreted this requirement further in the National Contingency 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."

EPA Region 9 has conducted a five-year review of the interim remedial actions implemented at the IMM site near Redding, CA. This review was conducted from December 2007 through July 2008. This report documents the results of the review.

This is the fourth five-year review for the IMM 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; the second five-year review was completed October 8, 1998; and the third five-year review was completed September 30, 2003.

II. Site Chronology

TABLE 1
Site Chronology

Event	Date
IMM 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
Feasibility Study Addendum Completed	1986
Record of Decision (ROD1) Selecting Interim Remedy Signed	1986
Upper Spring Creek Diversion Completed (final required component of interim remedy)	1991
OU-2 - "Boulder Creek": Richmond and Lawson Adits Acid Mine Drainage 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 (ROD 2) Selecting Interim 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 interim remedy)	2000
First Five-Year Review	1993
OU-3 - "Old /No. 8 Mine Seep OU": Seep Discharge Treatment	
Remedial Investigation and Feasibility Study of Options Completed	1993
Record of Decision (ROD 3) Selecting Interim Remedy Signed	1993
Emergency Storage Facility for Treatment Plant Completed (final required component of interim remedy)	2000
OU-4 - "Water Management OU": Dam and Treat Runoff from Slickrock Creek	
Remedial Investigation and Feasibility Study of Options Completed	1994
Feasibility Study Addendum Completed	1996
Record of Decision (ROD 4) Selecting Interim Remedy Signed	1997
Slickrock Creek Retention Reservoir Completion	2004
Second Five-Year Review	1998
Third Five-Year Review	2003
Site Improvements under 2000 Settlement	
Brick Flat Pit Phase II Dam Raise	2002
Richmond Mine Adits and Drifts Rehabilitation Completed	2003
Construction of Mine Waste Disposal Cell ("muck cell")	2003
Boulder Creek Tailings Dam Improvements Completed	2004
Matheson Ore Transfer Station Restoration	2005
OU-5 - "Sediment": Remove Sediment Susceptible to Erosion from Spring Creek Arm of Keswick Reservoir	
Remedial Investigation and Feasibility Study of Options Completed	June 2004
Record of Decision (ROD5) Selecting Interim Remedy Signed	September 2004
Remedial Design Completed	September 2007
OU-6 - "Boulder Creek Area Sources"	
Remedial Investigation and Feasibility Study	Ongoing
Fourth Five-Year Review	2008

III. Background

Iron Mountain is located in Shasta County, California, approximately 9 miles northwest of the City of Redding. The Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) Identification Number for the IMM Superfund Site is CAD980498612. The collection of mines on Iron Mountain is known as 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 IMM.

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 (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 of California (State) support, conducted its remedial investigation to characterize the nature and extent of contamination at the Site. EPA has issued five feasibility studies and two feasibility study addenda to support five records of decision (ROD) for the IMM site.

The EPA has identified the following as responsible parties: the former owner and operator, Aventis CropScience (the successor to Rhone-Poulenc, who in turn is the successor to Stauffer Chemical Company and Mountain Copper, Ltd.), and the current owner and operator, Iron Mountain Mines, Inc. (IMMI). Stauffer Management Company, on behalf of Aventis CropScience, performed certain cleanup work at IMM in response to seven EPA unilateral administrative orders.

EPA and the State settled cost recovery litigation with Aventis CropScience in December 2000. The settlement assures that the interim remedial actions selected in EPA's 1986, 1992, 1993, and 1997 RODs will be operated and maintained. Pursuant to the settlement, American International Group, Inc. (AIG), on behalf of Aventis CropScience, will perform the operation and maintenance (O&M) of the interim remedial actions implemented pursuant to the four IMM RODs for thirty years. Iron Mountain Operations (IMO) is the Site Operator under AIG. Aventis CropScience also entered into a Guaranteed Investment Contract with AIG to provide for a payment of \$514 million to the Federal or State agency performing oversight of O&M activities at IMM at year 30 to fund the performance of O&M activities beyond the initial 30-year period. Under the terms of a memorandum of understanding with the State, EPA is currently performing oversight of AIG O&M activities.

Basis for Taking Action

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, side hill, and open pit mine workings at IMM, and the AMD discharges from area sources in the Slickrock Creek and Boulder Creek watersheds at IMM. The exceedances of water quality standards and the accumulation of toxic sediments downstream of IMM historically caused severe environmental impacts and posed a potential threat to human health.

The Sacramento River is a source of drinking water for the City of Redding. The Central Valley Project (CVP) facilities of northern California are important components of California's water supply system. CVP operates under a complex operational plan to supply agricultural and drinking water, to produce power, and to address environmental concerns.

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 National Oceanic and Atmospheric Administration (NOAA) has listed the Upper Sacramento River as the most important salmon spawning ground in California. The Sacramento River downstream of Keswick Dam contains four races of anadromous Chinook salmon and steelhead. The Chinook salmon (fall-, late-fall-, spring-, and winter-run) migrate into, spawn, incubate, and rear in the reach of the river immediately downstream of Keswick Dam. Sacramento River winter-run Chinook salmon are listed as endangered by the NOAA Marine Fisheries Service (NOAA Fisheries) and California Department of Fish and Game (CDFG) under the United States Endangered Species Act. Central Valley spring-run Chinook salmon are listed as threatened by NOAA Fisheries and CDFG. Fall-run and late-fall-run Chinook salmon are identified as species of concern by NOAA Fisheries. Central Valley distinct population segment steelhead trout and the southern distinct population segment of North American green sturgeon are listed as threatened by NOAA Fisheries.

IV. Remedial Actions

Remedial Action Objectives

Iron Mountain Mine Acid Mine Drainage Discharges

The remedial action objective identified for the interim remedial action selected in ROD4 for EPA's IMM Superfund cleanup program is to eliminate the AMD discharges that are harmful to public health and the environment. EPA did not designate remedy specific remedial action objectives in RODs 1-4, but did identify three primary cleanup goals:

- 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 *Water Quality Control Plan for the Sacramento River Basin and San Joaquin River Basin* [Basin Plan] and statewide plans). These standards were established to protect the valuable Sacramento fishery and aquatic ecosystems. The Basin Plan calls for a water quality standard of 5.6 parts per billion (ppb) dissolved copper as an instantaneous maximum exposure.
- 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.

Spring Creek Arm of Keswick Reservoir Sediment

Remedial action objectives developed in ROD 5 (EPA, 2004) for contaminated sediment in the Spring Creek Arm of Keswick Reservoir (Spring Creek Arm) are:

- Protect the Sacramento River ecosystem from releases of heavy metals originating from the Spring Creek Arm by preventing the mobilization and redeposition of contaminated sediment into important fishery spawning habitats located in the Sacramento River downstream of Keswick Dam.
- Prevent adverse impacts on water quality and beneficial uses of the Sacramento River below Keswick Dam by reducing the metal loads and suspended solids associated with contaminated sediment discharged from the Spring Creek Arm to the Sacramento River.

1986 Record of Decision (ROD 1). Site-wide

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 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. EPA constructed flexible soil/bentonite caps 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 the construction of the Brick Flat Pit cap construction, EPA used tailings materials from the Minnesota Flat area, as well as several other tailings piles that contained relatively high concentrations of copper, cadmium, and zinc, as fill material beneath an impermeable membrane lining system. EPA completed construction of the partial cap in July 1989.

EPA, through an interagency agreement with Bureau of Reclamation (Reclamation), began construction of the Slickrock Creek diversion in July 1989 and completed construction in January 1990. The diversion consisted 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 CropScience began construction of the Upper Spring Creek diversion in July 1990 and the diversion was operational in January 1991. The Upper Spring Creek diversion consisted 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.

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. EPA determined that significant reduction in IMM area sources of AMD discharges is preferable to the proposed South Fork of Spring Creek diversion or enlargement of the Spring Creek Debris Dam. In EPA's 1997 ROD for the IMM site, EPA formally eliminated these two planned interim remedial activities.

Operation and Maintenance

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

The Site Operator is performing routine inspection and maintenance activities specified in the October 2000 *Statement of Work Site Operations and Maintenance, Iron Mountain Mine, Shasta County, California* (SOW). No significant unanticipated O&M 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 cubic feet per second (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 since it was constructed and is an ongoing O&M item. The deteriorating liner does not jeopardize the effectiveness of the interim remedy. 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.

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 was subsequently modified to incorporate the diversion into the Slickrock Creek Retention Reservoir clean water diversion selected in EPA's 1997 ROD.

1992 Record of Decision (ROD 2). 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 aerated simple mix and High Density Sludge components) through a combination of an enforcement action and fund-lead design and construction. Aventis CropScience began construction of the aerated simple mix components of the treatment plant in the late summer of 1993 and completed the construction in September 1994. Aventis CropScience 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 CropScience 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 CropScience 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 O&M was performed by representatives of Aventis CropScience until December 2000. Under the terms of the settlement, AIG has assumed responsibility for performing O&M of the treatment plant for 30 years. Under the terms of a memorandum of understanding with the State, EPA is responsible for oversight of AIG'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 on average 99.7 percent of metals from the AMD inflow. The treatment plant meets Clean Water Act water quality discharge requirements. The copper concentrations in the Sacramento River below Keswick Dam met ambient water quality criteria selected in ROD2 during the five-year-review period (data from August 2003 to January 2008). With operation of the full-scale treatment plant beginning in September 1994, the IMM copper discharge was reduced by greater than 80 percent and the zinc and cadmium discharges were reduced by greater than 90 percent from historic levels on an overall basis. Further reductions were obtained after construction of Slickrock Creek Retention Reservoir, as discussed under the 1997 ROD below. During the period from August 2003 through January 2008, EPA's interim remedial actions at IMM prevented the discharge of approximately 600,000 pounds of copper and 2 million pounds of zinc by treating approximately 1.5 billion gallons of concentrated AMD.

1993 Record of Decision (ROD 3). Old /No. 8 Mine 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 CropScience designed and constructed the facilities to collect and convey AMD from Old /No. 8 Mine to the treatment plant. Aventis CropScience 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 CropScience did not complete the construction of required emergency storage facilities until September 2000.

Operation and Maintenance

See O&M section under 1992 ROD for further analysis of the O&M of the treatment of these flows.

The Old/No. 8 Mine Seep area is located on the north side of Slickrock Creek near the sedimentation basin. There are two groundwater extraction wells and two grit chambers in the Old/No. 8 Mine Seep area. Approximately 40 to 300 gallons per minute (gpm) of AMD is extracted from the Old/No. 8 Mine Seep wells, passed through one of the grit chambers, and routed to the IMM treatment plant through the 18-inch-diameter Old/No. 8 Mine Seep

pipeline. The AMD from the Old/No. 8 Mine Seep pipeline and the discharge from Slickrock Creek Retention Reservoir both flow via the same pipeline to the IMM treatment plant, so the discharge from both sources must be considered for proper overall operation of the Slickrock Creek AMD control systems (CH2M HILL, 2004a).

After Slickrock Creek Retention Reservoir was completed, the Site Operator modified operation of the Old/No. 8 Mine Seep, including constructing a gravity drain system in February and March 2008. Recommendations from the April 3, 2008, site inspection were that the Site Operator continue active pumping of the Old/No. 8 Mine Seep and use the gravity drain system only as a backup collection system if the pumping wells are inoperable (see Section VI).

1997 Record of Decision (ROD 4). Water Management

Remedy Selection

The 1997 ROD focused on the Slickrock Creek watershed at Iron Mountain. Among other items, the 1997 ROD provided for design and construction of a 220-acre-foot (ac-ft)-capacity retention reservoir to collect area sources of AMD discharges in the Slickrock Creek Basin for treatment, surface-water diversion facilities, a hematite-erosion-control structure, an additional AMD-conveyance pipeline, and a tunnel for gravity discharge of treated effluent to Spring Creek. The interim remedy permits treatment of essentially all of the IMM AMD from the Slickrock Creek area sources, which comprise approximately 60 to 70 percent of the copper load and 40 to 50 percent of the zinc and cadmium load associated with the previously uncontrolled IMM discharges (EPA, 1997).

Remedy Implementation

Under an enforcement action, Aventis CropScience 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 Slickrock Creek Retention Reservoir and other remaining components of the 1997 ROD.

The hydraulic upgrades to the treatment plant, the AMD conveyance pipelines from 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 CropScience by September 2000.

EPA started construction in June 2001. During the spillway excavation in November and December 2001, movement of the hillslope above the planned spillway was observed. An investigation indicated an ancient landslide occupied an area of approximately 5 acres and up to 120 feet in depth above the spillway excavation. The slope was stabilized by use of a high-capacity tieback anchor system. Spillway design modifications, grout program modifications, and placement of fibercrete over a substantial portion of the right abutment were required by California's Department of Water Resources, Division of Safety of Dams. Slope stabilization and associated design modifications delayed the construction completion. The project was substantially complete on May 19, 2004, and was determined operational and functional by EPA and the State on August 26, 2004 (CH2M HILL, 2004b).

Operation and Maintenance

O&M of the interim remedies was assumed by AIG with oversight provided by EPA. The *Operations and Maintenance Manual, Slickrock Creek Retention Reservoir Project* outlines the O&M requirements for Slickrock Creek Retention Reservoir (CH2M HILL, 2004a). The O&M manual includes operation, inspection, maintenance, monitoring, and security requirements for Slickrock Creek Retention Reservoir and appurtenances, clean water diversions, AMD diversions, spillway, outlet works, sedimentation basin, and upstream hematite pile. No significant unanticipated O&M efforts were required after completion of Slickrock Creek Retention Reservoir.

The Site Operator constructed several rock check dams upstream of the Slickrock sedimentation basin. These upstream rock check dams are effectively reducing the amount of sediment accumulation in the main sediment basin (GEI Consultants, Inc., 2008). After startup and shakedown testing, the following IMM treatment plant operational guidelines were recommended for periods of high inflow from Slickrock Creek Retention Reservoir (CH2M HILL, 2005a). These are consistent with requirements in the O&M manual for the reservoir:

- Slickrock Creek Retention Reservoir inflow to the IMM treatment plant will be slowly ramped up during storm events by adjusting Slickrock Creek Retention Reservoir intake gates and using the emergency holding tank.
- The discharge from Slickrock Creek Retention Reservoir will be limited to 3,000 gpm (plus 250 gpm from the Old/No. 8 Mine), depending on water elevation within the reservoir, time of year, and forecasted weather.
- Discharge of 4,000 gpm will be avoided, unless necessary for dam operation.

Completion of Slickrock Creek Retention Reservoir and associated facilities, in combination with completed interim remedial actions to control the sources of AMD, was expected to result in a total reduction of contaminants discharged from Spring Creek Debris Dam to 5 percent of the pre-1994 discharge. For Water Years 2005 through 2007, the actual copper and zinc discharged from Spring Creek Debris Dam was only 2 percent of pre-1994 discharge.

Site Improvements under 2000 Settlement

The settlement provided funding for several site improvements, including rehabilitation of the underground workings in the Richmond Adit, 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 construction of improvements to the Boulder Creek Tailings Dam.

The State 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 (North Pacific Research, 2004). The completion of this project addresses the largest identified risk for an uncontrolled spill at the site by improving the reliability of the AMD collection system at the Richmond Mine.

The Brick Flat Pit phase II dam raise, construction of the muck cell, and re-lining and installation of cathodic protection for the thickener tank were completed in 2003 under EPA oversight.

The Boulder Creek tailings dam embankment and spillway were modified to direct storm flows to the spillway and to provide spillway capacity adequate to pass the peak 100-year storm flow. The spillway capacity was increased by increasing the height of the dam crest and adding a gabion wall, anchored adjacent to the existing spillway and with shotcrete (gunite) covering exposed gabions. Improvements were also made to the Boulder Creek channel upstream of the dam. Improvements to the Boulder Creek tailings dam were completed between December 2003 and October 2004 (TRC, 2005).

2004 Record of Decision (ROD 5). Sediment

Remedy Selection

The 2004 ROD selected an interim remedial action to control release of contaminated sediment from Spring Creek Arm. A potential future release of contaminated sediment could adversely impact important downstream fisheries through the deposition of sediments containing toxic levels of metals in spawning beds of the Sacramento River. The selected interim remedy will involve the partial dredging of sediment in Spring Creek Arm that is most susceptible to erosion, and disposal of dredged sediment in an engineered disposal cell located adjacent to Spring Creek Reservoir. Dredging will remove approximately 50 to 60 percent of the volume of the existing contaminated sediment in Spring Creek Arm. Sediment that is less susceptible to erosion will not be dredged at deeper depths in the most downstream pile, Pile C. The selected interim remedy will include operational restrictions on Keswick Reservoir pool elevations during rare storm or flood events to prevent erosion of sediment remaining at deeper depths within Spring Creek Arm (EPA, 2004).

Remedy Implementation

The remedial design for the Spring Creek Arm sediment interim remedial action was completed in September 2007. Construction of the interim remedy components, including the access road to the disposal cell, could begin as early as the fall of 2008.

V. Progress Since Last Review

Protectiveness Statement from Last Review

At the time of the last five-year review, the interim response actions had not fully addressed all of the discharges of acidity, copper, cadmium, and zinc at the IMM site. Therefore, the previous team concluded that the interim remedies were fully protective of human health, but not the environment. The last five-year review summarized Site data that indicate that EPA had made substantial progress and that the interim remedial actions had afforded substantial protection to the valuable Sacramento River ecosystem and water supply.

Implemented Remedial Actions and Decision Documents

During the five-year review period, through a combination of enforcement and fund-lead approaches, EPA completed construction of the major remaining component of the ROD 4 interim remedy, Slickrock Creek Retention Reservoir. The response action selected in ROD 4 addresses the Slickrock Creek area source AMD discharges, which are estimated to account for approximately 60 to 70 percent of the copper load and 40 to 50 percent of the zinc and cadmium load associated with the previously uncontrolled IMM discharges (EPA, 1997). This interim remedy came online in 2004 and has provided for more than 95 percent control, on an overall basis, of the historic IMM AMD discharges.

EPA selected the Spring Creek Arm sediment interim remedial action in the 2004 ROD (EPA, 2004), and completed the remedial design in September 2007. The site risk evaluation indicated that interim remedial action was warranted to prevent a potential future release of contaminated sediment that could adversely impact important downstream fisheries through the deposition of sediments containing toxic levels of metals in spawning beds of the Sacramento River.

EPA anticipates that an additional remedial investigation and feasibility study will be conducted to develop and evaluate control strategies for OU-6, the area sources of AMD in Boulder Creek. As discussed in Attachment 1, EPA has continued to collect IMM surface water quality data since completion of the Slickrock Creek Retention Reservoir interim remedy and has also collected surface water quality data to monitor the progress of remediation of other mines within the West Shasta Mining District. These data will be used in support of the OU-6 remedial investigation, feasibility study, and ROD.

During the five-year-review period, the Boulder Creek tailings dam embankment and spillway were modified to direct storm flows to the spillway and to provide spillway capacity adequate to pass the peak 100-year storm flow. Improvements to the Boulder Creek tailings dam were completed between December 2003 and October 2004 (TRC, 2005).

The Matheson Ore Transfer Station (Matheson) Restoration project was substantially completed in September 2005, and final acceptance was achieved in December 2005. Reclamation, the federal land manager for the Matheson area, funded EPA to perform the interim remedial action pursuant to an Interagency Agreement. The Matheson Restoration project included removal of pyritic waste materials containing elevated levels of lead and arsenic from the former ore transfer station located adjacent to the Sacramento River. A disposal cell was constructed at the nearby IMM Site, and waste materials were hauled and placed in the disposal cell. The Matheson site was restored to allow public access and use of the adjacent Sacramento River Trail system (CH2M HILL, 2005b).

Status of Recommendations and Issues from Last Review

A technical memorandum on the status of the recommendations and issues from the previous five-year review is included as Attachment 1 and is summarized below.

Achieving Chronic Copper Standards in the Sacramento River

The water quality in the Sacramento River below Keswick Dam has improved since EPA completed construction of Slickrock Creek Retention Reservoir under ROD 4. Because the IMM remedial action is not yet complete, Reclamation controls the discharges from CVP

facilities in accordance with the 1980 Memorandum of Agreement (MOU) between Reclamation and the State of California (Water Board and CDFG) to maintain compliance with the Basin Plan requirements. The copper concentrations in the Sacramento River below Keswick Dam did not exceed the Basin Plan maximum dissolved copper concentration of 5.6 ppb during the five-year-review period (data from August 2003 to January 2008).

After the 1997 ROD was signed, the State's Inland Surface Water Plan was vacated by the Court, and in 1998 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 also promulgated new criteria for chronic exposures for this same reach of the Sacramento River. Because the IMM remedial action was not yet complete, Reclamation has continued to operate CVP facilities in accordance with the 1980 MOU, and was not required to control the discharges from CVP facilities to maintain compliance with the CTR water quality standards.

Although Reclamation was not required to meet the CTR criteria of 4.1 ppb as a 96-hour average chronic copper exposure level, the copper concentrations in the Sacramento River exceeded the CTR on only 4 days (only 2 percent of the days sampled) during the five-year review period, compared to exceedances on 29 percent of the days sampled during the previous five-year-review period (EPA, 2003). EPA will evaluate the performance of the interim remedial actions implemented at IMM and the need for additional remedial actions as part of its feasibility study for OU-6 at IMM.

However, the issue identified in the previous five-year review (EPA, 2003) is still outstanding. The upgradient Shasta Lake water quality could negatively impact the water management component of the IMM remedy, especially during sustained periods of above average precipitation.

As recommended in the previous five-year review, EPA has continued to collect surface water quality data necessary to characterize the performance of the IMM interim remedies. These data will be used as part of the OU-6 Remedial Investigation, Feasibility Study, and ROD for IMM. The frequency of an uncontrolled release will be estimated under operations to meet both an instantaneous maximum standard and a 96-hour average chronic standard. The data will also be used to study the discharges from the area sources in the Boulder Creek watershed, which are estimated to constitute 5 percent or less of the overall historic IMM discharges of copper and zinc. EPA, the Water Board, and Reclamation also have continued to obtain data to characterize the sources and locations of elevated metal concentrations in Shasta Lake.

Additional discussions will be necessary among the regulatory stakeholders at IMM regarding the impact on the fishery resources in the Sacramento River from ongoing IMM and Shasta Lake metal releases. Based upon these discussions, a new memorandum of understanding should be developed to require Reclamation to meet both an instantaneous maximum standard and a 96-hour average chronic standard, and to resolve the problem of heavy metal loading in discharges from Shasta Dam impacting the water management efficiency of Spring Creek Debris Dam.

Miscellaneous Site Maintenance Issues

CH2M Hill identified items to be repaired at the site during the previous five-year review. None of the items identified impacted the effectiveness or protectiveness of remedies implemented under RODs 1 through 4. The Site Operator addressed the significant maintenance items, as summarized in Attachment 1. There are minor items that remain to be addressed, such as replacing the exposed polyvinyl chloride (PVC) pipe at the ends of the Boulder Creek Landslide horizontal drains with UV-resistant piping or placing a UV-resistant coating over the existing pipes.

The outstanding maintenance issues were communicated to the Site Operator on April 23, 2008, along with other issues and recommendations identified during the April 3, 2008, site inspection. Significant outstanding issues and observations from the April 3, 2008, site inspection are summarized under "Site Inspection and Interviews" in Section VI.

Treatment Plant Audit Recommendations

The previous five-year review concluded that the Site Operator was properly operating and maintaining the treatment plant and related facilities to meet Clean Water Act discharge requirements and to implement technology-based discharge requirements of the IMM RODs. The treatment plant effluent discharges meet Clean Water Act regulatory discharge requirements. Although the High Density Sludge technology is being properly implemented by the Site Operator, the High Density Technology has not been able to meet technology-based performance standards that EPA set in the October 2000 SOW pursuant to the December 2000 Consent Decree for the IMM Site. These numerical performance standards were set by EPA to reflect the performance expectations of the High Density Sludge technology that was selected in EPA's RODs for the site. EPA set the High Density Sludge performance standards based upon the data that were available at the time. EPA indicated in the SOW, that because the data set was limited, the treatment plant performance should be monitored and that the technology-based performance standards should be revised if warranted. The previous IMM five-year review recommended further study to determine whether the performance standards should be revised for dissolved zinc.

An evaluation of IMM treatment plant data collected between 2004 and 2007, following completion of Slickrock Creek Retention Reservoir, was performed as part of this five-year review and is documented in Attachment 3. The treatment plant was found to substantially comply with Clean Water Act effluent limits for total metals and the technology-based performance standards for dissolved copper. However, for the majority of days of operation, the IMM treatment plant effluent exceeded the technology-based performance standards for dissolved zinc and the 30-day average dissolved cadmium standard. EPA's review of the treatment plant performance data indicates that the Site Operator has properly operated the High Density Sludge treatment plant throughout the five-year review period. EPA has determined that it should formally modify the High Density Sludge technology-based performance standards (best-available-technology economically achievable) based on the metal-removal level currently achieved at the treatment plant. Recommendations for revised limits are presented in Attachment 3.

Other recommendations identified during the 2003 treatment plant audit were addressed, or are incorporated with other issues and recommendations identified during the April 3, 2008, site inspection. Significant outstanding issues and observations are summarized under the "Site Inspection and Interviews" in Section VI.

VI. Five-Year Review Process

Administrative Components

The IMM five-year review was conducted by Rick Sugarek with EPA and a CH2M HILL team of Sandra Shearer, John Spitzley, Caroline Ziegler, Dave Bunte, and Eric Halpenny. This five-year review includes site inspection reports, a review of treatment plant operational, influent and effluent analytical data, Sacramento River water quality analysis, and an update on the status of previous five-year review recommendations and issues.

Community Involvement

Stakeholders and members of the community were notified of the initiation of the five-year review process in the fact sheet dated February 2008. The IMM Five-Year Review notice was published in the Redding, California, newspaper, *Record Searchlight*, on February 21, 2008.

A telephone interview was conducted on April 22, 2008, with a downgradient property owner, Annette Rardin. Onsite interviews were conducted in March and April 2008 with the following IMO staff: Rudolph Carver, project manager; Wes Franks, site construction manager; and Bob Lindskog, IMM treatment plant operator. Issues and observations identified during the interviews are incorporated with the site inspection observations in Attachment 6.

Interviews of regulatory agency representatives were not performed during this five-year review. EPA determined that interviews were not necessary to provide additional information on site status. Interviews were performed during the previous five-year review. During the fourth five-year review performance period, EPA has been in regular contact with the IMM Technical Advisory Committee in support of the design of interim remedial actions selected in ROD 5 and the remedial investigation for OU-6.

Document Review

Attachment 2 provides a list of documents that were reviewed as part of the IMM Fourth Five-Year Review. Issues, recommendations, and conclusions from the document review were incorporated into the sections of this five-year-review report, as indicated by the citations throughout the text and attachments.

Data Review

This five-year review consisted of a review of the operational performance of the IMM treatment plant and current metal loading to the Sacramento River. Conclusions from the data review are presented below.

Treatment Plant Operational Performance

Attachment 3, "Minnesota Flats Treatment Plant Effluent Discharge" provides an evaluation of the operational performance of the IMM treatment plant in meeting the performance standards contained in the IMM SOW, dated October 2, 2000 (EPA, 2000). The IMM treatment plant has been in substantial compliance with Clean Water Act effluent limits for pH, total cadmium, total copper, total zinc, and total lead during the performance period.

Pursuant to the settlement agreement, EPA set dissolved copper, zinc, and cadmium performance 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. As part of this five-year review, EPA has reviewed the treatment plant performance data for the High Density Sludge technology. EPA's review of treatment plant performance data indicates that the Site Operator has properly operated the High Density Sludge treatment plant. However, the treatment plant effluent does not meet the technology-based maximum concentration limits, and the rolling 7-day and 30-day averages for dissolved zinc and the 30-day average for dissolved cadmium, even though the plant is properly operated. EPA has determined that it should formally revise the best-available-technology zinc and cadmium performance standards in the IMM SOW to more accurately reflect the amount of metals that can be removed by the High Density Sludge treatment technology.

Water Quality at Sacramento River below Keswick Dam

Attachment 4, "Site Evaluation and Compliance at Keswick Dam," evaluates the effectiveness of IMM interim remedial actions in reducing copper and zinc discharges from the site during the fourth five-year-review period. The memorandum also evaluates copper loads originating from other mines in the West Shasta Mining District and potential impacts on the protectiveness of the IMM remedy.

Reclamation routinely samples the water releases from 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 5 years, the dissolved copper concentrations in the Sacramento River below Keswick did not exceed the 5.6-ppb instantaneous maximum limit for the days when samples were collected. Although Reclamation was not required to control the discharges from CVP facilities to meet CTR water quality standards, between August 2003 and January 2008, the dissolved copper concentrations in the Sacramento River below Keswick Dam exceeded the CTR 4-day average chronic exposure limit of 4.1 ppb on only 4 days (only 2 percent of the days sampled), compared to exceedances on 29 percent of the days sampled during the previous five-year-review period (EPA, 2003). Sampling frequency was not increased to determine the number of exceedances on a 96-hour basis.

The final ROD for the IMM site will need to evaluate the effectiveness of the final proposed IMM source control remedial actions in meeting water quality objectives in the Sacramento River below Keswick Dam. This evaluation will need to consider the continuing metal loads from other mines in the West Shasta Mining District that discharge into Shasta Lake up gradient of IMM and then flow into Keswick Reservoir and the Sacramento River. Data from Water Years 2006 and 2007 show that the majority of copper load to the upper Sacramento River watershed is currently coming from the inactive copper mines in the

Shasta Lake watershed. The Water Board is working with the owner of the inactive copper mines, Mining Remedial Recovery Company. The Water Board adopted Resolution R5-2004-0090, which includes the *Use Attainability Analysis for the Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for Beneficial Uses at West Squaw Creek, Shasta County* (UAA) (Water Board, 2004). The UAA proposes changing the beneficial use requirements for West Squaw Creek, and focusing future remediation efforts on mines within the Little Backbone Creek watershed. Although significant reductions have occurred in the metal loading from West Squaw Creek, EPA data collected during the five-year-review period indicate West Squaw and Little Backbone creeks are currently contributing similar copper loads to Shasta Lake (see Attachment 4).

During the five-year-review period, dissolved copper concentrations ranged from less than 1 ppb to 3.4 ppb in water discharges from Shasta Dam. The upper Sacramento River total maximum daily load (TMDL) report (Water Board, 2002) states that Water Board staff will develop additional mine remediation and other activities as needed to address dissolved copper concentrations that exceed 1.3 ppb in Shasta Dam releases. The TMDL goal was exceeded on more than 50 percent of the days recorded from August 2003 through January 2008 in the Sacramento River below Shasta Dam. This upgradient water quality may adversely impact the water management component and protectiveness of the IMM remedies.

Additional discussions will be necessary among the regulatory stakeholders at IMM regarding the impact on the fishery resources in the Sacramento River from ongoing IMM and Shasta Lake metal releases. EPA expects the 1980 Memorandum of Understanding between the State and Reclamation (State Water Resources Control Board et al., 1980) to be renegotiated to define the manner in which CVP facilities will be operated to meet water quality standards in the upper Sacramento River.

Site Inspection and Interviews

CH2M HILL conducted an overall site inspection on April 3, 2008. This inspection included onsite documents and records; AMD conveyance pipelines; the Upper Spring Creek diversion; IMM treatment plant and sludge drying beds; Boulder Creek mouth, tailings dam, landslide, and channel; Richmond Mine; Lawson Portal; Brick Flat Pit; Old/No. 8 Mine Seep; Slickrock Creek Retention Reservoir; Matheson disposal cell; and site roads, slopes, and tanks. Numerous other inspections were performed or contracted by the Site Operator during the five-year review period. The "Site Inspection Checklist" is included as Attachment 5. Observations from the site inspections are presented in Attachment 6.

CH2M HILL performed a telephone interview with an adjacent property owner regarding maintenance of the downgradient property. Onsite interviews were conducted in March and April 2008 with Site Operator staff. Issues and observations identified during the interviews are incorporated with the site inspection observations.

The IMM site is generally well-maintained. No issues or observations were identified during the April 3, 2008, site inspection that are expected to impact the effectiveness or protectiveness of interim remedies implemented under RODs 1 through 4. Issues and observations related to implementation and scope of the O&M procedures were identified during the site inspection. These are detailed in Attachment 6. The following are significant five-year-

review recommendations and follow-up actions resulting from the site inspection and interviews:

- A few key Site Operator staff members are nearing retirement. The Site Operator should continue to develop strategies to decrease vulnerability to the loss of personnel.
- The Site Operator should prepare and submit management plans and reports to meet requirements of the SOW, including the Annual Operations Work Plan (Section 6.3 of the SOW) and the Landfill Management Report and Plan (Section 6.4 of the SOW). The Site Operator should use these submittals as a tool to notify the Oversight Agency of modifications to the Site planned for the next year.
- The urethane pipeline lining system for the Upper Spring Creek diversion has deteriorated since it was constructed and is an ongoing O&M item. EPA and the Site Operator should discuss plans to ensure that the deteriorating liner does not jeopardize the effectiveness of the Upper Spring Creek diversion.
- EPA should formally modify the SOW to update best-available-technology performance standards based on the metal removal level currently achieved at the treatment plant. Attachment 3 includes an assessment of the IMM treatment plant effluent discharge. The best-available-technology performance standards should also be evaluated and modified, if appropriate, every 5 years thereafter in compliance with the Section 14.2.3.2 of the SOW (EPA, 2000).
- The previous five-year review (EPA, 2003) recommended the contents of the fluid in Essential Solutions, Inc., chemical storage tanks across the road from the cementation plant be determined and proper containment be provided, if required, or the contents should be properly disposed. This recommendation should be addressed by IMMI.
- The Site Operator should monitor the effectiveness of recent drainage improvements at the Boulder Creek landslide and consider and implement further control measures, as necessary, to help control future displacement of the landslide.
- The concrete plugs in the ore chutes of the Richmond Adit continue to deteriorate. The Site Operator needs to develop a strategy to address the failing chute plugs and the associated risks to worker safety, mine access, and the AMD conveyance and treatment system.
- The Site Operator should continue to evaluate reasons for the reduced filtrate at Brick Flat Pit.
- The Site Operator should actively pump the Old/No. 8 Mine Seep for AMD collection and use the gravity discharge system constructed in March 2008 only as an emergency backup system.

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 inspections indicate that the IMM interim remedies are functioning as envisioned in the decision documents. No issues or observations were identified during the April 3, 2008, site inspection that are expected to impact the effectiveness or protectiveness of interim remedial actions implemented under RODs 1 through 4.

The IMM High Density Sludge treatment plant meets Clean Water Act discharge requirements. EPA's review of treatment plant performance data indicates that the treatment plant has been operated properly. However, the High Density Sludge technology has not been able to meet technology-based performance standards for zinc and cadmium that were initially set by EPA in the IMM SOW based upon a limited data set to reflect the expected performance of the High Density Sludge technology. EPA has determined that it should revise these numeric discharge requirements to reflect available performance data.

The objective of the interim remedial actions selected in EPA's four RODs 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 to meet protective water quality criteria (5.6 ppb maximum concentration for copper). The analysis in the decision documents estimated that the interim remedial actions implemented in RODs 1-4 would provide significant protection to the Sacramento River fishery and ecosystem. However, the protective water quality criteria are expected to be exceeded in rare wet years (estimated to be 1 in every 30 years in ROD 4). During the five-year review period, the 5.6 ppb maximum concentration for dissolved copper was not exceeded.

After the 1997 ROD was signed, the State's Inland Surface Water Plan was vacated by the court and EPA promulgated the 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. Because the IMM interim remedial action was not yet complete, Reclamation has continued to operate CVP facilities in accordance with the 1980 MOU, and was not required to control the discharges from CVP facilities to maintain compliance with the CTR water quality standards.

Although Reclamation was not required to meet the CTR criteria of 4.1 ppb as a 96-hour average chronic copper exposure level, the copper concentrations in the Sacramento River exceeded the CTR on only 4 days (only 2 percent of the days sampled) during the five-year review period, compared to exceedances on 29 percent of the days sampled during the previous five-year-review period (EPA, 2003). EPA will evaluate the performance of the interim remedial actions implemented at IMM and the need for additional remedial actions as part of its feasibility study for OU-6 at IMM.

The collection and treatment of the AMD from the Richmond, Lawson, and Old /No. 8 Mine adits, and the area sources of AMD from the Slickrock Creek watershed, has reduced the metal loading discharge over the past 5 years by greater than 95 percent. The clean water

diversions at Spring Creek and Slickrock Creek have been effective by controlling discharges from sources in the Slickrock Creek watershed and minimizing the volume of contaminated water in the Spring Creek Reservoir, thereby increasing the effectiveness of Reclamation water management operations.

EPA's interim remedial action selected in ROD 5 (EPA, 2004) is required to address outstanding risks to aquatic receptors from potential releases of hazardous substances from Spring Creek Arm to the Sacramento River ecosystem. Removal of contaminated sediment from Spring Creek Arm that is most susceptible to erosion, and disposal of dredged sediment in an upland disposal cell, will mitigate the risk for release events of contaminated sediment.

As discussed in Attachment 7, EPA has outlined IMM access controls in the SOW (EPA, 2000), and several interim actions, including fencing and security gates, have been taken at IMM. The IMM interim access controls and Spring Creek Debris Dam security measures are controlling potential human exposures and preventing adverse impacts to the integrity or protectiveness of the interim remedial measures.

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, toxicity data, surface water quality standards, and remedial action objectives are still valid, as discussed further below.

Changes in Standards and To Be Considered Criteria

Attachment 8 contains an analysis of applicable or relevant and appropriate requirements.

After the 1997 ROD was signed, the State's Inland Surface Water Plan was vacated by the court and EPA promulgated the 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. Because the IMM interim remedial action was not yet complete, the Reclamation has continued to operate CVP facilities in accordance with the 1980 MOU, and was not required to control the discharges from CVP facilities to maintain compliance with the CTR water quality standards.

Although Reclamation was not required to meet the CTR criteria of 4.1 ppb as a 96-hour average chronic copper exposure level, the copper concentrations in the Sacramento River exceeded the CTR on only 4 days (only 2 percent of the days sampled) during the five-year review period, compared to exceedances on 29 percent of the days sampled during the previous five-year-review period (EPA, 2003). EPA will evaluate the performance of the interim remedial actions implemented at IMM and the need for additional remedial actions as part of its feasibility study for OU-6 at IMM.

The CTR Criteria for Freshwater Aquatic Life Protection for Inland Surface Waters were included in the ROD 5 numeric performance standards for the planned sediment interim remedial action. The State has not taken any action to implement the revised EPA National Recommended Ambient Water Quality Criteria for copper using the Biotic Ligand Model. IMM numeric surface-water standards should be reevaluated if the State implements the

revised EPA National Recommended Ambient Water Quality Criteria or during the next IMM five-year review.

The dissolved zinc and 30-day dissolved cadmium technology-based performance standards set by EPA as part of the requirements in the SOW should be revised to more accurately reflect metal removal by the High Density Sludge AMD neutralization process. Changes to the technology-based performance standards should not change treatment plant operations by the Site Operator, particularly with respect to pH controls. Metal discharges during the past 5 years from the IMM treatment plant are substantially below the Clean Water Act effluent standards. Revision of the technology-based performance standards will not impact the protectiveness of the remedies originally selected in the RODs for IMM.

Risk Evaluations

No updates to the risk assessment were performed since 2003 related to RODs 1 through 4. There are no new toxicology data that impact the human health or ecological risk assessments.

Remedial Action Objectives

The interim remedial actions for the IMM Site continue to meet the remedial action objective of eliminating the AMD discharges that are harmful to public health and the environment. EPA has implemented a combination of source control, treatment, and water management components to assure an effective, implementable, and cost-effective cleanup program for the IMM AMD discharges. Performance of the interim remedial actions relative to the three primary cleanup goals for RODs 1-4 is summarized below:

- During the five-year review period the interim remedial action has complied with the water quality criteria established under the Basin Plan of 5.6 parts per billion (ppb) dissolved copper as an instantaneous maximum exposure to protect the valuable Sacramento fishery and aquatic ecosystems.
- During the five-year review period the interim remedial action has reduced the mass discharge of toxic heavy metals by greater than 95 percent from the historic IMM heavy metal discharge loads.
- During the five-year review period there has been no 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.

Question C: Has any Other Information Come to Light that Could Call Into Question the Protectiveness of the Remedy?

Since the last five-year review, species present in the Sacramento River have been newly listed as threatened species. Green sturgeon was listed as a federal candidate species during the third five-year-review period (EPA, 2003). On April 7, 2006, NOAA Fisheries issued a final rule to list the Southern distinct population segment of North American green sturgeon as a threatened species. This species is present below Keswick Dam. During the IMM third five-year review, an interview was conducted with Harry Rectenwald from the California Department Fish and Game. He stated that the water quality criteria developed for IMM

using winter-run Chinook salmon as the ecological receptor are protective of this newly listed species as well, because salmon is known to be the most sensitive of these receptors (EPA, 2003).

To meet water quality objectives in the Sacramento River for protection of all sensitive species living downstream of Keswick Dam, the final ROD for the IMM site will need to consider the entire water system that impacts the Sacramento River. Without further significant reduction in copper loads from other mines in the West Shasta Mining District, the upgradient Shasta Lake water quality could adversely impact the water management component and the protectiveness of IMM remedies during sustained periods of above average precipitation.

VIII. Issues

CH2M HILL identified issues and observations related to implementation and scope of O&M procedures (see Site Inspection and Interviews, Section VI). In general, the treatment plant and IMM site are properly operated and maintained. No issue was identified during the April 3, 2008, inspection that is expected to impact the effectiveness or protectiveness of remedies implemented under RODs 1 through 4.

IX. Recommendations and Follow-up Actions

Recommendations regarding O&M of the remedies and the IMM site should be implemented by the Site Operator or EPA, as specified under Section VI "Site Inspections and Interviews." None of the O&M items identified impact the effectiveness or protectiveness of interim remedies implemented under RODs 1 through 4. CH2M HILL communicated recommendations to the Site Operator in a memorandum on April 23, 2008, and during a meeting at the IMM Site on April 25, 2008. EPA will follow up with the Site Operator to develop a timeframe for the O&M tasks that are within their responsibility pursuant to the IMM SOW to assure near-term completion of the work by December 2009.

X. Protectiveness Statements

The interim remedial actions implemented at IMM (selected in RODs 1-4) are protective of human health and the environment and are consistent with the anticipated final remedy for the Site. The selected interim remedial actions have essentially eliminated the potential exposure and resultant threats to human health and the environment from AMD discharges from contaminant sources addressed by the interim remedial actions. The IMM interim remedial actions do not address all sources of discharges from the Site. Further remedial action is required.

The interim remedial actions have afforded substantial protection to the valuable Sacramento River ecosystem and water supply by eliminating greater than 95 percent of the historic metal discharges from the IMM Site.

During this five-year review period, the copper concentrations in the Sacramento River below Keswick Dam met the protective ambient water quality standard identified in RODs

1-4: the Basin Plan standard of 5.6 ppb for the maximum allowable dissolved copper concentration.

XI. Next Review

The next Five-Year Review for the IMM Site is required in 2013, five years after the date of this review.

XII. Works Cited

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