United States
Environmental Protection
Agency

Office of
Emergency and
Remedial Response

EPA/ROD/R09-86/011
October 1986

EPA

Superfund Record of Decision:

Iron Mountain Mine, CA

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA/ROD/R09-86/011	2.	3. RECIPIENT'S ACCESSION NO.
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9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT NO.
		11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS U.S. Environmental Protection Agency 401 M Street, S.W. Washington, D.C. 20460		13. TYPE OF REPORT AND PERIOD COVERED Final ROD Report
		14. SPONSORING AGENCY CODE 800/00
15. SUPPLEMENTARY NOTES		

16. ABSTRACT

Iron Mountain Mine (IMM) is located in the southeastern foothills of the Klamath Mountains, approximately nine miles northwest of the City of Redding, California. Between the 1860s and 1962, IMM was periodically mined for iron, silver, gold, copper, zinc, and pyrite. The mine area, believed to be one orebody which has been segmented by faulting, is located on 4,400 acres of property that includes underground workings, an open pit mining area, waste rock dumps, and tailings piles. Rainfall, infiltrating into the underground mine workings, mixes with ground water and the ore zone to produce sulfuric acid and high concentrations of zinc, cadmium, and copper. The resulting heavy metal-laden acidic waters, referred to as acid mine drainage (AMD), eventually discharge through mine adits or ground water seepage into the Spring Creek watershed streams, Spring Creek Reservoir, and the Sacramento River. The primary contaminants of concern include: AMD, copper, cadmium, and zinc.

The desired remedial action for this site was not selected due to excessive cost. Instead, a fund balancing waiver to the NCP was invoked, and an alternative that most closely approaches ARARs was selected. The alternative includes: capping selected cracked and carved ground areas using a soil-cement mixture or other suitable material; diverting clean surface water in Upper Spring Creek to Flat Creek, diverting clean surface water in South Fork Spring Creek to Rock Creek, and diverting clean Upper (See Attached Sheet)

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Record of Decision Iron Mountain, CA Contaminated Media: sw, sediments Key contaminants: acids, inorganics, heavy metals, cadmium		

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16. ABSTRACT (continued)

Slickrock Creek water around waste rock and tailings piles; enlarging Spring Creek Debris Dam from its present capacity of 5,800 acre feet to 9,000 acre feet; implementing perimeter control as needed to minimize direct contact threat; and performing hydrogeologic study and field-scale pilot demonstration to better define the feasibility of utilizing low-density cellular concrete to eliminate or reduce acid mine drainage formation. The estimated capital costs for the fund-balanced alternative is $68,100,000 with O&M present worth costs of $4,100,000.

RECORD OF DECISION
IRON MOUNTAIN MINE
REDDING, CALIFORNIA

DOCUMENTS REVIEWED:

I am basing my decision primarily on the following documents describing the cost-effectiveness of remedial alternatives for the Iron Mountain Mine site:

- Final Remedial Investigation Report, Iron Mountain Mine, near Redding, California, CH2M Hill, August 1985.
- Public Comment Feasibility Study, Iron Mountain Mine, Redding, California, CH2M Hill, August 2, 1985.
- Public Comment Feasibility Study Addendum, Iron Mountain Mine, Redding, California, dated July 25, 1986.
- Responsiveness Summary, dated September 1986.
- Summary of Remedial Alternative Selection, September 19, 1986.

DESCRIPTION OF OPERABLE UNIT:

- Cap selected cracked and caved ground areas on Iron Mountain above the Richmond ore body using a soil-cement mixture or other suitable material *;
- Divert clean surface water in Upper Spring Creek to Flat Creek, divert clean surface water in South Fork Spring Creek to Rock Creek, and divert clean Upper Slickrock Creek water around waste rock and tailings piles;
- Enlarge Spring Creek Debris Dam (SCDD) from its present capacity of 5,800 acre feet to 9,000 acre feet;
- Implement perimeter control as needed to minimize direct contact threat; and
- Perform hydrogeologic study and field-scale pilot demonstration to better define the feasibility of utilizing low-density cellular concrete to eliminate or reduce acid mine drainage formation.

* [Based on the present record, I believe that construction of a partial cap over the Richmond ore body is a necessary source control component of the overall remedy as envisioned by EPA. However, the potentially responsible parties are proposing to

implement a solution mining operation that may be able to effectively exploit the ore body as a resource and control the discharge of acid mine drainage from the mountain. Construction of the partial cap could adversely affect the solution mining operation. EPA intends to further explore the implementation and environmental results associated with a solution mining operation during the next 60 days. Therefore, no action will be taken to implement the capping component for a period of at least 60 days from the signature date on this Record of Decision. To the extent that new information causes EPA to modify its present opinion that the mountain should be partially capped, EPA would provide to the public an opportunity to comment prior to making any final decision. I will make a decision regarding the implementation of the capping component after the 60-day period has ended.]

DECLARATIONS:

Consistent with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) 40 CFR Part 300 et.seq., I have determined that the operable unit remedy previously identified is a component of what will be the appropriate Fund-financed action for this site in accordance with section 300.68 (j) of the NCP. These are components of a final EPA remedy that will provide adequate protection of the public health and welfare and the environment.

The selected operable unit, and ultimately the final remedy, will not meet all the requirements of the Clean Water Act (CWA) 33 U.S.C. §1251 et.seq. and, therefore, is somewhat less protective than the remedial action alternative that complies with all federal and state regulations. The reason is that federal water quality standards will be met in the Sacramento River below Keswick Dam but not in the immediate receiving waters as required by the CWA. Also, if treatment is required, not all point source discharges will receive Best Available Technology and not all non-point sources will be addressed through Best Management Practices. However, the final remedy is expected to be substantially effective in minimizing the discharge of heavy metals from the site which would threaten public health and welfare or the environment. I have determined that the level of protection provided by the operable unit most effectively mitigates and minimizes threats to and provides adequate protection of public health and welfare and the environment considering the need for additional protection at this site and the amount of money that may be available in the Hazardous Substance Trust Fund to respond to other sites which present or may present a threat to public health and welfare and the environment. I have also determined that the selected remedy is that remedy which most closely approaches the level of protection provided by applicable or relevant and appropriate Federal requirements considering the specific fund-balanced sum of money available for the Iron Mountain Mine site.

The State of California has been consulted and agrees with the approved operable unit and EPA's strategy leading to the implementation of a final remedy. All aspects of the Iron Mountain Mine remedy will be implemented in a phased approach, with the enlargement of Spring Creek Debris Dam (SCDD) being the last component remedy constructed. The reason for this is that the actual effectiveness of the other component source control, treatment, and water management alternatives will not be known until each component has been installed and monitored. Only until these actions are completed will EPA know the exact enlargement of SCDD needed to ensure that project cleanup objectives will be met. Therefore, this ROD will authorize enlargement of SCDD, but EPA will not begin the remedial action phase until the effectiveness of other component remedies has been determined. The operable unit will require future operation and maintenance activities to ensure the continued effectiveness of the alternatives. These activities will be considered part of the approved action and eligible for Trust Fund monies for a period not to exceed one year.

I have determined that a hydrogeologic investigation and a field-scale pilot demonstration test to determine the technical feasibility of injecting low-density cellular concrete into the underground mine workings, are appropriate next steps in determining the scope of the final remedy for Iron Mountain Mine. EPA believes that low-density cellular concrete may constitute a permanent approach to the reduction of acid mine drainage formation.

10/3/86

Date

J. Winston Porter
Assistant Administrator,
Office of Solid Waste and
Emergency Response

SUMMARY OF REMEDIAL ALTERNATIVE SELECTION

Iron Mountain Mine
Redding, California

September 19, 1986

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SITE: Iron Mountain Mine
REGION: IX

I. SITE LOCATION AND DESCRIPTION

Iron Mountain Mine is located in the southeastern foothills of the Klamath Mountains, approximately nine miles northwest of the City of Redding, California (See Figure 1). Between the 1860's and 1962, Iron Mountain Mine was periodically mined for iron, silver, gold, copper, zinc, and pyrite. The mine area is located on 4,400 acres of property that includes underground workings, an open pit mining area, waste rock dumps, and tailings piles. The rugged topography of the area is typical of a mountainous region with steep slopes bissected by streams. Elevations range from 600 feet on the Sacramento River several miles east of the mine, to 3,800 feet on top of Iron Mountain. The climate of the Iron Mountain area is characterized by warm, dry summers and cool, rainy winters.

Iron Mountain averages 70- 80 inches of precipitation per year, most of it falling in the form of rain between the months of November and April. Snow accumulation of several inches is common above the 2,000 foot elevation during the November- March storms, but usually melts in a few days.

Iron Mountain is drained by Boulder Creek to the north, and Slickrock Creek to the south of the mine. Boulder Creek, a perennial stream, receives a portion of its flows from the Lawson and Richmond adits via their mine portals. Slickrock Creek, an intermittent stream, receives discharges from underground seepage associated with Old Mine and/or No. 8 Mine and flows from storm water drainage from the Brick Flat Pit area. A debris slide diverted the original Slickrock Creek drainage and buried adits from which acid mine drainage is emanating. Two copper cementation plants are located on site and function to remove copper from <u>controlled</u> flows, such as those collected from mine portals and conveyed to the plants by a system of flumes. <u>Uncontrolled</u> flows such as surface runoff containing acid and heavy metals are discharged directly to receiving waters without treatment.

Slickrock and Boulder Creeks flow southeastward into Spring Creek. The Spring Creek Debris Dam and Reservoir were built in 1963 as part of the Central Valley Project (CVP). Since 1963, the waste has been collected in Spring Creek Reservoir and subsequently metered into Keswick Reservoir. The flow releases of the waste from the Spring Creek Reservoir is determined by the

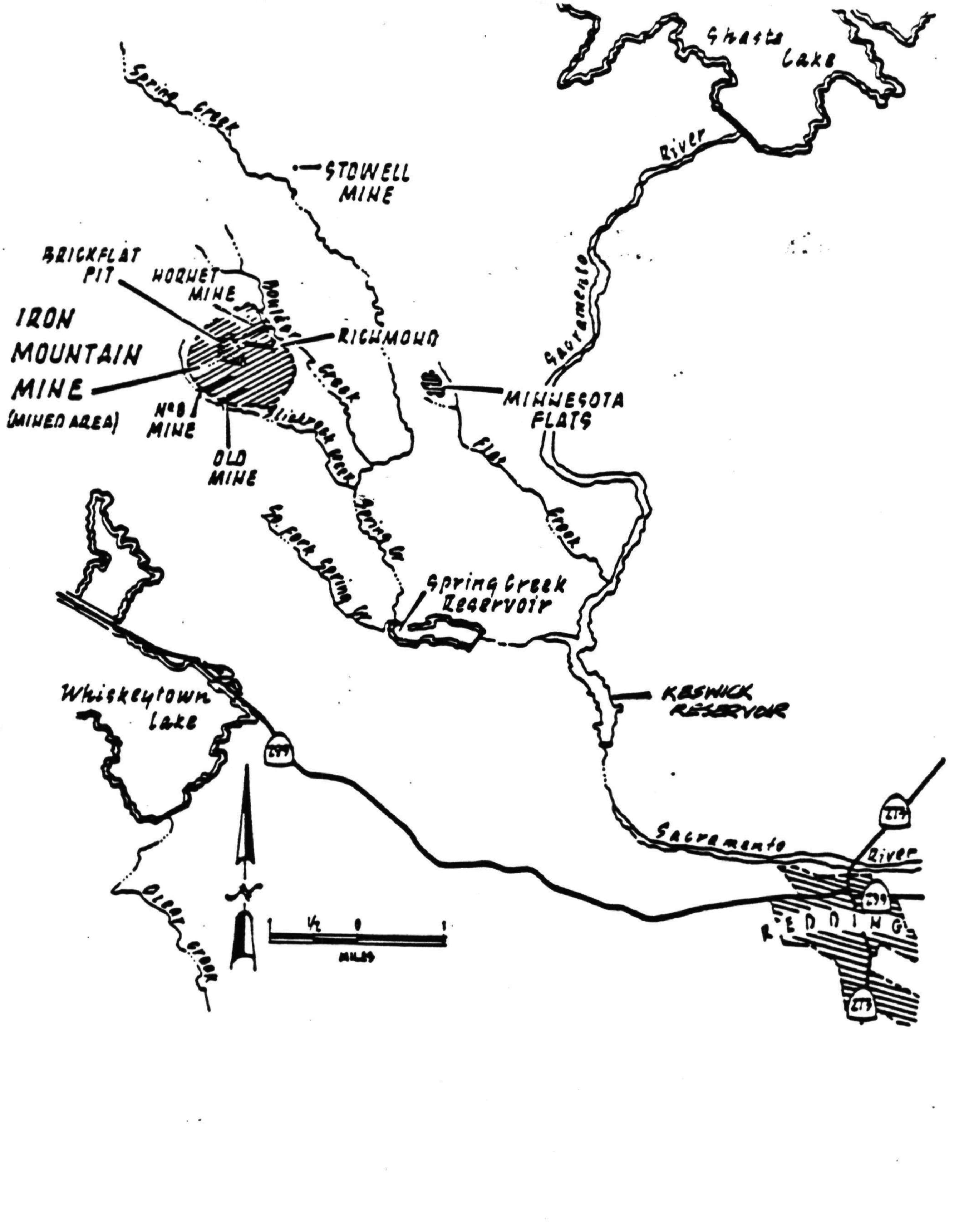

Shasta Lake
River
Spring Creek
STOWELL MINE
BRICKFLAT PIT
HORNET MINE
Boulder Creek
RICHMOND
IRON MOUNTAIN MINE (MINED AREA)
No 8 MINE
OLD MINE
Slickrock Creek
Sacramento
MINNESOTA FLATS
Flat Creek
Spring Cr.
So. Fork Spring Cr.
Spring Creek Reservoir
KESWICK RESERVOIR
Whiskeytown Lake
299
N
1/2 0 1
MILES
Sacramento River
REDDING
273
Clear Creek

FIGURE 1

amount of "dilution" water being released by the U.S. Bureau of Reclamation from Shasta Lake. A principle objective in operating the reservoir is to control the discharge of the contaminated water such that releases upstream from Shasta Lake provide sufficient dilution to meet current established levels for copper, zinc, and cadmium in the Sacramento River. Spring Creek drains into Keswick Reservoir which was formed by the construction of the Keswick Dam on the Sacramento River. Flat Creek, which also drains a portion of the mining complex, enters Keswick Reservoir just upstream of Spring Creek. The Sacramento River is a valuable fisheries resource and is used as a source of drinking water by the City of Redding (population: approximately 50,000 people).

II. OVERVIEW OF THE PROBLEM

Mineralized zones that have extensive underground workings from past mining activities are the primary source of contamination. As rain falls on the ground above the mineralized zones, it infiltrates into the underground mine workings where it mixes with groundwater, and then passes through the ore zone. As the groundwater passes through the ore, sulfuric acid is produced, and high concentrations of copper, zinc, and cadmium are leached from the mineralized zone. The resulting heavy metals- laden acidic waters are referred to as acid mine drainage (AMD).

The AMD is eventually discharged through mine adits (access tunnels entering the orebody and used during underground mining activities) or groundwater seepage into streams in the Spring Creek watershed (Slickrock Creek and Boulder Creek). The AMD mixes with runoff from the Spring Creek watershed and flows into Spring Creek Reservoir. This reservoir serves to control discharges from the Spring Creek watershed into the Sacramento River.

During periods of heavy winter rain, high volumes of runoff are produced from the Spring Creek watershed. This also coincides with high production of AMD from Iron Mountain Mine. At these times, releases from Shasta Lake are frequently reduced to maximize storage behind Shasta Dam and to prevent downstream flooding of the Sacramento River. When high runoff causes the Spring Creek Reservoir to exceed capacity, uncontrolled spills have occurred. Under these conditions, the releases from Shasta Lake are at times not sufficient to provide adequate dilution of the uncontrolled discharge from the reservoir. As a result, levels of copper, zinc, and cadmium exceeding lethal concentrations for aquatic life periodically occur in the Sacramento River. The last major adult fish kill occurred in 1969 when an estimated 200,000 salmon were killed. More often, sublethal concentrations occur that have detrimental effects on some aquatic species, including reduced rates of growth, interference with physiological processes necessary for successful migration, and inhibition of gill function. Past investigations in the Iron Mountain Mine area have documented the following environmental conditions which now exist and will continue as a result of toxic drainage from Iron Mountain Mine:

1. Heavy metal contamination of Boulder Creek, Slickrock Creek, Flat Creek, and portions of Spring Creek, causing the elimination of aquatic life and all other beneficial uses of these watercourses downstream of Iron Mountain Mine.

2. Heavy metal contamination of Keswick Reservoir, causing periodic fish kills ad a significant reduction in fish and aquatic invertebrates and unsightly deposits of metallic sludges in the lower one and one-half miles of the Reservoir downstream of Spring Creek. This contamination has reduced, if not eliminated, recreational uses of the lower Reservoir.

3. Periodic fish kills in Keswick Reservoir and in the Sacramento River downstream of Keswick Dam caused by uncontrolled spills of contaminated water from Spring Creek Reservoir. In addition, there are repeated instances when the LC50 levels for juvenile salmon and steelhead in the Sacramento River below Keswick Dam are exceeded. These instances are caused by uncontrolled spills at Spring Creek Reservoir. In addition, short-term exposure (6-8 hours) to high concentrations of heavy metals occurs below Keswick Dam from normal water releases at Spring Creek Reservoir during the Spring Creek powerhouse start-up.

4. Accumulation of copper and cadmium in the tissue of resident fish below Keswick Dam at levels which greatly exceed the statewide norm and which suggest adverse reproductive and other physiological impacts. In the case of cadmium, the levels in fish tissue below Keswick Dam are over five times the statewide norm.

5. Temporary discontinuation of domestic water from the Sacramento River for precautionary reasons during uncontrolled spill events at Spring Creek Reservoir.

6. Occasional loss of large volumes of fresh water in storage when the U.S. Bureau of Reclamation has had to release water from Shasta Dam to dilute high concentrations of heavy metals spilling from Spring Creek Reservoir.

III. SITE HISTORY

A. Mining History

Iron Mountain Mine is the southernmost mine in the West Shasta Mining District, an area mined since the early 1860's for silver, gold, copper, zinc, and pyrite. Although various parts of Iron Mountain Mine were developed as separate mines, it is generally believed that the massive sulfide deposits are part of one orebody which has been segmented by faulting.

Iron Mountain Mine was first secured for possible future value as a source of iron ore in 1865. Silver ore was discovered in 1879, and limited development and mining or Iron Mountain Mine's gossan (oxide ores) caps began. A small milling and leaching facility was constructed in the mid-1980's to process the gossan material for silver recovery. In 1895, the Iron Mountain Mine property was sold to British-owned Mountain Mining Company, Ltd., following discovery of massive copper sulfide deposits. Mining of the ore continued under the new ownership until 1897, when the property was transferred to Mountain Copper Company, Ltd., of London, England.

The Old Mine orebody was the first massive sulfide ore to be mined for commercial recovery of copper at IMM. Construction of a smelter and a narrow-gauge railway to transport the ore from the mine to the smelter was completed in 1896.

Between 1902 and 1908, several lawsuits were brought against Mountain Copper Company. Private property owners and the U.S. Forest Reserve sued Mountain Copper for destruction of vegetation by operation of the Keswick smelter, and an injunction was obtained prohibiting the roasting of ore. Smelting was gradually transferred to Richmond, California, and in 1907 the Keswick smelter was completely shut down. Mountain Copper completed a new smelter and processing plant in Martinez, California in 1908.

The Number 8 orebody, underlying the Old Mine orebody, was discovered in 1907. The Number 8 Mine was developed concurrently with the Hornet pyrite mine on the northeast side of the mountain. Beginning in 1900, pyrite ore from the Old Mine, and later the Hornet Mine, was sold for the production of sulfuric acid. Process residues were returned to Mountain Copper Company's Keswick Smelter for recovery of the copper, gold, and silver. The procedure was greatly simplified with completion of Mountain Copper's Martinez plant in 1908. The Martinez plant was complete with copper smelter, an acid plant, and facilities for manufacturing commercial fertilizers.

In 1914-15, California's first copper flotation mill was completed at Minnesota, on the Iron Mountain railway. The mill operated until March 1919, when it was closed because of low copper prices. A nearly flat area, later referred to as Minnesota Flats, was used for tailings disposal during the operation of the mill. Pyrite ore tailings were also deposited at Minnesota Flats during later periods of mining.

In 1920, a new crushing and screening plant was put into operation near the Hornet Mine to replace the crushing operations at Keswick. It was operated until 1943. An aerial tramway was completed in 1921 to transport the ore to Matheson, a few miles north of Keswick on the Southern Pacific Railroad line.

In 1928, as the copper market improved, the Minnesota mill was reconstructed just below the Number 8 Mine portal. However, tailings disposal in the steep canyon was a major problem; a tailings dam built on Slickrock Creek received numerous complaints from the California Fish and Game Commission. The dam was destroyed by floods in 1933, and the operation was shut down due to declining copper prices. A 250-ton/day cyanide leach plant was constructed in 1929 to recover silver and gold from the gossan in the area of the Old Mine orebody. The gossan was 23ned by open-pit methods, with tailings storage in Hogtown Gulch, adjacent to Slickrock Creek. An estimated 2.6 million tons of gossan was mined from 1929 to 1942. The tailings initially stored in Hogtown Gulch, were reported to have an iron content of 50 to 55 percent; during later periods, the content was reported to be as low as 30 to 35 percent.

Mining of the copper-zinc ore in the Richmond and Mattie orebodies was begun in 1942. High wartime metals prices prompted construction of a copper-zinc flotation plant at the Richmond portal. The plant operated from 1943 to 1947. Underground mining of the Richmond orebody ended in 1956.

In 1955, a large landslide composed of mine mill tailings filled the Slickrock Creek canyon to a reported depth of about 80 feet, covering two mine portals (Number 8 and Old Mine).

The Brick Flat orebody was mined by open-pit methods between 1955 and 1962. The first pyrite was mined in 1956 after the removal of 2.5 million tons of overburden. All mining operations were discontinued in 1963.

The Iron Mountain property was purchased from Mountain Copper Company by Stauffer Chemical Company in 1967. The property was subsequently sold to Iron Mountain Mines, Inc., in 1976. There has been some core sampling, but there is no evidence that mining has occurred under the current ownership.

B. Previous Remedial Actions

Several actions have been taken that have had an effect on the incidence and severity of AMD problems at Iron Mountain Mine. These measures, although lessening the pollution problems somewhat, have not been successful in eliminating the conditions discussed on page 4 of this document.

1. Copper Cementation Plants

In 1940, Mountain Copper Company, Ltd., constructed a copper cementation plant to recover copper from mine drainage in the Boulder Creek drainage area. In the cementation process, scrap iron is contacted with the AMD resulting in the precipitation of copper and dissolution of the scrap iron.

The Boulder plant and a similar plant in the Slickrock drainage, which was constructed by Iron Mountain Mines, Inc., in 1977, have been operated intermittently to recover copper from the AMD, thereby reducing concentrations of copper in Spring Creek and the Sacramento River. The copper cementation plants remove approximately 300 pounds per day (annual average) of copper from the AMD when properly operated. Zinc and cadmium, and other elements are not removed by this treatment method.

2. Spring Creek Debris Dam

The SCDD was constructed in part to help prevent toxic concentrations of metals and consequent fishkills as a result of discharges of AMD to Keswick Reservoir. The objective is to release AMD from SCDD at a rate which will result in safe metal concentrations below Keswick Dam. The debris dam has not been entirely effective in achieving this objective, particularly during periods of high precipitation which can produce runoff that exceeds storage capacity of SCDD. This results in uncontrolled spills of AMD. When Sacramento River base-flow is being stored at the same time to conserve water in Shasta Lake or to minimize downstream flooding, these acid metal-laden flows from SCDD are not diluted sufficiently to prevent fishkills, especially in the early life stages of fish.

In 1980, a Memorandum of Understanding (MOU) was developed between the State Water Resources Control Board (SWRCB), U.S. Bureau of Reclamation (USBR), and the California Department of Fish and Game (CDFG) for the purpose of minimizing the Spring Creek toxicity problem.

As part of this MOU, the USBR agreed to operate the Spring Creek Debris Dam and Shasta Dam water management system in such a manner that, to the extent possible, sufficient dilution water would be available to ensure that State water quality criteria below Keswick Dam would be met.

Also, under the agreement, the CDFG was to conduct fish toxicity tests to provide a basis for permanent toxicity criteria, release schedules, and water quality objective. After two years of intensive laboratory and field work, the CDFG identified the following levels of metals below which protect all life stages of anadromous salmon and steelhead below Keswick Dam: copper (5.6 ug/l); zinc (16.0 ug/l); and cadmium (0.22 ug/l). These recommended levels were adopted by the Regional Water Quality Control Board as Basin Plan objectives for the Keswick Dam area and approved by the State Water Resources Control Board (SWRCB) in August 1984. These objectives were approved by EPA on August 7, 1985 under Section 303 of the Clean Water Act.

The Regional Board, acting on behalf of the SWRCB, was responsible for undertaking environmental studies designed to identify the most feasible means of mitigating the problem through source control. The MOU may be revised once remedial action is completed at Iron Mountain Mine.

IV. EPA INVOLVEMENT

In June 1981, the State of California submitted the Iron Mountain Mine site as a candidate for the Interim Priorities List (IPL). When the IPL was released in October 1981, Iron Mountain Mine appeared in the fourth decade of candidate sites. Later, on August 31, 1982, the state submitted Iron Mountain Mine as a candidate for the National Priorities List (NPL). On December 30, 1982, EPA proposed the Iron Mountain Mine site for inclusion on the NPL. On September 8, 1983, through final rule-making, the site was included on the NPL.

In September 1983, EPA commenced a Remedial Investigation and Feasibility Study (RI/FS). The purpose of the RI was to assess the major sources of contamination leaving the site and collect data needed to identify and evaluate potential remedies. During the FS, the potential remedies were evaluated according to technical, environmental, public health, institutional, and cost criteria.

A. Remedial Investigation (RI)

A comprehensive investigation for the Iron Mountain Mine site was conducted between September 1983 and April 1985 to determine the nature, cause and extent of the environmental and potential public health impacts from past and continuing discharges of AMD. The extent of the surface and ground water contamination was established through:

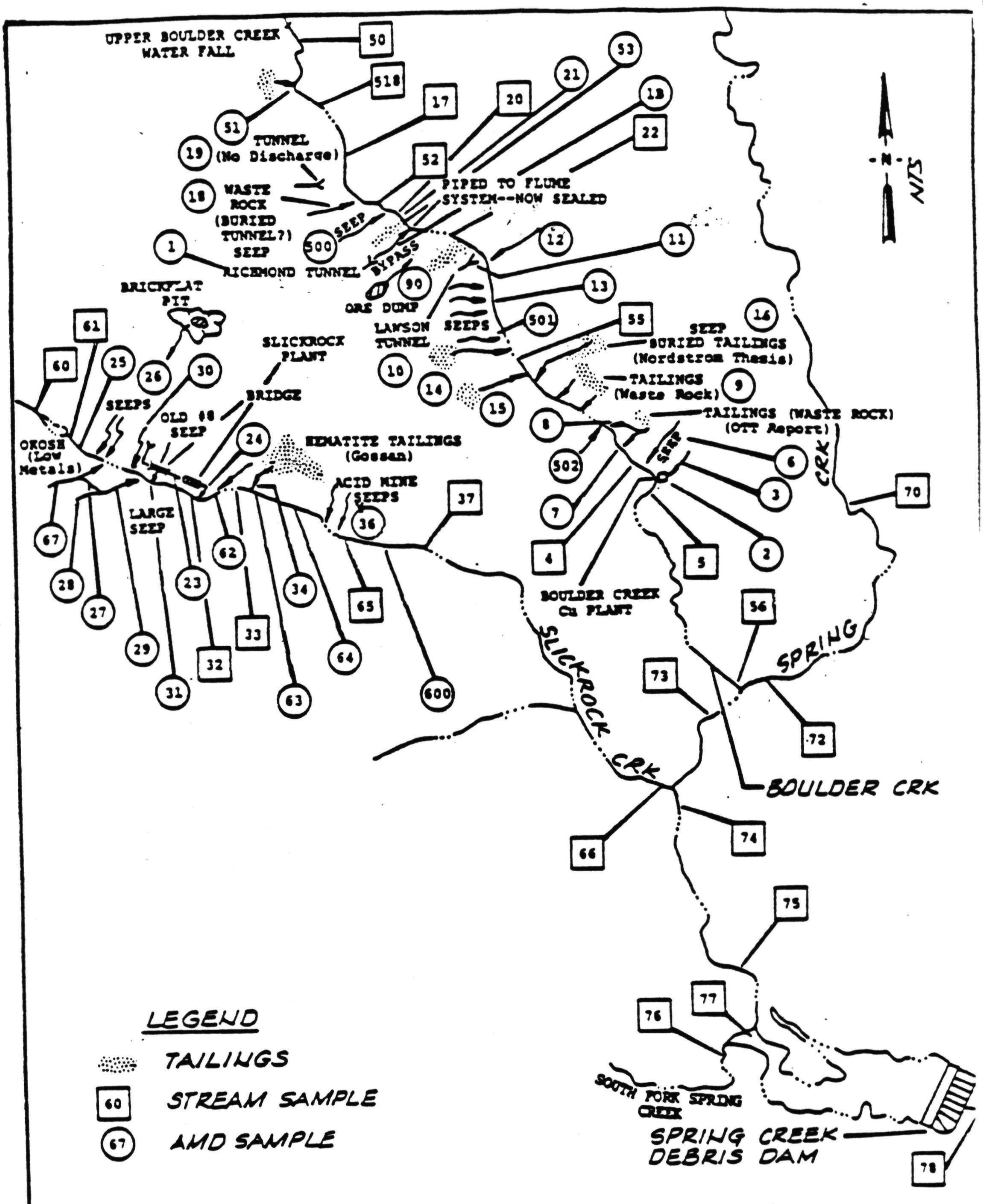
- Weekly sampling of the five major sources at the mine and three locations on Spring Creek, and bi-weekly sampling at 4 locations along the Sacramento River for heavy metals.

- Installation of flow measurement stations at 3 locations, including mine portals and downstream receiving waters.

- Measurement of precipitation at six gauges throughout the area.

- Two comprehensive surface water sampling surveys, involving 76 sampling points were conducted in September 1983 and December 1983 to identify and quantify all AMD sources. (See Figure 2)

- A review of existing information on the site including water quality, geology, and hydrology.



INTENSIVE SAMPLING SITE LOCATION MAP

- A program of field mapping of the areas overlying the Richmond orebody. This included geologic mapping, measurement of fracture orientations, and delineation of subsidence pits and their tributary drainage areas.

- A program of drilling and monitoring for the Richmond groundwater investigation. This program included installing four monitoring wells adjacent to the Richmond orebody, monitoring groundwater elevations, conducting aquifer testing, and groundwater quality testing.

During the 17 month RI, approximately 450 surface and ground water samples were collected and analyzed. A draft RI report was released in December 1984; the RI report was finalized and issued on August 23, 1985. The major findings of the RI are discussed below.

1. Major Sources of Pollution

EPA's RI found that the following five major sources account for approximately 72 percent of the copper and 86 percent of both zinc and cadmium being discharged from the site during the sampling period.

Richmond Portal: This source is a mine adit into the Richmond orebody which represents the major single source of AMD at Iron Mountain Mine. The Richmond orebody has been extensively mined, resulting in subsidence pits and closed drainages on the surface overlying the zone. Water which drains from the Richmond portal results from infiltration of surface water captured in the closed drainage areas overlying the orebody and by lateral inflow of groundwater from areas upgradient of the mine.

Lawson Portal: This source is a mine shaft located on Boulder Creek immediately below and to the east of the Richmond portal.

Old No. 8 Mine Seep: This source is located on the upper end of Slickrock Creek and is believed to originate from either the No.8 Mine and/or the Old Mine. The entryways for these mines were covered by a slide in the 1950's.

Big Seep (below Okosh Mine): This source is made up of seeps which discharge from the waste rock dump on the south side of Slickrock Creek.

Brick Flat Pit By-Pass: Water that is discharged from this source originates from the drainage area into Brick Flat Pit and is carried outside the pit by an earthen dam.

The relative contribution of metals from these sources is listed in Table 1; the average chemical composition of discharges from these sources is shown on Table 2.

Table 1. Relative Contribution of Metals
Averaged over 4 month Sampling Program

	COPPER		ZINC		CADMIUM		MAXIMUM DISCHARGES
SOURCE	Average lbs/day	% of All Sources	Average lbs/day	% of All Sources	Average lbs/day	% of All Sources	Cu,Zn & Cd Lbs/Day
Richmond Portal	180	31.0	1,118	70.0	7.8	69.0	5,600
Lawson Portal	32	6.0	209	11.0	1.4	11.0	1,100
Old No. 8 Mine Seep	109	25.0	45	3.0	0.4	4.0	1,000
Big Seep	50	9.0	21	1.0	0.2	1.0	400
Brick Flat Pit By-Pass	52	2.0	73	1.0	0.6	1.0	1,000
Other Sources		27.0		14.0		14.0	
TOTAL	423	100.0	1,466	100.0	10.4	100.0	

Table 2

SUMMARY OF MAJOR SOURCES--

AVERAGE CHEMICAL COMPOSITION

(DECEMBER 30, 1983 - MAY 16, 1984)

Parameter (mg/L, except as noted)	Richmond Portal	Lawson Portal	Old-No. 8 Mine Seep	Big Seep	Brick Flat Pit Bypass
Flow (gpm)[a]	73	50	89	277	35
pH (units)	0.6 to 1.4	1.6 to 2.8	1.7 to 3.1	2.2 to 3.1	2.3 to 4.6
Conductivity (Umhos/cm)	195,000	30,900	7,600	1,350	2,610
Temperature (°C)	26.5	20.4	16.2	9.9	11.7
Acidity (meq/L)	1,150	232	131	16	37
Aluminum	1,190	484	509	47	49
Antimony	0.295	<0.02	<0.02	<0.02	<0.02
Arsenic	34.5	4.6	0.19	0.03	0.47
Cadmium	10.1	2.4	0.46	0.05	0.41
Calcium	163	178	90	5	44
Chloride	75	5	10	4	2
Copper	184	55	120	12.9	14.4
Iron, total	13,000	3,560	1,270	141	369
Iron, ferrous	11,400	2,930	940	57	259
Lead	3.15	0.21	0.014	0.026	0.70
Magnesium	586	329	293	16	68
Manganese	13.5	9.0	11.9	0.44	1.8
Mercury (Ug/L	1.4	<0.1	0.1	<0.1	<0.2
Potassium	153	38	0.8	<0.3	0.5
Silica	23.8	15.0	18.9	2.6	8.1
Silver	0.014	<0.001	<0.001	<0.008	<0.001
Sodium	112	31	6.1	3.3	3.0
Sulfate	60,100	13,400	6,800	690	1,530
Thallium	0.19	0.03	<0.01	<0.01	<0.01
Total dissolved solids	69,400	19,000	10,900	1,100	2,500
Total suspended solids	92	20	11	9	6
Zinc	1,440	350	48.9	4.8	56.5

a) Boulder Creek

The existing water quality in Boulder Creek is quite variable and highly dependant on rainfall and the operation of the existing Boulder cementation plant. Boulder Creek water quality data is presented in Table 3. The sources of contamination along Boulder Creek consist of the following:

- Boulder Creek Cementation Plant

The Boulder Creek cementation plant receives acid mine drainage discharge continually from the Richmond and Lawson mine portals through a series of pipes and flumes. Leaks and spills from the collection system are additional minor sources of pollutant discharges. The quantity of the discharge from this plant is dependent on rainfall, and the quality is dependent on whether scrap iron is being maintained in the treatment plant.

It is estimated that the discharge from the Boulder cementation plant contributes approximately 20 to 40 percent of the copper, 90 to 95 percent of the cadmium, and 90 to 95 percent of the zinc measured in Lower Boulder Creek.

- Seeps

Numerous seeps exist along the Boulder Creek drainage. The primary source of these seeps may be acid mine drainage from the main orebody. Flows from these seeps are greatly reduced during the summer months and some may stop completely. The quality of these seeps is as follows:

Parameter	Range
pH	0.4 to 6.1 units
Cadmium, total	0.005 to 0.52 mg/l
Copper, total	1.0 to 13.4 mg/l
Zinc, total	0.3 to 59.7 mg/l

The percent contribution of seeps to Boulder Creek is listed on Table 4.

TABLE 3: Boulder Creek Water Quality

Parameter	Upper Boulder (Summer) Sept 1983	Upper Boulder (Winter) Dec 1983	Lower Boulder (Summer) Sept. 1983	Lower Boulder (Winter) Dec. 1983	Lower Boulder (Spring) May 1984
pH, units	6.8	6.3	2.25	1.8	--
Cadmium, total, mg/l	0.012	0.001	1.64	0.44	0.65
Copper, total, mg/l	<0.050	<0.050	3.52	1.45	1.10
Zinc, total, mg/l	0.912	0.020	302.00	46.2	90.3

o <u>Tailings Piles and Waste Dumps</u>

These sources contribute pollutants primarily during storm events. In addition to dissolved metals and acidic leachate, tailings and waste material are discharged directly to receiving waters in violation of federal suspended solids limitations and water quality standards. The percent contribution of these soures to Boulder Creek is listed on Table 4.

o <u>Other Sources</u>

Other sources of metal pollution probably consist of subsurface drainage entering Boulder Creek and dissolution of metal-bearing sediment in the creek. These other sources of pollution are estimated to be as follows:

	Summer		Winter	
Metal	lb/day	Percent Contribution	lb/day	Percent Contribution
Copper	8.7	76	26	23
Cadmium	0.2	3	0	0
Zinc	31.0	4	30	1

b) <u>Flat Creek</u>

The only identified source of pollutants discharged to Flat Creek is the Minnesota Flats tailings pile. The water quality of Flat Creek below Minnesota Flats is given below.

Parameter	Average	Range
Flow	280 gpm	58 to 9,000 gpm
pH	--	2.6 to 6.5 units
Copper	1.32 mg/l	0.003 to 7.63 mg/l
Cadmium	0.018 mg/l	0.002 to 0.050 mg/l
Zinc	1.92 mg/l	0.48 to 9.02 mg/l

c) <u>Slickrock Creek</u>

The existing water quality in Slickrock Creek is quite variable and highly dependent on rainfall and the operation of the Slickrock cementation plant. Slickrock Creek water quality data is presented in Table 5. The sources of contamination along Slickrock Creek consist of:

TABLE 4

Percent Contribution of Boulder Creek Seeps and Tailings Piles Waste Rock Dumps

Metal	Percent Contribution (Range) Seeps	Tailings Piles and Waste Rock Dumps
Cadmium	0.1 - 3	0.1 - 7
Copper	3.1 - 17	0.7 - 20
Zinc	0.1 - 3	0.1 - 4

TABLE 5: Slickrock Creek Water Quality

Parameter	Upper Slickrock (Summer) Sept 1983	Upper Slickrock (Winter) Dec 1983	Lower Slickrock (Summer) Sept. 1983	Lower Slickrock (Winter) Dec. 1983	Lower Slickrock (Spring) May 1984
pH, units	6.9	6.3	2.9	2.8	--
Cadmium, total, mg/l	0.001	<0.001	0.21	0.056	0.073
Copper, total, mg/l	<0.05	<0.05	27.1	8.50	9.47
Zinc, total, mg/l	--	<0.01	18.5	4.95	10.45

o Slickrock Cementation Plant

The Slickrock cementation plant receives acid mine drainage discharged continually from the Old-No. 8 mine seep. The quantity of the discharge from the cementation plan is dependent on rainfall, and the quality is dependent on whether scrap iron is maintained in the treatment tanks. It is estimated that the discharge from the Slickrock cementation plant contributes approximately 75 to 95 percent of the copper, cadmium, and zinc measured in Lower Slickrock Creek.

o Seeps

A few seeps exist along Slickrock Creek. The primary source of metals in these seeps appears to be from the old slide area, and from the hematite pile. It is also possible that the source of these seeps may be AMD from the main orebody. The major contributing seep is Big Seep. The source of the seep area is groundwater and surface water migrating through an old waste rock dump. The quality of the Slickrock seeps is as follows:

Parameter	(mg/l)
pH	2.7 to 6.5 units
Cadmium, total	0.001 to 0.30 mg/l
Copper, total	<0.050 to 42.6 mg/l
Zinc, total	0.01 to 24.8 mg/l

Flows from the seeps are greatly reduced during the summer and some may completely stop. It is estimated that these seeps contribute 2 to 25 percent of the metals in Slickrock Creek.

o Tailings Piles and Waste Dumps

The sources along Slickrock contribute pollutants both during storm and normal rainfall events. The hematite pile along Slickrock Creek contributes about 1 percent of the metals in Slickrock Creek.

o Other Sources

The other sources of pollution along Slickrock Creek are the Brick Flat Bypass that flows down the mountain and enters the creek, subsurface drainage, and dissolution of metal-bearing sediment in the creek. It is estimated that these sources can contribute up to 5-30 percent of the metals in Slickrock Creek depending upon the time of year in which the discharges occur.

d) Spring Creek

The existing water quality in Spring Creek is presented on Table 6. The source of contamination in Spring Creek have been described in the Boulder Creek and Slickrock Creek sections.

In addition, there are probably sediment deposits within the streambed, as observed along Slickrock Creek, which also contribute to metals pollution.

It is not possible to fully assess the metal contribution of the sediments, but it is estimated it is relatively minor in relationship to the contribution from Boulder and Slickrock Creeks.

e) Keswick Reservoir and Sacramento River

The source of contamination in Keswick Reservoir are inflows from Flat Creek and Spring Creek and sediments deposited within the reservoir. The average water quality in the Sacramento River is presented in Table 7.

The Sacramento River above Keswick Reservoir already contains metals as shown in Table 7. After Flat Creek and Spring Creek enter the river in Keswick Reservoir, the concentration of metals are elevated up two to three times. Due to the relative low concentrations of metals and the variable flows from Keswick Reservoir, it is not possible to accurately estimate the metals contribution from Flat Creek and Spring Creek.

3. Environmental Impacts

Due to past and continuing releases of AMD to receiving waters, Boulder Creek, Slickrock Creek, Flat Creek and portions of Spring Creek are essentially devoid of aquatic life. During the RI, between 1,143 and 3,695 pounds per day of copper, zinc, plus cadmium were carried from the site into the Spring Creek Reservoir. Of this total, between 623 and 3,328 pounds per day of copper, zinc and cadmium were discharged into the Sacramento River. These releases occurred over a period that is best characterized as relatively dry winter conditions. The above totals can be expected to rise significantly during normal or above normal rainfall conditions.

Off-site, subsurface migration of contaminated groundwater does not appear to be a problem at this site. The hydraulics of the site are such that the mine workings act as a drain, drawing groundwater towards the mountain, and discharging it into adjacent surface waters.

TABLE 6: Spring Creek Water Quality

Parameter	ABOVE IRON MOUNTAIN Average	ABOVE IRON MOUNTAIN Range	BELOW IRON MOUNTAIN Average	BELOW IRON MOUNTAIN Range
pH (units)	--	4.5 to 7.8	--	2.4 to 3.2
Cadmium, total, mg/l	--	<0.001 to 0.001	0.10	0.03 to 0.16
Copper, total, mg/l	0.06	0.03 to 0.10	1.94	0.97 to 2.74
Zinc, total, mg/l	0.12	0.07 to 0.15	12.5	3.25 to 17.4

Table 7

SUMMARY OF SACRAMENTO RIVER MONITORING

FEBRUARY 2, 1984, THROUGH JUNE 24, 1984

(Average of Detectable Values)[a]

Parameter (Ug/L, except as noted)	Sacramento River Below Shasta Dam	Sacramento River Above Spring Creek[b]	Sacramento River Below Keswick Dam	Sacramento River at Redding Intake	Sacramento River Below Keswick Dam[c]	
					Average	Range
pH (range of units)	6.4 to 8.1	6.5 to 8.2	6.3 to 8.1	6.3 to 8.0	--	--
Conductivity (mmhos/cm)	97	94	94	81	--	--
Temperature	9.6	10.2	9.9	10.3	--	--
Cadmium, total	0.10	0.29	0.55	0.23	--	--
Cadmium, soluble	0.18	0.29	0.41	0.37	2.5	1.8 to 4.0
Copper, total	3.5	6.5	8.5	15.8	--	--
Copper, soluble	3.7	4.6	4.8	4.9	24	10 to 52
Iron, total	224	339	505	470	--	--
Iron, soluble	63	76	66	66	--	--
Sulfate (mg/L)	3.7	4.6	5.2	6.3	--	--
Zinc, total	14.8	24.6	37.0	37.4	--	--
Zinc, soluble	13.0	26.3	30.8	39.8	196	23 to 500

[a]Only values reported above the detection limits were averaged.

[b]Sampling site appears to be influenced by backeddies from Spring Creek.

[c]Concentrations monitored by RWQCB during three spill events at Spring Creek Reservoir--January 1978, January 1983, and March 1983.

Note: No identifiable reasons for higher soluble concentrations compared to total concentrations of some constituents.

4. Impacts on Aquatic Life

a) Introduction

While the occurrence of toxicity has been documented in the Sacramento River, it is extremely difficult to quantify the extent of the loss in a river the size of the Sacramento. The fishkills occur during the wet season when the waters are typically muddy. Even with clear water, the river is difficult to survey with widths as great as 300 feet, depths as great as 35 feet, and fast currents that carry dead fish downstream. The most difficult mortalities to observe in the river are the fish most sensitive to metal toxicity - the early life stages of salmon and steelhead. These sensitive salmonid lifestages live underneath the gravel as small "sac fry" or in the river as small 2-inch "swim-ups" that have emerged from their nests.

In addition to the occurrence of lethal toxicity, there are more frequent occurrences of sublethal toxicity that could act to reduce the overall productivity of the population. Effects such as reduced growth rates, physiological problems, and diminished immune response are known to occur due to exposure to heavy metals. In a recent report to the U.S. Bureau of Reclamation, the U.S. Fish and Wildlife Service estimated that the monetary value of the chinook salmon and steelhead trout runs produced upstream from the Red Bluff Diversion Dam is approxmately $33.7 million annually. In addition, the economic value of these fishery resources, with attainment of fishery management goals, is anticipated to increase to $72 million annually.

b) Discussion

Valuable fisheries resources, including migratory populations of salmon, steelhead and resident populations of trout in the Sacramento River are significantly impacted by the AMD from the Spring Creek basin and have experienced numerous instances of above normal mortality over the last 46 years. These incidents which, have been directly attributed to AMD from Iron Mountain Mine were the result of observed mortality of adult fish in the Sacramento River and calculated mortality of eggs and fry on the basis of copper, zinc, and cadmium levels measured in the River below Keswick Dam. Table 8 was developed by the California Department of Fish and Game (CDFG) and lists the documented fishkills. CDFG has indicated that the Fall run of chinook salmon in the upper Sacramento River has ranged from an estimated high of 400,000 in 1953 to a low of 22,000 with an average decline of 87 percent in the last 20 years; that the average run of salmon over a 20 year period showed a decline from 275,000 to 75,000 salmon. This decline is attributed to several causes including AMD from Iron Mountain Mine.

TABLE 8
DOCUMENTED OCCURRENCES OF SALMON AND TROUT MORTALITIES IN THE SACRAMENTO RIVER ATTRIBUTED TO HEAVY METAL POLLUTION FROM SPRING CREEK DRAINAGE
SHASTA COUNTY

Date	Observation Location	Types of Mortalities Observed				Number of Mortalities Counted	Estimated Number of Mortalities	Method of Observation	Conditions in Sacramento River		Sacramento River Below Keswick Maximum Metal Concentrations (mg/l)	
		Salmon		Trout								
		Adult	Juvenile	Adult	Juvenile				Flow (cfs)	Clarity	Copper	Zinc
1940	Kenett Smelter Waste Pile					Unknown						
11/44	Balls Ferry	x				200	30% of spawning run	spot observation	3,000		0.061	---
Winter 1945	Balls Ferry		x					numerous cage tests			---	---
04/49	Balls Ferry		x		x	Unknown		inspect one mile of bank			0.04	0.65
04/22 1955	Redding Area		x			Hundreds		spot observations	5,000		---	---
11/22 1955	Keswick Dam	x	x			42		Keswick Fish Trap and bioassay of Spring Crk water	4,000	muddy	--- ---	--- ---
02/23 1956	Redding Area	x	x	x	x	Unknown		spot observation	27,000	muddy	---	---
01/19 1957	Redding Area		x			Unknown		spot observation	3,500		---	---
02/05 1957	Redding Area		x			Unknown		---	2,600	muddy	---	---
02/16-19/57	Redding Area		x			25		---	2,600		---	---
02/26 1957	Redding Area		x			250		---	12,000	muddy	---	---
09/26-30/57	Redding Area		x			25,000	---	survey 5 miles of one bank	7,500	muddy	---	---

TABLE 8

DOCUMENTED OCCURRENCES OF SALMON AND TROUT MORTALITIES IN THE SACRAMENTO RIVER ATTRIBUTED TO HEAVY METAL POLLUTION FROM SPRING CREEK DRAINAGE

SHASTA COUNTY

Date	Observation Location	Types of Mortalities Observed: Salmon Adult	Salmon Juvenile	Trout Adult	Trout Juvenile	Number of Mortalities Counted	Estimated Number of Mortalities	Method of Observation	Conditions in Sacramento River: Flow (cfs)	Clarity	Sacramento River Below Keswick Maximum Metal Concentrations (mg/l): Copper	Zinc
1940	Kenett Smelter Waste Pile					Unknown						
11/44	Balls Ferry	x				200	30% of spawning run	spot observation	3,000		0.061	---
Winter 1945	Balls Ferry		x					numerous cage tests			---	---
04/49	Balls Ferry		x		x	Unknown		inspect one mile of bank			0.04	0.65
04/22 1955	Redding Area		x			Hundreds		spot observations	5,000		---	---
11/22 1955	Keswick Dam	x	x			42		Keswick Fish Trap and bioassay of Spring Crk water	4,000	muddy	--- ---	--- ---
02/23 1956	Redding Area	x	x	x	x	Unknown		spot observation	27,000	muddy	---	---
01/19 1957	Redding Area		x			Unknown		spot observation	3,500		---	---
02/05 1957	Redding Area		x			Unknown		---	2,600	muddy	---	---
02/16-19/57	Redding Area		x			25		---	2,600		---	---
02/26 1957	Redding Area		x			250		---	12,000	muddy	---	---
09/26-30/57	Redding Area		x			25,000	---	survey 5 miles of one bank	7,500	muddy	---	---

According to the CDFG, the decline of the upper Sacramento River salmon and steelhead stocks represents a sizeable economic loss to the state due to the lost availability of these fish to the commercial and sport fishery. At times, the upper Sacramento River produced half of the state's Chinook salmon. Economic studies conducted by CDFG and the U.S. Fish and Wildlife Service have estimated that the continuing economic losses associated with the present depressed population levels of salmon and steelhead relative to the catch levels in the past have a net annual economic value ranging between $30-$40 million. CDFG believes that the incremental mortality caused by discharges from Iron Mountain Mine are responsible for a significant share of that economic loss.

Of particular concern is impact of AMD on populations of winter run chinook salmon, one of four genetically distinct populations of salmon in the river. According to the CDFG, the winter run population in the upper Sacramento River has declined precipitously in the past 20 years to the point where the National Marine Fisheries Service is evaluating a petition requesting that the winter run chinook be listed under the Endangered Species Act of 1973. The CDFG has apprised EPA that one of the priority actions that would be included in any winter run restoration or recovery effort is correcting the heavy metal pollution problem caused by Iron Mountain Mine. Additionally, the king salmon runs in the upper Sacramento River have experienced a 50 percent decline over the past 30-35 years, with heavy metal pollution from the Spring Creek basin being cited as one of the major responsible factors.

Because of the variations in the operation of the Shasta unit (Shasta Dam, Keswick Dam, Spring Creek Debris Dam, and the Spring Creek hydroelectric power plant), and unusual climatological conditions, there has not been any long-term undiluted spills and, thus, no observed mortality of adult fish in the Iron Mountain Mine area since 1969. There is, however, a shared concern among state and federal regulatory agencies that as competition for Shasta Lake water increases in the future, the U.S. Bureau of Reclamation may be held more accountable for ensuring that only the authorized uses of the water are allowed; this could result in the lack of adequate dilution water being made available to avert fishkills.

5. Potential Public Health Impacts

The degree of human risk associated with the AMD from the Iron Mountain Mine site depends on the nature and extent of exposure. The California Department of Health Services (Department), in an endangerment assessment prepared on August 22, 1984, for this project, discussed the types of exposure that represent a potential threat to public health. These included the following:

Dermal Contact: Near its source, the AMD contains sulfuric acid in concentrations that could cause serious eye injuries and skin irritation through direct exposure. Although the study area is located in rugged and remote terrain, the potential for human exposure cannot be ruled out. The area is located between two heavily used National Forest areas.

Areas adjacent to the mine property are frequently used for recreational purposes, especially for off-road vehicle use. The mine owners have complained of trespassing and vandalism problems on the site. The AMD is diluted as it enters Boulder Creek and Slickrock Creek and there is a less serious risk with regard to dermal contact with increased distance from the source.

Ingestion of Water: The potential for direct ingestion of AMD in the upper study area is considered small for two reasons: a) once the AMD enters the creeks, there is a discoloration associated with the precipitation of iron, and b) the remoteness of most of these areas limits access.

Cadmium concentrations measured at the Redding raw water intake have not exceeded the drinking water standards. A potential public health threat does exist due to the elevated concentrations of metals in the Sacramento River. Levels of cadmium in the River have approached and occasionally have exceeded the proposed EPA drinking water standard of .005 mg/l.

Ingestion of Fish: Ingestion of fish taken from Keswick Reservoir does not appear to represent a significant public health threat according to an analysis which expanded the endangerment assessment prepared by the Department of Health Services. However, the Department indicates that the long term risk from the bioaccumulative toxin, cadmium, should not be underestimated. The Department estimates that 50 percent of the body burden of cadmium is located in the liver and kidney of fish, with another 50 percent distributed across other tissues. Humans also accumulate cadmium in the liver and kidneys over their lifetime. It is felt that, without remediation, mine effluent will continue to be deposited in sportfishing areas of the Sacramento River and the concentration of cadmium in fish will continue to be elevated above normal levels.

6. Impacts on Public Welfare

Shasta Dam was constructed under the authority of Public Law 84-386, as part of the Trinity River Division, Central Valley Project. This law created several specific uses of Shasta Lake water, including the generation of hydroelectric power, water sales to farmers, and use as a drinking water supply. Shasta Lake also has a recreational value associated with tourism, boating, fishing, and swimming.

Release of Shasta Lake waters for pollution control in the Iron Mountain Mine area is not an authorized use of these waters. Nevertheless, since the construction of the Shasta Dam/Keswick Dam/Spring Creek Debris Dam water management system, Shasta Lake waters have been, and continue to be released for this purpose, when waters can be provided without adverse impacts to other project requirements. By controlling the release of these waters the U.S. Bureau of Reclamation (Bureau) has assisted other federal and state agencies, in promoting fishery resources in the Sacramento River.

Although it is difficult to quantify the exact value of Shasta Lake water, the Bureau has estimated the revenue that would be lost by releasing Shasta Lake water for pollution control. This was accomplished through the use of a mathematical water model that assumed that water that wasn't being released for pollution control would be sold for municipal and industrial purposes. Based on the Bureau's analysis, it was estimated that meeting less stringent standards (the original water quality standards that were in effect prior to the state adopting the existing water quality standards) in the Sacramento River would result in an annual loss in revenue from the U.S. Treasury of about $32 million, and that fish saved by releasing this additional dilution water would have an annual value of $1.4 million. Meeting the proposed Superfund metals levels, which are substantially lower, would cost about $456 million in dilution releases, with fish savings of about $9.6 million per year. Without remediation in the form of source control and treatment, releases of Shasta Lake water will be required until such time as Iron Mountain Mine ceases to discharge AMD.

V. ENFORCEMENT ANALYSIS - Confidential

(See Attachment)

VI. ALTERNATIVES EVALUATION

A. Introduction

The major objective of the feasibility study was to evaluate remedial alternatives using a cost-effective approach consistent with the goals and objectives of CERCLA. A cost-effective remedial alternative is defined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) 40 CFR §300, et.seq. as the alternative that effectively mitigates and minimizes threats to and provides adequate protection of public health and welfare and the environment. Except as provided in Section 300.68(i)(5), this requires the selection of a remedy that attains or exceeds applicable or relevant and appropriate federal public health and environmental requirements that have been identified for the specific site. In selecting the appropriate extent of remedy, EPA is directed to consider cost, technology, reliability, administrative and other concerns, and their relevant effects on public health and welfare and the environment.

The feasibility study process included the following steps: (1) identification of general response actions, (2) identification of target clean-up levels, (3) assembly of the universe of technologies relevant to the response actions, (4) retention of the surviving technologies as component actions, (5) assembly of the component actions into combined alternatives, (6) initial screening of the combined alternatives, and (7) detailed analysis of surviving combined alternatives. Nine combined alternatives (CA-1 to CA-9) underwent very detailed analysis. Three alternatives were considered in less detail and were included in the final alternatives matrix: Alternatives CA-10 ($1.4 billion), CA-11 ($350 million) and CA-12 ($263 million). The feasibility study results are presented in more detail in the following paragraphs.

Based on site background information and the nature and extent of the problems from the technical investigation to date, the key general objectives for the Iron Mountain Mine site were:

- To minimize off-site contaminant migration via surface water runoff and seepage, and
- To mitigate impacts and minimize the migration of contaminants that have already moved from the site through receiving waters.

The two areas targeted for remediation and selected general response actions were:

<u>Areas of Remediation</u>	<u>General Response Action</u>
Ore bodies and underground mine workings	No action, recovery, treatment, source control, and disposal
Surface water	No action, water management, treatment, and disposal.

The contaminants of primary concern at the Iron Mountain Mine site are copper, cadmium, and zinc because: a) these contaminants have been detected at high levels at the source and in surface waters receiving discharges from Iron Mountain Mine, b) acute dosages of these contaminants have been found to result in fish kills; sub-lethal impacts have, among other things, resulted in reduced rates of growth and accumulations of metals in fish tissues; and c) even when toxic levels are not reached, these metals act to depress the overall productivity of life in Keswick Reservoir and the Sacramento River.

B. Site-Specific Action Levels

Three sets of target clean-up levels were considered as primary cleanup objectives for Iron Mountain Mine:

1. Implement remedial actions to achieve the following EPA Water Quality Criteria for Protection of Aquatic Life below Keswick Dam:

Copper:	5.4	ug/l
Zinc:	47.0	ug/l;
Cadmium:	0.55	ug/l

2. Meet Regional Board Basin Plan Objectives for copper, cadmium and zinc in the Upper Sacramento River:

Copper:	5.6	ug/l
Zinc:	16.0	ug/l;
Cadmium:	0.22	ug/l

These objectives are based on a series of intensive studies conducted by the CDFG. According to CDFG, implementation of remedial activities that meet these objectives would provide safe levels having no chronic or acute effect on aquatic life in the Upper Sacramento River.

3. Meet background levels (established by the water quality upstream of the confluence of Spring Creek and the Sacramento River):

Copper:	3.5	ug/l
Zinc:	14.8	ug/l
Cadmium:	.1	ug/l

The secondary objective is to reduce the metals loading from the Iron Mountain Mine site to receiving waters.

C. Technology Development

A variety of technologies was examined with regard to technical feasibility, degree of public health protection afforded, environmental impact, institutional concerns, and cost.

The applicable technologies identified were then combined to form remedial action alternatives that addressed source control and treatment of AMD at the mine and surface water management.

Preferred technologies for the various components that addressed source control and water management are identified in Table 9.

D. Components for Detailed Analysis

The following discussion describes the components that were later combined into alternatives (see Table 10). Table 11 presents the technical, environmental, institutional and other considerations for each of the components (#1 through #11).

Component #1. Solution Mining (Proposed by IMMI)

Toward the end of the RI/FS, Iron Mountain Mine, Incorporated (IMMI) submitted a concept for a proposed metals recovery operation at Iron Mountain Mine. This proposal was developed independent of EPA's feasibility study by consultants for IMMI. This proposal included the in situ leaching of the sulfide orebody to extract copper, zinc, iron, and precious metals, and the recovery of the base metals as industrial and agricultural chemicals.

The basic principle of the IMMI proposal is to seal the Richmond and Lawson portals, recirculate AMD back into the mountain and draw off 2,000 gpm of concentrated acid mine water from in situ leaching, and treat it at a copper extraction plant. An acidified 1,800 gpm stream would be recycled for reinjection into the orebody to enhance metal leaching. A 200 gpm bleed stream is treated in the metal salts recovery plant and a waste-water treatment plant prior to discharging to receiving waters or irrigation.

Component #2. Partial Capping

The purpose of capping and constructing drainage ditches around cracked and caved ground areas above the Richmond orebody is to reduce the water available for generation of AMD by intercepting surface water and directing it away from the orebody. This source control method is applicable primarily to the Richmond-Complex orebody as this is the only source that shows significant contribution from surface water inflow. Cracked ground, caved ground, and other known primary conduits for inflow would be surface-plugged and sealed to reduce the rapid inflow of water into these areas. Surface water would be intercepted by a system of lined ditches and directed away from the orebody to reduce the potential of surface water finding a path of rapid inflow.

Table 9. Available Technologies

General Response Action	Technologies
OREBODIES AND MINE WORKINGS	
No Action	No action
Recovery	Mine the orebody using open pit, underground, or in situ methods
Treatment	In situ methods without metals recovery, and the use of surfactants or other inhibiting agents groundwater barrier walls, groundwater interception, pumping, and revegetation of disturbed areas. Injection of Low-density concrete in underground mine workings.
Disposal	Landfill
SURFACE WATER	
No Action	No action
Water Management	Transbasin stream diversion (pipe, open channel, flume), local stream diversion, enlarge existing storage, construct new storage, and modify CVP operating plan
Treatment	Precipitation (utilizing lime/limestone, sodium hydroxide, soda ash), biological neutralization, bogs, sulfide precipitation, starch xanthate treatment, clarifier thickener, aeration, chemical oxidation, biochemical oxidation, electroflocation, ionic flotation, carbon adsorption, solvent extraction, sodium aluminate, copper cementation, electrowinning, filtration, ion exchange, reverse osmosis, electrodialysis
Disposal (AMD)	Solar evaporation, deep well injection, controlled release, and deep water injection
Disposal (Solids)	Landfill (on or offsite), solids disposal in mine workings

Table 10. Components for Detailed Analysis

SOURCE CONTROL

- Partial capping
- Complete capping
- Groundwater interception
- Injection of Low Density Cellular Concrete in underground Mine Workings

TREATMENT

- Treatment of the three major sources
- Treatment of the five major sources
- Treatment of five major sources and other sources in Slickrock Creek
- Treatment of the five major sources plus other sources in Slickrock Creek and Boulder Creek

WATER MANAGEMENT

- Diversion of upper Spring Creek to Flat Creek
- Diversion of South Fork Spring Creek to Rock Creek
- Enlargement of Spring Creek Debris Dam
- Diversion of Upper Slickrock Creek around tailings piles

TABLE -1

Technical, Environmental and Institutional Considerations for Remedial Action Components

Component Alternative	Technical Concern	Environmental Concern	Institutional Concern	Other Concerns
SOURCE CONTROL				
Complete Capping	This alternative is expected to be 90 percent effective in intercepting infiltration and 50 percent effective in reducing AMD from Richmond portal. Cannot accurately predict overall effect on metals reduction. No serious constructability problems, but the removal of all vegetation from the site may cause permitting problems.	Reduced metals from IMM and improved water quality in the Sacramento River. Reduced vegetation and wildlife habitat.	No major impact from institutional requirements.	Improved protection of City of Redding drinking water supply.
Partial Capping	Proven technology, but innovative for this application. Difficult to accurately predict its effectiveness in reducing AMD from the Richmond portal.	Potential terrestrial disturbances during construction.	No major impact from institutional factors.	This alternative is estimated to be one of the most effective source control alternatives. This alternative minimizes waste at the source.
Injection of low-density cellular concrete	This technology is not proven in this application. This alternative would be equivalent to an experiment since it is not possible to accurately predict its effectiveness without implementing the alternative. However, anticipated hydrogeologic studies and pilot studies would reduce the uncertainties associated with its implementation. There would be a risk that it could be much less effective than the assumed effectiveness used in this report. There is also some uncertainty with regard to long-term reliability of the LDCC in contact with the AMD and the potential of new sources of AMD discharge as	As the water table rises, new sources of discharges from the orebody could affect vegetation and wildlife in areas presently not affected.	No major impact from institutional factors.	The risk of uncertainty and the effectiveness and reliability must be compared to potential reduction in O&M costs. The treatment alternatives have significant O&M costs beyond the 30-year evaluation period for this study. This alternative minimizes waste at the source; however, it could have an effect on potential future mining of the orebody.

TABLE 11
Technical, Environmental and Institutional Considerations for Remedial Action Components

Component Alternative	Technical Concern	Environmental Concern	Institutional Concern	Other Concerns
Groundwater Interception	This alternative is expected to be 90 percent effective in intercepting groundwater. Cannot predict accurately the overall effect on either water or metals reduction. No serious constructability problems. High level of safety required for work in underground tunnels.	Improved water quality in the Sacramento River resulting in improved aquatic habitat.	No major impact from institutional requirements.	Improved protection of City of Redding drinking water supply.
TREATMENT				
Five Major Sources	Utilizes proven technology. No serious constructability problems.	Improved water quality in the Sacramento River resulting in improved aquatic habitat.	Sludge generated from this process may be considered a hazardous waste and require extensive permitting.	Improved protection of City of Redding's drinking water supply.
Five Major Sources Plus other Slickrock Sources	Utilizes proven technology. No serious constructability problems.	Improved water quality in the Sacramento River resulting in improved aquatic habitat.	Sludge generated from this process may be considered a hazardous waste and require extensive permitting.	Improved protection of City of Redding's drinking water supply.
Five Major Sources plus other Slickrock and Boulder Sources	Utilizes proven technology. No serious constructability problems.	Improved water quality in the Sacramento River resulting in improved aquatic habitat.	Sludge generated from this process may be considered a hazardous waste and require extensive permitting.	Improved protection of City of Redding's drinking water supply.

TABLE 4

Technical, Environmental and Institutional Considerations for Remedial Action Components

Component Alternative	Technical Concern	Environmental Concern	Institutional Concern	Other Concerns
Treatment of three major sources (Richmond portal, Lawson portal, and Old No. 8 seep) with lime/limestone treatment	Proven technology.	Disturbance or loss of aquatic and terrestrial organisms and habitat during construction.	Sludge generated from this process may be considered hazardous waste and require extensive permitting.	This alternative would require perpetual O&M costs for handling sludge beyond the 30-year economic period used in this analysis. Does not minimize waste at the source.
WATER MANAGEMENT				
Diversion of Upper Spring Creek Diversion of South Fork Spring Creek.	Utilizes proven technology which involves no mechanical equipment. No serious constructability problems, but increased flooding potential along Flat Creek may cause permitting problem.	Improved water quality in Flat Creek and the Sacramento River resulting in enhancement of aquatic habitat.	Property acquisition may be required downstream on Flat Creek if property along creek is flooded.	Potential flooding in Flat Creek. Increased metals concentration in Spring Creek and related increased hazards associated with human contact. However, there is an overall benefit to public health aspects of the City of Redding drinking water.
Diversion of upper Slickrock Creek around tailings			Property acquisition may be required downstream on Rock Creek if property along creek is flooded.	
Enlargement of Spring Creek Debris Dam	Utilizes proven technology which involves no mechanical equipment. No serious constructability problems, but will require USBR approval.	Improved water quality in the Sacramento River.		

The caved ground areas would be filled and sloped to maximize runoff. A total of five caved ground areas would be filled; this will require a total fill quantity of approximately 40,000 cubic yards of material. To reduce vertical infiltration into caved ground areas, the areas would be filled and graded to drain using a filter material and low permeability layer.

Component #3. Complete Capping

This component involves capping approximately 15 acres overlying the Richmond orebody. The alternative would require stripping and grubbing of some of the existing vegetation, filling of the caved and cracked ground, some regrading of the site to limit slopes where possible, and construction of benches to divert water to adjacent drainages. A soil-cement surface barrier would then be applied to the area.

The six caved ground areas, totaling approximately 2 acres, would be filled with cobble- to sand-sized materials prior to applying the soil-cement. Two cracked ground areas would be filled with a slush-type grout and cobble- to sand-sized materials, with a low-permeability seal at the ground surface.

The lower portion of Brick Flat Pit would be filled similar to the caved ground areas to allow gravity drainage of water from the pit area.

Interception ditches and drains would be provided to intercept surface water and divert it away from areas where the orebody is exposed to surface runoff.

Component #4. - Ground Water Interception

In this component, groundwater moving toward the Richmond orebody would be intercepted by a tunnel and drill holes on either side of the orebody. Through gravity flow, the water would then be conveyed to Boulder Creek. Approximately 1,250 feet of the existing Richmond tunnel would be rehabilitated and used as the access tunnel for constructing the two new tunnels on either side of the orebody. These new tunnels would be approximately 7 feet in diameter and 1,600 feet in length.

A vertical system of drill holes would be installed approximately every 50 to 100 feet along the two new tunnels and would act as groundwater interceptors.

Component #5. Injection of Low-Density Cellular Concrete Into Underground Mine Workings

This component consists of filling the underground mine workings (UMW's) with a low-density cellular concrete (LDCC) to eliminate or reduce the formation of AMD. This objective could be met by LDCC injection if exposed ore could be sealed in the UMW's or if discharge could be reduced sufficiently to raise the groundwater table above the orebody, thereby minimizing available oxygen for the formation of AMD.

In developing this component, it was assumed that a concrete batch plant and materials storage facility would be constructed near the Richmond portal. Stockpiled at the site would be cement, chemicals for producing a low-density concrete (this chemical is a foaming agent which causes the concrete to expand and therefore reduces its density), and aggregate. The aggregate for the LDCC would be composed of Minnesota Flats tailings, available onsite hematite material, and waste rock and slide material from the Big Seep. This would reduce the cost for aggregate material and also reduce existing sources of surface runoff pollution. Water containing AMD would be conveyed to the batch plant, where it would be neutralized and used in the manufacture of the LDCC.

As the LDCC is produced, it will be pumped into the mine workings and allowed to solidify. This is intended to coat the exposed ore and plug the UMW's, which could bring the water table back to historical elevation, and eliminate or reduce AMD formation. Rehabilitation of the Richmond workings would be required to provide access needed to effectively inject the LDCC. Rehabilitation of the Hornet workings and others may also be necessary.

It is expected to take two years, operating 24 hours per day, to fill the workings with LDCC.

Component #6. Treatment

° Sub-Component 6 (a) Treatment of AMD from Three Major Sources

This component consists of collecting AMD from the Richmond portal, Lawson portal, and Old No. 8 seep, and conveying it to a lime/limestone treatment plant for treatment. This component assumes that the sludge produced from the treatment plant would be dewatered and taken to Brick Flat Pit (BFP) for disposal. It is estimated that BFP can accomodate dewatered sludge produced by treating the three major sources over a 30-year period.

For ease of transporting sludge to BFP, the lime/limestone treatment plant would be sited at the old processing facility near the Richmond portal. AMD from the Old No. 8 seep may or may not have to be pumped to the treatment plant, depending on final site layout and elevations.

BFP would be modified with an embankment to provide storage of the sludge produced from the treatment process. The walls of the pit would be coated to form a relatively impervious liner.

In conjunction with the treatment plant construction and modifications to BFP, road improvements to these sites will have to be constructed.

°Sub-Component 6 (b) Treatment of AMD from Five Major Sources of Pollution

AMD from the five major sources (Richmond portal, Lawson portal, Big Seep, Old No. 8 seep, and Brick Flat Pit diversion) would be collected and transported by gravity to the treatment plant. The maximum flow for this alternative is estimated to be 4,000 gpm. The expected overall removal of metals leaving the site with this alternative is 72 percent of copper and 86 percent of zinc and cadmium.

Small diversion structures would be constructed at Big Seep and the Brick Flat Pit diversion. Flows from these five sources would be combined into a PVC pipeline, which would be buried along the route of the existing access road and transported approximately 9 miles to the treatment plant located on 90 acres of land immediately adjacent to the Sacramento River.

The neutralization treatment process consists of the following units:

1. The addition of limestone to the AMD to increase the pH to 4.

2. Fifteen acres of first-stage settling lagoons to remove sludge.

3. The addition of lime to raise the pH to 8.5. The addition of air for the oxidation of soluble ferrous iron to insoluble ferric iron.

5. A heavy solids separator, together with 14 acres of second-stage solids lagoons for sludge removal.

The lagoons would be designed to allow the sludge to dry during the summer months. The remaining solids would then be hauled to either a Class I or Class II landfill constructed adjacent to the treatment plant.

°Sub-Component 6 (c) Treatment of AMD from Five Major Sources Plus Other Slickrock Sources

The component is essentially the same as Alternative 7 (b) with the exception that the sources on Slickrock Creek will also be collected and treated with the five major sources.

The collection system on Slickrock Creek would consist of an upper diversion dam which bypasses clean water around the reach of the creek that is impacted by the other sources including seeps, slide debris, and tailings piles.

A second diversion dam would be constructed downstream of the other sources to collect the flow from Big Seep, Old No. 8 Mine seep, and Brick Flat Pit diversion, together with the other sources. This AMD would flow by gravity and would be combined with the piped flows from Richmond portal and Lawson portal. The combined flow would then be routed to a lime/limestone treatment plant.

The maximum hourly flow for this alternative is estimated to be 42,000 gpm under 1978 conditions. This would require that the transport pipeline and limestone and lime treatment structures be enlarged above those estimated for Alternative 5. The size of the sludge lagoons would remain approximately the same. The expected overall removal of metals from the site with this alternative is 86 percent of copper and 93 percent of zinc and cadmium.

° Sub-Component 6(d) Treatment of AMD from the Five Major Sources Plus Other Boulder and Slickrock Sources

With this component, the five major sources and all other sources on Boulder Creek and Slickrock would be collected and treated. Upper diversion dams would be constructed on both Slickrock and Boulder Creeks to divert clean water around the areas of the creeks that are being contaminated by the other sources.

Downstream diversion dams would be constructed to capture and divert the remaining flows in the streams. The flows would be combined and would flow by gravity to the treatment plant.

The maximum hourly flow for this alternative is estimated to be 110,000 gpm under 1978 conditions. As with Alternative T-1b, this will require increasing the size of the pipeline and the treatment plant structures. It is expected that the overall removal of metals from the site with this alternative would be essentially 100 percent.

° Sub-Component 6 (e) Treatment of AMD from the Three Major Sources with Copper Cementation

With this component, the three major sources of pollution (Richmond portal, Lawson portal and the Old No. 8 mine seep) would receive copper cementation treatment. Copper cementation is an oxidation-reduction reaction whereby solvated (in solution) copper ions are exchanged for elemental iron (usually provided as scrap iron). This scrap iron, preferably well shredded to obtain good contact with the liquid waste stream, is placed in a basin large enough to produce fairly quiescent conditions. As the wastewater is passed through the basin, iron is dissolved into the stream and a copper sludge settles out. This process is currently being practiced at Iron Mountain Mine and is achieving good recovery of copper (as high as 95 percent plus removal in one of the cementation plants).

Component #7. Diversion of Upper Spring Creek

This component would reduce flow into SCDD by diverting upper Spring Creek to Flat Creek. A 16-foot-high, 100-foot-long, rock-filled diversion dam would be built on Spring Creek near Minnesota Flats to divert up to 800 cfs of flow.

An 8-foot-diameter tunnel, with a hydraulic capacity of approximately 800 cfs, would be constructed on the upstream side of the dam to divert the flow into the Flat Creek watershed. The length of this tunnel would be approximately 600 feet. A chute and energy dissipator would be constructed between the diversion and the point of discharge into Flat Creek.

Component #8. Diversion of South Fork Spring Creek

This component would reduce flow into SCDD by diverting the South Fork of Spring Creek (SFSC) to Rock Creek. To accomplish this, a 10-foot-high, 60-foot-long diversion structure would be built on SFSC. About 4,000 feet of 54-inch conduit would carry the diverted water to Rock Creek. The hydraulic capacity of the diversion system would be 250 cfs.

Component #9. Enlargement of Spring Creek Debris Dam

The existing Spring Creek Debris Dam would be enlarged at its present site. The present storage capacity of the dam is 5,800 acre-feet. This would be increased to a volume of between 7,000 acre-feet and 23,000 acre-feet depending on which cleanup objective is selected.

Component #10. Upper Slickrock Creek Diversion Around Tailings Piles

The purpose of this diversion is to reduce the volume of flow from the Big Seep pollution source. It is believed that as Slickrock Creek flows over and through the pile of slide debris that fills the canyon above the Big Seep area, a significant portion of the flow enters the loose slide material and reappears in the Big Seep area. Analysis of the Big Seep hydrograph has led to the conclusion that a significant reduction in the flow and pollution load from Big Seep could be achieved by intercepting and diverting Upper Slickrock Creek before it comes into contact with the slide debris.

This component would involve a diversion structure, an 18-inch PVC pipeline, and an energy dissipator at the end of the pipeline. Upper Slickrock Crek flow would be diverted around the slide area to the lower reach of Slickrock Creek.

A numerical water quality model was used to determine if any of the individual components could achieve either California Basin Plan Objectives or EPA Water Quality Criteria for Protection of Aquatic Life below Keswick Dam. The model used a mass balance approach to account for heavy metals as they are carried in the streams (Boulder Creek, Slickrock Creek, and Spring Creek) through Spring Creek Reservoir and eventually to Keswick Reservoir. The model regulated discharges from Spring Creek Reservoir such that when the discharge is mixed with Sacramento River water released from Shasta Lake, water quality objectives are met below Keswick Dam.

The results from the operation of the model indicated that the aforementioned components generally could not achieve either set of water quality objectives below Keswick Dam (or points upstream) if implemented individually. There are two exceptions, however. Conceivably, the Spring Creek Debris Dam could be enlarged to such a size that the objectives could be met through flow equalization alone. Or, the objectives could be met by using the Spring Creek Reservior as a collection basin and treating all liquids in it by lime neutralization. This latter approach could achieve background levels for metals below Keswick Dam at an estimated cost of $263 million. Treatment of the liquids in the Spring Creek Reservior will be carried forward as an alternative. Varying the capacity of the Spring Creek Reservior by varying the height of the dam will be carried forward as a component of many of the alternatives to be considered. It was felt that varying the size of the Spring Creek Debris Dam should not stand alone as an alternative because this would provide only dilution of the AMD, with no source control or treatment and with no reduction of total metals loading into the Sacramento River.

E. Description of Combined Remedial Action Alternatives

The previously described components were assembled into combined alternatives for more detailed analysis. Nine alternatives (CA-1 through CA-9) underwent very detailed analysis. Three more alternatives (CA-10 through CA-12) underwent a less detailed analysis. The proposal submitted by the site owner to establish a solution mining operation at the site was screened out in the Feasibility Study because it had not been developed to the point where EPA could determine the technical feasibility and economic viability of the project. In addition, the project did not demonstrate compliance with all applicable, relevant and appropriate federal and state requirements, and a site closure plan had not been developed.

The remedial action alternatives evaluated in the Feasibility Study and the Addendum to the Feasibility Study are:

(CA-1) Diversion of upper Spring Creek to Flat Creek, diversion of South Fork Spring Creek to Rock Creek, complete capping above the Richmond Orebody, groundwater interception, and copper cementation.

(CA-2) Diversion of upper Spring Creek to Flat Creek, diversion of South Fork Spring Creek to Rock Creek, complete capping, groundwater interception, and treatment.

(CA-3) Diversion of upper Spring Creek to Flat Creek, diversion of South Fork Spring Creek to Rock Creek, and treatment.

(CA-4) Complete capping, groundwater interception, and treatment.

(CA-5) Enlargement of SCDD, diversion of upper Spring Creek to Flat Creek, and diversion of South Fork Spring Creek to Rock Creek.

(CA-6) Enlargement of SCDD, diversion of upper Spring Creek to Flat Creek, diversion of South Fork Spring Creek to Rock Creek, and copper cementation for flows from Richmond portal, Lawson portal, and Old No. 8 seep.

(CA-7) Enlargement of SCDD, diversion of upper Spring Creek to Flat Creek, diversion of South Fork Spring Creek to Rock Creek, complete capping above Richmond orebody, ground water interception, and copper removal from Richmond portal, Lawson portal, and Old No. 8 flows using copper cementation.

(CA-8) Treatment of AMD from the Richmond portal, Lawson portal, and Old No. 8 seep with lime/limestone treatment, complete capping, Upper Spring Creek diversion, South Fork Spring Creek diversion, Upper Slickrock Creek diversion, and enlargement of Spring Creek Debris Dam. This alternative includes disposal of dewatered sludge from the treatment process in Brick Flat Pit.

(CA-9) Filling all the major mine workings (Hornet, Richmond, No. 8, and Old Mine orebodies) with LDCC, partial capping, Upper Spring Creek diversion, South Fork Spring Creek diversion, Upper Slickrock Creek diversion, treatment of the remaining AMD from the three major sources by lime/limestone neutralization, and disposal of dewatered treatment sludge in Brick Flat Pit, and enlargement of Spring Creek Debris Dam.

(CA-10) Excavation of the upper portions of the orebody, waste rock, and tailings piles and off-site disposal in a lined facility; removal of contaminated sediments in the affected tributaries and the Spring Creek Reservoir, and the removal of the Minnesota Flats Tailings pile.

(CA-11) Removal of the Minnesota Flats Tailings pile and bottom sediments in the tributaries and Spring Creek Reservoir with off-site disposal; collection of the leachate from all point and non-point sources, and treatment of the collected leachate with lime neutralization. This alternative includes construction of a nearby RCRA-type sludge disposal facility.

(CA-12) Utilization of the Spring Creek Reservoir as a collection basin for all point and non-point sources and treatment of all liquids passing through the reservoir with lime neutralization.

° NO ACTION ALTERNATIVE

The ability to successfully discharge contaminated water from Spring Creek Reservoir to meet dilution requirements depends on several factors. The timing of the storms occurring on Spring Creek watershed, the available storage in Spring Creek Reservoir when storms occur, and the available dilution water being released from Shasta Lake are all factors that determine whether or not contaminated water from Spring Creek will spill. Therefore, historical data from four different years were used to evaluate the effectiveness of the proposed alternatives. The year 1978 was selected because above average runoff occurred on the Spring Creek watershed and there was little dilution water available from Shasta Lake while water was being stored to replenish lost water supplies following two years of drought; this year was identified as the 'worst case' year. The years 1980 and 1981 were selected because total runoff from the Spring Creek watershed was about average for the period of record from 1967 to 1984. The 1983 water year was used because that year had the highest runoff volume into Spring Creek Reservoir for the period of record. In all cases, the data factored into the water quality model reflected the U.S. Bureau of Reclamation's (Bureau) operation plan for Shasta Lake for each of the four case years. The alternatives were analyzed assuming that the Bureau would continue to operate according to its plan for Shasta Lake. The alternatives do not necessarily require a modification of the Bureau's operating plans.

Alternatives CA-1 through CA-7 were evaluated for four different water years (described above) and two different sets of aquatic water quality criteria (also previously described); CA-8 and CA-9 were analyzed for two water years and two sets of aquatic water quality.

The point of compliance with the water quality criteria for alternatives CA-1 through CA-9 is below Keswick Dam (the most upstream point to which salmon can migrate).

Alternative CA-10 should achieve aquatic water quality criteria everywhere from the site proper downstream. Alternative CA-11 should achieve water quality criteria below the proposed collection dams, constructed on Boulder Creek and Slickrock Creek, but it would leave the tributaries near Iron Mountain Mine devoid of aquatic life. Alternative CA-12 should achieve water quality criteria below Spring Creek Reservoir, but it would leave the reservoir and points upstream devoid of aquatic life.

F. Alternative Screening

According of the NCP, alternatives must be developed for each of the following five categories "to the extent that it is both possible and appropriate".

a) Alternatives for treatment or disposal at an off-site RCRA permitted facility approved by EPA.

b) Alternatives that attain applicable and relevant federal public health or environmental standards.

c) As appropriate, alternatives that exceed applicable and relevent public health or environmental standards.

d) Alternatives that do not attain applicable or relevant public health or environmental standards but which will reduce the likelihood of present or future threat from the hazardous substances. This must include an alternative that closely approaches the level of protection provided by the applicable or relevant standards and meets CERCLA's objectives of adequately protecting public health and welfare and the environment.

e) A no-action alternative.

The following is a description of how each of the above combined remedial action alternatives and the total removal of the source alternative fits into each of the five categories:

a. Offsite disposal at a RCRA-approved facility
The only alternative that fulfilled these requirements is CA-10.

b. Alternatives fully complying with all applicable or relevant standards, guidance, and advisories

CA-10. For all practicable purposes, this is the same alternative as the one that exceeds all applicable and relevant and appropriatate standards. Due to data limitations, it was not possible to identify what lesser portion of the orebody and other sources would need to be removed to exactly meet all standards, guidance, and advisories. This would require mapping the fractures, faults, and all pathways of migration through the mineralized zone and determining the volume, quality, and location of contaminants discharged to receiving waters on a seasonal basis. This would involve an extensive underground exploratory program lasting several years at an estimated cost of about $5 million. It should be stressed that at the start of the Remedial Investigation (RI) in 1983, the RI/FS guidance had not clearly delineated that alternatives be developed for each of the five categories; there was, therefore, no perceived need to conduct an RI of such a comprehensive scope.

c. Alternatives exceeding all applicable or relevant standards, guidance, and advisories.

CA-10.

d. Alternatives meeting all CERCLA goals, but not fully complying with all applicable or relevant standards, guidance and advisories.

Alternatives CA-2 through CA-9 and CA-11 and CA-12. Combined alternatives CA-5 through CA-9 vary on their ability to meet appropriate and relevant environmental standards based on the amount of storage provided by the enlargement of the Spring Creek Reservoir.

e. A no-action alternative.

The No-Action alternative was carried through the Feasibility Study as a baseline to compare remedial action alternatives.

The combined alternatives matrix (Table 12) describes each alternative, presents the capital and operation costs to meet EPA standards for 1978 and the anticipated benefits of each alternative.

Table 12

Combined Alternatives Matrix[5]

ALTERNATIVE		COST ($ Million) Capital	O&M (Present Worth)	ANTICIPATED BENEFIT EPA Water Quality Criteria (EPAWQC) State Basin Plan Objectives (SBPO)
No Action		———	———	No benefit; continued degradation of water quality
CA-1	Upper Spring Creek and South Fork Spring Creek diversions combined with complete capping above the Richmond orebody, groundwater interception, and copper cementation	———	———[1]	Achieves EPAWQC below Keswick Dam for water years 1980 and 1983 and SBPO for water year 1980 only. Does not achieve EPAWQC or SBPO for water years 1978 or 1981.
CA-2	Upper Spring Creek and South Fork Spring Creek diversions, combined with complete capping above the Richmond orebody and groundwater interception combined with treatment	80.3	20.8[2]	Achieves EPAWQC and SBPO below Keswick Dam for all four water years considered.
CA-3	Upper Spring Creek and South Fork Spring Creek diversions combined with treatment	69.4	20.2[2]	Achieves EPAWQC and SBPO below Keswick Dam for all four water years considered.
CA-4	Complete capping above the Richmond orebody and groundwater interception combined with treatment	129.3	22.8[2]	Achieves EPAWQC and SBPO below Keswick Dam for all four water years considered.
CA-5	Enlargement of Spring Creek Debris Dam to 23,000 acre-feet, combined with uppper Spring Creek and South Fork Spring Creek diversions	37.4	0.6[2]	Achieves EPAWQC and SBPO below Keswick Dam for all four water years considered.
CA-6	Enlargement of Spring Creek Debris Dam to 23,000 acre-feet, comb[illegible]d with upper Spring Cree[illegible] South Fork Spring Creek [illegible]ersions, and [illegible]	30.6	1.1[2]	Achieves EPAWQC and SBPO below Keswick Dam for all four water years considered.

Table 1? [illegible]inued)

ALTERNATIVE		COST ($ Million) Capital	COST ($ Million) O&M (Present Worth)	ANTICIPATED BENEFIT EPA Water Quality Criteria (EPAWQC) State Basin Plan Objectives (SBPO)
CA-7	Enlargement of Spring Creek Debris Dam to 18,000 acre-feet, combined with upper Spring Creek and South Fork Spring Creek diversions, copper cementation, complete capping above the Richmond orebody, and groundwater interception	40.9	1.9[2]	Achieves EPAWQC and SBPO below Keswick Dam for all four water years considered.
CA-8	Treatment of Richmond portal, Lawson portal, and Old No. 8 with lime/limestone; total capping; upper Slickrock Creek diversion; upper Spring Creek diversion; South Fork Spring Creek diversion; and enlargement of Spring Creek Debris Dam (if needed)	42.3	13.0[2]	Achieves EPAWQC and SBPO below Keswick Dam for all four water years considered.
CA-9	Injection of low-density cellular concrete into old mine workings (Hornet, Richmond, Old Mine, and Old No. 8); partial capping; upper Spring Creek diversion; upper Slickrock Creek diversion; South Fork Spring Creek diversion; and enlargement of Spring Creek Debris Dam (if needed)	68.1	4.1[2]	Achieves EPAWQC and SBPO below Keswick Dam for all four water years considered.
CA-10	Excavation of the upper portions of the orebody, waste rock, and tailings piles with off-site disposal in a lined facility; removal of contaminated sediments in the affected tributaries and the Spring Creek Reservoir; and the removal of the Minnesota Flats tailings pile.	1,400	0.0[3]	Achieves background water quality at all points.

Table 12 (Continued)

ALTERNATIVE	COST ($ Million)		ANTICIPATED BENEFIT
	Capital	O&M (Present Worth)	EPA Water Quality Criteria (EPAWQC) State Basin Plan Objectives (SBPO)
CA-11 Removal of the Minnesota Flats tailings pile and sediments in the tributaries and Spring Creek Reservoir with off-site disposal; collection of leachate from all point and non-point sources, and treatment of the collected leachate with lime neutralization. This alternative includes construction of a nearby RCRA-type sludge disposal facility.		351[4]	Achieves background water quality at all points below the leachate collection impoundments near the confluence of Spring Creek and Flat Creek and Spring Creek and Slickrock Creek. Flat Creek and Slickrock Creek will remain contaminated upstream of these impoundments.
CA-12 Utilization of the Spring Creek Reservoir as a collection basin for all point and non-point leachate sources and treatment of all liquids passing through the reservoir with lime neutralization.		263[4]	Achieves background water quality at all points below Spring Creek Reservoir. The reservoir and upstream tributaries will remain contaminated.

Notes:

1. Since CA-1 did not meet water quality objectives, costs were not computed further, and CA-1 was effectively screened out.
2. Costs computed for achieving EPAWQC below Keswick Dam for water year 1978.
3. Costs for CA-10 through CA-12 not computed to same level of detail as for CA-2 through CA-9.
4. These costs include both capital and O&M costs.
5. Technical, environmental, public health and institutional considerations can be found in Table 11 for the components which make up the combined alternatives.

VII. THE IRON MOUNTAIN MINE REMEDY

Among the remedial action alternatives that could be implemented by EPA, the total removal of the source and sediments in receiving waters (Alternative CA-10) is considered the only remedy for the Iron Mountain Mine site which is capable of meeting project cleanup objectives and the full requirements of the Clean Water Act (CWA). This alternative would effectively eliminate discharges from Iron Mountain and restore all tributaries to pristine condition. This alternative was based on total removal of all the sources of contamination and hauling and disposing of them in a RCRA-approved facility. This includes material from the following four areas:

a) Remove approximately 3.5 million cubic yards of ore and waste rock and tailings piles along Boulder Creek and Slickrock Creek.

b) Remove an estimated 200,000 cubic yards of contaminated bottom sediments in Slickrock Creek, Boulder Creek and Spring Creek. It was assumed that sediment in Slickrock Creek near the Brick Flat Pit area would be removed using conventional construction equipment. For sediment removal in the other receiving waters, hydraulic clearing was assumed.

c) Remove approximately 620,000 cubic yards of contaminated bottom sediments in Spring Creek Reservoir.

d) Remove about 14,000 cubic yards of tailings material in the Minnesota Flat area.

The total cost of excavating and removing the source material and hauling it to a Class I landfill was estimated to be $1.4 billion.

Alternative CA-11 comes next closest to meeting all requirements, but water quality standards will not be met in Boulder Creek and Slickrock Creek and not all non-point sources will be addressed through Best Management Practices (BMP's). This alternative is the same as the total removal alternative except it does not include removing the orebody. It only includes removing bottom sediments in the creeks and reservoir and the Minnesota Flat Tailings pile. All costs developed for this portion of this alternative are based on the same assumptions discussed in CA-10. This would consist of excavating and removing over 800,000 cubic yards of waste to a RCRA approved landfill which is estimated to cost about $200 million.

This alternative will collect all point and non-point sources in Slickrock Creek and Boulder Creek; the contaminated water would be conveyed to a lime neutralization facility for treatment. This alternative would also include constructing a nearby sludge disposal site which would meet RCRA guidelines and all other institutional requirements. The estimated cost of treatment is $151 million, bringing the total cost of the alternative to $351 million.

Alternative CA-12 will meet background water quality in the Sacramento River below Keswick Dam but the applicable federal and state standards will not be met in Boulder Creek, Slickrock Creek, portions of Spring Creek, and in the Spring Creek Reservoir. This alternative involves allowing all point and non-point sources of pollution to discharge to Boulder Creek and Slickrock Creek, and then flow into the Spring Creek Reservoir. Contaminated water would then be pumped to a lime neutralization facility for treatment; treated water would be discharged to the Sacramento River. The resulting lime sludge would be disposed of in a nearby disposal site which would meet RCRA guidelines and other institutional requirements. Water quality standards should be met in Flat Creek since the only source of pollution, Minnesota Flats Tailings pile will be removed under this alternative. Also, non-point sources will not be treated with BMP's.

Under CA-1, water quality standards would not be met in either the immediate receiving waters or in the Sacramento River below Keswick Dam for several of the case years evaluated. CA-2 through CA-9 would improve water quality to varying degrees in immediate receiving waters, although not to the point where state water quality standards will be met; these objectives will, however, be met in the Sacramento River below Keswick Dam. With the exception of CA-9, these alternatives will not address discharges from non-point sources.

VIII. FUND BALANCING

Under 40 CFR §300.68(i)(1), the appropriate extent of remedy must be the cost-effective remedial alternative that effectively mitigates and minimizes threats to and provides adequate protection of public health and welfare and the environment. In addition, the remedy must be that which attains or exceeds applicable or relevant and apropriate Federal public health and environmental requirements that have been identified for the site. However, under §300.68(i)(5)(ii), EPA may select an alternative that does not meet applicable or relevant and appropriate Federal public health or environmental requirements when the need for protection of public health and welfare and the environment at the facility for all of the alternatives that attain or exceed applicable or relevant and appropriate Federal requirements is outweighted by the need for action at other sites that may present a threat to public health or welfare or the environment, considering the amount of money available in the Hazardous Substance Response Trust Fund. In the event of Fund-balancing, EPA must select the alternative which most closely approaches the level of protection provided by applicable or relevant and appropriate Federal requirements, considering the specific Fund-balanced sum of money available for the facility.

The estimated cost to implement the remedy (CA-10) that would meet applicable or relevant and appropriate Federal environmental and public health standards for the Iron Mountain Mine site is estimated to be $1.4 billion. EPA evaluated the funds remaining under the current Superfund authorization and subsequent interim fundings. In our analysis, we have considered that increased funding may become available if the pending Superfund reauthorization is enacted.

At this time, funds under the current Superfund authorization and the subsequent interim funding are nearly depleted; funding that remains is committed solely to keep ongoing remedial planning activities on an active status. Therefore, these remaining funds are not only unavailable to Iron Mountain Mine but, even if available, would not be adequate to implement an operable unit or final remedy at the site.

The Superfund reauthorization, if enacted, may provide funding in an amount ranging from $5.4 billion to about $8.5 billion in order to respond to 888 proposed and final NPL sites over a five year period ($1.7 billion annually). Committing $1.4 billion, or 16 to 26 percent of the potentially reauthorized amount, to the cleanup of Iron Mountain Mine would effectively consume at least the equivalent of one year's worth of funding. This would be at the expense of remedial response action at NPL sites, expenditures for emergency response action, and other program needs. This would severely limit the capability of the Agency to take timely and effective cleanup action where needed to protect public health and welfare and the environment. The full impact of commiting these funds solely to Iron Mountain Mine would be to deny funding for site cleanup at between 140 and 470 NPL sites (assuming that the typical cost of Remedial Design and Remedial Action for an NPL site ranges from $3 million - $10 million).

As previously mentioned, Alternative CA-11 at a cost of $351 million is the alternative that most closely approaches but does not achieve the requirements of the CWA. This alternative would utilize Boulder Creek and Slickrock Creek to capture all point and non-point sources of pollution; contaminated water would then be pumped from each of the two creeks to a lime neutralization facility for treatment. Alternative CA-11 is expected to further degrade water quality beyond current conditions in these receiving waters. The reason is that, at present, discharges of AMD from the three major sources of pollution are receiving copper cementation treatment prior to discharge to receiving waters. Nevertheless, water quality in Spring Creek, Spring Creek Reservoir, and Keswick Reservoir would improve substantially to the point where certain beneficial uses may return on a year round and/or seasonal basis. Water quality below Keswick Dam would improve beyond that required to protect fish in the Sacramento River. Committing funds for this alternative would be at the expense of funding cleanup actions at between 35 and 117 NPL sites.

Alternative CA-12 would further degrade water quality in Boulder Creek, Slickrock Creek, portions of Spring Creek and in Spring Creek Reservoir because AMD from the three major sources of pollution will not receive copper cementation treatment prior to discharge to receiving waters. Contaminated water would be pumped from Spring Creek Reservoir to a lime neutralization facility for treatment and then discharged to the Sacramento River. However, water quality in Keswick Reservoir and below Keswick Dam would improve substantially; water quality below Keswick Dam would be essentially the same as that in the Sacramento River above the confluence where discharges from Iron Mountain Mine enter the river. The level of cleanup provided by this alternative is higher than that needed to protect aquatic life in the Sacramento River below Keswick Dam. Funding this alternative would preclude EPA from taking cleanup action at between 26 and 87 sites on the NPL.

After considering these fund-balancing issues, CA-9 ($72.2 million) is the alternative that most closely approaches the requirements of all applicable or relevant and appropriate federal and state requirements, yet it also balances the need to conserve monies in the Fund. Funding this remedy would have a less significant impact on EPA's ability to use the fund at other sites, yet it would also provide significant protection at the IMM site. Alternative CA-9 will meet Federal Water Quality Standards for aquatic life below Keswick Dam for all water years considered; the State Basin Plan standards should be met for other than the 'worst case' condition. Meeting these criteria and standards should protect the salmon population in the Sacramento River below Keswick Dam. In addition, implementation of Alternative CA-9 should greatly improve water quality in the tributary streams between Iron Mountain and the Sacramento River. The basis for identifying CA-9 as the Fund-balanced remedy is discussed in more detail in Chapter IX.

IX. SUMMARY EVALUATION OF ALTERNATIVES

With the exception of CA-1, each combined alternative will meet the two project cleanup objectives for each of the case years for which they were analyzed. Alternative CA-1 will not meet EPA standards for 1978 and 1981 conditions or State Basin Plan objectives for the years 1978, 1981, and 1983.

A. Features and Costs of Combined Remedial Alternatives

Alternative CA-1 does not meet either EPA or State water quality objectives and is not considered an appropriate remedial action alternative for site cleanup because releases from the site would continue to present acute and chronic impacts on aquatic life.

Alternatives CA-2, CA-3, and CA-4 will meet both EPA and State water quality objectives through various combinations of source control, lime/limestone neutralization treatment, and water management alternatives at costs ranging from $89.6 million to $151.1 million. These alternatives differ in the number of AMD sources that will receive treatment.

Alternatives CA-5, CA-6 and CA-7 will also meet both project cleanup objectives at a cost substantially below those projected for Alternatives CA-2 through CA-4. These alternatives differ most notably in the increased storage capacity of the Spring Creek Reservoir provided by the enlargement of Spring Creek Debris Dam. Alternative CA-5 will meet cleanup objectives by relying exclusively on water management measures to ensure that adequate dilution water is available to meet project cleanup objectives below Keswick Dam. Under this alternative, no source control or treatment remedies would be implemented. Alternative CA-6 is similar to Alternative CA-5 except that this alternative would utilize copper cementation treatment of 'controlled' AMD flows at a lower cost to meet EPA cleanup objectives and slightly higher cost to meet State cleanup objectives. Alternative CA-7 relies upon source control, treatment, and water management remedies to meet EPA and State cleanup objectives at a higher cost than both Alternatives CA-5 and CA-6 but considerably lower than Alternatives CA-2 through CA-4.

Alternatives CA-8 and CA-9 meet project cleanup objectives through a variety of source control, treatment, and water management remedies. These alternatives are very similar and differ only in the extent of capping that would be required over the Richmond orebody, and the volume of AMD receiving lime/limestone neutralization treatment. CA-9 also includes the injection of low-density cellular concrete; this is not a component remedy of CA-8. CA-8 will meet federal and state objectives at costs ranging from $55.3 million - $62.7 million; CA-9 will meet the same objectives at a cost of $72.1 million to $85.1 million. Although the cost of CA-9 may be higher, the actual cost of CA-9 may be less for several reasons: a) further studies may indicate that the underground mine workings do not need to be completely filled with LDCC; 2) if waste rock at Big Seep can be used in the formation of LDCC, the Upper Slickrock Creek diversion ($790,000) could possibly be eliminated; and 3) if LDCC is fully successful, it would preclude the need to construct a lime neutralization facility, which has an estimated capital cost of about $8 million. More important, however, CA-9 is an approach that aggresively moves to stop AMD formation. Under other alternatives, for instance, AMD may continue to be formed, and thus require treatment, for hundreds of years.

B. Evaluation of Combined Remedial Alternatives

CA-2 through CA-4 will meet primary and secondary cleanup objectives and the goals of the NCP at a relatively high cost when compared to the other alternatives. CA-2 and CA-3 treat the five major sources of pollution plus all other sources discharging in Slickrock Creek through lime neutralization; CA-4 addresses these same sources in addition to treating all other sources in Boulder Creek. These alternatives will be generating tremendous volumes of lime sludge each year which, on a periodic basis will continue to require the identification and development of new off-site disposal areas. Treatment of AMD and off-site disposal will be required for a period of time far exceeding the 30-year project period, and perhaps be needed in perpetuity. This, in effect, significantly increases the State's commitment to operate and maintain the lime neutralization facilities, and will require that nearby undeveloped land be committed for land disposal for as long as Iron Mountain Mine continues to discharge AMD. The need for long-term treatment tends to make these alternatives less reliable. These alternatives would reduce the metals loading to receiving waters and meet Federal and State standards, but for the added cost, would not result in a further improvement in Water Quality at the point of compliance. For the above reasons, CA-2 through CA-4 are not considered cost-effective remedies for the Iron Mountain Mine problem.

CA-5 will meet both EPA and State water quality objectives at the point of compliance (primary objective) at a relatively low cost, but will not meet a principal goal of the NCP or the secondary cleanup objective. The reason for this is that CA-5 does not address the problem at its source or minimize the migration of hazardous substances, pollutants or contaminants because it relies exclusively upon the dilution of these pollutants to meet primary cleanup objectives. For these reasons, this alternative was not considered to be an appropriate remedy for Iron Mountain Mine.

CA-6 utilizes copper cementation treatment, and like CA-5, relies on dilution to meet primary cleanup objectives. For the same reasons as discussed under CA-5, and in consideration of the fact that copper cementation will not meet the BAT requirements of the CWA, this alternative was not considered an appropriate CERCLA response to the Iron Mountain Mine problem.

When compared to CA-5 and CA-6, alternative CA-7 provides an improved balance of source control, treatment and water management components to meet primary and secondary cleanup objectives at a slightly higher cost. CA-7 also utilizes copper cementation treatment and, thus, will not meet Best Available Technology, as specified by the CWA. CA-7 will result in a reduction of pounds per day of heavy metals entering the Sacramento River through implementation of source control and treatment alternatives, but to a lesser extent when compared to other source control and lime neutralization treatment alternatives. This is because the copper cementation process does not remove cadmium or zinc from the AMD. Therefore, while CA-7 will meet the primary cleanup objective, it will only partially fulfill the secondary objective. Also, CA-7 will do very little to improve overall water quality in immediate receiving waters. For these reasons, CA-7 was not considered an appropriate remedy for Iron Mountain Mine.

CA-8 and CA-9 are very similar as previously noted and will, therefore, be evaluated together. Both of these alternatives provide a good balance of source control, treatment and water management. By utilizing lime neutralization treatment of the three major sources, both CA-8 and CA-9 will satisfy the BAT requirement of the CWA. This, combined with capping (and in the case of CA-9 the use of LDCC) will result in substantial water quality improvement in the immediate receiving waters and will, therefore, reduce the amount of heavy metals discharged to the Sacramento River. For approximately 6-8 months of the year, from about late-Spring to early-Fall, there should be no discharges of AMD to receiving waters. During these periods, it is anticipated that there will be a return of certain beneficial uses to Keswick Reservoir and possibly a return of other beneficial uses to portions of Spring Creek.

In the case of CA-9, lime neutralization treatment may not be needed if the injection of LDCC is successful in preventing or reducing the formation of AMD. Even if LDCC is not fully successful, the volume of AMD that would need to be treated is thought to be much less than under CA-8. Therefore, Brick Flat Pit will have a sustained storage life for lime sludge beyond the 30-year period calculated for CA-8. This means that off-site disposal can be postponed to a later date and the rate of developing new off-site disposal sites under CA-9 will be slower when compared to CA-8. CA-9 will also utilize waste rock and tailings piles and treated AMD from the three major sources when formulating the LDCC. This brings CA-9 an additional step forward in meeting the requirement of the CWA by addressing non-point sources; these sources will not be addressed by CA-1 through CA-8.

The most attactive feature of CA-9, however, is the use of LDCC. If fully successful, this alternative could prevent or significantly reduce AMD to a point where treatment may not be required. This, of course, would mean that there would no longer be a need to utilize Brick Flat Pit as a storage basin or a need to identify and develop new off-site lime sludge disposal sites. It is this aspect of CA-9 that makes it a superior choice over the other combined remedial action alternatives.

X. IDENTIFICATION OF FUND-BALANCED REMEDY AND REMEDY SELECTION STRATEGY

Alternative CA-9 is the appropriate Fund-balanced remedy for Iron Mountain Mine. Alternative CA-8 is EPA's next preferred alternative. These two alternatives differ principally in the use of LDCC, in the volume of AMD to receive lime/limestone neutralization treatment, and whether a partial cap (CA-9) or complete cap (CA-8) is constructed.*

Full implementation of alternative CA-9 is expected to significantly improve water quality in the Iron Mountain Mine area. Table 13 presents the anticipated water quality benefits that should result from CA-9. Water quality in Keswick Reservior and the Sacramento River would also see similar water quality improvements. Removing the Minnesota Flats Tailings pile, the only known source to impact Flat Creek, would result in immediate improvements in water quality and, over time, may cause a return of all beneficial uses to this water course.

Reducing the metals loading to receiving waters would also mean that there are fewer heavy metals in solution; fish in the Sacramento River have been shown to bioaccumulate these metals. If it were possible that bioaccumulation, which has been demonstrated in fish tissue, was also causing a potential human health problem, we anticipate that this impact would be eliminated or reduced by the remedial action program.

Also, installation of perimeter control (i.e., fencing, posting warning signs) should minimize potential public health impacts associated with coming into contact with AMD or AMD-laden waters.

The selected alternative for this operable unit consists of the source control and water management components that are common to both CA-8 and CA-9. The Agency is not now prepared to make a final decision on whether to proceed with the source control measure of injecting low-density cellular concrete into the underground mine workings or straight lime/limestone neutralization treatment of AMD. To assist in making this decision,

Table 13. Anticipated Water Quality Improvements with CA-9

	Current Water Quality (mg/l)				CA-9			
RECEIVING WATER	COPPER	ZINC	CADMIUM	pH	COPPER	ZINC	CADMIUM	pH
BOULDER CREEK	4.25	25.0	0.17	2.1-3.3	1.20	6.1	0.03	2.7-4.0
SLICKROCK CREEK	2.56	0.99	0.012	3.5-4.1	0.15	0.06	0.001	4.7-5.5
SPRING CREEK	1.2	4.7	0.03	3.0-3.4	0.47	2.1	0.01	3.4-4.5

this ROD authorizes EPA to conduct a hydrogeologic investigation, and LDCC pilot and demonstration testing to determine a) if the site is conducive to the application of LDCC; b) the proper formulation of LDCC needed to withstand AMD corrosion; and c) if LDCC is technically feasible, reliable, and can be successfully implemented at Iron Mountain Mine. If these studies conclude that LDCC is technically feasible and can be implemented, EPA will prepare a second Record of Decision (ROD) documenting the selection of the source control measure.

Alternatively, if the site is not conducive to the application of LDCC or if LDCC is judged to be technically infeasible, a second ROD will be prepared to select the components of CA-8 (complete capping of the Richmond orebody and lime/limestone treatment) that have not been selected by this ROD.

* Construction of a partial or complete cap over the Richmond ore body is consistent with EPA's current view of Iron Mountain as a waste source. A cap will reduce infiltration of precipitation and thus reduce the volume of acid mine drainage that is formed. However, the ore body could be considered a resource, suitable for exploitation by a solution mining process (as currently proposed by the potentially responsible parties). Placing a full or partial cap over the ore body could be a hindrance to efforts to implement a solution mining process. Therefore, EPA will not begin implementation of the capping component for a grace period, while the possibility of developing the ore body as a resource is considered further. Commercial development of the ore body would have to include acid mine drainage discharge control measures and other environmental safeguards. A final decision regarding the capping component will be made following the grace period.

XI. SUMMARY OF RECOMMENDED OPERABLE UNIT

The recommended operable unit consists of:

o Approximately 2.5 acres of cracked and caved ground areas above the Richmond orebody will be capped using a soil cement mixture or other suitable material. The areas will be graded and benched and covered with the soil cement mixture. Interception ditches will be used to divert clean surface water runoff from the orebody.

o Up to 800 cubic feet per second (cfs) of clean surface water will be diverted from the Upper Spring Creek watershed before it reaches that portion of the basin affected by Iron Mountain Mine. This will be accomplished by constructing a low diversion dam and an 8-foot tunnel through the ridge that separates the Spring Creek and Flat Creek watersheds. A chute and energy dissipators will be needed to complete the conveyance of flows from Spring Creek to Flat Creek.

o Up to 250 cfs of clean water will be diverted from the South Fork of Spring Creek across the drainage divide into Rock Creek which discharges to the Sacramento River below Keswick Dam. The purpose of this alternative is similar to the Upper Spring Creek diversion and will require a small diversion dam and 4,000 feet of pipeline to complete the conveyance of flows to Rock Creek.

o Clean water from Upper Slickrock Creek will be diverted around the waste rock and slide debris, which contribute to releases from Big Seep, to the lower reach of Slickrock Creek.

o Spring Creek Debris Dam will be enlarged from its present storage capacity of 5,800 acre feet to 9,000 acre feet.

o Installation of Perimeter controls as necessary to minimize any direct contact threats.

o Perform hydrogeologic study and field-scale pilot demonstration to better define the feasibility of utilizing LDCC to minimize AMD formation.

XII. RECOMMENDED CLEANUP OBJECTIVES AND DESIGN YEAR

Designing a cleanup program to meet EPA Water Quality Criteria for Protection of Aquatic Life for the 'worst case' condition (1978) was judged to be appropriate because it is under conditions similar to 1978 that the greatest impacts on aquatic life would be felt. It should be noted that the so-called "worst case" year is based on very few years of data. Also, water quality model runs predicted that, targeting a cleanup program to meet EPA water quality criteria for the 1978 runoff conditions (wet year following a drought) would ensure that more stringent State criteria for the other three cleanup case years would be met. Stated differently, the EPA program should meet State criteria for every year except the worst case year, at which time the federal standards will be met. Under these conditions, meeting federal standards should prevent fish kills from occurring in the Sacramento River.

XIII. CONSISTENCY WITH OTHER ENVIRONMENTAL LAWS

According to the NCP, 40 CFR Part 300.68 (i)(1), remedial actions must attain or exceed applicable or relevant and appropriate Federal public health and environmental requirements unless one of the exceptions of Section 300.68(i)(5) applies. One of these exceptions is Fund-balancing. This provision allows EPA to select the alternative which most closely approaches the level of protection provided by applicable or relevant and appropriate requirements by considering the amount of money remaining in the Trust Fund and the need to take action at other NPL sites.

The selected overall remedy (CA-9) is presented for the discussion of the consistency with other environmental laws even though the current ROD is for the first operable unit only. The selected remedy would fill the major mine workings with low-density cellular concrete to greatly reduce AMD production; partially cap Iron Mountain to reduce the infiltration of clean water into the ore body; divert clean surface waters away from tailings piles and contaminated areas; if necessary, treat the (reduced) flow of AMD from the major point sources by lime neutralization; and enlarge Spring Creek Debris Dam to provide flow equalization. In order to reduce infiltration of clean water into the mountain, some grading and filling of depressions is anticipated in addition to the partial cap. In particular, an open pit called the Brick Flat Pit is to be filled to prevent accumulation of water. Dewatered sludges from the lime neutralization process, as well as the tailings from the Minnesota Flats Tailings piles, will be placed in the Brick Flat Pit. The selected remedy does not: address all waste rock dumps or tailings piles along Boulder Creek and Slickrock Creek; collect and treat all seeps or sub-surface drainage along Boulder Creek and Slickrock Creek; address metal-bearing sediments in receiving waters; or fully achieve aquatic water quality standards in Boulder Creek, Slickrock Creek, portions of Spring Creek, and Keswick Reservior. In essence, the selected remedy will achieve aquatic water quality standards below Keswick Dam, but not in the tributary streams; however, water quality in these receiving waters is expected to improve substantially to the point where certain beneficial uses may return on a seasonal basis.

The major environmental statutes that should be addressed with regard to this site include the Resource Conservation and Recovery Act (RCRA), the Clean Water Act (CWA), the National Environmental Protection Act (NEPA), and the Endangered Species Act (ESA). In addition, the selected alternative's consistency with a number of other Federal and State regulations is discussed in the Feasibility Study and its Addendum.

<u>RCRA</u>

The partial capping of the mountain and the filling of Brick Flat Pit with tailings from the Minnesota Flats area as well as disposing of dewatered lime sludges are two components of the selected remedial action that are of interest here. Iron Mountain Mine is an inactive mining site, and the solid materials found at the site are considered mining wastes; hence, RCRA is not generally applicable or relevant or appropriate. However, portions of the RCRA Subtitle C requirement may be relevant and appropriate for some aspects of the remedy. We considered the RCRA Subtitle C requirements in formulating various aspects of the alternative remedial actions. In addition, Subtitle D requirements may be appropriate at the site. In particular, grading and capping to reduce infiltration of rain waters into tailings piles (or the ore body) seems appropriate. The partial cap is intended to be placed over badly fractured areas and areas of relatively low slope. A soil/cement mixture appears to be the most cost-effective approach to reducing infiltration into the ore body: The multi-layered clay cap does not appear to be necessary for this application. Also, because of the steepness of some of the slopes, complete capping of the mountain is not technically feasible or practical.

With regard to the disposal of sludges generated by the lime neutralization process, it may be most protective to place the sludges (after dewatering) in a double-lined facility. Such a facility would have to be located off-site, because there are no areas suitable for such a facility on-site. However, the selected remedy is to place these sludges in Brick Flat Pit on top of Iron Mountain. This is considered a more appropriate approach for several reasons: (1) the pit needs to be filled in order to prevent water from ponding in it, (2) the metals contained in the dewatered sludge are relatively immobile and hence should be safe to place in an unlined pit, (3) should the metals migrate, they would reenter the ore body and eventually be recaptured by the AMD treatment system, and (4) the pit provides the probable least-cost disposal option. It is estimated that Brick Flat Pit could provide 30-plus years of disposal capacity, depending on sludge generation rates. (If the LDCC is fully successful in stopping AMD formation, then no treatment would be required, and no sludges would be generated.)

Placement of the tailings from the Minnesota Flats area in Brick Flat Pit is also selected. The tailings came from an ore roasting operation near Iron Mountain, and they contribute approximately one percent of the total metals discharge from the site via surface water runoff. Removal of the tailings from their present location would allow Flat Creek to be restored. Placement of these materials in Brick Flat Pit is somewhat analogous to placing materials that have migrated off-site from a landfill back on the landfill prior to capping. The metals concentrations are less that those of the underlying ore body, and the volume is significantly less than that of the ore body.

CWA

Section 301 of the Federal Clean Water Act requires that any point source discharge to waters of the United States meet technology-based effluent limitations (Best Practicable Technology Currently Available (BPT) by July 1, 1977, and Best Available Technology Economically Achievable (BAT) by July 1, 1984) as well as effluent limitations necessary for achieving compliance with water quality standards, by July 1, 1977. All Clean Water Act requirements may be met by preventing discharge. Waters of the United States in the Iron Mountain Mine area include Boulder Creek, Flat Creek, Slickrock Creek, Spring Creek, Keswick Reservoir, and the Sacramento River.

EPA has determined by Best Professional Judgement that the effluent limitations for mine drainage at 40 CFR Part 400, Subpart J, which are achievable by using lime treatment and precipitation, meet the BPT/BAT/BCT requirements of the CWA for point source discharges at this site.

Water quality standards established pursuant to the CWA are currently applicable to the Sacramento River and tributaries above Hamilton City. These standards were adopted by the Central Valley Regional Water Quality Control Board on April 27, 1984, and were approved by the State Water Resources Control Board and EPA. These standards limit dissolved concentrations of cadmium (0.00022 mg/l), copper (0.0056 mg/l), and zinc (0.016 mg/l). Other applicable water quality standards include a pH range of 6.5 to 8.3, with a maximum deviation of 0.3 units from ambient conditions, as well as freedom from color, turbidity, settleable material, sediment, toxicity, and suspended materials in amounts that adversely affect beneficial uses. Water quality standards are currently violated at all times for each of these water bodies except for the Sacramento River below Keswick Dam.

While substantial water quality improvement above current conditions is expected through implementation of Alternative CA-9, State and Federal standards will probably not be met in portions of Spring Creek, Slickrock Creek, Boulder Creek, and Keswick Reservoir at any time. Alternative CA-9 achieves water quality at a point below Keswick Dam. As described under Fund Balancing, the cost of meeting water quality objectives in the stream near the source is extremely large and fund balancing is used to back off to a less costly remedy.

NEPA

Under NEPA, an Environmental Impact Statement (EIS) must be prepared for Federally-funded projects. The environmental analysis included in the Feasibility Study is normally considered to be the functional equivalent of the EIS. However, in this case, the environmental impact of the proposed stream diversions are beyond the scope of the Feasibility Study. Therefore, prior to final design and construction of water diversion components or changes in the crest or pool elevations of the Spring Creek Debris Dam, the Bureau of Reclamation, under an agreement with EPA, will conduct any necessary supplemental environmental assessments.

ENDANGERED SPECIES ACT OF 1973

The winter run of salmon are being considered by the National Marine Fisheries Service for protection under the Endangered Species Act. Therefore, if the Service takes final action to protect the winter run of salmon, this legislation would be applicable to the cleanup of Iron Mountain Mine since the site is the main source of pollution that places the salmon at risk. The operable unit and final remedy for Iron Mountain Mine will achieve water quality standards in the Sacramento River below Keswick Dam, the major spawning area for the salmon. In taking remedial action at Iron Mountain Mine, EPA will be in compliance with the intent of the Endangered Species Act.

XIV. OPERATION AND MAINTENANCE

A. Capping of Cracked and Caved Ground Areas

Maintenance will be required for the ditches, benches, and soil-cement cap. The ditches will require periodic maintenance consisting of the removal of debris and repair of cracked sections. Benches will need periodic removal of debris.

B. Water Management Alternatives

Expected operation and maintenance requirements are minimal for these alternatives. There are no mechanical or electrical system components to maintain and no process to monitor or manage. It is possible after an extreme runoff event that some repair of channel erosion damage could be required. Sediment accumulation could be a problem at some point in the system, although proper design considerations should reduce any associated maintenance problems to a minimum.

XV. COMMUNITY RELATIONS

Documents made available for public review and comment included the Remedial Investigation (RI) and Feasibility Study (FS) reports and the Addendum to the FS.

The RI was made available for review and comment in February 1985, and again on August 2 through August 23, 1985. The public comment period for the FS was held between August 2 and August 23, 1985. Public notification of the public comment period was announced two weeks prior to the public comment period through notices in local newspapers. A Fact Sheet summarizing the contents of the RI and FS reports was sent to the mailing list during the week of July 22, 1985. A public meeting was held on August 15, 1985 in Redding, CA. The majority of comments received at the public meeting were from IMMI and Stauffer. These parties stated their objections to the implementation of the EPA cleanup program, and voiced strong support for allowing IMMI to proceed with its concept for an in situ leaching and metals recovery project.

Written comments were received from the PRP's, state agencies, one resident along Flat Creek, and sportsfishing and recreational organizations. In general, the PRP's and their consultants supported the IMMI proposal, stated opposition to an EPA funded cleanup action, and called into question the credibility of the FS. State agencies and other organizations lent support for an EPA funded remedial action and raised concerns about proceeding with the IMMI proposal. Responses to the comments are presented in the attached Responsiveness Summary.

A fact sheet summarizing the results of the Addendum to the FS was sent to the mailing list on July 14, 1986. The public comment period for the Addendum was held from July 25 through August 15, 1986. Public notification of the public comment period was announced about three weeks prior to the public comment period through notices in local newspapers.

Written comments were received by the PRP's, federal and State regulatory agencies, two landowners near the site, consultants associated with IMMI, and 33 citizens who signed petitions and/or form letters supporting the IMMI proposal, and 5 letters from residents in the Redding area.

As a general statement, comments from the PRP's and consultants for IMMI stated firm support for the IMMI proposal and opposition to the EPA proposed cleanup program. There was a concern that injecting the LDCC into the underground mine workings would interfere with the IMMI proposal and would also destroy a valuable mineral resource. The PRP's voiced strong opposition to proceeding with LDCC because it is an unproven technology for the purposes for which it would be applied at Iron Mountain Mine. The PRP's stated that the technology was not technically feasible; Stauffer indicated that, for this reason, the approach was not consistent with the NCP because it was not an established technology. The PRP's also stated that the IMMI proposal was a far superior alternative and that IMMI had secured funding to finance its commercial mining venture and an environmental control program. Stauffer asserted its view that Region IX had incorrectly interpreted the Clean Water Act in applying BAT for control of AMD from "abandoned mines"; that water quality compliance criteria must be negotiated on a case-by-case basis, and that the point of compliance for meeting cleanup objectives should continue to be met below Keswick Dam. Stauffer also protested that the three week public review and comment period was inadequate and inconsistent with CERCLA and the community relations provisions of the NCP because the Addendum represented a sharp departure from the original FS and that important and complex technical issues were raised by the FS Addendum.

The petition and form letters stated that the IMMI proposal was needed to bolster Shasta County's economy, that the IMMI cleanup program was more efficient and cost effective than the EPA cleanup programs, that the impacts of discharges of AMD on the Sacramento River are highly questionable, and that the EPA cleanup program was "basically ludicrous".

Federal and state regulatory agencies agreed with the implementation of CA-9 as the best solution to the Iron Mountain Mine problem, although support was also mentioned for CA-8; there was a consensus of the regulatory agencies opposing the IMMI commercial mining venture as an acceptale response to site problems. Specific comments and EPA's responses are presented in the attached Responsiveness Summary.

XVI. SCHEDULE

o Approve Remedial Action; Sign Record of Decision	Week of September 22, 1986
o Commence Remedial Design and Remedial Action of Water Management alternatives	Funding Pending Reauthorization of CERLCA

Once CERCLA has been reauthorized, the RD/RA phase for Iron Mountain Mine is proposed to be implemented in the following manner:

1.	Pre-Design for all source control and treatment components	FY 1987, 1st QTR
2.	Hydrogeologic investigation and LDCC pilot and demonstration test	FY 1987, 1st QTR
3.	Remedial Design	FY 1987, 3rd QTR
	a) Partial capping	
	b) Upper Slickrock Creek diversion	
	c) South Fort Spring Creek diversion; and	
	d) Upper Spring Creek diversion	
4.	Remedial Action	
	a) Partial capping	FY 1987, 4th QTR
	b) Upper Slickrock Creek diversion	FY 1988, 1st QTR
	c) South Fort Spring Creek diversion; and	FY 1988, 3rd QTR
	d) Upper Spring Creek diversion	FY 1988, 3rd QTR
5.	Remedial Design: LDCC (if feasible)	
	a) Richmond	FY 1989, 3rd QTR
	b) Slimrock	FY 1990, 2nd QTR
6.	Remedial Action: LDCC	
	a) Richmond	FY 1991, 1st QTR
	b) Slimrock	FY 1991, 3rd QTR
7.	RD/RA: Lime Neutralization (if needed)	Will be determined by results of LDCC pilot and demonstration tests.

XVII. FUTURE ACTIONS

After this Record of Decision is signed, EPA will enter into an Interagency Agreement with the U.S. Bureau of Reclamation (Bureau) for the design and construction of the source control and treatment components of the selected remedial action. In this manner, the Bureau will function in a role identical to that of the U.S. Corps of Engineers under the Superfund program and will oversee and manage the design and construction of the selected remedial action. This agreement will build upon the national interagency agreement between EPA and the Bureau for the cleanup of NPL sites.

The Bureau will assist EPA's cleanup efforts by seeking funding for the design and construction of the water management components of the selected remedial action. EPA may need to advance Trust Fund monies to the Bureau to begin certain of these activities so as to not interupt the site cleanup process. Under the terms of the agreement, the Bureau will reimburse EPA for these advanced monies.

Implementation of the selected alternative is expected to proceed under a phased approach, with monitoring following the construction of each component remedial action alternative. This will allow EPA to fully determine the efectiveness of each alternative. The phased approach will be implemented in the following manner:

<u>OPERABLE UNIT</u>

- <u>Capping above Richmond orebody</u>

  Design - 6 months

  Construction - 9 months (under suitable weather conditions)

- <u>Surface Water Diversions</u>

  Design - 12 months

  Construction - 18 months

- <u>Enlargement of Spring Creek Debris Dam</u>

  Design - 18 months

  Construction 18 months

  (This component will not begin RD/RA until all the source control, treatment (if needed) and water management components have been constructed and monitored for their effectiveness).

- Richmond Hydrogeologic Investigation

  The object of the investigation is to:

  1. Identify the main sources of inflow and AMD to the underground mine workings;

  2. Determine the vertical and lateral distribution of hydraulic head and permeability; and

  3. Evaluate slope stability and the strength of geologic material.

  These objectives will be accomplished, in part, through a groundwater drilling program and an assessment and survey of the underground mine workings. This investigation may identify another fill material or source control measures that may be equally or better suited for the Iron Mountain Mine site. Should this be the case, Region IX would propose to expand the LDCC pilot test described below to include an examination of these alternatives.

- Pilot and Demonstration Test of Low-Density Cellular Concrete

  1. Pilot Test

  The objective of this test is to determine the proper formulation of LDCC to withstand attack and corrosion from AMD. This will include a) laboratory test that will examine the effects of acid attack on various cement and additives; b) adhesion and fracture and interface leach tests to determine the applicability of LDCC to an acid environment; and c) determination of the geotechnical and hydrologic characteristics of LDCC.

  2. Demonstration Tests

  A small-scale demonstration test, and possibly a larger-scale test, will be conducted in the underground mine workings; this will require the partial rehabilitation of the Richmond adit. If a larger-scale test is deemed necessary, it will, in all likelihood, be conducted in the Lawson portal; in effect, this test will serve as the first phase of the implementation of LDCC.

  The final scope and cost of the ground water investigation and the LDCC pilot and demonstration test are currently in the process of being fully developed.

- Implement perimeter control as needed to minimize direct contact threat.

STATE OF CALIFORNIA—HEALTH AND WELFARE AGENCY Attachment 2 GEORGE DEUKMEJIAN, Governor

DEPARTMENT OF HEALTH SERVICES
TOXIC SUBSTANCES CONTROL DIVISION
NORTHERN CALIFORNIA SECTION
4250 POWER INN ROAD
SACRAMENTO, CA 95826
(916) 739-3145

September 11, 1986

Mr. Keith Takata, Chief
Superfund Program Branch
Toxics and Waste Management Division
U.S. Environmental Protection Agency
Region IX
215 Fremont Street
San Francisco, CA 94105

Dear Mr. Takata:

COMMENTS ON THE DRAFT RECORD OF DECISION FOR IRON MOUNTAIN MINE, AUGUST, 1986

The Department of Health Services (DHS) has reviewed both the Environmental Protection Agency's (EPA) Public Comment Feasibility Study Addendum, July 25, 1986 and the Draft Record of Decision (ROD), August, 1986 on Iron Mountain Mine. The former report is an addendum to the EPA Public Comment Feasibility Study Report dated August 2, 1985. DHS agrees with the general approach and strategy of EPA's recommended remedial action for Iron Mountain Mine as outlined in the draft ROD, but we suggest change, clarification or definition on some points.

The strategy calling for a phased implementation of several operable units is in the best interest of the State. We understand these units to be: partial capping of cracked and caved ground areas above the Richmond orebody; surface water diversion of Upper Spring Creek, South Fork Spring Creek and Upper Slickrock Creek; and enlargement of the Spring Creek Debris Dam. The ROD should also include provisions for establishing base line data on surface water measurement and sediment transport, in addition to the monitoring program assessing the impact of each component before the next is implemented. Further, a clearer definition of the areas to be included in the partial capping alternative is necessary.

We support EPA's selection of the combined alternative number nine (CA-9) because of its presumably lower operation and maintenance costs. We further concur that final commitment to injection of low density cellular concrete (LDCC) into the underground mine workings" as a source control for acid mine drainage (AMD) be reserved until the results of the pilot and demonstration tests prove its feasibility. The ROD's ground water investigation to evaluate LDCC injection should be broadened to include a hydrogeologic investigation of flow paths in the highly fractured rock zones.

We recommend immediate implementation of operable units located on or upstream of Iron Mountain Mine property which are unaffected by the results of the pilot/demonstration testing of the LDCC. We request, however, a more detailed analysis of the costs to the State for implementation and operation and maintenance of these units. Specifically, we need to know the State's share of these costs for State fiscal years 1986-87 and 1987-88.

EPA should specify in the ROD that additional remedies will be implemented if site clean-up objectives are not met by the proposed plans or if implementation of the plans creates a condition of imminent and/or substantial endangerment.

Finally, the planning and design of the operable units and of the LDCC pilot and demonstration tests must include a DHS input, review and approval process.

AMD at Iron Mountain Mine poses a serious environmental threat, and we look forward to working with EPA towards a solution. Please direct future communication to the attention of:

Anthony J. Landis, P.E., Chief
Site Mitigation Unit
Northern California Section
Department of Health Services
4250 Power Inn Road
Sacramento, CA 95826

If your staff have any questions regarding these comments, please have them contact Candace A. McGahan of our office at (916) 739-3998.

Sincerely,

James T. Allen, Ph.D.
Chief, Northern California Section

cc: Mr. William Crooks, RWQCB, Sacramento
County of Shasta, DPW, Redding

STATE OF CALIFORNIA Attachment 3 GEORGE DEUKMEJIAN, Governor

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD—
CENTRAL VALLEY REGION
3201 S STREET
SACRAMENTO, CALIFORNIA 95816-7090
PHONE: (916) 445-0270

9 September 1986

Mr. Keith Takata, Chief
Environmental Protection Agency
Superfund Programs Branch (T-4)
Toxic Waste Management Division
215 Fremont Street
San Francisco, CA 94105

FINAL COMMENTS - REMEDIAL INVESTIGATION/FEASIBILITY STUDY FOR IRON MOUNTAIN MINE

This letter contains the Regional Board staff's final comments and recommendations regarding a CERCLA cleanup program at Iron Mountain Mine. These comments and recommendations are based on our review of the December 1984 Remedial Investigation Report, the August 1985 Feasibility Study, and the July 1986 Feasibility Study Addendum.

Our own goals and objectives for an acid mine drainage control program at Iron Mountain Mine are as follows:

1. Improve water quality in the Sacramento River downstream of Keswick Dam so as to protect aquatic life and eliminate potential impacts on domestic water supplies in this portion of the river.

2. Improve water quality in lower Keswick Reservoir and the Spring Creek watershed to restore some measure of beneficial uses in these waters.

3. Implement a mine drainage control program which provides assurance of long-term effectiveness with minimum operating and maintenance needs. (The control program should not be dependent on future water storage and dilution policies, and should consider the inherent instability of the mountain area.)

In reviewing combined alternatives CA-1 through CA-9, we believe that implementation of CA-9 would most effectively achieve the above-stated goals. We concur with the phased approach to implementing CA-9. Capping of the ground surface over the Richmond ore body should be initiated as soon as possible, as should the recommended pilot studies needed to determine the feasibility of using low density cellular concrete (LDCC).

We support a request for funding of the principle water management actions; the upper and South Fork Spring Creek Diversions and enlargement of the Spring Creek Debris Dam. The design studies for these facilities should proceed. However, we recommend that the diversion facilities on South Fork and upper Spring Creek be designed with the capability of releasing water downstream to control pH in lower Spring Creek and Spring Creek Reservoir. The need for pH control in Spring Creek Reservoir will depend ultimately on the success of the source control program. With adequate source control, it may be possible to raise the pH to a level which would cause metal precipitation in Spring Creek Reservoir as opposed to Keswick Reservoir, where metals currently precipitate. In addition, any plan to construct water storage and diversion facilities for the purpose of adequately diluting acid mine drainage would be inadvisable without a long-term agreement with the Bureau of Reclamation concerning operation of these facilities in conjunction with releases from Keswick and Shasta Dams.

We recommend that the upper Slickrock Creek Diversion be included in the initial phase implementation only if initial studies indicate that the waste rock material, which presumably produces the Big Seep discharge, will not be used in the formulation of the low density concrete.

To summarize, we recommend that the Superfund cleanup program at Iron Mountain Mine proceed as follows:

<u>Phase I</u>

- Surface capping of the ground overlying the Richmond ore body.
- Pilot and demonstration studies on the feasibility of LDCC.
- Request funding for water management alternatives and initial design studies.
- Evaluate water quality impacts.

<u>Phase II</u>

- Implement filling of the underground workings with LDCC if Phase I studies indicate effectiveness.

(or)

- Implement alternative source control, such as lime/limestone or other treatment of major point sources.
- Evaluate water quality impacts.

<u>Phase III</u>

- Complete water management alternatives (if needed).
- Evaluate water quality impacts.

In conclusion, we wish to express our appreciation for the efforts of your agency and CH2M Hill in completing the Remedial Investigation/Feasibility Study and helping to resolve this long-standing water quality problem.

WILLIAM H. CROOKS
Executive Officer

cc: U.S. Bureau of Reclamation, Sacramento
Department of Fish and Game, Region I, Redding
Department of Health Services, Sacramento
Water Resources Control Board, Division of Water Quality, Sacramento
CH2M Hill, Redding

RESPONSIVENESS SUMMARY

Iron Mountain Mine
Redding, California

EPA 48.9L17.0
September 23, 1986

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RD/R84/014

RESPONSIVENESS SUMMARY
IRON MOUNTAIN MINE SITE
REDDING, CALIFORNIA
August 1986

INTRODUCTION

The purpose of this Responsiveness Summary is to document the following items for the public record: (1) the concerns and issues raised by private citizens and governmental agencies during the remedial planning process, (2) comments and questions raised during the public comment period on the Feasibility Study, and (3) the response of EPA to these comments and concerns.

COMMUNITY RELATIONS ACTIVITIES

The following community relations activities were undertaken to inform interested parties and solicit their comments throughout the Remedial Investigation (RI) and Feasibility Study (FS):

- Community Relations Plan. Interviews were conducted with local and state agencies, elected officials, and interested organizations in August 1983. The concerns and information needs identified during the interviews were used to design a Community Relations Plan for the site.

- Information Repositories. Information repositories were established at the Shasta County Library and the California Regional Water Quality Control Board office in Redding. Copies of relevant technical reports and other written materials were available for public review at these locations.

- Fact Sheets. Fact sheets were distributed to the project mailing list in April 1984, January 1985, August 1985, and July 1986. The fact sheets provided updated information about the activities, schedule, and findings of the RI/FS.

- Public Comment Period and Public Meeting. A 3-week public comment period for the August 5 Public Comment Feasibility Study report was held from August 2 to 23, 1985. A public meeting to discuss the FS was held on August 15, 1985. The public comment period and meeting were announced in the August 1985 fact sheet and in display advertisements placed in the Sacramento Bee on July 19, 1985, and The Record Searchlight

(Redding) on July 20 and August 10, 1985. Approximately 40 citizens plus representatives from local, state, and federal agencies attended the public meeting.

- Public Comment Period. A 3-week public comment period for the Public Comment Feasibility Study Addendum (submitted July 25, 1986) was held. The public comment period was announced in the July 1986 fact sheet and in display advertisements placed in the Sacramento Bee and the Record Searchlight (Redding) on July 8, 1986.

- Press Release. A press release was issued on August 30, 1985, to announce the availability of the final Remedial Investigation Report.

CONCERNS RAISED PRIOR TO THE FEASIBILITY STUDY COMMENT PERIOD

A number of concerns were raised during the interviews held for the Community Relations Plan in August 1983. The Regional Water Quality Control Board (RWQCB) has also received inquiries and concerns at meetings and in telephone conversations since its involvement with the site beginning in 1976. These comments and concerns are summarized below.

- Impacts on Fisheries and Tourism. The negative impact of acid mine drainage on sports and commercial fisheries, tourism, and the environment in general was the major concern expressed by resource agencies, local government, sports fishing groups, tourist-related businesses, commercial fishing groups, and the League of Women Voters.

- Drinking Water Quality. Because the City of Redding water supply has not been affected to date by acid mine drainage, drinking water quality has not been a major public issue. However, the RWQCB has received several inquiries about drinking water quality since its involvement with the site.

- Groundwater Quality. Two residents with wells located on property downstream of the site have appeared at RWQCB meetings and have called RWQCB staff on a few occasions to inquire about Iron Mountain Mine activities.

o **Funding of Site Cleanup.** Local officials reported receiving a few inquiries about why Iron Mountain Mine, Inc., is not paying for site cleanup. There was concern that taxpayers' money was being spent to solve a problem created by a potentially responsible party.

CONCERNS RAISED DURING THE FEASIBILITY STUDY COMMENT PERIOD

The concerns raised during comment periods are separated into two groups in this summary:

1. Public comments raised during the review period of the August 5, 1985, Public Comment Feasibility Study

2. Public comments raised during the review period of the July 25, 1986, Public Comment Feasibility Study Addendum

PUBLIC COMMENTS ON AUGUST 2, 1985, PUBLIC COMMENT FEASIBILITY STUDY

Eighteen individuals, organizations, and agencies submitted comments on the Feasibility Study at the public meeting on August 15, in writing during the public comment period, or both. The following list includes the names of the commenters, their affiliation, whether their comments were oral or written, and the manner in which their comments are identified in this report.

AUGUST 2, 1985 FS--LIST OF COMMENTERS

Bruce Boyer, IMMI Consultant (public meeting and written), Boyer

California Air Resourcers Control Board, Air

California Department of Fish and Game (public meeting and written), CDFG

California Department of Food & Agriculture, Agriculture

California Regional Water Quality Control Board (Redding) (public meeting), RWQCB

Chico Fly Fishing Club (written), Chico Fly Fishers

Gary Collier, Citizen (public meeting), Collier

Davy McKee Corporation (public meeting and written), Davy McKee-Morgan, Davy McKee-Turk

Iron Mountain Mines, Inc., (public meeting and written), IMMI-Arman, IMMI-Foster

Arthur Katzakian, Jr., Citizen (written), Katzakian

Daniel C. McLean, IMMI Metalluriqical Consultant (public meeting and written), McLean

Robert S. Miller, Citizen (public meeting and written), Miller

Orwig Nor, Citizen (public meeting), Nor

Anette and Bob Rardin, Citizens (public meeting and written), Rardin

The Resources Agency of California, Department of Conservation-Division of Administration, Conservation

Stanley E. Ross, Citizen (public meeting), Ross

Shasta Cascade Wonderland Association (public meeting), Shasta Cascade

Bill Siemering, Citizen (public meeting), Siemering

Stauffer Chemical Company (public meeting and written), Stauffer

U.S. Fish and Wildlife Service (written), FWS

Charlie Wilson, Citizen (public meeting), Wilson

Most of the comments are from people currently or previously associated with Iron Mountain Mines, Inc., or previous owners of the mine. Many of the commenters raised similar questions and concerns regarding the Feasibility Study Report. For this reason, the comments were paraphrased and summarized under categories. Every attempt was made to accurately paraphrase comments and respond to all comments that required a response.

The comments and responses to them are grouped into the following categories:

1. General Comments on Feasibility Study Report
2. Study Findings and Methodology
3. Fishkill Methodology and Results
4. Environmental and Public Health Hazards

5. Need for Remedial Action

6. Costs of Remedial Action

7. Timeframe for Implementing Remedial Action

8. Liability for Iron Mountain Mine Problems

9. Placement of Iron Mountain Mine on National Priorities List

10. Availability of RI and FS Reports/Public Comment Period

11. Technical Input and Review of RI/FS

12. IMMI Proposal

13. Other Remedial Action Alternatives

14. Preferred Remedial Action

15. Other Concerns (Miscellaneous)

CATEGORY 1--GENERAL COMMENTS ON FEASIBILITY STUDY REPORT

COMMENT 1-1

Five commenters (IMMI-Arman, Stauffer, Boyer, McLean, Miller) commented that the Feasibility Study Report is biased against IMMI and/or technically inadequate to responsibly evaluate the reasonableness or effectiveness of the potential remedial alternatives. One commenter (Stauffer) questioned the accuracy of the cost comparisons that were presented.

RESPONSE TO COMMENT 1-1

EPA believes that sufficient information and data were available through past state sampling and EPA's Remedial Investigation to provide a relative comparison of the effectiveness of remedial action alternatives as presented in the Feasibility Study Report. The report is not intended to draw conclusions about the cost-effective remedy, but to provide EPA with a full range of alternatives from which to select an appropriate remedy. We believe the report presents an unbiased evaluation of the IMMI alternative. EPA has also stated its willingness to consider the IMMI alternative to the extent that IMMI can provide specific technical and financial assurances.

EPA is confident that the feasibility level cost estimates will fall within a -30 to +50 percent accuracy range.

Comments concerning specific technical aspects of the Feasibility Study Report are responded to under the appropriate categories of this Responsiveness Summary.

COMMENT 1-2 (IMMI-Arman)

Thousands of dollars of Superfund money was needlessly spent or lost through lost or destroyed equipment; two and three engineers riding around to do one engineer's duty, such as sampling water or supervising construction progress; lack of engineering and inappropriate design, causing loss of manhours while the subcontractors were waiting for revised plans; loss of additional hundreds of manhours while subcontractors were waiting for materials to be delivered; duplication of efforts and costs in having to replace previous construction, etc. EPA was made aware of this problem, but apparently was not interested and is now defending CH2M HILL's workmanship and Feasibility Study as satisfactory and accurate.

RESPONSE TO COMMENT 1-2

The design and installation of flow measuring stations at the five major sources and at three stations on Spring Creek were subcontracted to another firm. This firm transported its own rental equipment and materials to the site as it was required. To our knowledge, no major time losses were experienced. This portion of the project was completed within the originally estimated cost.

The subcontractor was given the acidic characteristics of the mine drainage, and chose to use galvanized stilling wells. Due to acid attack, the stilling wells were replaced with plastic pipe at three of the sites.

The only equipment that was lost during the study was a velocity meter. This was not charged to the project.

Water sampling, bed measurements, and flow measurements were taken by an environmental scientist and a technician. These two people were required to reduce the time required for this work so that measurements for all sites could be accomplished within a 1-day period during a given sampling period. All expenditures by EPA were not inconsistent with the NCP.

COMMENT 1-3 (Boyer)

Why didn't CH2M HILL defend its Feasibility Study at the public meeting when attacked by individuals who pointed to obvious mistakes in the report?

RESPONSE TO COMMENT 1-3

The purpose of the public meeting is to allow the general public an opportunity to ask questions and make comments regarding the results of the Feasibility Study. EPA's contractor that conducts the study, in this case CH2M HILL, is invited to the meeting to help EPA answer questions regarding the study. They provided that service at the August 15 meeting. Once the questions and answer period is over, the meeting is open to public comments. EPA's contractor assists EPA in responding to public comments during preparation of the Responsiveness Summary, not during the public meeting.

COMMENT 1-4 (McLean)

The Feasibility Study Report is highly biased toward justifying IMM's placement on the National Priorities List.

RESPONSE TO COMMENT 1-4

EPA would like to clarify that the purpose of the Feasibility Study is to develop and evaluate remedial action alternatives for sites listed on the NPL. It is not conducted for the purpose of placing a site on the NPL. (See also Category 9 for further response to this issue.) The findings of EPA's RI support the data and information used by the State in applying the Hazard Ranking Scoring to the IMM site. This is a further indication that the Hazard Ranking Scoring was properly used to evaluate the IMM site. EPA wishes to restate that the nature and extent of the IMM problem justifies its placement on the NPL.

COMMENT 1-5 (Conservation)

The Department of Conservation is vitally concerned with mining activity, mineral resource conservation and development, and the reclamation of mined lands throughout the state. Any proposed plan or regulation that might affect mineral resources, specifically or in general, is of great interest to us.

RESPONSE TO COMMENT 1-5

No response required.

CATEGORY 2--STUDY FINDINGS AND METHODOLOGY

COMMENT 2-1

Three commenters (Boyer, IMMI-Arman, Miller) questioned the validity of the data collection and presentation on Tables 2-4 and/or 2-6 of the Feasibility Study Report. They stated the following points:

- The tables show assays of soluble concentrations higher than the total concentrations of the same mineral. It is footnoted that there are no identifiable reasons for these differences. It is obvious that errors were made someplace in the process, laboratory technique, calculations, or sampling. However, there was no attempt to eliminate the erroneous data from use.

- Even though samples were taken and the heavy metals or the negative environmental attributes were analyzed and found to be beyond the limits of detection, these samples were not included. Elimination of these "non-detectable" assays changes the resulting averages and presents an erroneous report.

- The statistical inaccuracy of these tables brings into question the validity of data collection and analysis throughout the rest of the report. These tables and any other sections of the report impacted by them should be disregarded.

- The inclusion of these erroneous data represents purposeful "statistical cheating" and an intentional bias against IMMI.

- Does EPA want to stake its reputation on the firm that prepared these tables? This same firm also found low levels of cadmium in Shasta Lake and higher levels in Keswick.

RESPONSE TO COMMENT 2-1

All data collected followed established EPA quality assurance/quality control procedures to verify the validity of the data. In addition, ion balances were performed on samples for which sufficient data were obtained to confirm the data.

For some analyses, reported soluble concentrations exceeded the total concentrations as was pointed out in footnotes to the tables. Field blanks processed in the same manner as the samples did not identify contamination during field handling. The difference between total and soluble concentrations may have been depicting the standard deviation of the analysis at the lower concentrations.

The complete data which were summarized in Table 2-6 of the Feasibility Study Report are presented in the Remedial Investigation Report. These data could be summarized and presented either as ranges or as averages. For simplification, the average of detectable values was presented and identified in a footnote to the table so that the reader was alerted to how the data were presented. There was no intent to hide this. Anyone reading the report can refer to the total data presented in the RI report should they wish to analyze the data for themselves.

Data presented in Table 2-6 for the Sacramento River below Keswick Dam represent both a "no-spill" condition from Spring Creek Debris Dam (February 2, 1984 through June 28, 1984) and "spill" conditions in January 1978, January 1983, and March 1983. As would be expected, the concentrations of metals during spill conditions was much greater than those measured during no-spill conditions, due to lower dilution of acid mine drainage in the Sacramento River during spill conditions.

COMMENT 2-2 (Boyer)

At the public hearing, the Water Board minimized the role of 19 other mines in the West and East Shasta Mining Districts with statements like "over 90 percent of the acid mine drainage comes from Spring Creek." This is not true, as surveillance of the mines in the East Shasta District is poor. This is brought out on page 9 of the U.S. Geological Survey 78-32, May 1978. Levels of zinc and cadmium from these mines are high. Sulfate ion can be used as a marker for the total load of acid mine drainage entering the Sacramento River. Heavy metals enter the receiving waters as sulfates. On dilution with water of higher pH and ample buffering strength, the heavy metals are precipitated, leaving the sulfate ion in the water. Using sulfate ion as a marker and according to Fish and Game and Central Valley Water Quality Control board staffs' own analysis and tables, Spring Creek is shown to be delivering less than 11 percent of the total acid mine drainage in Sacramento River water (Table 2-6), and in another of their charts, less than 23 percent of the total acid mine drainage in the water.

RESPONSE TO COMMENT 2-2

Other mines in the West and East Shasta Mining Districts have been extensively monitored by the Regional Water Quality Control Board for a number of years. Several have been issued discharge requirements with programs and schedules for cleanup action. Several of these mines do discharge high concentrations of Cu, Zn, Cd upstream of Iron Mountain Mine. Monitoring studies show that the impacts of these discharges are localized, and the metal concentrations are diluted by the 4 million-plus acre-feet of water in Shasta Lake (the receiving water body into which these discharges enter). Numerous sampling efforts, including those in the EPA Remedial Investigation, have shown that metal concentrations below Shasta Dam (downstream from the other mines but upstream from the Iron Mountain Mine discharge) are safe for aquatic life. Toxic concentrations of heavy metals in the Sacramento River occur only after the addition of drainage from Iron Mountain Mine via Spring Creek.

COMMENT 2-3 (Davy McKee-Turk)

The goal of adequately protecting aquatic life in the Sacramento River below Keswick Dam from releases of acid mine drainage migrating from the site does not mean that the point of compliance should be located in an area where IMMI could be adversely affected by conditions arising from operations and areas not under their control. Davy McKee recommends that the point of compliance be located at a point under the control of IMMI and that the criteria for compliance be adjusted to allow for downstream dilution.

RESPONSE TO COMMENT 2-3

EPA and the State believe that below Keswick Dam is the appropriate location to establish the point of compliance for a federally funded remedial action. Should the IMMI project be allowed to go foward in lieu of the EPA program, the water quality standards that would need to be met at the point of compliance would also have to be met in immediate receiving waters. These areas would, in effect, be under IMMI's control as Davy McKee has suggested. Meeting water quality standards in immediate receiving waters should ensure that water quality standards below Keswick Dam will be met. Flows above the Spring Creek confluence with the Sacramento River are relatively clean. In addition, compliance can be checked with a direct measurement at this point. If the point of compliance were moved above Spring Creek Reservoir, computations would have to be made regularly to predict the effect of Iron Mountain Mine releases as they pass through Spring Creek Reservoir, Keswick Reservoir, and as they become diluted with variable flows from Shasta Dam.

COMMENT 2-4 (IMMI-Arman)

In CH2M HILL's Feasibility Study Report, there are no data on the pyrite tailing pile located directly on the bank of

Keswick Lake (Sacramento River). The rainwater draining from this pile contains leached minerals. The Regional Quality Control Board is aware of this drainage site. Obviously, the RWQCB does not consider this tailing pile to be a mineral problem, or they would have included it in the CH2M HILL investigation report; after all, the main issues are the mineral effects on the Sacramento River. If there is no problem or mineral pollution concerning this pile, then why should there be any concern with similar material miles away on the Iron Mountain Mines property? The same circumstances apply to the old smelter area that drains into the Sacramento River from the bank of Spring Creek at the Sacramento River. By not including all of the data in the computed model calculations, the final results would be misleading. It appears that these seeps or drainages from the above two waste areas were not reported in the Feasibility Study because it would weaken the pollution claims against Iron Mountain Mines, Inc. (IMMI). Also omitted were 16 mines in the West Shasta Copper/Zinc District that cause AMD directly into Shasta Lake and the Sacramento River.

RESPONSE TO COMMENT 2-4

Discharges from other mining sites into Shasta Lake were taken into account by measurements taken above Spring Creek in the Sacramento River. The RWQCB has also taken measurements at Matheson and determined their contribution to the Sacramento River to be insignificant.

COMMENT 2-5 (IMMI-Arman)

The Basin Plan objectives for mineral content in the Sacramento River, according to a statement by Mr. Thomas A. Mix at the August 15, 1985, public meeting, "were designed specifically for Iron Mountain Mine." These objectives were not for limitations on other dischargers. This represents a very biased restraint against Iron Mountain Mine.

RESPONSE TO COMMENT 2-5

The State has adopted water quality objectives for Cu, Zn, and Cd in the upper Sacramento River (above Hamilton City). These numbers were adopted at the levels deemed necessary for the protection of all life stages of salmonids in the river. The numbers are based on lengthy studies by the California Department of Fish and Game and researchers outside the state. These are receiving water objectives and, together with the federal standards, they were identified for the purpose of targeting a cleanup program for Iron Mountain Mine site.

COMMENT 2-6 (IMMI-Arman and Katzakian)

The Feasibility Study Report states that "All of the individual unit process operations in the IMMI proposal employ technology that has been demonstrated to varying degrees in similar applications" and goes on to say that "No operating commercial solution mining facilities have been identified which combine all the processes proposed by IMMI." The report then expresses the concern: "Will one system working inadequately cause the next system to fail?" These same fears can be expressed for using any of the combined EPA alternative plans, based on the statement in the executive summary that "Based upon the limited available information, it is not possible to accurately predict the overall effectiveness of any of the combined alternatives." It apparently is not known what the effectiveness and environmental impact of employing any of the combined alternatives would be.

Mr. Arman stated that it seems reasonable to expect some sort of positive recommendations after the expenditure of approximately $900,000; the most obvious result should have been that Iron Mountain Mine did not belong on the NPL and the "no action" alternative should have been recommended.

RESPONSE TO COMMENT 2-6

The Iron Mountain Mine site is very complicated with respect to rainfall, surface water hydrology, and the movement of groundwater through the ore zone. The data developed during the Remedial Investigation are the best available data to characterize the hydrology. However, these data were collected for only a brief time with regard to history. Therefore, there are some uncertainties when estimating the effectiveness of remedial actions affecting the movement of groundwater through the orebody. During predesign or design, EPA will seek to develop additional data to properly design and construct the remedy.

Even though it is not possible to accurately predict the overall effectiveness of each individual alternative, the alternatives were compared on the same basis. EPA is confident that water quality objectives will be met with the combined alternatives selected. If objectives are not met after the alternatives have been implemented, EPA will seek to implement other remedial actions to ensure that these objectives will be attained through the Remedial Action program.

The uncertainty about the effectiveness of the remedial alternatives has nothing to do with the documented fishkills and the potential health threats that preclude the "no action" alternative. The results of this study will be used by EPA to select a permanent remedial action for the Iron Mountain Mine site. The extent of the environmental problem alone precludes the selection of the no action alternative.

COMMENT 2-7 (IMMI-Arman)

It is stated in the Feasibility Study Report that "all applicable technologies were considered." The only technologies considered were a rehash of previous studies (ten known studies funded through state and federal agencies) that had been discarded, were incomplete, or had already been proven not feasible. The one new suggestion was diverting water from the south fork of Spring Creek into Rock Creek. This one suggestion does not seem sufficient for such a costly study.

Everything in the "study" pertained only to water runoff caused by rainfall. No alternatives were considered, including Iron Mountain Mines, Inc.'s proposal that involved commercial removal or processing of the ore deposits, which are the actual source of minerals in the water.

RESPONSE TO COMMENT 2-7

All applicable technologies were considered in the Feasibility Study, including the IMMI proposal. Some of the alternatives were considered in previous studies.

The IMMI proposal is a commercial mining venture (which includes marketing of agricultural and other products) that cannot be implemented by EPA because EPA cannot become involved in competing with other manufacturers of agricultural and other types of goods. Therefore, this alternative could not be evaluated on the same basis as the other non-commercial alternatives. In addition, the IMMI proposal was screened out because it contained insufficient data for evaluation.

The recommencing of mining by conventional mining methods was considered, but was considered infeasible because of the depressed copper market and because of competition from third world countries, which is driving copper prices down.

EPA is still considering the IMMI proposal as a potential remedial alternative. However, there are certain assurances that IMMI would have to provide before EPA can accept its proposal in lieu of one of the combined alternatives presented in the Feasibility Study Report. EPA has provided IMMI with negotiation options for further consideration of its proposal. However, IMMI has not selected which option it prefers for further discussion.

The Feasibility Study considered all major movement of water that contained metals.

COMMENT 2-8 (Katzakian)

On Table 2-2, average chemical compositions, there appear to be some large discrepancies between the sum total of all the individual ions in solution with the total dissolved solids measurements. For the Richmond Portal, the discrepancy is 19,090 mg/l. For the Lawson Portal, it is 2,390. This represents a 27.5% difference for the former and a 12.6% difference for the latter. The three other analyses are in substantially good agreement.

Discrepancies like this cast doubt on the correctness of the analyses made in that set. Why was this data not checked for internal consistency and rechecked when discrepancies were found?

RESPONSE TO COMMENT 2-8

The original data from which those data presented in Table 2-2 were averaged and were checked for an anion-cation balance. Based on this check, data found to be in error were deleted. A comparison of total dissolved solids (TDS) with the cations and anions presented in Table 2-2 may not necessarily totally agree, given the fact that every element and compound in the solution was not analyzed for, and because heating of the sample in the TDS analysis can drive off volatile compounds such as carbonates.

COMMENT 2-9 (McLean)

No solid factual data or design criteria are provided to support most of the alternative project expenditures proposed, hence there is no way for anyone to judge how complete and accurate any of the project designs or cost estimates are.

The O&M costs are particularly misleading in that annual O&M costs are not given and there is no indication of the life span and depreciation rate of each alternative assumed in the calculations.

There is no indication as to how perpetual operations will be funded and by whom.

RESPONSE TO COMMENT 2-9

The conceptual design criteria and cost estimates are given in the appendices of the Feasibility Study Report.

On page A-1 of the Feasibility Study Report, the discount rate and life span are given respectively as 10 percent and 30 years.

The State of California is responsible for O&M requirements after the alternatives are implemented.

COMMENT 2-10 (McLean)

Mr. McLean submitted the following questions regarding the lime neutralization treatment:

1. What is the expected period of operation and what are the estimated annual O & M costs and depreciation allowances?

2. Will the above costs be covered by Superfund money in perpetuity? If not, what is the expected source of operating funds?

3. How long will it take to prepare EIS's for stream diversions, the nine-mile pipeline, and the hazardous waste production and disposal operation which a neutralization plant producing Cu,-Zn-Cd sludge will be?

4. Which plant size is actually recommended?

5. Has the 90-acre site on federal land actually been cleared as a hazardous waste disposal site?

6. What are the design criteria on which sizing and costing of the plants are based?

RESPONSE TO COMMENT 2-10

1. Should the lime/limestone neutralization process be a selected alternative, it may be necessary to operate it indefinitely. Present worth O&M costs are presented in the FS report. Depreciation allowances are not included; however, discount rates for O&M costs are shown in Appendix A of the Feasibility Study Report.

2. The State of California will fund O&M during the life of the project. Federal fund money would have been available to fund the first year of O&M to ensure that the RA was performing as expected.

3. EPA has determined that the RI an dFS process is functionally equivalent to NEPA and therefore, an EIS will not be required.

4. No plant size was recommended. A range of plant sizes was presented in the FS report to allow EPA to select the final remedial action.

5. The 90-acre site on federal land is not part of the Alternatives CA-7, 8 or 9.

6. A lime/limestone neutralization process was piloted for the RWQCB at the IMM site. The results of this study were presented in the report identified as Reference 1, Appendix F of the Feasibility Study Report. The design criteria, on which sizing and costing of the lime/limestone neutralization plants were made, were based on a scale-up of the design criteria in that reference based on flow and acidity.

COMMENT 2-11 (McLean)

Mr. McLean submitted the following comments and questions concerning water analyses and analytical methods:

The water analyses presented, especially those for cadmium in the Sacramento River samples, indicate that little or no quality control was applied at the laboratories making the analyses. Nowhere in the report is there any discussion of the reproducibility or accuracy of the used (sic) for cadmium in the fractional microgram concentration range, yet this is one of the most critical elements in the whole study. The study infers that the laboratories can reliably distinguish between levels of 0.2 ppb of Cd (the RWQCB target for the river) and 0.4 ppb, which is unacceptable.

If the standard EPA method for cadmium (Method 213.1) was used, its lower level of detection is 5 ppb. This obviously is not a reliable method, per se, for water samples at lower concentrations. If some other method was used, it has not been described, and standardization data indicating its reproducibility and standard deviation at Cd levels less than 5 ppb are not reported. Inclusion of this type of data is essential to establish the authenticity of the analyses reported for this critical toxic element, yet the subject is completely ignored.

In Tables F-15 and F-16 of the draft Remedial Investigation Report, about one-half of the analyses show soluble Cd as being greater than total Cd, a chemical impossibility. Similar illogical data for zinc, copper, and iron are contained in essentially all of the analytical tables in both reports. This is shrugged off in several tables by a footnote saying that it cannot be explained.

These "unexplained" data actually indicate both poor quality control of analytical procedures and/or insensitivity of the methods used to the range of metal concentrations involved. They also indicate an obvious lack of competence by the study investigators in conducting and monitoring a critical chemical analysis program.

If any credence is to be attached to the river water analyses or the computer outputs based on them, a full description of the actual methods used, their methods of standardization, standard deviations and the quality control procedures used during the study should be included in the report.

Questions to be answered under this topic are:

1. What analytical methods were used for the water analyses of Cu, Zn, and Cd? What are their lower limits of detection and standard deviations in the range of 0.1 to 5 ppb?

2. What laboratory qualification and quality control procedures were followed in the water analysis program?

3. What steps were taken to determine why so many soluble values exceeded total values?

4. Where are the data for periodic duplicate samples that are required to be run in any EPA investigation?

5. Which values (total or soluble) were used in the computer program?

6. What does the term "100-Day Fishery Evaluation for Mortality" mean (as used in Tables G-13 through G-16) and how does this relate to 96-hour LD-50 data?

7. Were the data in Tables G-13 through G-17 used as the principal bases for acceptance or rejection of the various alternatives?

RESPONSE TO COMMENT 2-11

1. Copper, zinc, and cadmium were normally analyzed using ICAP. Low level concentrations were analyzed using graphite furnace atomic adsorption. Specific detention limits and standard deviations vary with the sample matrix and metals concentrations. These data are available in the data packages provided by the Contract Laboratory Program (CLP) laboratory. Therefore, to determine the detection limit and standard deviation for a specific set of data, the reader will have to refer to that specific data package which may be obtained from EPA.

2. The laboratories used for analyzing the samples collected in this study were part of EPA's CLP. The specific qualifications for laboratories participating in the CLP and the quality control procedures they must follow are described in Contract Laboratory Program, Statement of Work, Inorganic Analysis, May 18, 1982 and July 1984 (SOW # 784).

3. Where possible, the samples containing higher soluble than total concentrations of metals were re-analyzed to confirm the results.

4. The results of the periodic duplicate samples are contained in the EPA QA/QC package of results. These were not included in the RI report.

5. The computer model used both total and soluble metal concentrations. Total metal concentrations were used in Spring Creek. Soluble metals were used in Keswick Reservoir and in the Sacramento River.

6. The "100 Day Fishery Evaluation for Mortality" was a 100-day period used in the USBR model. The 96-hour LD-50 data developed by the California Department of Fish and Game were applied to this 100-day period in the USBR model.

7. The number of spill days and the metals concentrations were used to compare alternatives not meeting the objectives as to their relative effectiveness.

COMMENT 2-12 (McLean)

Mr. McLean submitted the following comments and questions concerning groundwater studies:

IMMI was told at a meeting in the CH2M HILL offices in Redding in August 1984 that groundwater study and monitoring would be a major segment of this study to determine the extent of groundwater pollution of surrounding areas. Several monitoring wells were placed on the IMMI property and samples taken periodically. However, the only groundwater data presented are for three holes drilled in the Richmond ore body by Ruskin at a depth to water of less than 50 feet (see Table 6-11 in the Draft Report). We request answers to the following questions:

1. Where are the groundwater data from the special wells put in by CH2M HILL?

2. What groundwater flow measurements were used to determine the effectiveness of the Richmond groundwater intercept alternative?

3. Did the groundwater studies show that there is no movement of groundwater away from the ore body and no contamination of any surrounding groundwater?

4. How long will it take to complete the preliminary work required for Groundwater Interception Alternative SC-6 as outlined on page 7-30?

5. Did a competent mining engineer study and approve of this alternative?

RESPONSE TO COMMENT 2-12

1. The data from the Richmond Groundwater Investigation are presented in the Final Remedial Investigation Report, Iron Mountain Mine, August 1985.

2. Measurements of temperature, discharge, and chemical concentration at the Richmond portal along with the temperature of groundwater measured at the CH2M HILL-installed monitoring wells were important measurements used to determine the effectiveness of the Richmond groundwater interception program. These data are available in Appendix I of the Final Remedial Investigation Report, Figures I-3 through I-7.

   Along with measurements made at the Richmond portal, packer tests conducted on two of the monitoring wells and pump tests conducted on all four of the monitoring wells are available in sections of Appendix I labeled "Packer Permeability Tests" and "Pumping Test Results." Table I-1 summarizes the results of the pumping tests.

   Groundwater hydraulic gradients were calculated from water levels observed in the four monitoring wells. Well hydrographs (water levels) are graphically depicted in Figure I-2.

3. The groundwater studies showed that there was no contamination of groundwater in the four monitoring wells installed by CH2M HILL. It is possible, but not probable, that contamination of groundwater occurred downslope of Iron Mountain Mine. Hydraulic gradients in the vicinity of the monitoring wells appear to be toward the mine. However, more wells would have to be drilled to prove that the gradient is toward the mine cavity along the axis (east and west ends) of the mine.

4. The preliminary work required for the groundwater interception Alternative SC-6 would take at least 6 months. The preliminary work is outlined on page I-3 of the Final Remedial Investigation Report (Richmond Groundwater Investigation recommendations). The time includes:

   - 1 to 2 months for drilling new wells and setting up a pumping and monitoring system

   - 4 to 6 months of monitoring discharge out of the Richmond portal

   - 2 to 4 weeks of evaluation

5. EPA's Mining Engineering Group and a representative from the U.S. Bureau of Mines, both members of the Technical Advisory Committee, reviewed the Feasibility Study.

COMMENT 2-13 (Miller)

The final selection of alternatives as described by alternative, Sections 7 and 8, and their evaluation, Appendix F, plus the costs thereof, Appendix A, leave much to be desired to make an intelligent selection of an alternative with a potential price tag of 42.8 million dollars.

Consider the item of capping as an example. The recommended procedure, soil cement, requires that the soil? body which will have cement added to it must be first classified as to percent sand, silt, and clay. This is required to determine the amount of cement required. Thickness of the soil cement also is required. There is no indication that this has been done. Some soils are not amenable to this type of treatment, such as gravels and coarse sands.

Construction requires the cement (a specified amount to achieve desired results) to be thoroughly mixed with soils and the mixture material, then watered and rolled. While some of the area involved would be amenable to this type of operation, the steeper hillsides would not. Terracing would, in some areas, not be possible. Without proper installation, this type of treatment is very questionable. Incidentally, I personally have supervised this type of installation.

I would like to see the basis for arriving at the costs and documentation of feasibility, if they exist.

The groundwater interceptor system is doubtful. In theory, such a system might be possible; however, in the real world and on the mountain proposed, success is very doubtful.

The idea is like placing one tile drain through a 100-acre field and expecting it to drain the entire field.

In the scheme proposed, there would be too many alternative paths water could take, instead of finding its way into the periphery tunnels.

Enlarging the dam is practical; however, USBR has this responsibility and IMMI or the previous owner (Stauffer) should, in no way, be liable for this action inasmuch as the original Spring Creek dam project was not built to the recommended size at the desire of Congress.

The same applies to the SW diversion. This also was not approved by Congress.

If these two actions are desired, then USBR should be the responsible party with retribution coming from Mountain Copper Company, if possible.

RESPONSE TO COMMENT 2-13

A design of the soil-cement mixture was not performed as a part of the Feasibility Study. This activity is usually a part of the design of the remedial measure. Based on reconnaissance of the site, it appears there is sufficient surficial soil that a soil cement cap can be constructed using onsite soils. However, during final design, it may be found that some importing of soil or fly ash is necessary or is more economical than adding additional cement.

The cost estimate provided in the Feasibility Study Report does allow for some regrading of the site to reduce the steepness of some of the slopes. However, in some steep areas it may be found that some other permeability-reducing measure is more appropriate during final design. It should also be remembered that infiltration is not as great a problem in steeply sloping areas because the runoff percentage of rainwater is naturally higher in these areas. But as commented, there are areas that are not practical for capping--an example is the sides of brick flat pit.

The basis of cost for the cap assumes regrading of portions of the site and a 12-inch-thick cap extending approximately 100 feet beyond the surface projection of the ore body, excluding the sides of brick flat pit. It also includes some interception ditches that will accumulate the runoff at intermediate locations along the hillside.

The basis for arriving at costs are outlined in the Appendix of the Public Comment FS. A cost comparison is made for the alternatives on a present worth basis.

The interception tunnel and drill holes should be capable of significantly reducing the groundwater inflow into the ore body. Dewatering tunnels have been used in the past to dewater mine workings. This method, in addition to using the interception tunnel, also includes the use of relatively closely spaced drill holes to increase the likelihood that high permeability areas such as fractures, joints, or faults will be drained by the interception system.

The analogy of a tile drain in a 100-acre field may not be directly applicable to the interception method proposed in the Feasibility Study. However, if the tile drain was up to 500 feet in depth and was continuous around the site and to the ground surface, it would probably be effective in reducing the groundwater surface inside its perimeter associated with a high exterior ground surface.

With regard to enlarging Spring Creek Dam and implementing the other water management alternatives, the USBR has indicated that it will participate with an interagency agreement with EPA and may choose to recover its costs under the authority of CERCLA.

With regard to responsible parties for the implementation of the dam and diversions, Mountain Copper Company is no longer in business and the USBR is not considered a responsible party.

COMMENT 2-14 (Shasta Cascade)

Will the remedial action alternatives include restoration of Spring Creek and Slickrock Creek so they are able to support aquatic life?

RESPONSE TO COMMENT 2-14

None of the remedial alternatives include a restoration program for Spring Creek or Slickrock Creek. The source control and treatment technologies could incidentally improve conditions in portions of these streams. However, it is not anticipated that these receiving waters will support aquatic life following the implementation of remedial alternatives which include these technologies.

CATEGORY 3--FISHKILL METHODOLOGY AND RESULTS

COMMENT 3-1

Three commenters (Boyer, McLean, and Miller) had questions concerning the computer model used in the Feasibility Study and specifically the 72 percent fish mortality estimate given in Appendix G of the Feasibility Study Report. These commenters wanted to know what species of fish this percent applied to, what section of the river was modeled, and what life stages of fish were modeled. One commenter wanted to know what computer model was used, how it worked, and what input data were used.

RESPONSE TO COMMENT 3-1

Two computer models were used in the Iron Mountain Mine study. The first was a water quality model that uses a mass balance approach for accounting for heavy metals in the Spring Creek watershed. This model is similar to the USBR Spring Creek toxicity model which was developed for the Central Valley Fish and Wildlife Management Study. The second model is a fish toxicity model which was developed by the USBR and is part of their model described above.

Spring Creek Water Quality Model

The Spring Creek water quality model was used to compare the relative effectiveness of each of the combined alternatives that were evaluated. The alternatives were compared on the basis of meeting the two alternative sets of cleanup objectives described in the Feasibiltiy Study Report. The point of compliance for meeting these objectives is in the Sacramento River immediately below Keswick Dam.

The model was calibrated to 1978 and 1983 using historical efficiencies for the Boulder Creek and Slickrock Creek copper cementation plants.

The model was then set up for base case years for each of the four historic years studied (1978, 1980, 1981, and 1983). This consisted of estimating metal loadings for copper, zinc, and cadmium at the five major source locations and the other sources as they were combined in Boulder Creek and Slickrock Creek. These base cases assumed no remedial actions in place, including no copper cementation plants. To compare the effectiveness, metal load reductions were estimated for each source depending on which component alternative was being evaluated. The component alternatives (i.e., capping, groundwater interception, diversions, copper cementation, treatment, debris dam enlargement, etc.) were then combined in a manner to meet the two different objectives depending on which case year was evaluated.

Fish Toxicity Model

The fish toxicity model used concentrations of copper, zinc, and cadmium, which are computed in the Sacramento River below Keswick by the water quality model, to estimate Sacramento River salmon mortalities. These concentrations vary at different locations down to the river based on inflow from tributaries to the Sacramento River. The mortality estimates were based on California Department of Fish and Game bioassay studies (published information) and data which were compiled and summarized by the U.S. Fish and Wildlife Service on the distribution. The model considers all life stages of fish in the river. The model estimated the effects of metals on fish mortality from Keswick Dam to Red Bluff (approximately 60 river miles).

The purpose of the fish toxicity model was to make a relative comparison of the effects on fish for alternatives or combinations of alternatives that do not meet the objectives. It was not for the purpose of projecting fishkills to justify the existence of IMM on the NPL. The documented observed fishkills, even without the computer model, demonstrate a potential environmental threat.

This model was calibrated to the 1978 case year by using the estimated 72 percent fish mortality figures from the USBR study. This figure was the estimated percent of fish (salmon only) that would have been killed in 1978 if some would not have been caught and transported to Coleman Fish Hatchery. The estimate took into account all life stages of fish and was for 60 miles of river from Keswick Dam to Red Bluff.

COMMENT 3-2

Three commenters (Boyer, IMMI-Foster, and Katzakian) question whether fishkills in the Sacramento River are a problem and do not believe the documented fishkills are related to discharges from Iron Mountain Mine. Some believe the fishkills are based on a projection by the computer model.

RESPONSE TO COMMENT 3-2

The California Department of Fish and Game (DFG) has been involved since the early 1940's with various studies on Spring Creek and the Sacramento River associated with toxic acid mine waste. According to DFG, the documented fishkills listed in the Feasibility Study Report at locations below Shasta Dam are directly attributed to mining operations at Iron Mountain on the basis of actual observations of dead fish in the river, inspections of the acid mine waste streams, and water analyses for metals in the river, both above and below the area influenced by Iron Mountain as well as in Spring Creek. The occurrence of at least 30 fishkills in the last 40 years on an irregular basis is due to variations in hydrologic events controlling the ratio of toxic acid mine wastes to clean river waters released from Shasta Dam.

COMMENT 3-3 (BOYER)

The following are statements or questions by Mr. Boyer to be addressed in this section:

> Is there any spawning area above Redding (i.e., between Shasta Dam or Keswick Dam and Redding)?
>
> When the Dept. of Fish and Game recently did fish autopsies, they found one fish that was in perfectly good health with 4 ppm of cadmium in its liver.
>
> The decline in anadromous fishes was particularly noticeable after the Shasta and Keswick dams were built.
>
> If Iron Mountain Mines, Inc. through Spring Creek is killing 72% of the fish in the river, please explain, on this basis, the anadromous fish run for 1984. According to Fish & Game and Sacramento Valley River Water Users Association, the runs have increased steadily, at least since 1982. 1984 has been the best run in a decade.
>
> California Fish and Game have made major biological and chemical errors in their toxicity tests because they did not consider coprecipitation of copper, zinc and cadmium with iron and aluminum. Although they proved that zinc and copper are synergistic in intoxication properties. They perhaps did not realize that almost all the copper is precipitated at pH 6 and that zinc is antagonistic to the formation of cadmium thionen, and this will protect the organism from the toxic effects of cadmium. Furthermore, copper is capable of displacing both zinc and cadmium from metalothionen; thus copper can be taken up by lysosomes from which copper is excreted to the bile.
>
> Also, according to the National Research Council, selenium will protect organisms from the toxic effects of cadmium. In fact, the biologist who performed the toxic test on Keswick fish perhaps doesn't realize that there is biological interaction, both positive/negative, competitive, synergistic as well as antagonistic among 25 elements, 16 of which are definitely essential to life; 5 of them definitely unnecessary for life; 4 of these

> are toxic at relatively low levels that influence the tolerance of cadmium (also from the National Research Council).
>
> With these facts of life...it is hard for me to believe that all factors of toxicology and biochemistry were considered for the fish toxicology tests, and that subsequently the data that went into the computer program. Please also remember that Mr. Pedri claims that cadmium containing fish are the highest in the state at Keswick-Redding area. When he was questioned about the San Lorenzo River in Santa Cruz County, he said that it was high too. Perhaps if more tests were made, he would find that Keswick-Redding was not the highest in the state.

Mr. Boyer also had concerns regarding laboratory analyses results and stated that data used in the computer analyses for comparing alternatives were based on these analyses and therefore in error. These concerns are discussed in Category 2 of this Responsiveness Summary.

RESPONSE TO COMMENT 3-3

There are spawning areas between Keswick Dam and Redding.

Tissue Contamination

The State Water Resources Control Board has been monitoring body burdens in fish collected in waters throughout the state since 1976. At the Sacramento River station at Keswick, metals detected in rainbow trout tissues are at values that represent a significant elevated toxic pollutant level compared to all the other stations in the state. These elevated metal residues include cadmium, silver, chromium, copper, nickel, and zinc. There is a limited amount of knowledge concerning the biological effects of these body burdens with the exception of cadmium, where long-term exposure and bioaccumulation studies have been reported in the literature. The concentration of 4 ppm found in trout livers from the Keswick station exceeds the values reported to represent detrimental exposure to cadmium.

King Salmon Run in 1984

King salmon have a complex life cycle that includes residence in the Sacramento River for approximately 3 or 4 months up to the juvenile life stage with a return to the natural stream as a spawning adult 3 or 4 years later. Factors that influence the relative success of this year's class of salmon include, most importantly, the end of the El Nino current in the northern Pacific Ocean and also good streamflow conditions for these fish during the period they were juveniles in the river.

Iron Removal in Toxicity Studies

DFG's toxicity tests essentially simulated the events in the river. When acid mine waste is discharged into Keswick Lake, precipitation of metals begins. The metals precipitate at different rates and at different pH levels. Iron and aluminum are the first to come out of solution followed by copper, zinc, and cadmium. In terms of what metals are available to cause toxicity problems for salmon and steelhead below Keswick Dam, only copper, zinc, and cadmium remain in the dissolved form at toxic concentrations. This conclusion was supported by actual chemical measurements of river water for both total and dissolved metals. Because migratory fish cannot get above Keswick Dam, and aluminum and iron precipitates essentially do not occur in significant amounts below the dam, the smothering effect that these precipitates have on eggs does not present a risk to wild salmon and steelhead. However, the precipitates would present a risk to eggs in a bioassay experiment.

Fish Physiology

The discussion of fish physiology with respect to what happens to metals once they are inside the fish is unclear. Fish physiologists have postulated a number of mechanisms that allow fish to either eliminate metals from their body or sequester them in parts of their body where they do less harm. More importantly, physiologists have identified a number of different fish tissues directly damaged by exposures to copper, zinc, and cadmium. Therefore, damage can occur during exposure to concentrations less than those that cause death.

COMMENT 3-4 (Davy McKee-Morgan)

Appendix G of the report contains a description of a water quality modeling effort. This model is utilized by the EPA to compare the effectiveness of the various alternatives. The report as published gives few details as to the actual preexisting tests that were performed that were used as input to the model. Not having the original report, I would like to question how these fish bioassays were conducted. There is evidence in the recent literature which supports the contention that all stages of fish from ichthyoplankton to the adult stages that have been raised in waters containing metals offer a greater resistance to these metals than do similar stages of the same fish species grown in waters not containing these metals. Thus, it is important to utilize fish species that have been grown in waters containing metals if valid results are to be obtained. There has been a decent fishery in the Sacramento River and its tributaries all during the 125 years that this mine has operated, and the greatest impact to these fisheries has been the artifical structures constructed in these streams by the Bureau of Reclamation.

RESPONSE TO COMMENT 3-4

An acclimation phenomena has been observed with certain stocks of fish challenged with zinc. These test results indicate that these particular fish can tolerate slightly higher zinc concentrations at a reduced mortality rate. To account for acclimation as much as possible, DFG chose a salmon stock native to the upper Sacramento River as the test species for the onsite toxicity tests using Spring Creek waters. These onsite results confirmed the applicability of laboratory results.

The acclimation phenomena seems to be dependent on fish receiving consistent exposure of zinc, through preceding life stages. This can also selectively kill the more sensitive individuals. Consistent exposure to metals does not always occur in the Sacramento River below Spring Creek throughout the main fish development period (fall and winter) and during all years. Because the discharge of larger quantities of acid mine waste is irregular, instances occur when eggs are not exposed to chronic concentrations of metals in the fall but unacclimated fry are exposed to metals during the winter. Additionally, there are some generations that return as adults that did not experience significant exposure to metals as juveniles due to either a favorable series of hydrologic events that occurred during their stay in the river as juveniles or the fact that they may have resided at a tributary or a hatchery as juveniles.

There has been a consistent long-term declining trend in the upper Sacramento River king salmon and steelhead populations, especially in the 26-mile reach between Keswick Dam and Balls Ferry where documented toxic concentrations of metals occur.

COMMENT 3-5 (IMMI-Foster)

The report also cites fish kills as another problem. This assertion is based on a computer model projection by the Regional Water Quality Control Board and the California Department of Fish and Game. However, the model included erroneous criteria, including the assumption that there are spawning beds between Keswick Dam and the City of Redding. There is one small riffle above the dam, but the 5 or 6 miles below Keswick Dam do not have any spawning beds remaining. Yet, that area was used in the model and supposedly represents where fish were killed. In addition, of the documented fish kills that are attributed to acid mine drainage from IMM, only three were at the mouth of Spring Creek. The other 30 documented kills were in Shasta Lake, quite a ways upriver from Spring Creek.

RESPONSE TO COMMENT 3-5

Significant king salmon spawning beds exist between Keswick Dam and the City of Redding along with excellent rainbow trout habitat. DFG makes annual estimates of the king salmon spawning stocks in this area.

The statement that the list of fishkills presented in the Feasibility Study Report includes three kills below Shasta Dam and 30 above Shasta Dam is incorrect. The correct tally of the list referred to is 31 kills below Shasta Dam and one kill above Shasta Dam.

COMMENT 3-6 (IMMI-Arman)

IMMI is aware of most, if not all, of the toxicity studies conducted at Spring Creek regarding fish health and is also well aware of the inadequacies of those tests and their inconclusive results. The EPA studies admittedly were not conducted on the Sacramento River and it is not known under what conditions they were taken, nor is it known how such unrelated studies can be used as a basis for proposing water quality criteria for protection of aquatic life in the Sacramento River.

It is very probable that wherever the EPA studies were conducted, there was not the same natural buffering action that is present in the Sacramento River.

RESPONSE TO COMMENT 3-6

In reports describing metal toxicity test results, such as those presented by EPA, the constituents in dilution water that affect metal toxicity are always reported. The criteria chosen for the Sacramento River water take into account the presence of constituents that affect metal toxicity.

The pH of the river is an important factor affected by the acid mine waste. Although the river has buffering capacity when it leaves Shasta Lake, the river pH is at times significantly depressed when limited dilution water availability yields a higher ratio of acid Spring Creek water to river water. The depression of the river pH decreases the precipitation rate of the metals and increases toxicity. One example was during the 1969 fishkill when the river pH at Redding actually dropped as low as 5.7.

It should be recognized that the actual process of detoxification by precipitation of metals in the river is not instantaneous. Precipitation occurs over time and distance as the waste moves down the river with different metals undergoing different rates of precipitation. Actual measurements of river water during spill episodes at Spring

Creek show that dissolved metal concentrations in the critical range for salmon and steelhead can exist as far downstream as Balls Ferry, a river reach of approximately 26 miles. Below that area a combination of dilution and precipitation generally reduces the dissolved concentrations to non-critical levels.

COMMENT 3-7 (Katzakian)

The report appears to be well written, but contains numerous inconsistencies and errors in the data tables. The first of these is the fish kill table presented on pages 3 and 4 of Chapter 3. I do not understand how fish kills in Shasta Lake and at the base of the Dam relate to acid mine drainage from Iron Mountain Mine, since any drainage from the mine takes place well downriver from these sites. Also, the table indicates that fish kills at Redding, where extensive dilution has taken place, are not significantly different than fish kills observed much closer to the mine in Spring Creek and Keswick Reservoir, where higher heavy metal concentrations are observed. In addition, there is no information as to the cause of the fish kills and whether or not any significant fish kills take place during the late spring, summer and early fall months. Also, for a large percentage of the observed fish kills, there either is no estimate of the number killed or no identification of the species killed. Based on the data in this table, I fail to see its relevance to this report.

RESPONSE TO COMMENT 3-7

The one fishkill listed as occurring in Shasta Lake has nothing to do with discharges from Iron Mountain Mine via Spring Creek. It was listed because the table was taken in its entirety from another reference as shown on the bottom of the table. There were four other fishkills listed as "Below Shasta Dam." These have not yet been verified as to whether or not they were below the influence of Iron Mountain Mine discharges (Spring Creek). It doesn't necessarily mean that they occurred at the base of Shasta Dam.

The remaining 27 occurrences of fishkills presented in the table are at locations affected by Iron Mountain Mine releases.

Documented fishkills are also discussed in the Response to Comment 3-2.

COMMENT 3-8 (Miller)

The Corps of Engineers is considering some riprap work on the river below the diversion dam. The Department of Fish and Game has stated that riprap deprives the sands and gravels needed for spawning in that portion of the river to the point where 85 percent of the spawning fish are killed. How does this mortality rate relate to the 72 percent fish mortality rate assumed for the IMM no-action alternative?

RESPONSE TO COMMENT 3-8

This proposed riprap project does not relate to the Iron Mountain Mine issue. A geological study conducted by the Department of Water Resources concluded that the riprap project would reduce the available spawning gravels in the project area by 85 percent.

COMMENT 3-9 (Shasta Cascade)

Is there any record of the number of fish fry that have been endangered and/or killed by pollution problems? Has there been a dollar value placed on the loss of this resource?

RESPONSE TO COMMENT 3-9

The only composite information found during the Feasibility Study on fishkills resulting from pollution problems is the table shown in Chapter 3 of the Feasibility Study Report.

The U.S. Fish and Wildlife Service estimates a dollar value in their comments in Appendix B of this Responsiveness Summary.

CATEGORY 4--ENVIRONMENTAL AND PUBLIC HEALTH HAZARDS

Comment 4-1 is a general summary of comments and questions that were received concerning public health and environmental hazards. A general response is provided by EPA under Response 4-1. Specific comments and responses are then presented. Responses to Comments 4-2 through 4-9 are provided by EPA. Responses to Comments 4-10 through 4-25 are provided by the California Department of Health Services, Epidemiological Studies and Surveillance Section.

GENERAL COMMENTS AND EPA RESPONSE

COMMENT 4-1

Seven commenters (Boyer, Davy McKee, IMMI-Foster, IMMI-Arman, McLean, Miller, Stauffer) commented that while the Feasibility Study Report discusses potential public health and environmental hazards associated with acid mine drainage from Iron Mountain Mine, actual risks are not proven and cannot be used as justification for placing Iron Mountain Mine on the National Priorities List or for requiring mitigative action. The Feasibility Study Report in fact concludes that the potential problems of dermal contact, ingestion of contaminated water, and ingestion of contaminated fish are insignificant or present no public health hazard. The potential of fishkills in the Sacramento River as shown in the Feasibility Study Report is based on incomplete and misleading data. The Feasibility Study was continued at considerable expense to develop alternative solutions to problems that were shown not to exist.

RESPONSE TO COMMENT 4-1

The objective of the public health and environmental assessment presented in the Feasibility Study Report is to assess, based on the no-action alternative, potential risks associated with acid mine drainage both at its source and migrating from the site. Under the no-action alternative, it is assumed no remedial actions would be implemented to correct the problems, and future land use could change. Potential remedial action alternatives were identified, developed and evaluated because releases of AMD from IMM have impaired water quality and aquatic life for a significant period of time. These impacts have been documented and continue to pose a significant potential threat to the environment.

The information presented in the Feasibility Study Report is primarily based on data developed during the Remedial Investigation. Both investigations, the Remedial Investigation and the Feasibility Study, are conducted after a site has been placed on the National Priorities List (NPL). The placement of a site on the NPL is based on a hazard ranking system evaluation which is prepared prior to the Remedial Investigation and Feasibility Study. Therefore, comments regarding the hazard ranking system and placement of the site on the NPL have no relevance to the Feasibility Study. If, however, the no-action alternative is selected by EPA subsequent to the Feasibility Study, then the site is removed from the NPL.

Public Health

Three types of exposure to acid mine drainage were discussed in the Feasibility Study Report:

- o Dermal contact with acid mine drainage (AMD)
- o Ingestion of waters affected by AMD
- o Ingestion of fish affected by AMD

Dermal Contact. As stated in the DOHS Endangerment Assessment (Appendix B of the Feasibility Study Report), "direct human exposure will probably be rare because of the remoteness of the area." This is based on the current land use. However, land use could change in the future where human exposure could be more likely. In fact, Iron Mountain Mines, Inc., in a letter to the Governor of California dated August 13, 1985, stated objectives for the site that include a private wildlife and game preserve and the development of an exclusive subdivision surrounded by a private recreation park.

Dermal contact under the no-action alternative represents the greatest health hazard with respect to the other two types of exposure (ingestion of water or ingestion of contaminated fish). At the Richmond portal, the AMD contains sulfuric acid in concentrations (pH = 0.6 to 1.4) that could cause serious eye injuries and skin irritation through direct exposure (according to DOHS). The sulfuric acid is accessible to direct human contact at the portal, in the flume conveying AMD to the Boulder Cementation Plant, and at the Boulder Cementation Plant.

The AMD is diluted as it enters Boulder Creek, Slickrock Creek, and Spring Creek, and there is less risk with regard to dermal contact in these areas. The pH in Boulder Creek was measured to range from 1.8 to 2.3 and for Slickrock Creek was measured to range from 2.8 to 2.9. Measured pH values for lower Spring Creek ranged from 2.4 to 3.2.

Ingestion of Contaminated Water. Potential ingestion of contaminated water from the Iron Mountain Mine site was discussed in the Feasibility Study Report for two different areas--the upper study area (at the source, Boulder Creek, Slickrock Creek, Spring Creek, or Spring Creek Reservoir) and at the City of Redding municipal drinking water supply intake.

The potential for ingestion of AMD in the upper study area under the existing land use is considered small because of the remote location, and it would be unlikely that anyone would willfully drink water that is discolored or has an odor associated with it. However, the contaminated water is accessible both on IMMI property and on other property along Spring Creek. The potential for this exposure could change with future land use changes.

The potential for ingesting contaminated water from the City of Redding water supply is also discussed in the Feasibility Study Report. This could occur if domestic drinking water standards for cadmium are exceeded in the City of Redding water supply. Even though there are no known measured concentrations of cadmium exceeding these limits at the city's raw water intake, they could be exceeded during periods where discharges from Spring Creek are uncontrolled while releases of dilution water from Shasta Dam are reduced for flood control purposes.

The limits would have to be exceeded regularly for this to pose a significant public health threat.

Ingestion of Fish. Ingestion of fish taken from Keswick Reservoir does not appear to represent a significant public health threat as discussed in the Feasibility Study Report. This was based on an analysis that expanded the analysis prepared by DOHS in its endangerment assessment (Appendix B of the Feasibility Study Report). The discussion in the main body of the Feasibility Study Report compared metal concentrations from eating fish in Keswick for one year using the same scenario as DOHS to values for the normal dietary intake. The difference in the analyses is that the one in the text is based on metals measured in fish flesh whereas the one prepared by DOHS is based on metals measured in fish livers. The reference material in Appendix B is included in its original form as is all other reference material received from authors other than EPA's contractor.

Public Health Summary. As discussed above, dermal contact represents the greatest public health hazard with respect to the other types of exposure mentioned above. Exposure to sulfuric acid under current conditions is not the same with respect to exposure during the period of active mining and could change based on future land use. Exposure to AMD at a pH ranging from 2 to 4 is not the same as potential exposure to AMD at 0.5 to 1.0. Several attempts were made to obtain all pertinent information from the Iron Mountain Mine files. However, no health and safety records were provided for the period of active mining.

In conclusion, the public health issues are not the critical factors in deciding what remedial action alternatives will be selected by EPA. Instead the comparison of alternatives is primarily based on meeting the selected cleanup objectives in the Sacramento River below Keswick Dam, thereby minimizing the endangerment to the environment presented by the AMD. The public health issues also have little effect on the overall cost associated with any of the remedial action alternatives.

Environmental Concerns

The environmental concerns for the Iron Mountain Mine site are based on the effects of AMD migrating from the site on aquatic life. The effects on aquatic life that are documented in the Feasibility Study Report are the following:

- The continued flow of AMD has caused portions of Slickrock Creek, Boulder Creek, and Spring Creek to be essentially devoid of aquatic life.

- Records for the fishkills listed in the Feasibility Study Report were taken from a USGS report. The table in the Feasibility Study Report documents a reference for each fishkill. This information for 1940, 1944, 1948, and 1949 did not establish the exact location of the reported fishkills below Shasta Dam. According to the California Department of Fish and Game, with the exception of these 5 years, all other fishkills listed are attributed to the AMD migrating from the Iron Mountain Mine site.

- In addition to fishkills, the AMD being discharged has physiological effects on fish and also depresses the overall productivity of the river according to the California Department of Fish and Game.

- Additional information regarding environmental concerns is provided by the U.S. Fish and Wildlife Service in Appendix B.

EPA RESPONSE TO SPECIFIC COMMENTS

COMMENT 4-2 (McLean)

Since no factual evidence has been produced in the study to show that there is any threat to human health, why is the IMM site retained on the NPL as a major "abandoned" mine and threat to the public health?

RESPONSE TO COMMENT 4-2

According to the National Contingency Plan, Section 300.66(7), "Sites may be deleted from the NPL when no further response is appropriate. In deleting sites, the Agency will consider whether any of the following criteria have been met...(c) based on a remedial investigation, EPA has determined that the release poses no significant threat to public health or the environment, and therefore, taking of remedial measures is not appropriate at that time."

Based on the information obtained during the Remedial Investigation, the IMM site did not meet the above criteria for removal from the NPL. For example, documented fish kills resulting from discharges from the IMM site are an obvious significant threat to the environment.

COMMENT 4-3 (McLean)

For the same reasons cited above (Comment 4-2), what is the validity of the reason given for rejecting the IMMI proposal, which states "there would be a risk to the public health..." (page ES-9 in the Executive Summary, paragraph 1)?

RESPONSE TO COMMENT 4-3

It has not been demonstrated that the IMMI proposal can attain applicable, relevant, and appropriate federal and state requirements. It is therefore not a complete proposal. The risk is associated with continuing impacts to the environment and aquatic life and potential impacts at the City of Redding water supply intake while the project is being developed and IMMI seeks to secure funding for the project. Also, bioaccumulation of metals in both humans and fish would continue to present risks. EPA does not want to increase any existing or potential risks by not responding as mandated under CERCLA.

COMMENT 4-4 (McLean)

Why has the historical record of public exposure to AMD waters in Pennsylvania, West Virginia, and the IMMI Redding area not been considered and discussed in the report?

RESPONSE TO COMMENT 4-4

Potential public health threats are based on site-specific exposure routes and characteristics of the contaminants. Exposure during active mining of the site is not necessarily the same as potential exposure during the current or potential future land use conditions.

COMMENT 4-5 (McLean)

Since the potential threat to human health is essentially zero, and none of the sporadic fishkills in the Sacramento River are totally attributable to the AMD discharge from

IMM, what is the justification for the rush to spend $5 to $140 million at this site when there are dozens of more dangerous sites throughout California and the nation to which these funds could be applied for greater public protection?

RESPONSE TO COMMENT 4-5

Iron Mountain Mine is the State of California's worst water quality problem associated with releases from mining sites. The RWQCB has estimated that IMM carries an average of 2,350 pounds/day of zinc, 300 pounds/day of copper, and 50 pounds/day of cadmium into the Sacramento River. In our investigation, we found that under relatively dry water conditions, IMM contributed a minimum of 623 and up to 3,328 pounds/day of heavy metals into the Sacramento River. We have documented that releases of AMD from IMM have severely degraded water quality and resulted in fishkills directly attributable to the site.

EPA and the State are proceeding in a manner designed to ensure that the environmental conditions resulting in releases from IMM are responded to in a timely and efficient manner. The funds that have been expended at IMM to date have not directly precluded remedial response action at other toxic waste sites in California.

COMMENT 4-6 (McLean)

Since the only real threat of AMD is sporadic fishkills, these could be compensated for by building new fish hatchery facilities at a very nominal cost. Why was this simple alternative not considered?

RESPONSE TO COMMENT 4-6

The objectives of every remedial action are to "...mitigate and minimize threats to and provide adequate protection of public health, welfare, and the environment..." as specified in 40 CFR 300.68(j).

Building a fish hatchery to replace fish being killed by releases from the IMM site was not considered because it would not address the underlying environmental problem and would not, therefore, meet the objectives of 40 CFR 300.68(j).

The California Department of Fish and Game's position is that it is not appropriate to compensate for the losses to one of the aquatic resources destroyed by pollution by engaging in expensive hatchery production. CDFG has informed EPA that it considers the most appropriate action to be protection of all the affected resources by implementing remedial actions at the Iron Mountain Mine site.

Additionally, CDFG believes that the angling public should not be asked to abandon the use of a river section because of an improperly controlled toxic waste stream. EPA agrees.

COMMENT 4-7 (McLean)

Why is there no mention of the fact that the original ranking evaluation was incorrect and that a true reranking may completely eliminate IMM as a candidate for Superfund expenditures? Mr. Jack W. McGraw, Assistant Administrator, EPA, in his letter of 2/5/85 to IMMI indicated that this would be part of the evaluation procedure.

RESPONSE TO COMMENT 4-7

The hazard ranking score, based on the best available information, was accurate. The EPA has apprised IMMI through numerous pieces of correspondence that the agency has reviewed the HRS scoring of IMM and has concluded that the findings of the Remedial Investigation, when factored into a reranking of the site, would cause the site to receive an HRS score sufficiently high to remain on the NPL.

COMMENT 4-8 (Air)

The lime/limestone water treatment plan has potential air impacts relating to release of these five toxic metals. Our concern focuses on the aeration process to convert ferrous to ferric iron. Aeration presents the possibility for entrainment of particulate matter in exhaust gases.

If this method of remediation is chosen, the EIR should give sufficient information about the process and plant for the air pollution control district and the ARB to determine the need for emissions control and appropriate technology to achieve it.

RESPONSE TO COMMENT 4-8

The aeration system which would be used in the lime/limestone treatment process is not expected to entrain particulate matter in the exhaust gases. If a lime/limestone treatment process is chosen as a remedial action, and if an EIR is required, the necessary information will be provided to the ARB.

COMMENT 4-9 (Agriculture)

The feasibility study states that the continual discharge of heavy metals into the Sacramento River has exceeded lethal concentrations for aquatic life and will continue to do so unless remedial action is implemented at the Iron Mountain Mine. This acid mine drainage has the potential of impairing agricultural yields as well since the contaminated

Sacramento River water serves as irrigation water for agricultural lands.

RESPONSE TO COMMENT 4-9

There is a potential for improving agricultural yields, however, it appears to be unlikely since drinking water standards have never been exceeded in the Sacramento River near Redding. In addition, metals concentrations in the Sacramento River are lower during the irrigation season.

DOHS RESPONSE TO SPECIFIC COMMENTS

INTRODUCTION

In August 1984, the Epidemiological Studies and Surveillance Section (ESSS) responded to a request by Mark Galloway of the Toxic Substances Control Division to provide an endangerment assessment for the Iron Mountain Mine site in Shasta County. The assessment was based on data provided by the Environmental Protection Agency (EPA) contractor CH2M HILL. This endangerment assessment was subsequently incorporated into the Feasibility Study at the site prepared by CH2M HILL. Public comments on the Feasibility Study were received by ESSS in September 1985, and responses to comments related to the endangerment assessment were prepared as presented below.

Several comments were based on the recalculation of health risk from consumption of cadmium-contaminated fish. The Department of Health Services (DOHS) assessment was based on a table of fish "tissue" cadmium levels provided by CH2M HILL. Subsequently, in the Feasibility Study, these tissue levels were identified as liver levels and risk was recalculated on the basis of fish muscle levels not made available at the time of the DOHS assessment.

Because the Iron Mountain site is not located in a population center, as is the case with many other hazardous waste sites, the environmental aspects of the endangerment assessment would appear to form the driving force for remediation.

COMMENT 4-10 (Davy McKee-Morgan)

Water downstream from the cementation plants is essentially similar to recreational water in other areas of Shasta county and no incidences of eye or skin damage have been reported. Contact with individuals in Pennsylvania indicates that no eye or skin damage has resulted from acid mine drainage in that state.

RESPONSE TO COMMENT 4-10

Scientific studies in humans demonstrate that eye contact with acid (hydrochloric) with pH values below 4.5 leads to irritation, while values from 3.5 to 4.5 produces reversible corneal damage. Water samples from streams in the area were documented with lower pH ranges of 2.2 to 3.6. This provides a basis for potential health hazards.

COMMENT 4-11 (Davy McKee-Morgan)

Metal content of fish filets rather than fish liver should be used as the basis of estimating human exposure via sport fish consumption.

RESPONSE TO COMMENT 4-11

Fish muscle data from 10 trout caught below Keswick dam in 1979-1980 are available and have been used for a revised estimate. This revised estimate was made subsequent to the August 1985 Public Comment FS. While risk of eating fish is reduced in the revised estimate, the long-term risk from this bioaccumulative toxin must not be underestimated. Without remediation, mine effluent will continue to be deposited in sport fishing areas of the Sacramento River. The concentration of cadmium in fish will continue to rise and health risk will increase. More complete and current data on cadmium in the Sacramento River ecosystem are needed to adequately predict this increase in health risk.

COMMENT 4-12 (Davy McKee-Morgan)

Comparison of stream water with drinking water standards is not relevant because the standards are applied after municipal water treatment.

RESPONSE TO COMMENT 4-12

Comparison with drinking water standards is provided because these are the most highly standardized reference values. The endangerment assessment does not state or imply that the drinking water quality has been compromised by effluent from the Iron Mountain Site.

COMMENT 4-13 (Boyer)

The chance of humans being injured by acid mine drainage is remote as the access is limited by permission of the property owner.

RESPONSE TO COMMENT 4-13

Human exposure cannot be excluded given the relative proximity of a population center and the recreational use of surrounding areas. Any unfenced area must be considered to permit unlimited public access.

COMMENT 4-14 (Boyer)

Ingestion of harmful amounts of toxic levels of the elements is remote if indeed non-existent. The feasibility study of CH2M HILL says so.

RESPONSE TO COMMENT 4-14

Again, the potential for damage to public health via ingestion of metals exists and has been quantified on the basis of available information.

COMMENT 4-15 (Boyer)

Ingestion of fish from the Sacramento River by humans is benign as far as toxic levels of cadmium, copper, or zinc are concerned, because if the fish do accumulate these metals, it is in the liver.

RESPONSE TO COMMENT 4-15

The highest tissue levels of cadmium are found in the liver, but all tissues are affected by a heavy body burden of this metal. It is estimated that 50 percent of the body burden of cadmium is located in the liver and kidney, with another 50 percent distributed across other tissues. Unfortunately, people also accumulate cadmium in the liver (and kidney) over their lifetime. Accumulation of metals in these organs is a response to elevated exposures and indicates that the organism is at risk for biological effects of these agents. While copper and zinc are essential trace elements, they are both toxic at high exposures and lower exposures can lead to disruption of metabolic processes involving these metals as well as calcium and iron.

COMMENT 4-16 (Boyer)

In TOXICOLOGY, a book by Casarett, Ph.D., and Doull, M.D. and Ph.D., (McMillen 1975), the normal urinary levels of cadmium in the U.S. range from .5 to .11 mcg. per liter. No wonder municipalities are concerned about meeting basin standards. This book also states, on page 468, that in 1971, "the levels (of cadmium) in milk from 61 American cities were found to be 17 to 30 ppb." I am wondering if Superfund money was spent to clear up this problem.

Zinc is not only an essential element for life and reproduction, but is antagonistic to the effects of cadmium. Zinc is also a component of insulin as well as at least 25 essential enzymes and hormones. It is required in the syntheses of DNA and the proper development and functioning of reproductive organs.

RESPONSE TO COMMENT 4-16

The current edition (1980) of the text cited by Mr. Boyer does not include reference to these cadmium concentrations in milk. While zinc is an essential trace element, and is biologically regulated, excess zinc ingestion interferes with biological function of other trace elements, primarily iron, copper, and selenium.

COMMENT 4-17 (Stauffer)

While there is a problem of heavy metal discharge... the related dangers have been exaggerated.... There is no human health hazard presented.... Statements such as "it is possible that the EPA Safe Drinking Water Act maximum containment level for cadmium could be exceeded at the City of Redding municipal water intake"... are very misleading.

RESPONSE TO COMMENT 4-17

One of the analyses of intake water at the plant yielded a cadmium level at the safe drinking water maximum. This suggests that the range of values already overlaps the standard. Care was taken in the endangerment assessment to avoid exaggerating the threat to municipal water in Redding.

COMMENT 4-18 (Stauffer)

The pH measurements on which the onsite possibility of eye or skin irritation is based are not those of any water with which the public contact is foreseeable, but rather those at the drainage outfall of the Richmond portal. The study reveals no record of any injury to anyone...from the Iron Mountain discharge waters.

RESPONSE TO COMMENT 4-18

The pH of water from streams in the area is in the irritation range as detailed above. We did not study incidences of injury, since our aim was to describe endangerment. Prior injury is not a prerequisite for EPA action under Superfund.

COMMENT 4-19 (Stauffer)

Mineralized taste of the stream water would be sufficient to stop a theoretical trespasser from drinking enough of the water to cause a problem.

RESPONSE TO COMMENT 4-19

Hopefully this would be the case; however, we have no information on the taste, color, or smell of the water.

COMMENT 4-20 (McLean)

IMM should be reranked on the basis of the new health effect data in the report, which justifies the immediate removal of IMM from the NPL as a first logical alternative.

RESPONSE TO COMMENT 4-20

Endangerment assessment is part of the feasibility study of an NPL site. It is not used to rank the site or place it on the NPL list. Please also see the Response to Comment 4-2 above, and Comment 9-1 below.

COMMENT 4-21 (McLean)

Four human health threats were cited in the "IMM Hazard Ranking System evaluation." They were dismissed by the (feasibility) study; these conclusions justify the immediate removal of IMM from the NPL.

RESPONSE TO COMMENT 4-21

The endangerment assessment prepared by DOHS has no bearing on the original ranking of the site, as mentioned above. Estimates of human health risk form only a portion of the endangerment assessment, which also includes estimates of risk of environmental damage. Please also see the Response to Comment 4-2 above, and Comment 9-1 below.

COMMENT 4-22 (McLean)

Local stream water with pH of 2.0 to 4.5 is in the same range as river waters in Pennsylvania and West Virginia where there have been no recorded incidences of adverse effects on eyes, skin, or from ingestion. No incidences of adverse effect on employees or visitors have been recorded in over 107 years at the Iron Mountain site.

RESPONSE TO COMMENT 4-22

Scientific reviews of epidemiology of health effects of acid mine drainage (AMD) are needed to support this view. It should be noted that a great deal of our information on the problem of cadmium toxicity in humans resulted from observations of a physician in a residential community downstream from a mine that was discharging cadmium. Thus, there is certainly some precedent for concern over health effects caused by mine effluents. In addition, prior injury is not a prerequisite for EPA action under Superfund.

COMMENT 4-23 (McLean)

The report bases its justification for recommending the expenditure of millions on the "opinion" of an alleged State Health expert that AMD is a potential contact threat to human health.

RESPONSE TO COMMENT 4-23

The wording as well as the content of the DOHS endangerment assessment and also the Feasibility Study Report chapter on health effects makes it clear to what extent a health risk is estimated to exist. This estimate is based on available information and was not exaggerated. The evaluation was appropriately prepared and has played an appropriate role in the Feasibility Study as a whole. A substantial and imminent threat to human life is not a major consideration in the sequence of events involved in EPA actions at this site.

COMMENT 4-24 (McLean)

A true professional evaluation of the AMD contact threat should have contained a documented record of adverse health effects incurred by AMD exposure in Pennsylvania, West Virginia, and Redding, as well as bio-assays of AMD contact toxicity in animal models.

RESPONSE TO COMMENT 4-24

Epidemiological studies and animal assays are not an initial step in public health risk assessment at hazardous waste sites.

COMMENT 4-25 (IMMI-Arman)

Possible health hazards because of Redding drinking water, contact with AMD, or ingestion of sport fish are found by the Feasibility Study to not represent any significant health risk. Because of this, Iron Mountain Mines should be removed from the NPL.

RESPONSE TO COMMENT 4-25

The Feasibility Study and the DOHS endangerment assessment are in substantial agreement as to the extent of human health hazard. These assessments are part of the Feasibility Study and were not involved in the original ranking process.

CATEGORY 5--NEED FOR REMEDIAL ACTION

COMMENT 5-1 (Chico Flyfishers)

The Chico Flyfishers Club recognizes the high value of the fishery supported by the Sacramento River, and even more importantly, the value of the fishery once it reaches its full potential when this dump is controlled. The Environmental Protection Agency is to be commended on the cleanup plan prepared for the waste site.

COMMENT 5-2 (CDFG)

This hazardous waste site releases the largest volume of acid mine waste affecting the greatest downstream area in California. The metal-laden waste has been proven to cause substantial damage to salmon and steelhead populations and other aquatic life. We are pleased with the report's outline of alternative courses of action to protect the upper Sacramento River from these toxins. Actions need to be taken as soon as possible to correct the pollution problem.

COMMENT 5-3 (Shasta Cascade)

Salmon resources are a very important part of the area's future economic prosperity. Whatever is necessary to remove pollutants from the Sacramento River must be done. The enlargement of the Spring Creek Reservoir would be a significant step. We cannot delay any further in taking action.

COMMENT 5-4 (FWS)

The Fish and Wildlife Service is primarily concerned with adverse impacts that acid mine drainage from Iron Mountain Mine has on anadromous fish resources of the Sacramento River. Limited fish and wildlife resources occur in the lower Spring Creek drainage, largely because of extensive land disturbance, devegetation, and the erosive character of soils in this area. In our opinion, the overall benefit of significantly reducing or eliminating toxic discharge to the Sacramento River will far outweigh the impacts of remedial measures, whether they be major structural, source point, or water diversion related.

RESPONSE TO COMMENTS 5-1, 5-2, 5-3, AND 5-4

EPA appreciates the support of the above commenters for the need to proceed with remedial action.

CATEGORY 6--COSTS OF REMEDIAL ACTION

COMMENT 6-1 (IMMI-Foster)

The proposed alternatives would be a continuing cost for as long as it continues to rain in the Redding area. They would completely destroy all possibilities of mineral production and income. Therefore, cost recovery would be impossible, and the taxpayer would ultimately be stuck with the bill.

RESPONSE TO COMMENT 6-1

Under the current Superfund legislation, EPA is responsible for paying the O&M costs for the first year. The operation and maintenance costs for the remaining years would be paid for by the State of California.

EPA is confident that implementation of any agency-funded remedial action would not preclude or present an unreasonable barrier to future mining at the site.

COMMENT 6-2 (McLean)

What is the definition of "cost-effectiveness" as it is used for Superfund sites?

RESPONSE TO COMMENT 6-2

According to the definition in the NCP, cost-effectiveness is defined as the lowest-cost alternative that effectively minimizes threats to and adequately protects the public health, welfare, and the environment.

CATEGORY 7--TIMEFRAME FOR IMPLEMENTING REMEDIAL ACTION

COMMENT 7-1 (Davy McKee-Turk)

EPA has stated that it would take a year for design and 2-3 years for construction of a lime neutralization facility. Davy McKee's experience indicates that they could construct this type of facility in 18 to 24 months, including the design of the processing facilities.

RESPONSE TO COMMENT 7-1

At this time, EPA is not proceeding with lime/limestone neutralization and would only do so if needed. The design and construction of other component remedial action alternatives will actually be completed far in advance of the estimates for the treatment works.

COMMENT 7-2 (Rardin)

Once action has been implemented, how long will it take to clean up Iron Mountain? Is it likely that any of the diversion dams would ever be removed in our lifetime?

RESPONSE TO COMMENT 7-2

Once a remedial action is implemented, the benefits to the Sacramento River are expected to be immediate. Acid mine drainage leaving the site, although reduced by implementing various proposed alternatives, is expected to continue for many years.

Should an alternative be selected that includes the construction of surface water diversion structures, it is not expected that these diversion structures would be removed in our lifetime.

CATEGORY 8--LIABILITY FOR IRON MOUNTAIN MINE PROBLEMS

COMMENT 8-1 (Collier)

Will IMMI have to pay for construction of the lime neutralization plant?

How much liability will government agencies have to assume for contributing to the problem by the operation of Shasta Dam and Keswick Dam? There should be more examination of what the government has done to exacerbate the problem at IMM.

RESPONSE TO COMMENT 8-1

Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), responsible parties are liable to reimburse EPA for all costs expended in taking a response action at an NPL site. This would include the cost of constructing a lime neutralization facility, should it be deemed necessary to meet cleanup objectives. Under CERCLA, a responsible party is defined as the current owner or operator of the site, the past owner or operator, and persons who generated or were involved in transport, treatment, or disposal of hazardous substances at the site. IMMI, as the current property owner, may be liable to reimburse EPA for past response costs, and any costs expended by the agency in implementing Combined Alternative CA-7.

The operation of the Shasta Dam, Keswick Dam, and Spring Creek Debris Dam has no real effect on discharges of AMD that leave the IMM site. The IMM problem probably existed long before the construction of these dams.

The USBR currently operates Spring Creek Debris Dam to minimize the toxic effects of AMD from IMM on aquatic life below Keswick Dam.

CATEGORY 9--PLACEMENT OF IRON MOUNTAIN MINE ON THE NPL

COMMENT 9-1

Three commenters (IMMI-Arman, IMMI-Foster, McLean) stated that Iron Mountain Mine was erroneously placed on the National Priorities List (NPL) in the first place, due to incorrect and misrepresented data. The following points were made:

- o Flat Creek (the RWQCB's basis of groundwater ranking) has only 6 residents, not 40.
- o There are no water wells in the Flat Creek drainage, and the quality of water for all residents of Flat Creek meets all primary drinking water standards.
- o Spring Creek does not and never has caused the quality of the City of Redding's water supply from the Sacramento River to exceed the EPA primary drinking water standards even under the "worst case" conditions over the past 100 years.
- o There is no factual evidence produced in the study to show that IMM in its present state is any threat to human health. It is no different from any other normal copper mining operation meeting prescribed effluent limitations, yet it was falsely classified as an "abandoned" hazardous waste site. IMM should be re-ranked on the basis of the new health effect data in the report which justifies the immediate removal of IMM from the NPL as a first logical alternative.

RESPONSE TO COMMENT 9-1

Releases from IMM do not have to exceed drinking water standards at the water supply intake in order to be considered as a candidate for the NPL. Evidence of release to the surface water pathway (which is one of three pathways considered when evaluating a site for placement on the NPL) is obtained when releases from a site are above background; this has been documented by past State sampling and during EPA's Remedial Investigation.

According to the National Contingency Plan, Section 300.66(7), "Sites may be deleted from the NPL when no further response is appropriate. In deleting sites the Agency will consider whether any of the following criteria have been met...(c) based on a remedial investigation, EPA has determined that the release poses no significant threat to public health or the environment, and therefore, taking of remedial measures is not appropriate at that time." Based on the information derived during the Remedial Investigation, the Iron Mountain Mine site did not meet the above criteria for removal from the NPL.

The findings of EPA's Remedial Investigation that there is a low potential for onsite human exposure to acid mine drainage (dermal contact and ingestion)) has no bearing because it is not considered in the hazard ranking scoring of a site.

COMMENT 9-2 (Miller)

There are many pollution sites in California that are in more need of Superfund money than Iron Mountain Mine.

RESPONSE TO COMMENT 9-2

EPA believes that through the Federal Superfund program and the State Superfund program administered by the Department of Health Services, priority toxic waste sites are receiving appropriate remedial and emergency response actions and are being funded at appropriate levels. Funding the Iron Mountain Mine RI/FS has not directly precluded remedial response actions at other priority sites.

CATEGORY 10--AVAILABILITY OF RI AND FS REPORTS/ PUBLIC COMMENT PERIOD

COMMENT 10-1

Three commenters (Davy McKee-Morgan, IMMI-Arman, Stauffer) commented about difficulties in obtaining the Remedial Investigation and Feasibility Study Reports for review and about the inadequacy of the public comment period. The following comments were made:

- Mr. Morgan stated that on August 2, 1985, he asked EPA to send three copies of the Feasibility Study Report to the Davy McKee Corporation for review. They received one copy on August 9 and one on August 12; one was sent by IMMI and one by CH2M HILL. This allowed only a short time for Davy McKee to review the report and prepare for the August 15 public meeting.

- Mr. Arman stated that 21 days is inadequate for public comment on a project of this size. Even though the Feasibility Study Report was completed for release on August 2, distribution was delayed for several days. He believes the information repository at the Redding public library never did receive a copy of the report. This was a definite disadvantage to the public. More time between the public meeting and the close of the comment period would have allowed a much more comprehensive and detailed critique of the report. Additional time for comment was requested from EPA, but this request was refused.

- Stauffer also commented that the 3-week comment period is unreasonably short for such a complex report. Typically, EPA provides for a comment period of at least 60 days and often longer. Further, it is EPA practice to provide for input from interested parties prior to the publication of a Feasibility Study Report. The National Contingency Plan provides that industry input should be solicited by the Technical Advisory Committee (TAC) in the development of remedial options. The TAC did not include an industrial representative, nor is Stauffer aware that any effort was made by the TAC to solicit industry views.

  The shortness of the comment period was aggravated by the fact that the Feasibility Study Report was not released to Stauffer Chemical Company until August 8 and could not be made available to technical staff until August 12.

Stauffer stated its intention to submit detailed comments to EPA by September 30, 1985, and requested EPA to defer any decision on the selection of a remedial option or the commitment of funds until EPA reviews these comments.

Stauffer's effort to review the Feasibility Study Report was also hindered because they did not have the analytical data that were the basis for establishing the remedial alternatives. They requested the Remedial Investigation Report for review on several occasions, but did not receive it from EPA.

RESPONSE TO COMMENT 10-1

EPA is under no obligation to provide copies of the Feasibility Study Report to IMMI contractors; our responsibilities were fulfilled in providing IMMI with its own copy. We believe it is IMMI's responsibility to forward copies of any reports it wants reviewed directly to its contractors. Nevertheless, EPA did provide IMMI and its contractors with five copies. Copies were also available at two information repositories in Redding (the public library and the RWQCB offices) and at EPA's Region 9 office from August 2 through August 23 for review and comment by the public and interested parties. The availability of the report was announced in newspaper notices 2 weeks before the beginning of the public comment period and in a fact sheet distributed to the project mailing list.

According to Section 300.67(d) of the NCP, the typical timeframe in the Superfund program for review of documents is 3 weeks; EPA met that requirement. EPA believes the 3-week public comment period was adequate to receive public comment.

EPA did informally extend the review and comment period to September 30, in part to consider Stauffer's comments. We believe this decision demonstrated a good faith effort on the part of EPA to consider comments on the Feasibility Study Report. Stauffer was encouraged to submit comments to EPA close to the August 23 date so they could be considered prior to the selection of a remedial action. However, EPA did not receive Stauffer's comments until October 9, almost 7 weeks past the close of the public comment period.

The Feasibility Study Report was reviewed by a representative from Stauffer at EPA's Region 9 office on August 6 or 7. The draft Remedial Investigation Report was available for public review at the information repositories in February 1985, as stated in a fact sheet that was distributed to the project mailing list. Two copies of the final RI report were made available to Stauffer, one to its San Francisco office and one to the President of Stauffer.

During the course of EPA's investigation, there appeared to be no interest on the part of the potentially responsible parties (PRPs) or industry groups regarding their participation in the Remedial Investigation/Feasibility Study. The Technical Advisory Committee was composed of representatives from Federal and state regulatory agencies, some of whom have extensive experience with the mining industry and mining-related matters. Since there was no interest expressed by the PRPs, EPA considered the availability of the draft RI report and the 3-week public comment period for the draft FS report as the principal means of securing industry's and the PRPs' views on the RI/FS.

CATEGORY 11--TECHNICAL INPUT AND REVIEW OF THE RI/FS

COMMENT 11-1

Four commenters (Boyer, IMMI-Arman, McLean, Miller) questioned the composition of the Technical Advisory Committee (TAC), as follows:

- The National Contingency Plan provides that industry input should be solicited by the TAC in the development of remedial options. No effort was made to solicit industry views or include an industrial representative on the TAC. Why weren't representatives from industry, economic development, politics, or the general public included on the TAC?
- The TAC included only representatives from government agencies and appears to be a biased group that has been blaming Iron Mountain Mine for all the fish problems in the Sacramento River.
- Is it policy that only government agencies are represented on technical advisory committees? Is industry ever included?
- The study should have been reviewed by recognized technical experts in the fields of analytical chemistry, biology, computer programming, and acid mine drainage abatement technology.

RESPONSE TO COMMENT 11-1

It is not policy that only governmental agencies be represented on technical advisory committees. Industries have been included on these committees. Industry input is encouraged, but not required. During the course of EPA's investigation, interest was not expressed by, nor did EPA perceive interest from, the PRPs, industry groups, or the public regarding their participation in the Remedial Investigation/Feasibility Study.

The TAC was composed of representatives from State and Federal agencies with expertise in critical areas that would ensure that EPA had a full understanding of the environmental problem at IMM and possible solutions to the problem. The TAC served only in an advisory capacity to EPA and had no decision-making power; all project decisions rested with EPA in consultation with DOHS and RWQCB.

One technical committee of the TAC included a metallurgical processing expert and a mining waste expert. Later, the TAC was expanded to include a representative from Colorado School of Mines Research Institute (CSMRI).

COMMENT 11-2 (Stauffer)

Orebody Capping

Throughout the report, EPA's contractor suggests complete capping of the site above the Richmond orebody at a cost of $7.0 MM. Complete capping is unnecessary and impractical. Instead, diversion of local surface drainage channels from above the pyrite deposits, closure of major mine openings (including the Brick Flat pit) and filling of caved areas and ground cracks should be undertaken.

These actions will result in a substantial reduction of near vertical water infiltration to mine workings in three major AMD source areas--Brick Flat, Richmond, and Hornet. This selective closure and diversion program can be accomplished at an estimated cost of $2.5 MM and will accomplish essentially all of the objectives of the capping remedy.

Combined Alternatives CA-5, 6, and 7 ignore the beneficial effect of selective capping and rely entirely on reservoir expansion and water diversion to meet cleanup objectives.

RESPONSE TO COMMENT 11-2

Based on the information obtained during the Remedial Investigation, complete capping is estimated to be much more effective than partial capping and surface diversions. However, if a phased approach is taken, partial capping could be implemented prior to complete capping to verify the analyses in the Remedial Investigation. If partial capping and diversion prove to be more effective than estimated, complete capping may not be necessary.

COMMENT 11-3 (Stauffer)

Any groundwater intercept system at this site is expensive and of questionable benefit. As indicated in later comments on the Remedial Investigation Report, the extent of groundwater contribution to downstream heavy metal levels has not been clearly identified in the investigative report.

Our analysis and that of CH2M HILL indicate that contamination of laterally moving groundwater is not a major contributor to site releases. Diversion of Slickrock Creek around selected tailings areas will substantially reduce contamination measured in the upper Slickrock Creek area at moderate expense.

To include an expensive groundwater intercept system (at a cost of $10.0 MM), with no assurance of its effectiveness or need is not a cost-effective use of fund monies and is contrary to the direction of the NCP.

RESPONSE TO COMMENT 11-3

The Remedial Investigation indicated that limited data were obtained during the RI and recommended further studies prior to implementing the groundwater interception alternative.

Results of the Remedial Investigation indicate that approximately one-third of the average flow from the Richmond portal is groundwater. The Richmond portal (see Figure 6-6 in RI) accounts for 31 percent of the copper and 70 percent of zinc and cadmium. Therefore, assuming metal load reduction is proportional to the flow exiting the portal, then 10 percent of the copper and 23 percent of both zinc and cadmium of the overall metals leaving the site are due to groundwater.

There is no information available to fully determine the effectiveness of diverting Slickrock Creek with regard to metal load reduction on Big Seep.

COMMENT 11-4 (Stauffer)

A major cost factor in Alternates CA-5, 6, and 7 is inclusion of a substantial expansion of the holding capacity of Spring Creek Reservoir.

We believe there is inadequate data available at the present time to justify such an expansion. Diversion of upper Spring Creek and Slickrock Creek, combined with selective plugging, sealing, and water diversion in the immediate vicinity of mine workings will sufficiently reduce the volume of water collected at the Debris Dam that the present facility can be utilized without expansion.

RESPONSE TO COMMENT 11-4

The data used in the model to evaluate alternatives that include reservoir expansion are based on historic Spring Creek Reservoir inflows and metal loadings and flow releases from Shasta Dam. Using this information, the analyses in the Feasibility Study indicate that the alternative identified in this comment by Stauffer does not meet the cleanup objectives established by EPA.

COMMENT 11-5 (Stauffer)

Heavy Metal Removal

Treatment of collected water for removal of heavy metals, other than the cementation process currently operated, is impractical and unnecessary. It will most likely create a hazardous waste disposal problem for disposal of the large volume of metal contaminated sludge generated by the treatment system (because of the RCRA mixture rule) which is overlooked entirely in the report.

RESPONSE TO COMMENT 11-5

Treatment of collected water for removal of heavy metals will create sludge which may be classified as a hazardous waste. This does not necessarily mean that this treatment technology is impractical and unnecessary. The disposal of metals-laden sludge was considered with regard to RCRA requirements in the report in the event RCRA is relevant and/or applicable.

COMMENT 11-6 (Stauffer)

Five major sources (Richmond portal, Lawson portal, Old No. 8 mine, Big Seep, and Brick Flat) are stated to account for 72 percent of copper and 86 percent of zinc and cadmium leaving the mine area. The scope of chemical analysis and sampling from this investigation are not sufficient to be certain of these proportions. It is likely that just three (Richmond, Lawson, Old No. 8 mine) of the cited sources account for most of the total metal loading entering Spring Creek Reservoir. Obviously, this is a critical point, since if three rather than five major sources of contamination need to be addressed, substantial savings in remedial action costs can be achieved.

RESPONSE TO COMMENT 11-6

As stated in our remedial investigation, about 72 percent of the copper and 86 percent of both zinc and cadmium were found to originate from the five major sources at Iron Mountain Mine for the period between February 29 through May 8, 1984. In addition, it was pointed out that this was during relatively dry weather conditions, which is not necessarily representative of heavy rainfall conditions. Because of the complexity of the Iron Mountain site and the extent of mine tailings and acid mine drainages, both from point and nonpoint sources, it would be extremely difficult to come up with an accurate estimate of the contribution from each source at the site during varying rainfall conditions. It would be expected that during initial rainfalls in the fall months, there would be a large flush of metals from exposed ores. During this period, the metal loadings from these sources is expected to result in a very large contribution. It is also possible that after this initial flush with heavy rainfall on the mountain, flows from the Richmond portal, Lawson portal, and Big Seep could increase substantially and represent an even larger portion of the total metals contribution to Spring Creek Debris Dam than what was estimated during our relatively dry winter period.

The overall remedial actions were not based upon individual metal concentrations or loadings from any of the five major sources, but were based upon the overall metals leaving the site and their effect on the Sacramento River below Keswick. Source control alternatives were primarily directed toward the Richmond orebody and the resultant acid mine drainage leaving the Richmond portal and did not address the other major sources. Surface water diversions were based strictly upon the total metals leaving the site, not upon where they originated from; therefore, whether the majority of the metals were originating from three sources as opposed to five sources do not appear to affect the cost of the overall remedial action alternatives.

COMMENT 11-7 (Stauffer)

Subsurface flows along Slickrock Creek are stated to account for a substantial portion of metals entering Spring Creek during late May and early June, 1984. Indeed, the map on Figure 6-10 shows large increases in flow and metal content (ninefold increase in copper content) in the lower reach of Slickrock. This single sampling effort on Slickrock is not adequate to draw this conclusion and should be followed up to confirm this finding. If true, this could be of greater significance than is suggested in the report because it has a direct bearing on the recommended remedial actions (groundwater intercept).

RESPONSE TO COMMENT 11-7

As presented in Table F-22 in the Remedial Investigation study, four surveys were made in the Slickrock Creek to determine additional sources of copper. The data suggest that copper and other heavy metals are picked up as the stream moves through old mining deposits. It does not appear that these observations have any bearing on our recommended groundwater interception alternative.

COMMENT 11-8 (Stauffer)

The last six findings reported in the summary of the Remedial Investigation Report relate to the behavior of subsurface water and the potential for interception before it encounters the orebodies. The available data, as presented, are insufficient to draw any of these conclusions.

RESPONSE TO COMMENT 11-8

Three of the conclusions listed in the Executive Summary are actually a listing of the results from hydrogeologic testing rather than conclusions drawn from the data.

The last conclusion listed in the Executive Summary states that 17 gpm would be intercepted if tunnels are 100 percent effective. It is not known if the tunnels will be this effective; therefore, we recommend further testing to determine effectiveness (page I-3 of the Remedial Investigation).

The 17 gpm is estimated from the results of both the permeability testing and analysis of the portal hydrographs. The hydrographs analyzed included those from both 1984 and 1985. The 1984 conditions were after several years (1982 and 1983) of greater than normal rainfall. The 1985 conditions were after a year (1984) of lower than normal rainfall. The hydrographs indicate approximately the same low flow conditions during 1984 and 1985; therefore the groundwater flow component probably does not vary substantially. The temperature data appear to substantiate the conclusion that low flow conditions are associated with groundwater flow. During times of low flow, the temperature associated with Richmond portal AMD is approximately equal to the temperature of groundwater measured in the monitoring wells (see page I-16 and Figure I-3 for more detailed discussion).

One of the conclusions listed in the Executive Summary is that groundwater becomes contaminated as it flows through the massive sulfide orebody into the Richmond mine workings. This was concluded from data that indicate (1) groundwater is flowing toward the Richmond orebody, (2) the groundwater quality as measured in the monitoring wells is much better than the AMD flowing from the Richmond portal, and (3) the base flow from the Richmond portal is on the order of 17 gpm.

The conclusion in the Executive Summary that describes the relative contributions to the AMD is based primarily on 1984 data. However, some data from 1983 during relatively wet months were used in formulating the conclusion. This conclusion is based on analysis of the Richmond portal hydrograph and engineering judgment and should be re-evaluated using additional data determined during subsequent testing discussed in the Remedial Investigation and Feasibility Report.

COMMENT 11-9 (Stauffer)

It is noted in this report that the evapotranspiration of the study area is considered to be 40 inches. Since rainfall at the mine is considered to average about 80 inches, then 40 inches is available for runoff and infiltration below depth of plant root zones. This amount of evapotranspiration appears high considering the type of vegetation and soil present and, in fact, contradicts data presented in the section on hydrology (see below). This is a critical factor, since the volume of infiltration has a direct bearing on the extent, if any, of surface capping and source control needed at this site.

RESPONSE TO COMMENT 11-9

The 40 inches of evapotranspiration referred to in this comment was presented in the climate section of the remedial investigation report for the purposes of presenting general information. It is the potential evapotranspiration for the site; not the actual which is dependant upon such factors as soil moisture content (including infiltration), type of vegetation, and quantity of vegetation. This value was not used in the determination of the effectiveness of surface capping and source control alternatives presented in the feasibility study report.

COMMENT 11-10 (Stauffer)

The soil is indicated as being Type C of the Soil Conservation Service runoff categories. This soil type has a slow infiltration or higher than average runoff which could be accentuated by the steep topography. Both factors are favorable under these circumstances. Unless special conditions exist, infiltration would likely be less than 25 percent of the total rainfall into undisturbed hillsides. Twenty-five percent of 80 inches of rainfall is 20 inches, which cannot support the 40 inches of evapotranspiration mentioned above. The soil may be more permeable than Type C, but there are no analytical or descriptive soil data supporting this conclusion. These data need to be further explored and confirmed before any capping alternative can be considered.

RESPONSE TO COMMENT 11-10

The evaluation of effectiveness of the capping alternatives was based on observed rainfall, historic rainfall, observed discharge from the Richmond portal, and historic runoff from the Spring Creek watershed. Soil types for estimating runoff from rainfall and the average evapotranspiration value were not used in this analysis. As discussed in the Response to Comment 11-10, the actual evapotranspiration at the site is not directly related to the potential evapotranspiration of 40 inches.

COMMENT 11-11 (Stauffer)

On page 4-2, average monthly inflow to Spring Creek Reservoir is presented. The monthly inflows for February and March, 119 and 124 cfs, do not correlate well with the rainfall figures on page 2-2 of 14.1 and 7.8 inches, respectively, for the same months. Thus, there is clearly a lack of correlation of precipitation, infiltration, and surface water flows critical to selection of an appropriate cost-effective remedial action.

RESPONSE TO COMMENT 11-11

The average monthly precipitation presented in the remedial investigation report in Table 2-1 is not for the same period as the inflow into the Spring Creek Reservoir presented in Table 4-1. The information as presented in those tables was not used in the analyses of the effectiveness of source control alternatives in the feasibility study, but was presented in the RI to show seasonal variations of precipitation and Spring Creek flows.

COMMENT 11-12 (Stauffer)

The objectives of the groundwater investigation of the Richmond orebody spelled out on page 4-6 require a much more comprehensive field effort than the four holes and limited tests reported in Appendix I. These limited tests indicate wide ranges in hydrologic properties. For example, permeabilities from four pumping tests span almost two orders of magnitude, i.e., 0.28 to 0.0042 foot per day. The transmissivities are given as 13 to 480 gal/day/foot. There is no calculation that would give rise to the conclusion that these values by themselves are consistent with observed flows discharging from the Richmond portal.

RESPONSE TO COMMENT 11-12

Within each borehole the two types of permeability tests were reasonably consistent and the variation in permeability was found to decrease spacially toward the orebody. This variation in fractured rock is typical and should be expected.

The drain formula shown on page I-16 was used as an independent check on the permeabilities determined from pump testing. The results of this analysis indicated the average permeability of the formation was approximately the average of the extreme values measured in the testing program. Other calculations using Darcy's Law were also performed, but not published, that indicated the measured permeabilities were consistent with the flow from the Richmond portal.

All the data collected were consistent: temporally, spacially, and independent of method used. Therefore, we believe conclusions can be drawn from the data. However, we agree that the data did not completely define the groundwater flow around the mine, and we therefore recommend that additional work be performed prior to final design. The work performed for the Remedial Investigation and Feasibility Study is consistent with the goals of these reports.

COMMENT 11-13 (Stauffer)

A conclusion is made on page 4-7 that the discharge from the Richmond portal is from three sources--lateral inflow, rapid infiltration, and surface water infiltration. This seems reasonable, but the proportions derived from the unusually low flow 1984 hydrograph studies are probably not dependable, and certainly not sufficient to be used as a basis for major engineering expenditures at the site.

RESPONSE TO COMMENT 11-13

EPA believes that these conclusions should be tested prior to construction of the groundwater interception system. When additional data are obtained, the contributions of the different sources may need to be modified.

COMMENT 11-14 (Stauffer)

Recommendations for work on any subsurface intercept system should be contingent on results of surface water sealing and diversion work. The type of work necessary to establish the viability of underground intercept as a remedial measure must be more elaborate than indicated and may well still prove inconclusive. The fractured-rock hydrology in the vicinity of a mine with numerous openings and levels of openings can prove a deficient subject on which to develop reliable data.

RESPONSE TO COMMENT 11-14

We tend to agree with the phased implementation program. And as discussed earlier, additional data should be obtained prior to construction of the groundwater interception scheme.

COMMENT 11-15 (Stauffer)

Chapter 6 contains several efforts at ranking the sources of heavy metals pollution at Iron Mountain. Three sets of data were obtained on flow rates and on the copper, zinc, and cadmium contents from "intensive sampling" from a variety of sources. These show that the Richmond portal, the Lawson portal, and the Old No. 8 mine seep constitute 92 to 99 percent of the total of these metals leaving the site. This is in accordance with historical data. It should be the basis for concluding that remedial action should be limited to these specific sources, not the five suggested later in the feasibility study.

RESPONSE TO COMMENT 11-15

See response to Comment 11-16.

COMMENT 11-16 (Stauffer)

A further attempt of a mass balance covering a span of 10 weeks from February 20 to May 8, 1984, is considered by CH2M HILL to be more accurate than the above. The measurements were, however, during an exceptionally dry period and are probably no better than the intensive sampling data. These results should be discontinued, and the sampling data cited above should be used for considering remedial action.

RESPONSE TO COMMENT 11-16

The RI report described mass balances that were obtained under both wet weather conditions and also an 11-week period during dry weather conditions. It was pointed out in the report that during the two intensive surveys, five major sources contributed 95 to 99 percent of the sum of the copper, zinc, and cadmium. These April and December samplings were made over a 2- to 4-day period which at times, under varying rainfall conditions, probably caused major variations in flow. In addition, the material balances were made over an 11-week period under relatively dry weather conditions, in which all sampling was conducted within a 6-hour period and flows were accurately gauged. It would be expected that the contribution of the five major sources during dry weather conditions and under wet weather conditions would vary. It was also pointed out in the RI report that the Richmond portal was the major contributor of acid mine drainage from the site. All these results were taken into consideration in selecting remedial action alternatives. Source control alternatives at the site only address the Richmond orebody because this appears to be the major contributor both under dry weather and wet weather conditions.

What determines which sources of acid mine drainage which need remediation is based upon the reduction in metals required to meet State and EPA water Quality objectives in the Sacramento River.

COMMENT 11-17 (Stauffer)

In Appendix D, the ESA geotechnical consultants letter report (four pages) addresses the subject of "source control." With regard to subsurface efforts, it states that a program detailed enough to define the subsurface flow systems in the area is probably not practical. Therefore, the four-hole test program recommended and completed was unnecessary and of no benefit.

RESPONSE TO COMMENT 11-17

EPA believes that the testing program did obtain useful data from which meaningful conclusions can be made with regard to groundwater movement and quantities.

COMMENT 11-18 (Stauffer)

Appendix D recommends backfilling of subsidence depressions, including a clay capping. This recommendation appeared to include total backfilling of the Brick Flat open pit, which is impracticable because of its volume.

RESPONSE TO COMMENT 11-18

The recommendation includes backfilling of Brick Flat Pit to an elevation that would establish gravity drainage from the pit along the haul road cut at the south end of the pit. Depending upon the method selected for drainage of the pit, this may require a fill up to 16 feet deep in the eastern portion of the pit. The recommendation does not include filling the entire pit.

COMMENT 11-19 (Stauffer)

Mine exit sealing is suggested, but the report acknowledges it is not practicable for the Lawson and Hornet tunnels. In our opinion, sealing the Richmond portal would likely result in water exiting from other places on the mountain side. It is impossible to seal the Old mine and No. 8 mine sites.

RESPONSE TO COMMENT 11-19

We tend to agree.

COMMENT 11-20 (Stauffer)

For subsurface interception, use of "drainage tunnels" is proposed, although it is recognized to be costly and uncertain. Water quality from such tunnels may be contaminated and the work of no use at this particular site.

RESPONSE TO COMMENT 11-20

Additional testing as recommended in the Remedial Investigation and the Feasibility Study should be performed to evaluate the effectiveness of the groundwater interception drifts prior to implementation. However, we believe the technique is feasible for interception of groundwater, and problems associated with intercepting areas of contaminated groundwater are not major design problems.

COMMENT 11-21 (Stauffer)

The evaluation of electrochemical processing alternatives (by R. L. Clarke) is premature because the ultimate flow rates and metal concentrations and proportions cannot be known until the source control work is completed. Flows certainly will be less than the 2,000 gpm and most likely less than the 200 gpm rates that Clarke assumes.

RESPONSE TO COMMENT 11-21

Dr. Robert Clarke evaluated electrochemical alternatives for metal recovery early in the RI phase of the Iron Mountain Mine study. His evaluations were based upon existing flow and metal concentrations that had been observed from Iron Mountain Mine, and those evaluations were intended only to assist in screening of treatment technologies for acid mine drainage.

COMMENT 11-22 (Stauffer)

The letter from the Department of Health Services (Appendix H) states that the mine area "poses a significant danger to hikers who would go to that area." Stauffer disagrees with this conclusion. This has never been known to be a problem, since the appearance of the stream (with iron staining and color) is such as to discourage casual exposure. Other than flow direct from the Richmond and Lawson portals, acidity is not so low as to cause any dermal hazard.

RESPONSE TO COMMENT 11-22

EPA acknowledges Stauffer's opinion. However, the AMD laden waters leaving the Richmond and Lawson portals is clear when transported via the flumes for treatment. The water in the flumes could be mistaken as drinking water that is being conveyed elsewhere for consumption.

COMMENT 11-23 (Stauffer)

The hydrologic tests in the vicinity of the Richmond orebody used as a basis for establishing groundwater flow in that area is inadequate. Four borings put down for that purpose were pump tested, but equilibrium rates of extraction were never achieved during the test period. The excessive drawdowns produced invalidate the calculations of hydrologic properties.

RESPONSE TO COMMENT 11-23

EPA believes that meaningful conclusions can be drawn from the data obtained from the field investigation.

Large drawdowns do not invalidate the use of pump tests but can produce some errors if properly evaluated. Errors can be minimized by analyzing specific portions of the drawdown and recovery data. Furthermore, during a constant discharge pumping test, equilibrium conditions will not occur unless a recharge boundary (i.e., stream) is encountered. The pumping tests were evaluated using the standard non-equilibrium formulas, and results were consistent with packer permeability testing results.

COMMENT 11-24 (Stauffer)

The conclusion that 17 gallons per minute of base flow would be captured by groundwater placed on both sides of the Richmond mine is speculation. For one thing, the 17 gallon per minute base flow figure comes from the dry year of 1984. Also, it is not established that the apparently near-constant base flow in the Richmond portal actually derives from the kind of groundwater flow that could be captured by "drainage tunnels" or is lateral flow.

RESPONSE TO COMMENT 11-24

See response to Comment 11-8. We have also recommended that additional testing be performed prior to implementation of the groundwater interception drifts.

CATEGORY 12--IMMI PROPOSAL

Several people commented regarding Iron Mountain Mines, Inc.'s proposed alternative. These were primarily people currently or previously associated with Iron Mountain Mines, Inc., or with previous mine owners (Boyer, Davy McKee-Morgan, Davy McKee-Turk, IMMI-Foster, IMMI-Arman, Katzakian, Miller, McLean, Stauffer, and Collier). These people expressed several benefits associated with the project and concerns with EPA's evaluation of the IMMI alternative in the Feasibility Study. These comments are paraphrased and summarized below with corresponding responses.

COMMENT 12-1

The IMMI proposal would be an economic plus for the local area, would not cost the taxpayer, and would allow use of Superfund money for other projects.

RESPONSE TO COMMENT 12-1

Assuming IMMI can obtain financing, the project could be implemented without use of taxpayer money. EPA agrees that these are both positive benefits and are part of the reason why EPA is encouraging IMMI to enter into an agreement whereby IMMI can provide detailed information to back up its claims that the project is economically, technically, and environmentally sound, and that future money would be available to repair further environmental harm that might occur should the IMMI proposal fail. Most importantly, the legal duty placed upon EPA by CERCLA does not include selection of a remedy that provides economic benefit. Instead, EPA's obligation is to choose a cost-effective remedy that adequately protects human health, welfare, and the environment. Therefore, economic benefit cannot be the focus of EPA's analysis of remedial alternatives.

COMMENT 12-2

The alternative was treated in a superficial manner in the Feasibility Study because EPA, RWQCB, and EPA's contractor don't understand the proposal.

RESPONSE TO COMMENT 12-2

The IMMI alternative was not evaluated and compared to EPA alternatives primarily for three reasons:

1. The proposed IMMI alternative was received by EPA one week prior to publishing the draft Feasibility Study Report.

2. The IMMI alternative cannot be compared on a cost-effective basis with EPA alternatives because EPA cannot implement a commercial mining facility. Therefore, it is considered a potential alternative that could be implemented in lieu of EPA's selected alternative.

3. There was not enough information available to determine if the project was technically, economically, and environmentally feasible. That is why IMMI consultants are planning pilot studies and marketing studies.

EPA must be assured that the combined processes will work, project cleanup objectives will be met, and the project will not create a worse (potential) environmental problem than the one it is trying to solve. If needed, IMMI will be required to design and construct additional remedial actions to meet site cleanup objectives. Assurances must also be made that funds will be available for all post-closure site cleanup activities that will be designed to ensure that site cleanup objectives will continue to be met.

Without all of the above assurances, EPA cannot consider selecting the proposed IMMI alternative. Although the IMMI proposal was initially screened in the Feasibility Study, EPA has made it very clear that it would consider the IMMI proposal if it could be demonstrated that it was as effective as the EPA cleanup program. In fact, in a meeting on July 25, 1985, with IMMI, EPA outlined three options under review by the Agency for considering the IMMI proposal as a solution to the IMMI problem. IMMI was afforded the opportunity of selecting one of the three options. These three options were described in a letter to IMMI, dated September 4, 1985. In late September 1985, IMMI verbally stated its preference to proceed with the third option, under which IMMI would proceed at its own risk.

EPA has also retained a consultant to evaluate the technical feasibility of IMMI's proposed in-situ leaching and metals recovery process, and to evaluate the marketability of the proposed products generated by this process. These evaluations, together with any additional information supplied by IMMI, will be used as a basis for future consideration of the IMMI proposal.

It is EPA policy to have potentially responsible parties fund needed site investigation and cleanup activities to the extent that these activities are conducted in strict accordance with the NCP and will result in meeting project objectives. However, if these activities will not be conducted in a timely and expeditious manner, and the PRP has not provided certain financial assurances, EPA will proceed with the needed action. This is the case with the Iron Mountain Mine site.

COMMENT 12-3

EPA's proposed alternatives would prevent future mining of mineral resources.

RESPONSE TO COMMENT 12-3

EPA's recommended alternative may have an effect on future mining, but would not preclude future mining activities.

COMMENT 12-4

The information in the Feasibility Study Report was biased against the IMMI proposal and was aimed to discredit it.

RESPONSE TO COMMENT 12-4

The information provided in the Feasibility Study Report was not intended to be biased or for the purpose of discrediting IMMI's proposed alternative. In fact, page ES-8 of the Feasibility Study Report states: "The inherent advantage of the proposed IMMI alternative is that it would be constructed and operated by IMMI. In addition, should it function as described by IMMI, it could be the only profitable alternative."

Technical and environmental concerns were identified in the Feasibility Study Report based on information provided to EPA at the time the report was prepared. Some of these technical and environmental questions have been answered, whereas others will have to be answered as the result of further studies mentioned above.

COMMENT 12-5

The IMMI proposal is an innovative project and recycles metals, which is encouraged by the NCP, whereas EPA's proposed alternatives do not recycle.

RESPONSE TO COMMENT 12-5

EPA agrees that the IMMI project is innovative and recycles waste. This is the reason EPA has stated that it will consider the IMMI proposal provided the assurances described in the response to Comment 12-1 are met.

CATEGORY 13--OTHER REMEDIAL ACTION ALTERNATIVES

COMMENT 13-1 (Collier)

Placement of a permanent cap will prevent additional mining and put IMMI out of business. Wouldn't a feasible alternative be oiling of the surface as a temporary measure; this would prevent water percolation, would test whether a cap will even work, and would allow possible implementation of IMMI's alternative in the future.

RESPONSE TO COMMENT 13-1

Oiling would not necessarily prevent inflow and infiltration into the orebody.

Placement of a permanent cap would not necessarily prevent additional mining on the site.

Results of the Feasibility Study indicate that a cap would be effective in reducing the discharge of acid mine drainage from the site.

The Feasibility Study is looking at permanent remedies to the problems, not temporary solutions.

COMMENT 13-2 (Nor)

EPA and the other concerned agencies should consider the potential economic benefits of maintaining a viable mining operation. While EPA is not in the private enterprise business, the government is in the mining business, through the Bureau of Mines. It would seem possible for the government and private industry to take joint action that would allow continued mining. If this possibility of continued mining is not investigated, all of the alternatives have not been considered.

RESPONSE TO COMMENT 13-2

If the IMMI proposal is allowed to proceed, it must be financed with private capital since the purpose of the Superfund is to elimiinate the danger posed by a hazardous waste site. Congress did not intend the fund to be used in commercial ventures. Therefore, a joint venture at IMMI is not a realistic alternative. A joint venture with the Bureau of Mines would have to be discussed with that Agency.

COMMENT 13-3 (Ross)

Alternatives that include diversion of Upper Spring Creek would cause flooding of his property; similarly, diversion of the South Fork Spring Creek would damage other properties. The City of Redding's proposed hydroelectric project would divert Upper Spring Creek to the Keswick Lake area, which would prevent property damage and also have the economic benefit of generating hydroelectric power. Why wasn't this alternative considered in the Feasibility Study? If the City of Redding does implement this project, would EPA consider it in lieu of the diversion alternatives included in the Feasibility Study Report?

RESPONSE TO COMMENT 13-3

The Spring Creek diversion alternative may have an effect on downstream property owners living on Flat Creek. The extent of the effect will have to be determined during final design.

If the City of Redding implements its proposed pump storage hydroelectric project on Upper Spring Creek, the Spring Creek diversion discussed in the Feasibility Study Report may not be required. There is no assurance that the City will build this project. However, if it is built, it would serve the same purpose as the proposed Spring Creek diversion. EPA would like to keep this option open if the City obtains the necessary permits and licenses to construct its hydroelectric project.

COMMENT 13-4 (Stauffer)

Stauffer Chemical Company believes that more cost effective remedial options should be available to meet both EPA and California water quality criteria than have been proposed in the Feasibility Study. In contrast with option CA-7, which would cost a staggering $42.8 million, it is our opinion that options should be available at an expenditure of approximately $5 million.

Once such option would combine (1) alternative WM-1, the diversion of upper Spring Creek; (2) treatment of mine drainage from the Richmond and Lawson portals to remove copper, zinc, and cadmium; and, (3) control of the reduced discharge volumes from the Spring Creek Debris Dam to ensure adequate dilution.

Alternative WM-1 would serve to divert up to 800 cfs or 1,500 acre feet per day of flow from the Spring Creek Debris Dam reservoir. Diversion of this flow would render unnecessary the proposal to increase the reservoir capacity. With those reduced volumes, it would be feasible to obtain sufficient dilution at the Keswick Dam in the Sacramento River to meet water quality criteria under varying conditions of flow from Shasta Dam.

An additional advantage of Alternative WM-1 is the possibility of combining this alternative with the installation of a hydroelectric facility for the generation of power. The diversion of Spring Creek would involve about a 1,000-foot drop requiring some form of energy dissipation to avoid massive erosion and silting problems. Passive means for energy dissipation have been proposed in the Feasibility Study under option WM-1. The recovery of hydroelectric power, however, would provide for the utilization of a natural resource, as well as economic return.

Treatment of AMD from the Richmond and Lawson portals would provide for up to a 50 percent reduction in the dissolved copper concentration and as much as a 90 percent reduction in zinc and cadmium concentrations at the Spring Creek Debris Dam. Improved treatment of AMD from these two sources combined with the diversion of upper Spring Creek and the control of flow from the Spring Creek Debris Dam should permit compliance with water quality criteria at the Keswick Dam discharge.

There appears to be general agreement with a phased or stepwise approach to the IMM acid mine drainage problem. Although we believe that the above lower cost alternative would meet water quality criteria, additional remedial steps are entirely feasible and could be subsequently incorporated if proven to be necessary. The foregoing option will be more completely reviewed, together with other options, in preparation of our further comments to be submitted by September 30.

RESPONSE TO COMMENT 13-4

According to the analyses presented in Appendix G, it is not likely that the alternative of WM-1, treatment of two major sources and operation of Spring Creek Debris Dam, would meet objectives and it certainly would not meet all applicable, relevant, and appropriate federal and state requirments. For example, Alternative No. 12 on page G-27 of the Feasibility Study Report includes WM-1, treatment of five major sources, groundwater interception, and diversion, and assures efficient operation of Spring Creek Debris Dam.

EPA agrees with a stepwise approach to the implementation and monitoring of remedial actions.

EPA would seriously consider allowing Stauffer to implement its $5 million remedy if it could prove that it would succeed in meeting cleanup objectives for 1978 conditions.

COMMENT 13-5 (FWS)

One alternative not fully addressed is construction of a combined inflow and pumped storage dam in the Spring Creek basin upstream from the confluence of Boulder Creek. This measure is presently being proposed by the City of Redding in their application for license to the Federal Regulatory Energy Commission for a hydroelectric project in Spring Creek (Project No. 8499). The project would provide a storage dam to receive both inflow from upper Spring Creek and pumped storage from Keswick Reservoir. The proposed project would have the capability of diverting and releasing up to 1,600 cfs from the upper Spring Creek basin, thereby eliminating the occurrence of spills from Spring Creek Debris Dam. This alternative would provide the additional benefit of hydroelectric energy capacity for 110 MW, enough to pay for the project. Our initial assessment of the City of Redding's proposal is that it would greatly benefit anadromous fish resources. The Service strongly recommends that this alternative be fully addressed in the Feasibility Study.

RESPONSE TO COMMENT 13-5

This alternative would have the same effect as the diversion of Spring Creek, which has already been evaluated. The difference is that the hydroelectric project would be implemented by the City of Redding, reducing the overall cost of the selected combined remedial action alternatives. As stated in the response to comment 13-3, EPA will keep this option open.

CATEGORY 14--PREFERRED REMEDIAL ACTION

COMMENT 14-1 (CDFG)

As trustee of California's fish and wildlife resources, our department seeks full protection of those resources in the upper Sacramento River. Of the alternatives listed, CA-7 comes the closest to that goal. We support this alternative, given that each component of the waste control system is evaluated after construction and measures are added as necessary to achieve full protection. Such additional measures could include effluent treatment, adjusting the debris dam storage capacity, and coordinating releases from Shasta Lake, Spring Creek Reservoir, and Spring Creek Powerhouse.

RESPONSE TO COMMENT 14-1

EPA appreciates the support of CDFG. We anticipate that implementation of remedial action at IMM will achieve our mutual goal of protecting the fish and wildlife resources of the Sacramento River.

COMMENT 14-2 (Rardin)

As citizens, we are concerned about the pollution created at Iron Mountain and support your efforts to remedy the problem. We encourage you to consider combined alternative number four, which calls for complete capping, groundwater interception, and treatment by lime/limestone. We believe that capping and groundwater interception are important in that they are preventive; that is, waterways would not be polluted to the existing extent.

If the Environmental Protection Agency should select a combined alternative that includes the building of a diversion dam on Spring Creek, we strongly request that you consider rerouting the water to Keswick Dam rather than down Flat Creek. We own approximately 16 acres on Flat Creek on Iron Mountain Road. On our land, there are two residences and several other buildings that may be affected by routing Spring Creek down Flat Creek. There are also concerns about soil erosion and the quality of our water supply and system, which water is obtained from the north fork of Flat Creek where it joins Flat Creek proper.

We do not want to be relocated in the event that you should select diverting Spring Creek down Flat Creek. We ask that you consider other solutions rather than forcing the sale of private property, not only for ourselves, but also for other private property owners along both Flat and Rock Creeks.

RESPONSE TO COMMENT 14-2

EPA will take whatever steps are necessary to mitigate impacts that are expected to result from the diversion of Spring Creek, if the diversion is implemented by EPA rather than the City of Redding (see Response 13-3).

The Department of Health Services (DOHS) has also provided the following response to Comment 14-2:

The Feasibility Study assumes that no residential water, other than the Redding municipal system, is potentially affected by effluent from the Iron Mountain site. A determination should be made as to whether any residences are using or could use onsite water for household purposes.

COMMENT 14-3 (Stauffer)

Combined alternative CA-6, which calls for enlargement of the Spring Creek Debris Dam and the resulting increase in storage capacity to 13,000 acre feet, diversion of Upper Spring Creek, diversion of South Fork of Spring Creek, and copper cementation, is less costly than Option CA-7 by approximately $10 million. The EPA, however, announced its preference for Option CA-7 at the public meeting in Redding, California, on August 15.

According to this report, (page ES-8) combined alternative CA-6 fully complies with all applicable or relevant standards, guidelines, and EPA Superfund advisories. Assuming that the cost estimates are correct, there appears to be insufficient justification for EPA to select alternative CA-7 in favor of alternative CA-6. Stauffer Chemical Company, however, believes additional remedial options can be developed which would be more cost effective by an order of magnitude; that is, in the range of $5 million. We intend to outline these options in our subsequent comments to be submitted by September 30.

Combined alternatives CA-5 and CA-7, which also meet all applicable or relevant standards, guidelines, and advisories, are substantially more expensive than alternative CA-6 and do not provide sufficient benefits over CA-6 to justify the added cost. Therefore, by comparison, alternatives CA-5 and CA-7 are not cost effective and should be rejected as inconsistent with the National Contingency Plan.

RESPONSE TO COMMENT 14-3

When compared to CA-6, EPA believes that Combined Alternative CA-7 better meets the intent of the NCP because it:

- Minimizes of the production of waste/AMD, and

- Addresses the hazardous waste problem at its source

Combined Alternative CA-6 does neither, but relies strictly on dilution to meet project cleanup objectives. Combined Alternative CA-7 provides a good balance of source control, treatment, and water management alternatives to meet cleanup objectives.

As stated in Response 13-4, EPA would seriously consider allowing Stauffer to implement its $5 million remedy if it could prove that it would succeed in meeting cleanup objectives for 1978 conditions.

COMMENT 14-4 (RWQCB)

For reasons which we have previously discussed, we request that EPA implement a control alternative which includes some measure of source control. Although we concur with the overall program objective of meeting state or federal water quality objectives at Keswick Dam, we feel strongly that the selected control program should result in significant water quality improvement upstream of this point; i.e., lower Keswick Reservoir and the Spring Creek watershed. This will be the case only if EPA selects a control strategy aimed at reducing acid/heavy metal discharges from the major sources at the mine. Of the alternatives listed in the Feasibility Study, we recommend that EPA select CA-7 for implementation. This alternative, which combines source control and water management approaches, meets the program cleanup objectives even in the most critical year evaluated and appears to present an opportunity for shared responsibility between the state/ EPA and the Bureau of Reclamation. We are aware of the efforts by EPA and the Bureau to develop an Interagency Agreement defining this implementation responsibility, and we commend these efforts.

We believe that implementation of the selected control alternative should be a phased program with source control actions receiving first priority. If evaluation of the initial source control actions shows that we have not achieved a satisfactory level of control, additional actions, source control, and/or water management should be implemented. In previous correspondence, we have expressed reservations about the upper Spring Creek Diversion. We would not recommend implementation of this component of CA-7 until additional studies are made on its positive and negative impacts.

With regard to the Mine owner's proposal for a commercial mining operation as a solution to the problem, we believe that Iron Mountain Mines, Inc., should be given the opportunity to test this proposal and to determine if it is a technically and economically feasible method of controlling the discharge of toxic substances from the Mine. However, until further information is provided which verifies that this is a viable process at the Iron Mountain Mine site, the proposed actions and schedule of the Superfund Program should not be altered. We were informed by Iron Mountain Mines, Inc., and the Davy McKee Corporation in July 1985, that the required testing of their solution mining proposal would take six to eight months. Therefore, there should be no conflict between the completion of this testing and the scheduled implementation of Superfund alternatives if the solution mining plan does not appear feasible.

RESPONSE TO COMMENT 14-4

EPA agrees with a phased implementation approach. The proper phasing of alternatives will be determined during project design.

EPA will consider IMMI's proposal if IMMI provides the required information and assurances, as discussed in previous categories.

COMMENT 14-5 (Conservation)

Our specific recommendations are:

1. The "No Action" proposals be implemented for both the mine workings and the surface water until the Iron Mountain Mines, Inc., proposal for in situ solution mining is evaluated. We believe this evaluation should be completed within one year.

2. If that evaluation indicates that in situ solution mining is not feasible, then we would recommend a combination of copper-cementation of the acid mine drainage, transbasin diversion of upper Spring Creek, and enlargement of existing storage capacity of Spring Creek Reservoir.

RESPONSE TO COMMENT 14-5

1. The extent of the environmental problem, the impact on public welfare, and potential pH health impacts presented by IMM site do not support the "no action" alternative.

2. The alternative proposed above does nothing to address the problem at its source and relies strictly on dilution to control the problem. EPA cannot evaluate the above alternative because it has not proposed specific figures for the enlargement of Spring Creek Debris Dam; this precludes EPA from determining if the project will meet site cleanup objectives.

COMMENT 14-6 (Agriculture)

In addition to CA 6, the CDFA favors adoption of the commercial ore recovery option since it is the only profitable alternative available. We recognize that this is not a presently viable option since, as stated on page 9 of the executive summary of the feasibility study, delaying cleanup of the site while waiting for more information to adequately assess the sufficiency of this alternative would risk public health and environment. Therefore, this department recommends adopting CA 6 with the proviso that the commercial ore recovery option be employed if the necessary information becomes available in time to effectively evaluate this alternative and if the alternative is found to be sufficient.

RESPONSE TO COMMENT 14-6

No response required.

CATEGORY 15--OTHER CONCERNS (MISCELLANEOUS)

COMMENT 15-1 (Wilson)

If the problem at Iron Mountain Mine is solved, would there still be other sources of pollution that would continue to create problems?

RESPONSE TO COMMENT 15-1

In the Spring Creek watershed, there is another source of pollution, but it represents less than 1 percent of the total metal load in that stream. By solving the Iron Mountain Mine problem, most of the pollution in the Spring Creek drainage would be controlled. In addition, as the alternatives show, the fish in the Sacramento River would be protected.

There are other mines in the Shasta Lake watershed area that discharge into the lake. However, the levels of those metals entering the Sacramento River system are mitigated by the fact that Shasta Lake is a huge reservoir of neutral water that tends to precipitate those metals out. Some of these sites alluded to above are proceeding under state enforcement action to abate discharges to receiving waters. It is possible that the remaining sites will be similarily required to implement site cleanup plans.

RD/R78/028

PUBLIC COMMENTS ON JULY 25, 1986, PUBLIC COMMENT FS ADDENDUM

Seventeen individuals, organizations, and agencies submitted specific comments during the public comment period. In addition, three form letters were submitted with a combined total of 30 signatures. The following list includes the names of the commenters, their affiliation, and the manner in which their comments are identified in this report. The names listed in the last item are those individuals who signed one of the form letters. Some signatures were not legible.

JULY 25, 1986, FS ADDENDUM- LIST OF COMMENTERS

Wanda Hunt Babcock, Citizen, Babcock

Morgan Orwig, Citizen, Orwig

William H. Martin, Citizen, Martin

Mary L. Girard, Citizen, Girard

U.S. Bureau of Reclamation, Bureau

U.S. Department of Interior, Office of the Secretary, Secretary

Paul Contini, Citizen, Contini

Tom B. (signature not legible), Citizen, Tom B.

Joanne Danielson, Citizen, Danielson

Bruce Boyer, IMMI Consultant, Boyer

Davy McKee Corporation, Davy McKee-Morgan

Iron Mountain Mines, Inc., IMMI-Arman

Daniel C. McLean, IMMI Metallurgical Consultant, McLean

Robert S. Miller, Citizen, Miller

Anette and Bob Rardin, Citizens, Rardin

Stauffer Chemical Company, Stauffer

U.S. Fish and Wildlife Service (written), FWS

Form Letter Signatures:

Donald West
Roger L. Campbell

Ron Young
Florence J. Maddox
John M. Maddox
Raymond E. Leslie
Barbara Fargo
Joe Fargo
Steve Maddox
Allen K. Buck
Sara Buck
Tony Bettencourt
Darlent Bettencourt
Charlotte Buck
Elaine Johnston
Charles A. Parsons
K. M. Parsons
Wayne P. Carnes
Todd E. Carnes
Bert Sharp
Wm. H. Martin
D. L. Eickenberg
Not Legible
Bruce Boyer
C.D. Shearman
Philip J. Nider
Don B. Brown
Aloma J. Stull
Donald G. Bowers
Barry Boyer

Many of the commenters raised similar questions and concerns regarding the Feasibility Study Addendum Report. For this reason, the comments were paraphrased and summarized in a number of categories. Every attempt was made to accurately paraphrase comments and respond to all comments that required a response. All comments in their original form are included in the appendixes.

The comments and their responses to the Feasibility Study Addendum are grouped into the following categories:

A1. General Comments on Feasibility Study Report
A2. Study Findings and Methodology
A3. Environmental and Public Health Hazards
A4. Costs of Remedial Action
A5. Liability for Iron Mountain Mine Problems
A6. IMMI Proposal
A7. Other Remedial Action Alternatives
A8. Preferred Remedial Action
A9. Other Concerns (Miscellaneous)
A10. Proposed New Combined Alternatives CA-8 and CA-9
A11. Comments Relating to Component Alternatives
A12. Comments Relating to the Clean Water Act
A13. Comments Relating to the Point of Compliance

CATEGORY A1--GENERAL COMMENTS ON THE FS REPORT

COMMENT A1-1 (McLean)

The major difficulty with the whole CH2M HILL feasibility study is that it is an attempt made by inexperienced engineers to apply technology, which has been developed for conventional hazardous waste disposal sites (landfills) located on relatively flat ground, to rugged, highly faulted mountainous terrain containing huge old mine workings. This is a problem requiring the skills of specialized geologists, hydrologists, and mining and civil engineers with mining operation experience. No such personnel have been observed on this project at any meetings I have attended. Consultants used by the EPA have never visited the IMMI property or tried to communicate with the IMMI staff despite its offer of full technical cooperation.

The result of the obvious inexperience involved is the generation of a mass of confusing data and vague interpretations which provide no real basis for judging the actual effectiveness of any of the alternatives proposed. No qualified engineering firm could accept this type of report as a basis for selection of a viable abatement system. It is difficult, therefore, to understand why non-technical EPA staff members evidently believe they are in a position to make multi-million dollar judgments using the inadequate information contained in these CH2M HILL reports.

RESPONSE TO COMMENT A1-1

Much of this comment reflects the commenter's opinion, for which there is no response. The response to the remaining portion of the comment will attempt to help clarify the misunderstandings that the commenter apparently has with respect to the following categories:

- Applicable technologies for the site
- Qualified specialists involved in the study
- Site visits
- Consultant's coordination with the IMMI staff

Applicable Technologies

A technology screening was performed during the Public Comment FS which considered several technologies. Members of the IMM Technical Advisory Committee (TAC) participated in the screening process. The expertise of the members is discussed below. This screening process resulted in the applicable technologies used to develop the nine combined alternatives presented in the Public Comment FS and the subsequent

FS Addendum. These screened technologies used in the alternatives are listed below:

- Lime/limestone neutralization of acid mine drainage
- Surface water diversions
- Enlargement of an equalizing reservoir
- Capping over the orebody
- Groundwater interception
- Injection of LDCC

Some of these technologies could be used on "landfill type" hazardous waste sites on relatively flat ground. It is unlikely that groundwater interception, injection of LDCC, and enlargement of a reservoir would be used on a landfill site. Capping is a common technology used on landfill sites and probably not very common for use on mine waste sites. Lime/limestone neutralization and surface water diversions could be used on landfill sites, but are probably more applicable to the IMM site.

Qualified Specialists

EPA's contractor put together a project team which included qualified specialists in the requisite areas of expertise to develop the alternatives identified in the feasibility study process. The project team included mining engineers, civil engineers, geologists, hydrologists, and chemists. In addition, a technical advisory committee was formed which included staff from the U.S. Bureau of Mines, Colorado School of Mines, a geochemist from the USGS, EPA staff with experience in mining, and several other members.

Site Visits

Essentially all key staff assigned to the Iron Mountain Mine project visited the site.

Consultant Coordination

EPA's consultants met with IMMI staff and exchanged several telephone calls at EPA's direction.

CATEGORY A2--STUDY FINDINGS AND METHODOLOGY

COMMENT A2-1 (McLean)

The Public Comment FS Addendum presents no quantitative comparisons as to the actual remedial effectiveness of each alternative.

RESPONSE TO COMMENT A2-1

Combined Alternatives CA-1 through CA-9 were developed to meet two sets of water quality criteria (EPA Water Quality Criteria for the Protection of Aquatic Life and the State Basin Plan objectives). These criteria are presented on page 4-1 of the August 2, 1985, Public Comment Feasibility Study. As shown in Summary Tables 3 and 4 of the July 25, 1986, Feasibility Study Addendum, all combined alternatives, except CA-1, meet these criteria.

The effectiveness of individual component alternatives in reducing spills from Spring Creek Debris Dam and reducing metals entering the Sacramento River are presented in Tables 7-4 and 7-5 of the Feasibility Study Addendum.

COMMENT A2-2 (McLean)

The FS Addendum presents questionable capital cost data with no backup data for confirmation.

RESPONSE TO COMMENT A2-2

Detailed cost estimates for the new component alternatives are presented in Appendix A of the Feasibility Study Addendum. Detailed cost estimates for the component alternatives developed previously were presented in Appendix A of the August 2, 1985, Public Comment Feasibility Study. These individual component alternatives were assembled to form the combined alternatives, and the individual costs were summed to determine the total cost of the combined alternatives. These costs should fall within the acceptable -30 +50 cost range required by EPA.

COMMENT A2-3 (McLean)

The choice of equipment for the various processes for the alternatives presented in the FS addendum indicates a poor understanding by the report writers. An example is the inclusion of a $2.9 million belt filter to dewater sludge which is to be deposited in an open pit.

RESPONSE TO COMMENT A2-3

Various dewatering techniques were investigated during previous pilot plant studies conducted for the Water Resources Control Board. The preliminary selection of the belt filter for dewatering the lime sludge was based upon the limited onsite land available for the dewatering facility and the need to dewater the lime sludge to provide a lower volume of sludge such that the storage capacity in Brick Flat Pit is sufficient for a 30-year period.

The preliminary selection of other process equipment in the cost estimates was based on previous operating data from full-scale lime neutralization plants.

COMMENT A2-4 (McLean)

None of the alternatives proposed (with the exception of major stream diversions or reservoir enlargements) have an indicated life span of more than 30 years; which for cost involved is totally unacceptable.

RESPONSE TO COMMENT A2-4

Page A-1 of the August 2, 1985, Public Comment Feasibility Study explains that all cost estimates are performed using a 30-year project life, as directed by OMB Circular No. A-94, to allow the federal government to compare this project with other federal projects.

COMMENT A2-5 (McLean)

There is no indication of actual annual operating costs for each alternative so that the public or legislators can know exactly what state tax burdens would be involved for the perpetual future.

RESPONSE TO COMMENT A2-5

As explained on page A-1 of the August 2, 1985, Public Comment Feasibility Study, the annual O&M costs were evaluated using their present worth value as directed by OMB Circular No. A-94. The annual O&M cost is about 10 percent of the total present worth O&M cost.

COMMENT A2-6 (Miller)

Tables 5 and 6 of the FS Addendum, which compare various components of project alternatives on the basis of a relative cost benefit scale, give no indication as to what the benefit to actual value might be.

RESPONSE TO COMMENT A2-6

The relative cost-benefit data presented in Summary Tables 5 and 6 were calculated from the data presented in Tables 7-4 and 7-5. The actual costs of the component alternatives and their expected benefit in spill and metals reductions are presented in Tables 7-4 and 7-5.

COMMENT A2-7 (Stauffer)

The evaluation of CA-8 and CA-9 presented in the FS Addendum is inadequate. There is insufficient consideration of the "engineering implementation" or technical feasibility of each of these alternatives. There is insufficient consideration of costs for the two new alternatives. Implementation of one of these alternatives would be one of the most expensive Superfund cleanups in the nation.

RESPONSE TO COMMENT A2-7

EPA does not agree with the above comment. All components of CA-8 and CA-9, with the exception of LDCC, are proven technologies that are both technically feasible and can be implemented at IMM. EPA agrees that there are some unanswered questions concerning the technical feasibility and implementability of LDCC. For this reason EPA is proposing to conduct a groundwater investigation and pilot and demonstration testing of LDCC.

COMMENT A2-8 (Stauffer)

A further shortcoming of this addendum (in fact the entire Feasibility Study) is the failure to include and properly cost the disposal of the waste from the lime/limestone treatment system. EPA has stated that under RCRA regulations, this waste might be characterized as a hazardous waste (we disagree). The requirements for disposal of this waste and the costs of such disposal are not properly considered or included in this study. These requirements would add substantially to the cost of any alternative considered at this site employing lime/limestone treatment, but would have a particularly large impact on CA-8 because of the large volume of waste generated from the multiple streams being treated.

RESPONSE TO COMMENT A2-8

As stated in the FS Addendum, the lime/limestone sludge generated with Alternatives CA-8 and CA-9 would be dewatered and disposed of in Brick Flat Pit, which has a capacity of 30 years of sludge storage. The cost of the dewatering facilities, access road to Brick Flat Pit, O&M, and costs for solids transport and disposal are included in the cost estimates for these alternatives.

If RCRA does apply to the lime/limestone sludge disposal, then the cost of a RCRA-approved landfill would add substantial costs to the sludge disposal.

CATEGORY A3--ENVIRONMENTAL AND PUBLIC HEALTH HAZARDS

COMMENT A3-1 (IMMI-Arman)

Salmon runs in 1986 are the highest ever experienced by commercial fishermen. Why then do the Water Board and the Department of Fish and Game claim that minerals from IMM are killing salmonids and fingerling trout?

RESPONSE TO COMMENT A3-1

There are documented fishkills that have been directly attributed to the discharge from IMM. A detailed discussion of the environmental concerns is presented in the August 2, 1985, Feasibility Study.

COMMENT A3-2 (Stauffer)

In selecting a remedial action, EPA should be mindful that the acid mine drainage sought to be controlled does not present a threat to public health. The concern is a low order environmental concern relating to fishkills; therefore, EPA should adopt a far more cost-effective remedy than proposed in CA-8, CA-9, or the previous Alternatives CA-1 through CA-7.

RESPONSE TO COMMENT A3-2

Although IMM presents a potential public health threat, it has, and continues to present serious impacts to the environment and the welfare of the public. The impacts on the environment and aquatic life have been clearly documented by the RWQCB and CDFG. These are reasons alone for EPA to consider spending public funds to abate the IMM problem.

COMMENT A3-3 (Rardin)

Have any provisions been considered for the safety of life, personal and real property for the proposed Spring Creek diversion to Flat Creek?

RESPONSE TO COMMENT A3-3

These provisions will be considered during the final design. However, the cost estimates presented in the FS include cost for these types of provisions.

CATEGORY A4--COSTS OF REMEDIAL ACTION

COMMENT A4-1 (Miller)

What is the EPA definition of cost-effectiveness in terms of finite dollars?

RESPONSE TO COMMENT A4-1

Cost-effectiveness is defined as the lowest-cost alternative that effectively minimizes threats to and adequately protects the public health, welfare, and the environment. Cost-effectiveness does not have a finite dollar amount, and is used to compare the relative cost and effectiveness of one alternative versus another.

COMMENT A4-2 (Miller)

The total cost of the LDCC, with lime neutralization and mine rehabilitation, is $74,105,000, considerably higher than the estimate included in the Addendum.

RESPONSE TO COMMENT A4-2

The capital cost of $74,105,000 presented in the above comment uses different assumptions to derive the costs than those used by CSMRI in the Feasibility Study Addendum. CSMRI's assumptions were based upon their previous experience with LDCC.

COMMENT A4-3 (McLean)

All of the capital costs for Alternatives CA-8 and CA-9 exceed the average Superfund capital expenditure of $7 million by a factor of 5 to 20 times. Since it does not pose any public health threat, what is the justification for these large sums of money for implementation of these alternatives.

RESPONSE TO COMMENT A4-3

The expenditure of public funds for the cleanup of IMM is justified based on the extent of the environmental problem, as well as impacts presented by IMM on the public welfare and aquatic life.

CATEGORY A5--LIABILITY FOR IMM PROBLEMS

COMMENT A5-1 (Miller)

Will IMMI be held to the new water quality objectives presented in the F/S Addendum to the same degree as the EPA alternatives should IMMI implement its plan?

RESPONSE TO COMMENT A5-1

IMMI will be required to develop a cleanup program that meets all applicable, relevant, and appropriate federal and state requirements (see response to Comment 2-3). Therefore, IMMI will be required to meet the new water quality objectives that were discussed in the FS Addendum because they are a requirement of the Clean Water Act.

CATEGORY A6--IMMI PROPOSAL

COMMENT A6-1 (Stauffer, McLean, IMMI-Arman, Miller, Davy McKee-Morgan, Babcock, Boyer)

Why was the IMMI Recovery Proposal not evaluated in the F/S Addendum?

RESPONSE TO COMMENT A6-1

The IMMI Recovery Proposal is being evaluated by the Colorado School of Mines Research Institute in a separate study. The purpose of that study is to determine the technical and economic feasibility of the IMMI proposal. The proposal was not included in the FS Addendum because it is not a proposal EPA would implement. Instead, EPA is evaluating the IMMI proposal as a potential substitute for the alternatives developed in the Feasibility Study. Should EPA conclude that the IMMI proposal is adequate in all respects, and if agreement can be reached between IMMI and EPA, then the IMMI proposal would be implemented in lieu of and not as part of the remedial action at the site.

COMMENT A6-2 (Davy McKee-Morgan, McLean)

Why was not the Colorado School of Mines Research Institute evaluation of the IMMI proposal included in the F/S Addendum?

RESPONSE TO COMMENT A6-2

The purpose of the FS Addendum was to present two additional RA alternatives under consideration by EPA for public review and comment. A secondary objective was to apprise the public of the CWA requirements and the extent to which those requirements would affect site cleanup. The CSMRI report is being prepared to evaluate the IMMI proposal separately and independently from the Superfund remedial action.

COMMENT A6-3 (Martin)

The SOLUTION to the IMM problem should be handled by IMMI.

RESPONSE TO COMMENT A6-3

EPA will allow the IMMI proposal to go forward in lieu of a federally funded cleanup program if IMMI can meet the following conditions:

a. As part of its commercial mining venture, incorporate an environmental cleanup program that will meet all applicable and relevant and appropriate federal and state requirements, including the Clean Water Act.

b. Conduct any bench, pilot, and demonstration tests deemed necessary by EPA and the state to prove the technical feasibility of the IMMI proposal.

c. Demonstrate that its proposal is completely sound from a technical, economic, and environmental standpoint.

d. Develop a site closure plan to go into effect immediately after the solution mining operations have ceased.

e. Demonstrate it has funding in hand to design, construct, and operate its commercial mining venture and a broad environmental cleanup program.

f. Has a financial assurance mechanism in place for site closure operations; this must meet EPA's approval.

g. Reach agreement with EPA on all technical and legal elements and incorporate that agreement in a legally enforceable document.

COMMENT A6-4 (Secretary and FWS)

The IMM proposal includes shattering the orebody using explosives and recovering metals by an acid leaching process. If the procedure becomes uneconomical, it could lead to abandonment of the site in a more hazardous state than it is now and would greatly increase cleanup costs.

RESPONSE TO COMMENT A6-4

EPA shares this concern. Prior to allowing IMMI to proceed with its in-situ mining alternative, EPA must be assured that the funds will be available for all post-closure site cleanup activities, and that this alternative will not create a worse (potential) environmental problem than the one it is trying to solve.

COMMENT A6-5 (Miller)

Why does not EPA recommend the IMMI alternative which is better in all respects than any of the EPA alternatives with regard to complete control and removal of AMD from waters of the United States?

RESPONSE TO COMMENT A6-5

EPA is not in a position to recommend the IMMI alternative as the appropriate remedy for the IMM site because IMMI has not satisfied all of the conditions discussed in the response A6-3 above.

CATEGORY A7--OTHER REMEDIAL ACTION ALTERNATIVES

COMMENT A7-1 (Orwig, Contini)

A mining alternative should be included in the FS.

RESPONSE TO COMMENT A7-1

Open pit and underground mining alternatives, along with IMMI's proposed in-situ mining process, were considered during the Feasibility Study and are presented on page 5-7 of the August 2, 1985, Feasibility Study report.

COMMENT A7-2 (Boyer)

All the combined alternatives developed in the FS are flawed because the orebody or the materials from its composition are not removed from the area.

RESPONSE TO COMMENT A7-2

Total removal of the IMM orebody was considered as an alternative to meet the Clean Water Act. As described in the FS Addendum, the estimated cost for implementing this alternative was so exorbitant it was not considered cost-effective, and was therefore not considered further.

COMMENT A7-3 (McLean, Davy McGee-Morgan)

There is no discussion of the alternatives proposed by Stauffer Chemical Company.

RESPONSE TO COMMENT A7-3

The alternatives proposed by Stauffer Chemical Company were reviewed. However, it was determined that some of Stauffer's basic assumptions were not consistent with information obtained in the Remedial Investigation, and that these alternatives would not meet the water quality objectives established for the site if their assumptions had been consistent with the ones used by EPA. Therefore, Stauffer's alternatives were not considered in the Feasibility Study.

COMMENT A7-4 (Stauffer)

Stauffer has previously proposed an $8.1 million project which would comply with water quality standards at the point of compliance below Keswick Dam. We urge EPA to consider this option as an alternative if the commercial mining option is not adopted.

RESPONSE TO COMMENT A7-4

See response to Comment A7-3.

COMMENT A7-5 (Stauffer)

Stauffer agrees with EPA that the total removal option be eliminated from further consideration.

RESPONSE TO COMMENT A7-5

No response required.

CATEGORY A8--PREFERRED REMEDIAL ACTION

COMMENT A8-1 (Babcock, Boyer)

I strongly urge you to reject Proposals CA1-CA9 inclusive and accept the Iron Mountain Mines Inc.-Davy McKee Inc. proposal.

RESPONSE TO COMMENT A8-1

Because IMMI has not satisfied the conditions outlined in the response to Comment A6-3, EPA is not in a position to accept the IMMI proposal. EPA will, therefore, continue to consider CA-8 and CA-9 as potential remedies for IMM.

COMMENT A8-2 (Miller)

It is hoped that EPA will recognize the practicality of a resource recovery plan, such as the in-situ mining process proposed by Iron Mountain Mines. A proposal of this type should merit serious consideration; particularly when costs and sources of funding are taken into account.

COMMENT A8-3 (Contini)

I urge you to reconsider your proposals and save the taxpayers considerable dollars by encouraging private removal of the orebody.

COMMENT A8-4 (Danielson)

It is my belief that Davey McKee's extraction program far surpasses any of the other alternatives proposed in both a financial and technical sense.

RESPONSES TO COMMENTS A8-2 THROUGH A8-4

EPA has left the door open to IMMI to come forward with a commercial mining venture, incorporating a broad-range environmental cleanup program, to the extent that conditions in the response to Comment A6-3 are fully satisfied. It is EPA's preference that PRP funds be used to clean up the IMM site, rather than federal Superfund monies. It is EPA's position that IMMI has had ample time to address the conditions noted in Response A6-3; that, at an appropriate point, the Agency may need to expend public funds as cleanup funds, if the above-referenced conditions still have not been met.

COMMENT A8-5 (Bureau)

Either CA-8 or CA-9 would produce significant benefits to the salmon resource.

RESPONSE TO COMMENT A8-5

EPA agrees.

COMMENT A8-6 (Girard)

I am in favor of source management as opposed to stream management. The latter would adversely affect our land by reducing the flow in Spring Creek leaving more toxic drainage through our property. Changing the course of the stream goes against the history of riparian rights and water laws in our state.

RESPONSE TO COMMENT A8-6

EPA also favors source control and treatment alternatives but recognizes that stream management will also be needed to meet project cleanup objectives. EPA will consider allowing the City of Redding hydroelectric project to proceed in lieu of the Upper Spring Creek diversion if the City succeeds in its efforts to secure approval for its project. Nevertheless, EPA is hopeful that through the implementation of source control and treatment alternatives that the water quality along Spring Creek will be improved or, at a minimum, not degraded beyond current conditions. In fact, there should be no discharges of AMD to receiving waters during the dry periods causing the possible return of certain beneficial uses to receiving waters. Discharges of AMD during the winter months should receive the benefit of dilution provided by rainfall in the Spring Creek basin, keeping water quality within acceptable limits.

COMMENT A8-7 (Secretary and FWS)

We support Alternative CA-9 as being what we perceive to be in the best interests of the fish and wildlife.

RESPONSE TO COMMENT A8-7

No response required.

COMMENT A8-8 (Boyer and 28 Signatures on a Form Letter)

The Iron Mountain Mine proposal should be implemented because it is an environmentally and economically sound mining program which will not only solve any inferred pollution problem, but will also boost the economy of the Redding area.

RESPONSE TO COMMENT A8-8

Please see response to Comments A8-2 through A8-4.

CATEGORY A9--OTHER CONCERNS

COMMENT A9-1 (Davy McKee-Morgan)

Does the Superfund law apply to complete removal of mineral resources?

RESPONSE TO COMMENT A9-1

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is the "Superfund law." The National Contingency Plan (NCP) is the plan for implementing that law. The plan requires that at least one alternative be examined, if feasible, that includes offsite disposal of contaminants at a RCRA-approved facility.

In this case, the source of contaminants happens to be a mineral resource. Removal of the source was considered, but not evaluated in detail, and eventually screened because it was infeasible with regard to costs.

COMMENT A9-2 (Bureau and Secretary)

We emphasize the value of the chinook salmon, steelhead trout, and resident trout. These provide an extensive river sport fishery (steelhead and rainbow trout) and ocean commercial fishery (chinook salmon). At one time the upper Sacramento River (Redding-Anderson) produced over one-half of the total mainstem spawning run of fall-run chinook salmon, estimated to exceed 200,000 spawners in the 1950's.

The estimated monetary value of the chinook salmon and steelhead trout runs below Red Bluff Diversion Dam is approximately $33.7 million annually. The estimated economic value is anticipated to increase to $72 million annually.

RESPONSE TO COMMENT A9-2

No response necessary.

COMMENT A9-3 (Miller)

Why does EPA continue to develop additional alternatives for the IMMI site?

RESPONSE TO COMMENT A9-3

The original purpose of the new alternatives presented in the Feasibility Study Addendum were developed to identify alternatives which comply with all the provisions of the Clean Water Act.

COMMENT A9-4 (Miller)

Why were not RCRA requirements considered when the remedial action alternatives were developed? Is it legal to ignore RCRA?

RESPONSE TO COMMENT A9-4

The applicability, relevancy, and appropriateness of RCRA as it applies to proposed remedial alternatives were considered, but not deemed applicable to CA-8 and CA-9. Alternatives CA-1 through CA-7, which were developed during the Public Comment FS, considered potential RCRA requirements with regard to lime sludge disposal.

COMMENT A9-5 (Miller)

If EPA can ignore the requirements of RCRA, will IMMI be held to complying with all provisions of RCRA should they implement their plan?

RESPONSE TO COMMENT A9-5

Until EPA has received and reviewed and evaluated a final IMMI plan for its in situ mining and site cleanup programs, the Agency is unable to determine whether RCRA would or would not be applicable, relevant, and appropriate to the IMMI operation.

CATEGORY A10--PROPOSED NEW COMBINED ALTERNATIVES CA-8 AND CA-9

COMMENT A10-1

Two commenters (FWS and Secretary) have indicated that based on their analyses, Combined Alternative CA-9 would provide the greatest level of protection for anadronomous and resident fish resources as well as other aquatic and terrestrial habitats important to fish and wildlife.

RESPONSE TO COMMENT A10-1

No response required.

COMMENT A10-2 (Secretary)

Combined Alternative CA-9 will have a higher implementation cost, but should result in a more reliable control system, less maintenance, and less chance of failure during critical periods of high runoff in comparison with CA-8.

RESPONSE TO COMMENT A10-2

EPA concurs with this comment.

COMMENT A10-3 (Bureau)

Combined Alternative CA-8 could be modified to treat the acid mine drainage by dumping large quantities of lime or limestone in the mines and sealing the portals. Valves could be installed to release the treated water. This modified alternative would solve the sludge disposal problem.

RESPONSE TO COMMENT A10-3

The treatment scheme proposed in this component may be theoretically possible but may not be practical because of the following aspects:

- In order to achieve ferrous iron removal, the iron must be oxided to the ferric iron state. This could not practically be achieved with this treatment scheme.

- Metals removal is dependent on achieving the optimum pH. By dumping lime into the mines, the pH cannot be controlled. High pH water resulting from overdosing with lime would have to be neutralized prior to discharge.

- The lime would be continually neutralized by the acid mine drainage and would have to be replaced on a regular basis.

- The sludge produced would have to settle out with the mine workings. It is quite possible that sludge would exit the portals, along with the treated water.

- There would probably not be sufficient storage of the wet sludge within the mine workings.

COMMENT A10-4 (Stauffer)

Combined Alternatives CA-8 and CA-9 are environmentally unsound. CA-8 would create mountains of gypsum waste.

RESPONSE TO COMMENT A10-4

The commenter has not discussed what aspects of CA-8 and CA-9 the commenter considers to be environmentally unsound. However, EPA believes that CA-8 and CA-9 are environmentally sound responses to the IMM problem because both these alternatives will minimize the metals discharging to the receiving waters. This should improve water quality substantially above current water quality in the immediate receiving waters.

For Alternative CA-8, the dry solids produced by the lime/limestone neutralization process will be deposited in Brick Flat Pit.

COMMENT A10-5 (Stauffer)

Combined Alternative CA-9 includes filling the mine workings with low-density cellular concrete. This is an unproven technology and a high risk option and is inconsistent with the NCP. It is an unreasonable alternative because of the following:

- Mine workings would have to be reworked before the plugging operation began.

- Worker safety would be significant during the rehabilitation of the mine workings.

- Injection of the LDCC would require installation of an onsite plant to produce LDCC 24 hours a day for a minimum of 2 years and probably more.

RESPONSE TO COMMENT A10-5

The commenter has not stated the reason for its belief that the use of LDCC is inconsistent with the NCP and therefore, EPA is unable to fully respond to the comment. Nevertheless, the NCP states in 300.68[i] that "innovative or advanced technology shall, as appropriate, be evaluated as an alternative to conventional technology." LDCC is such as technology, and it was evaluated as an alternative to conventional treatment of AMD. For this reason, EPA considers that it has complied with the intent of the NCP. The risk associated with LDCC is not clear at this time. Prior to making a final decision on LDCC, EPA will fully evaluate and weigh the risks associated with proceeding with LDCC.

Rehabilitating a portion of the mine workings is a technique commonly used in the mining industry and should not present unusual technical and safety concerns. Also, the construction of an onsite concrete batch plant is not unusual for large construction projects.

COMMENT A10-6 (Stauffer)

Neither Combined Alternative CA-8 or CA-9 is cost-effective while achieving its objective of protecting the public health, welfare, and the environment.

Some water quality improvement may be achieved by the implementation of CA-8 or CA-9; however, water quality standards will not be met in portions of Keswick Reservoir and surface streams at the site. Therefore, substantial additional expenditures necessary to implement either of these alternatives compared to Stauffer's recommended remedial action or previous alternatives developed by EPA cannot be justified under cost-effective requirements of the NCP based on questionable and marginal improvements in stream quality.

RESPONSE TO COMMENT A10-6

EPA has determined that Stauffer's recommended remedial action is incapable of meeting site cleanup objectives, will not meet all applicable, relevant, and appropriate requirements, and therefore not comply with the requirements of the NCP. For these reasons, this alternative does not warrant further consideration as a potential remedy for the IMM site. Alternatives CA-1 through CA-7 are not considered to be cost-effective responses for various reasons including cost, ability to meet primary and secondary cleanup objectives, and ability to comply with the Clean Water Act. At this time, EPA is unable to make a final cost-effectiveness determination for CA-8 and CA-9 because the Agency must first determine the technical feasibility and implementability of LDCC at IMM. In the interest of expediting response actions at IMM, EPA has chosen to select and implement the components common to both CA-8 and CA-9, as well as the partial cap, while the Agency evaluates the LDCC remedial technology. Following this evaluation, EPA will determine the cost-effective remedy and, thus, the final scope of the response for IMM.

COMMENT A10-7 (Stauffer)

Combined Alternative CA-9 using LDCC is inconsistent with the requirements of the NCP. Since the NCP emphasizes the use of established technology and requires the use of the lowest cost alternative that is technically feasible. The FS Addendum acknowledges that LDCC is unproven technology and it costs more than any other alternatives presented that are technically feasible.

RESPONSE TO COMMENT A10-7

LDCC is an unproven technology for application at mining sites similar to IMM with AMD problems. Section 300.68 (h)(2)(v) of the NCP states that the detailed analysis of alternatives should include an analysis of whether other advanced innovative or alternative technologies are appropriate to reliably minimize or prevent a future threat to the public health or welfare and the environment. Section 300.68(h)(3) further states that in performing the detailed analysis, it may be necessary to gather additional data to complete the analysis. EPA has therefore chosen to conduct pilot and demonstration tests to determine the technical feasibility and implementability of LDCC at IMM. Although LDCC appears to cost more than other alternatives (during the 30-year project period), the cost of CA-9 may, in fact, be less for reasons discussed in the FS Addendum and when considering that the remedial response to the release of AMD can continue in perpetuity. Therefore, if LDCC succeeds in eliminating or significantly reducing the formation of AMD to the point where treatment will not be required in perpetuity, there would be a substantial cost savings realized in proceeding with LDCC over than other remedial action alternatives that include treatment.

COMMENT A10-8 (Miller)

Combined Alternatives CA-8 and CA-9 are of highly dubious long-term effectiveness since they do not involve proven technology as applied at similar sites and environmental circumstances.

RESPONSE TO COMMENT A10-8

Combined Alternative CA-8 contains treatment, water management, and source control alternatives which are proven technologies. The only component of Alternative CA-9 for which the effectiveness cannot be predicted is filling the underground workings with LDCC. As explained in the FS Addendum, major exploratory programs and pilot studies would be required before EPA decides to proceed with full-scale implementation of LDCC.

COMMENT A10-9 (Miller)

Filling the mine workings with concrete is totally absurd. It disregards the $600 million value of the ore reserves at Iron Mountain. It is incredible that this alternative (CA-9) not only seems to be preferred, but is also suggested as a prototype for use at other mining operations.

RESPONSE TO COMMENT A10-9

The LDCC will only be used to fill areas that have been previously mined out. This should have no effect on mining the remaining ore through conventional mining methods at a time when it becomes profitable. EPA is not now considering LDCC as a prototype because certain unanswered questions remain about its technical feasibility. However, if it is found to be feasible, it could serve as a prototype to address problems similar to IMM at other National Priority List mining sites.

COMMENT A10-10 (IMMI-Arman)

The sludge generated by the lime neutralization plants would be a greater problem than the original acid mine drainage.

RESPONSE TO COMMENT A10-10

The acid mine drainage discharged from Iron Mountain Mine has been documented to be responsible for fishkills in the Sacramento River. This is the existing problem. The sludge produced by the lime/limestone neutralization plants will remove the metals which would have been discharged to the receiving waters. Proper handling of this sludge will preclude metals from being discharged and should not present an environmental problem.

COMMENT A10-11 (Stauffer)

Combined Alternatives CA-8 and CA-9 increase the projected costs of remediation from previous excessive levels to the exorbitant and wasteful range of $50 million to $70 million. These options are grossly inconsistent with the NCP as they are beyond any possible argument that they meet the requirement of cost-effectiveness.

RESPONSE TO COMMENT A10-11

Cost is only one factor that the NCP directs that must be considered in the selection of a remedy; other factors include technology, reliability, administration, and other concerns. While the projected cost of remediation is high, EPA does not consider the cost to be exorbitant when taking into account the unique nature and extent of the IMM problem. The cost to the government in taking a remedial response action should be offset by increased revenue to the U.S. Treasury through the sale of Shasta Lake waters for authorized uses that would have been used to abate the IMM problem. The USBR has apprised EPA that between $9 million and $32 million is lost annually from the U.S. Treasury for this purpose. At this rate, the payback to the government in taking remedial action at IMM should be on the order of 2½ to 8 years. In this context, the cost of Superfund remediation gives the appearance of being a most reasonable expenditure.

CATEGORY A11--COMMENTS RELATING TO COMPONENT ALTERNATIVES

COMMENT A11-1 (IMMI-Arman)

The injection of LDCC into the underground mine workings will destroy future mining of the orebodies.

RESPONSE TO COMMENT A11-1

The use of LDCC will not necessarily preclude conventional underground or open pit mining of the orebody. The only areas that would be filled or lost are those which are mined out already. In fact, LDCC could enhance underground mining by providing additional support in the existing adits and crosscuts. Areas which have not been previously mined will not be filled with LDCC. Thus, the new ore can be accessible to conventional mining technologies.

COMMENT A11-2 (IMMI-Arman)

It is not possible to create a permanent bond or seal between LDCC and the massive sulfide to keep underground seepages from flowing. How will LDCC be bonded to loose and powdery sulfate material located 200 to 400 feet below surface level?

RESPONSE TO COMMENT A11-2

The LDCC material which is proposed has been used in several tests to extinguish burning coal and to pillar walls in an underground copper mine and appears to bond and seal very well. In addition, the low viscosity of the material will permit encapsulation of rubblized rock and ore in the mine. The exact formulation of the material and handling properties will be developed during the test phase of the project.

COMMENT A11-3 (IMMI-Arman)

How will the underground workings be filled?

RESPONSE TO COMMENT A11-3

To date, LDCC has been injected into mined out cavities from surface drill holes for subsidence control. If LDCC is the selected alternative at IMMI, drill hole and underground placement will be evaluated during final design.

COMMENT A11-4 (IMMI-Arman)

After LDCC is injected into the mine workings, what will prevent the "reactive forces of nature" from creating seepages in the future?

RESPONSE TO COMMENT A11-4

The injection of LDCC into the mine working is designed to raise the groundwater table to premining conditions and encapsulate rubblized massive sulfide ore. LDCC will also add substantial neutralization reagent underground if "reactive forces of nature" create new conditions at IMM. Also LDCC is only a portion of the total remedial action. The other ones, such as capping will prevent most surface water from entering the mine workings.

COMMENT A11-5 (IMMI-Arman)

What is the basis of the 85% effectiveness for the LDCC alternative?

RESPONSE TO COMMENT A11-5

The 85 percent effectiveness for the LDCC alternative was arrived at by considering several factors. These included encapsulation studies conducted on broken/rubblized coal piles to extinguish coal mine fires, complete cavity fill for subsidence control at a site in Wyoming, and adhesion studies of LDCC on pillars for air wall control in an underground mine. In addition, access and size of the area to be filled were weighed and examined. Based on the above factors, it was concluded that LDCC could be 80 to 90 percent effective.

COMMENT A11-6 (Rardin)

We obtain our water (drinking and agricultural) from Flat Creek.

RESPONSE TO COMMENT A11-6

During the remedial investigation, a survey was conducted to determine if the residences along Flat Creek were using water which could possibly be contaminated by runoff from the Minnesota Flats tailings pile. At that time, no residences were identified that were using Flat Creek water. Water in Flat Creek below Minnesota Flats exceeds the EPA Safe Drinking Water Standards for cadmium, copper, iron, and manganese. If Alternative CA-9 is implemented, the Minnesota Flats tailings pile may be removed. This should improve the water quality in Flat Creek.

COMMENT A11-7 (Miller)

For the Upper Slickrock Creek Diversion, why does EPA recommend this alternative which does not have identifiable quantifiable benefits?

RESPONSE TO COMMENT A11-7

As shown in Tables 7-4 and 7-5 of the Feasibility Study Addendum, the Upper Slickrock diversion will reduce uncontrolled spills from Spring Creek Debris Dam. This is an identifiable and quantifiable benefit.

COMMENT A11-8 (Miller)

If the lime neutralization process is implemented, how will the dewatered sludge be placed in Brick Flat Pit so that it evenly covers the open pit?

RESPONSE TO COMMENT A11-8

The dewatered sludge will be dumped at one edge of Brick Flat Pit. It will then be spread to allow drying during non-rainfall conditions. Once the sludge is dried, it is expected that the material will support heavy equipment.

COMMENT A11-9 (Miller)

Persons who prepared the Component Alternative Summary Table 7 apparently overlooked the following Negative Issues:

Component Alternative	Additional Negative Issues
SOURCE CONTROL	
Partial Capping	(a) Creates an area subject to wind erosion and dust formation.
	(b) Decreases time of concentration which results in faster surface runoff contributing to increased downstream runoff.
	(c) Increases runoff resulting in increased erosion and flooding.
	(d) Could produce more sediment and carry more heavy metals directly into receiving waters.
Complete Capping	(a) The same as those listed in Partial Capping only to a greater degree.
	(b) Extremely difficult construction problem on steep slopes; may require benching and major earth moving effort.

	(c)	A temporary measure subject to losing seal by earth movement (earthquakes) as well as fracturing by alternate freezing and thawing, etc.
	(d)	Although considered a proven technique by the authors, a question arises as to whether it is proven on terrain and soil conditions similar or equivalent to those at Iron Mountain.
Groundwater Interception	(a)	Although the author(s) admit that this approach is not proven in this type of application, our experience suggests a low level of effectiveness because there is no aquifer or no defined water table. Would only intercept water moving through cracks and fissures into the new tunnels.
Low Density Cellular Concrete	(a)	Rater adequately covered the possible shortcomings of this technology with the exception of any thought being given to the destruction of about $400 million of valuable strategic natural resources and compensation therefor.
	(b)	The text of the report suggests that one of the principal purposes of this treatment will be to raise the water level above the orebody. In the highly fractured area in which the mine is located, the practicality of doing this is questioned. New seeps will develop with AMD being produced therefrom. A result of not accomplishing this will mean the continuing breakdown of the orebody throughout its contact interface with the massive concrete (LDCC) plug. Should this occur, AMD will continue to flow from the mine.

With these possibilities in mind, it is plain to see why the EPA proposal was so well weasel worded that all Redding chickens went south; i.e., assumed effectiveness; could rank; still difficult to accurately predict its effectiveness; if fully successful; etc.

(c) The question is then raised as to why EPA is even considering such an experimental untried gamble with Superfund monies when IMMI is proposing to use completely tried and proven techniques which will work and do a far superior job than any of EPA's fairy tales and the IMMI plan is to use private capital to do so.

It almost appears to be just the insane desire on the part of State and Federal Government to spend Superfund dollars, thereby propagating their own jobs. As a citizen and taxpayer, I object to this Government foolishness. The chances of EPA recovering its money from the owners, past or present, is extremely remote. In fact if the plan to fill the mine with (LDCC) concrete were to be implemented, EPA may have to settle with the owner for confiscation of a property with a resource valued at more than four times the cost of the remedial actions.

WATER MANAGEMENT

South Fork Spring Creek Diversion

(a) The report quite correctly cites that this alternative feature cannot be evaluated as to its accomplishments.

Upper Spring Creek Diversion

(b) Once again, the report avoids making any claims with respect to the accomplishments of this component, calling it unknown.

Both of the above alternative components were identified as having best cost-benefit ratio. Again, cost-benefit needs to be quantified using finite numbers in the benefit column not a relative rating. The benefit needs to be positively identified: i.e., salmon directly traced to being saved by the alternative plan component, then the value of each salmon, etc. Benefits need to be primary, not secondary. The use of this type of wording in the report opens the door to the use of benefit values that can be claimed in accordance with the Water Resources Council Guidelines used for other federally funded or cooperative (cost-sharing) projects.

Upper Slickrock Diversion

(a) Once again, the report fails to include a prediction as to the effectiveness of this alternative. More speculation on the part of EPA. Why recommend something that cannot have identifiable quantifiable benefits?

TREATMENT

Lime Neutralization

(a) The process is proven; however, the process generates a perpetual toxic waste problem far greater than the AMD, which can be cleaned by the IMMI plan.

(b) Proposals within the plan call for the sludge to be dried to 40 percent moisture content, then transported to the Brick Flat Pit. A barrier across the entrance to the pit would be needed and the pit walls and floor would be lined, possibly a double membrane with subsurface drainage to comply with RCRA. A question is raised as to how this very moist material is to be placed so that it evenly covers the open pit. The material is too dry to flow and too wet to support earth moving equipment. This, of course, only applies to the first year operations. From then on, the question becomes more involved. When it rains, the sludge is rewetted, the moisture content is raised above 40 percent; and, although a crust may form during summer months, the stability and bearing strength becomes less; hence, there is no opportunity to use equipment. A new, very treacherous hazard is formed; someone stepping on the crust and dropping into a quagmire similar to quicksand, which is toxic. Not a pleasant situation being mandated and perpetuated by EPA.

(c) A second hazard exists--as the pit fills by some magic means not yet described by EPA, and as successive years of rainfall fill the reservoir with sludge that could flow. What happens if a major earthquake strikes this area? Will the embankment hold, or will it be breached under possibly less than worst case conditions? A breach would release a slug flow of toxic material which would flow down the hill, then down Boulder Creek, wiping out everything in its path and ultimately flowing into the Sacramento River above Keswick Dam, possibly causing a wave which could breach or overtop Keswick Dam, causing very serious and devastating flooding. Flooding with water and sludge polluted by all the toxic substances accumulated at the Brick Flat Pit plus, possibly, all of the materials accumulated at the Spring Creek Debris Dam, does not paint a pretty scene. And to think that EPA is proposing such an alternative!

RESPONSE TO COMMENT A11-9

Partial Capping

a. It is not anticipated that wind erosion will be a substantial problem. However, measures to prevent, reduce, or mitigate wind erosion and dust are a detail which will be addressed during the final design of this alternative.

b. Decreasing the time of concentration could increase or decrease the peak flow downstream once it is combined with receiving waters. The affects of this change in runoff are a detail which will be addressed during final design.

c. Any potential increase in erosion from increased runoff will be addressed during the final design.

d. It is unlikely that increased runoff into the receiving waters would carry more heavy metals than would be reduced by preventing the migration of these waters through the orebody. However, this will be considered during final design.

Complete Capping

a. See above answers.

b. We agree that there will be a substantial earthmoving operation to construct the complete cap. However, the actual areas to be capped will be reviewed during the final design. Some very steep areas (e.g., north face of Brick Flat Pit) will likely not be covered. This is not expected to significantly influence the effectiveness of the total cap. The runoff in these steep areas is high at present, and therefore a cap will not reduce the infiltration as much as in the flatter areas.

c. The final design of the cap will consider the freeze-thaw and earth movement potential. Earthquakes causing significant permanent ground displacement are not considered to be a serious problem in the capped area. Other earth movements associated with continued caved ground formation will be included in the design criteria.

d. The report states for SC-3, "This method uses conventional materials, equipment, and construction techniques applied in an innovative manner." There is no claim that this method has been performed on terrain or soil conditions similar to those at Iron Mountain Mine. However, the construction methods are conventional, and the construction of Brick Flat Pit indicates steep temporary cuts for the benches are possible.

   Soil cement (SC-4) has been placed on slopes steeper than 3:1 (horizontal to vertical). Many pond and reservoir embankments have soil-cement as an erosion protection membrane.

   The terrain and soil conditions will be considered in the final design of the cap.

Groundwater Interception

Dewatering of mine workings by tunnels for the purpose of hydrological isolation is a proven technology. Some examples known to us include: the Yerington Pit in Yerington, Nevada; the Bouganville deposit in Papua, New Guinea; and the Twin Buttes Pit near Tucson, Arizona.

The tunnels (collection galleries) will intercept flow moving in open fractures and joints and convey water intercepted in long holes drilled from the tunnels. The orientation and length of the long holes can be varied to maximize the effectiveness in intercepting groundwater flow toward the workings.

Low-Density Cellular Concrete

No natural resources will be destroyed; conventional mining activities can take place in ore containing areas. In addition, the $400 to $600 million figure appears to represent a value in the ground, not a net present value of the resource.

The suggested purpose of LDCC is to reestablish the original groundwater table and prevent further oxidation of the massive sulfide through encapsulation of the rubblized areas. New seeps may develop, but if the surface or groundwater does not come in contact with ore, AMD will not form.

Also, this is the very same problem envisioned with in situ leaching. If a reservoir of AMD is created in the mine (highly fractured), it could also leach out and cause environmental problems.

Water Management

Tables 7-4 and 7-5 of the Feasibility Study Addendum present data which show that both the Upper Spring Creek diversion and the South Fork Spring Creek diversion will reduce spills from Spring Creek Debris Dam. These spill reductions would be the major benefits of these two surface water diversions.

As shown in Tables 7-4 and 7-5, the Upper Slickrock Creek diversion is expected to reduce the metals leaving the IMM site. This reduction would be the benefit of this diversion.

Treatment

The lime/limestone neutralization process does produce a large quantity of sludge. If this sludge is properly handled, it should present no environmental problem.

The lime/limestone sludge would be dewatered to approximately 40 percent solids and then dumped in Brick Flat Pit. The sludge would be spread and allowed to dry. The sludge would then be graded to slope such that any rainwater would runoff to a low area from which the runoff would be continuously removed by pumping.

The retaining wall which will be installed at the entrance to Brick Flat Pit would be designed to withstand earthquakes expected in the IMM area. Even if the retaining wall should fail, the sludge in Brick Flat Pit will be relatively dry and not be fluid. Thus, it should not flow into Slickrock Creek and cause the sequence of events described in this comment.

COMMENT A11-10 (Contini)

Plugging and capping the Iron Mountain property is not feasible because it will cause the acid mine drainage to surface elsewhere.

RESPONSE TO COMMENT A11-10

Both the partial and complete capping would prevent the direct inflow of surface water runoff into the underground workings. Capping should not cause AMD to surface elsewhere. The injection of LDCC into the mine workings is designed to raise the groundwater table to premining conditions and encapsulate rubblized massive sulfide ore. LDCC will also add substantial neutralization reagent underground. It is possible that filling the underground workings with LDCC may cause groundwater to surface elsewhere. However, depending upon the effectiveness of the LDCC in preventing the formation of AMD, the quality of these seeps may or may not be relatively free from AMD.

COMMENT A11-11 (Bureau)

At a future date, the useful life span of the Spring Creek Debris Dam should be determined as well as the amount of sediment that will be deposited in the reservoir.

RESPONSE TO COMMENT A11-11

The U.S. Bureau of Reclamation is currently responsible for the useful life of Spring Creek Debris Dam. The implementation of the remedial action should not have a significant effect on sediment deposition in the reservoir.

COMMENT A11-12 (Bureau)

The capping and diversion alternatives provide the greatest cost benefit. And we support the phased approach to implementation.

RESPONSE TO COMMENT A11-12

EPA appreciates the Bureau of Reclamation's support.

COMMENT A11-13 (Bureau, FWS)

We do not believe that partial or complete capping will result in significant environmental concerns with respect to vegetation and wildlife.

RESPONSE TO COMMENT A11-13

No response necessary.

CATEGORY A12--COMMENTS RELATED TO THE CLEAN WATER ACT

COMMENT A12-1 (Stauffer)

EPA has added remedial Alternatives CA-8 and CA-9 based on Clean Water Act standards including (i) BAT effluent limitations for all pollution sources at Iron Mountain Mine, and (ii) ambient water quality criteria applicable to the Sacramento river and its tributaries. EPA justifies these additions on the ground that the NCP requires identification of alternatives that meet or exceed all "applicable or relevant" environmental standards.

The NCP, however, clearly specifies that applicable and relevant standards will be evaluated and "identified for the specific site." 40 CFR Section 300.68(i). Likewise, the preamble to the NCP "reemphasizes that the determination and implementation of applicable and relevant and appropriate requirements will be made on a case-by-case review is especially critical when applying Clean Water Act standards which are themselves based on complex, case-by-case analysis. Yet the FS Addendum fails even to acknowledge the diverse issues which the Agency will need to resolve before it can determine whether particular Clean Water Act standards should be deemed applicable or relevant to the Iron Mountain Mine site. These unresolved issues include at least the following:

- To the extent the acid mine drainage at the site has nonpoint sources, it is not appropriate to apply technology-based effluent limitations issued for point sources under the Clean Water Act. The Clean Water Act recognizes that nonpoint sources are not amenable to technological solutions; instead they require site specific management practices or land use controls. Nonpoint source pollution is addressed by area wide water quality management plans developed under Section 208.

- To the extent the acid mine drainage has nonpoint sources, site-specific, water-quality-based effluent limitations are also not be appropriate. Under the Clean Water Act scheme for nonpoint sources, water quality standards are taken into account on a regional basis in the Section 208 plans. They are not, as a general rule, factored into the requirements for an individual source. In this fashion, the pollution from all sources in an area can be taken into account in developing nonpoint source pollution control requirements.

- To the extent the discharge from the mine has point sources, existing effluent limitations, e.g., for the iron ore subcategory of the ore mining and dressing point source category, 40 C.F.R. Part 440, are not appropriate either. Those standards apply to "discharges from (a) mines operated to obtain iron ore, regardless of the type of ore or its mode of occurrence," 40 C.F.R. Section 440.10 (emphasis added). They do not apply to inactive mines and were not based on a consideration of conditions associated with inactive mines. Rather, EPA based the standards on a study of waste water generation at operating mines, 47 Fed. Reg. 25683, 25688 (1982), where pollution control measures may be achievable more efficiently than in an abandoned mine.

- If a discharge under the Clean Water Act is a non-point source, but technology-based effluent limitations which have been promulgated are not applicable, effluent limits normally are based on "best professional judgment" ("BPJ"). To the extent that effluent limitations based on BPJ are appropriate here, they should take into account a variety of technological and economic considerations for toxic and nonconventional pollutants. BPJ standards reflecting the best available technology economically achievable ("BAT") should take into account the technology, cost, and other factors identified in Section 304(b)(2) as well as the economic impact factors applicable in Section 301(c) variances. BPJ standards for conventional pollutants (e.g., total suspended solids, biochemical oxygen demand) reflecting "best conventional pollutant control technology" ("BCT"), should take into account the cost reasonableness tests contained in Section 304(b)(4)(B). It is unclear how these factors might appropriately be applied in calculating BPJ effluent limitations for the Iron Mountain Mine site.

- If promulgated Clean Water Act Effluent limitations are otherwise appropriate for the site, a Section 301(c) economic impact variance might still be available if the economic impacts of compliance are excessive; but in fact, there are no applicable standards.

- To the extent the mine discharge has point sources, water-quality-based effluent limitations may not be appropriate for reasons similar to those discussed above with regard to nonpoint sources. If there are other sources of pollution of the stream segment affected by the mine's discharge, including nonpoint sources from the Iron Mountain Mine site or other upstream sites, it would be appropriate to perform the water quality analysis on a regional basis.

- In assessing the water quality impacts of the mine discharge, it would be appropriate to define a reasonable "mixing zone" in the receiving waters.

COMMENT A12-2 (Stauffer)

This is an improper application of this requirement. According to the Clean Water Act, BAT must be applied to these process streams and point source discharges for which effluent limits have been established after careful studies have been completed. None have been established for acid mine drainage for inactive mine sites. Water quality criteria should therefore be established on a cost-effectiveness/case-by-case basis.

RESPONSE TO COMMENT A12-1 AND A12-2

Stauffer Chemical Company submitted extensive comments concerning the Clean Water Act. The Feasibility Study Addendum presented two new combined alternatives, CA-8 and CA-9, which contain pollution control components aimed primarily at reducing or eliminating the discharges for the two copper cementation plants onsite. These plants are the greatest sources of pollution at Iron Mountain, discharging acid mine drainage containing up to 3 tons of toxic heavy metals per day at pH's that have been measured below one standard unit. Among the major applicable goals of the Clean Water Act is the elimination of the discharge of pollutants to surface waters. Stauffer would argue that a cleanup alternative such as its own $8.1 million proposal, which allows the continued untreated discharge from the plants, is conceivably justifiable under the Clean Water Act. EPA strongly disagrees.

As stated in the Feasibility Study Addendum, Section 301 of the Clean Water Act requires that discharges from point sources, such as the cementation plants, meet both technology-based pollution control effluent limitations, and any more stringent limitations necessary for achieving compliance with water quality standards. One of Stauffer's repeated contentions is that water quality standards should be neglected at all points above Keswick Dam. The water quality standards that apply below Keswick Dam clearly apply to all tributary streams above it, including Boulder, Slickrock, Flat, and Spring Creeks. The numeric and narrative standards are listed in the Addendum, and are a part of both state and federal law.

EPA has determined using Best Professional Judgment that effluent limitations achievable using lime treatment and settling technology satisfy the technology-based pollution control requirements of the Act. This technology will raise the discharge pH from about 1-2 to approximately 6-9, and will at minimum achieve maximum concentration limits of 0.3 mg/l copper, 1.5 mg/l zinc, and 0.1 mg/l cadmium. Maximum concentrations discharged from the copper cementation plants during the Remedial Investigation were 2 to 3 orders of magnitude above these limits:

- 111 mg/l copper
- 1,270 mg/l zinc
- 8.9 mg/l cadmium

Stauffer has presented many generalized arguments concerning the Clean Water Act without relating them to any specific sources of pollution, or receiving streams, at Iron Mountain Mine. It is therefore difficult to ascertain the point of several of these arguments. Summaries of issues raised in the discussion on pages 3 to 5 of Stauffer's letter and EPA responses follow.

- Technology-based limitations should not be applied to nonpoint sources of acid mine drainage.

  EPA has not applied technology-based limitations to any nonpoint sources, and Stauffer has failed to identify any nonpoint sources at Iron Mountain Mine. The copper cementation plants are clearly point sources. Although many sources of pollutants such as waste dumps are commonly referred to as nonpoint sources, they are in fact point sources for the purposes of the Clean Water Act.

- Water quality-based effluent limitations should also not be applied to nonpoint sources.

  Again, without a particular reference to a nonpoint source, the point of this argument is unclear.

- Promulgated EPA effluent guidelines such as those for the Iron Ore Subcategory of the Ore Mining and Dressing Point Source Category should not be applied to point sources at inactive mines.

  As stated above, EPA established using Best Professional Judgment that effluent limitations achievable using lime treatment and settling meet the technology-based requirements of the Act. Even if the mine were active, EPA questions whether the Iron Ore Subcategory guidelines would be applicable.

- If a discharge under the Clean Water Act is a nonpoint source, but EPA-promulgated effluent limitations are not applicable, effluent limitations normally are based on "best professional judgment."

  Again, it is not possible to respond to this issue without a specific reference to a nonpoint source of pollution at the site.

- Water quality-based effluent limitations may not be appropriate for point sources if there are other sources of pollution of the stream segment affected by the mine's discharge including nonpoint sources at Iron Mountain Mine and other upstream sites.

  EPA disagrees. Water quality-based effluent limitations are appropriate to point sources, and may in fact become more stringent if other sources of pollution affect a stream segment. In this case, Iron Mountain Mine is the only source of pollution on Boulder and Slickrock Creeks. Iron Mountain is by far the largest source of pollution on Spring Creek, and the one other known source is under a Regional Board Order to Cease discharge.

- In assessing the water quality impacts of the mine discharge, it would be appropriate to define a reasonable "mixing zone" in the receiving waters.

  The receiving waters of the copper cement plants are Boulder and Slickrock Creeks. Although the California Basin Plans contain no provisions for mixing zones, EPA typically calculates the available dilution using a stream's 7Q10. In the case of Boulder Creek, this might allow a small mixing zone. Slickrock Creek, however, is intermittent and no mixing zone would be allowable.

CATEGORY A13--COMMENTS RELATED TO POINT OF COMPLIANCE

COMMENT A13-1 (Stauffer)

EPA adopted combined alternatives upon belief they must abandon the point of compliance concept presented in the Public Comment FS submitted in August 1985. This provided for compliance in the Sacramento River just below Keswick Dam. Now EPA asserts they must impose the most rigorous controls upstream from Keswick Dam to meet the requirements of the Clean Water Act and the requirement of Best Available Technology Economically Achievable. This interpretation is entirely wrong.

The designation of a point of compliance with water quality standards at a point in the Sacramento River continues to be justified.

RESPONSE TO COMMENT A13-1

EPA to answer.

COMMENT A13-2 (Miller)

What are the specific new objectives established by EPA, in the FS addendum, in terms of finite numbers?

RESPONSE TO COMMENT A13-2

EPA's new secondary objective is to develop a cost-effective remedy that will minimize the discharge of metals from the IMMI site into the receiving waters. There are no finite numbers, and this objective will be used only on a relative benefit basis when comparing one alternative versus another.

RD/R89/014