Iron Mountain Mine Superfund Site and the Shasta Mining District

August 2016

ASTSWMO Brownfields and Superfund Symposium
Agenda

Past
- Mining history, environmental impacts
- NPL listing and remediation

Present
- Site operation
- Optimizing treatment

Future
- Final Record of Decision
- Shasta Mining District, watershed challenges
Site Overview

- 4,400 acre property
- Mined 1890-1963 for copper, zinc, gold, silver, and pyrite
- Spring Creek flows into the Sacramento River
  - Most critical spawning habitat for salmon in CA
  - 20% of California’s water supply
  - Major source of hydroelectric power
Golden state mine recorded as worst water

Inside a toxic hellhole, Iron Mountain Mine

ENVIRONMENT Iron Mountain's runoff polluted rivers for century

By Peter Fimrite  Published 4:00 am, Sunday, August 29, 2010

Redding — Researchers working in the abandoned Iron Mountain copper mine knew they faced radical conditions.

Shovels left overnight in puddles deep in the mine dissolved where the water touched them. Rock hammers dipped in the water came up copper-plated after a few minutes.

When droplets dripped on the scientists from translucent green stalactites deep within the mine, they had to dab them with baking soda to neutralize the liquid before it burned them.

Even wearing hazardous-material “moon suits” with masks, goggles and gloves, those working in the Superfund site’s hot, humid upper chamber had a sour, gritty taste in their mouths.

“Basically, your teeth are dissolving,” says Charlie Alpers of Davis, a U.S. Geological Survey scientist and UC Davis research associate.

The result of that 1996 trip, recently published, Alpers and colleague Kirk Nordstrom discovered the most acidic water found in nature. And there’s more. Other scientists recently announced the discovery of an acid-producing microbe that thrives in the superacidic environment.

World’s ‘Worst Water’ Found Near Redding

Acidity at Iron Mountain mine stuns scientists

By Carl T. Hall

CHRONICLE SCIENCE WRITER
Acid Mine Drainage

Richmond Ore Body

Impacts to Spring Creek
(pH = 3)
Impact on the Environment

• Largest source of surface water pollution in US. Historic discharges into Sacramento River:
  • 6 tons metals per day

• More than 30 documented large-scale fish kills
  • Habitat for steelhead and four runs of Chinook Salmon (including endangered Winter Run Chinook Salmon)

• Site listed on National Priorities List (Superfund) in 1983 to address ecological risk
Site Remediation

• Extensive EPA investment: $500M spent so far

• Successful enforcement

• Collaboration with partners (State and Federal)

• Cutting-edge science
Main Mine Area of Iron Mountain Mine

Adits in the mine workings
Adit Rehab and AMD Collection

Then

Now

AMD

Then

Now

AMD
Project: 2006 Grand Award Winner
American Council of Engineering Companies

Photo: EPA Superfund 25th Anniversary Winner

2004 Slickrock Creek Retention Reservoir

AMD Collection
AMD Treatment and Disposal

Minnesota Flats Treatment Plant

Sludge Drying Ponds

Brick Flat Pit
Iron Mountain Mine Today

- Site operator implements $5M/year remedy
- ~250M gallons treated per year
- Treatment plant effectiveness: influent contains 300,000 ppb Cu-T, effluent contains ~3 ppb
- 97% reduction of metals leaving site
O&M – Site Management Into the Future

• Emergency Preparedness Plan
  • Plans for various emergency scenarios
  • Regularly updated
  • In-person emergency responder meetings

• Asset Management Plan
  • Tracks components of remedy that have potential to

• Investigating Metals Recovery
  • Innovative way to shrink environmental footprint of site and increase on-site storage capacity
Final Cleanup Decision: Preparing for the Future

Operable Unit 6: Boulder Creek

• Focuses on unremediated drainage (last 3% of metals leaving site)
• Tramway and railroad areas
  • Arsenic bioavailability investigation
  • Extensive Water Quality Modeling

To fully understand final remedy, must consider changing conditions:

• Site is part of a complex water management system
• Drought, potential raising of Shasta Dam, etc.
Dissolved Copper at Shasta Dam Outlet, 2010-2015

IMM Compliance Point = 5.6 ug/L

Shasta Lake TMDL Limit = 1.3 ug/L
Shasta Dam TMDL Limit 1.3 ppb Copper

Iron Mountain Mine

Compliance Point 5.6 ppb Copper
Shasta Dam TMDL Limit 1.3 ppb Copper
Iron Mountain Mine
Compliance Point 5.6 ppb Copper
Sacramento River
Shasta Dam TMDL Limit 1.3 ppb Copper
Stowell

Early Bird

Keystone

Balaklala

Shasta King

Mammoth

Golinsky

Stowell

Keystone

Balaklala

Shasta King

Mammoth

Golinsky
<table>
<thead>
<tr>
<th>Mine</th>
<th>Openings with plugs</th>
<th>Rehab Events</th>
<th>Leakage Rate (Cu lbs/day)</th>
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<td>3.7</td>
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<td>0</td>
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<td>Keystone</td>
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<td>2 (blowout)</td>
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<td>Shasta King</td>
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<td>Stowell</td>
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<td>Golinsky</td>
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<td><strong>Subtotal (From Photo)</strong></td>
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West Squaw Creek

Average Annual Copper Concentration (ug/L)
Conclusions

• Extensive NPL cleanup efforts at Iron Mountain Mine

• Final sitewide remedy requires holistic approach

• Evaluating Shasta Mining District helps us understand our remedy at Iron Mountain Mine more fully

• Not just managing one mine: contributing to protection of a critical water system