

**American Academy of Environmental Engineers and Scientists
Industrial Waste Management Grand Prize Award Winner**

***Iron Mountain Mine
Sediment Removal Remediation Project***

**2014 Excellence in Environmental Engineering & Science Awards
Washington D.C. April 24, 2014**



CH2MHILL

EPA Region 9

- Iron Mountain Mine Superfund Site
- Project completion: \$45 million



EPA Remedial Action

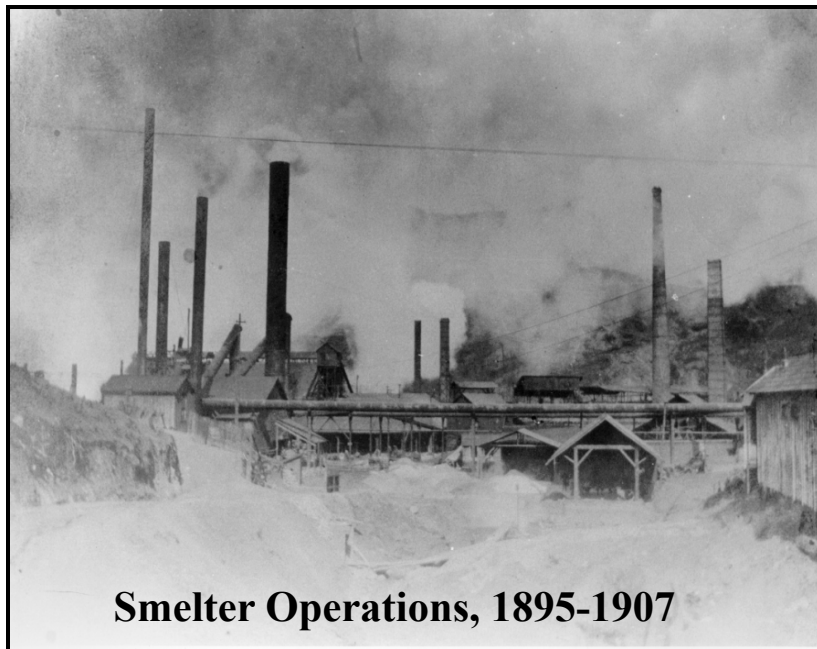
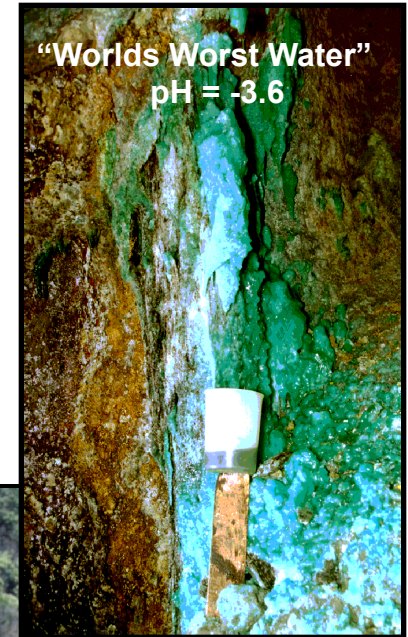
- Hydraulic dredging of 160,000 cubic yards contaminated sediments
- First ARRA funded project nationwide in Superfund Program
- Construction and dredging accelerated from 3 years to 18 months
- Thirteen small business subcontractors completed the work
- Close cooperation by federal, state and local government agencies

Green Remediation

- Tier 2 equipment
- Hydroelectric power source for pump stations and treatment plants
- Project enables additional \$3 million per year peak power production

Iron Mountain Mine

- Largest discharger of metals to surface waters in U.S.
- Numerous, massive fish kills in Sacramento River
- Placed on National Priority List in 1983
- Contaminant discharge reduced by 98 percent



Smelter Operations, 1895-1907



Boulder Creek, pH 2

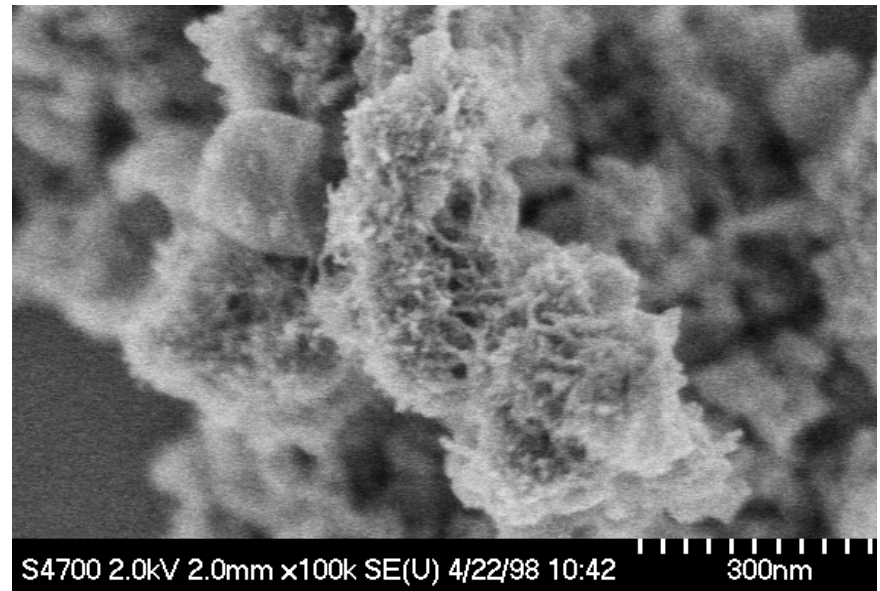
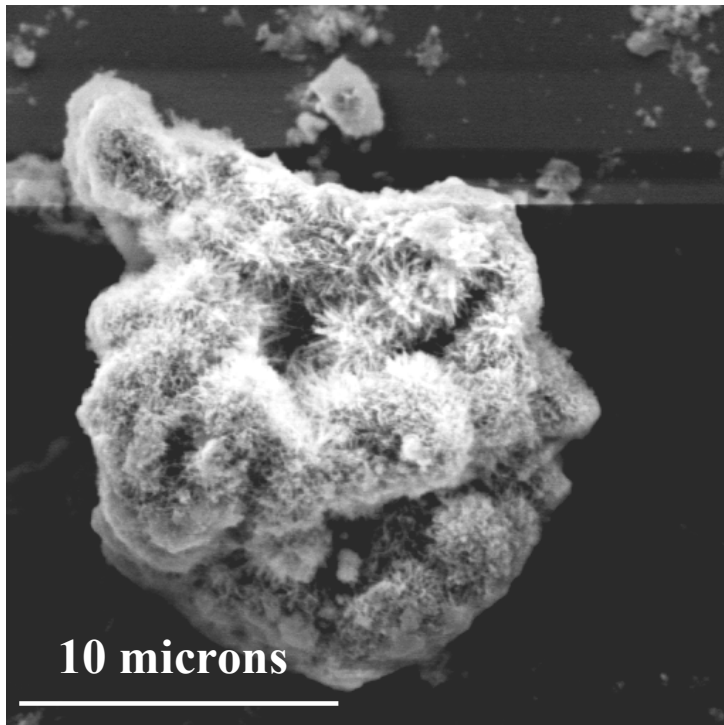
Spring Creek Arm of Keswick Reservoir



Photo October 8, 1998

Sediment Characterization

- Fine grain size
- Large surface area: ~ 50 square meters per gram
- Sediment pore water: 100 percent mortality at 200:1 dilution



High-resolution scanning electron microscopy by J. Coston (Guarini)

Project Elements

Chemical (lime) and Polymer Treatment

- pH adjustment and liquid/solids separation

14-inch Hydraulic Dredge

- Swinging ladder, cutter head, ~ 6,000 gpm

Pump Stations

- Three stations - 600 horsepower, electric

Sediment and Water Conveyance Pipelines

- 2 miles; elevation gain: +350 feet

Sediment Removal Remediation Project





Confined Disposal Facility

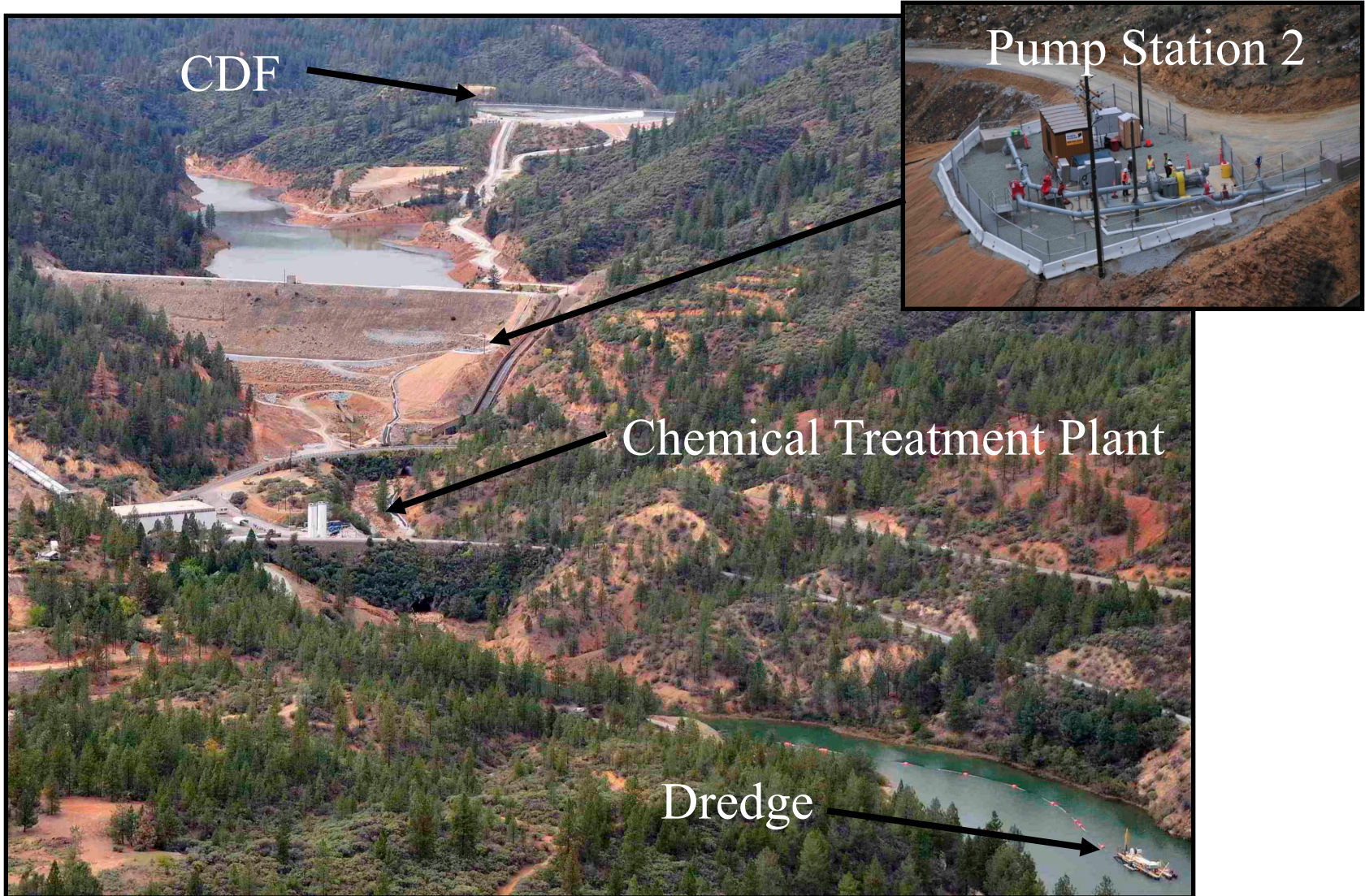
- Capacity: 275,000 cubic yards
- Two cells: primary and secondary
- Liners: earthfill, 60 ml HDPE

Chemical Treatment and Polymer Plants



- Chemical plant capacity: 7,000 pounds per hour
- Polymer capacity: 34 gallons per hour neat polymer

Sediment Removal Remediation Project



Sediment Removal Remediation Project



Engineering Controls

- Hydraulic dredging: 2 to 3 foot lifts
- Turbidity curtains
- Remote water quality sensors



Water Quality Monitoring

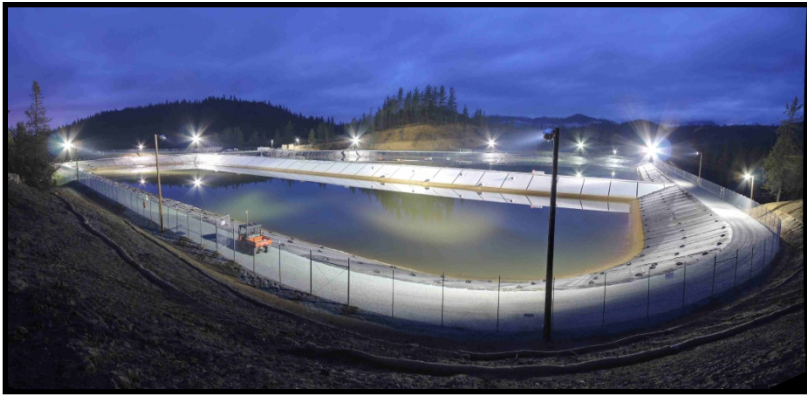
YSI 6920 sondes / real-time internet transmission

Turbidity, pH, temperature, DO, and conductivity

Daily sampling/onsite analytical testing



Sediment Removal Remediation Project



October 14, 2009
Day 1 of Dredging Complete
14 inches of rain in 24 hours



Sediment Removal Remediation Project

Confined Disposal Facility Operations

pH > 11

Dredged slurry
6 to 12 % solids



Anionic Polymers



Confined Disposal Facility Dredging Complete

Sediment Removal Remediation Project



**Confined Disposal Facility
10 months after dredging completed**



Confined Disposal Facility Closure

CDF was covered with geotextiles, granular fill, and earth fill

Geogrid placed above the geotextile in high water content/ very low strength areas.



**Confined Disposal Facility
Grading, Liner Placement, and Revegetation Complete**



Key Project Attributes



- **Hydraulic dredging:** 6,000 gpm with a 14-inch dredge conveyed 12,000 feet with 350-foot elevation gain
- **Highly unusual oxy-hydroxide sediments:** dredged without exceeding water quality standards; treated, dewatered, and capped within ~16 months of dredging
- **Project control systems:** with three-phase quality management and integrated project scheduling, 13 small businesses could complete a complex project with less than 5 percent subcontract modifications
- **Municipal, agricultural, and fishery water supplies:** Removed 150,000+ tons of copper, zinc, iron, and arsenic-contaminated sediment from Keswick Reservoir