FINAL REPORT
FOR THE
Sonnemann Mine Tailings Reclamation Project
Owyhee County, Idaho





U.S. Bureau of Land Management
Owyhee Field Office
Boise District
3948 Development Avenue
Boise, Idaho 83705

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I. SUMMARY

The State of Idaho completed a Site Investigation Report that identified surface water and soil as the principal exposure pathways at the Sonnemann Mine site (DEQ, 2005). The Site Investigation identified water management issues resulting in erosion of the tailings pile. Mine tailings along the Williams Creek stream bank were unstable and produce sediment to Williams Creek, affecting water quality and aquatic habitat in both Williams Creek and Jordan Creek. The Site Investigation stated that "DEQ believes that to eliminate erosion, South Mountain Mining Company and the BLM should first consider installing cutoff trenches above the tailings impoundment to intercept overland flow and redirect it towards the unnamed perennial drainage to the north of the tailings. They should also consider re-grading the tailings piles to provide a stable surface area, upon which an evapotranspiration cap can be installed and revegetated."

The U. S. Bureau of Land Management (BLM) conducted a CERCLA time-critical removal action at the Sonnemann Mine site in the fall of 2007. The main actions being the re-grading and configuring of the tailings piles, installation of a geomembrane and geotextile cap over the tailings pile, placement of top soil, seeding, and installation of other water and sediment management features. Details are provided below in this report.

II. SITE CONDITIONS AND BACKGROUND

A. Site Description

The Sonnemann Mine, a historic and now inactive mining site, is located along Williams Creek in the Jordan Creek subbasin, southwest Idaho Figure 1 (after DEQ, 2005, Figure 2-1). Although much of the Sonnemann Mine and Mill site is on patented mine lands, the large three-tiered tailings pile is located on public lands managed by the Bureau of Land Management (BLM) (Figure 2).

The Sonnemann Mine is a lead, zinc, and silver lead mine located in Owyhee County, Idaho, approximately 18 miles southeast of Jordan Valley, Oregon, and 20 miles south of Silver City, Idaho. The site is located near the headwaters of Williams Creek on the northwest flank of South Mountain. The mine was developed within the same sulfide-rich metamorphosed sediments as the old Golconda Tunnel located 0.20 miles southeast of the Sonnemann.

Ownership History:

The ownership history of the Sonnemann Mine, also known as the new Golconda Tunnel, Sonnemann Mine, and South Mountain Mine, is unclear. Two major veins of gold, silver, and lead were discovered in 1868 on South Mountain but were not developed until 1869. In 1874, a small smelter was established in the town site of Bullion City, later renamed South Mountain, which lies on private land 0.75 miles north of the Sonnemann Mine. Early ownership of the Golconda Group is vague but it has been reported that "in the fall of 1874, San Francisco parties bought up the more important mines and incorporated as the South Mountain Consolidated Mining Company. The Company opened up the Golconda, Bay State, Yreka and other mines" (V.P. Jennings, unpublished manuscript). Failure of the Bank of California on August 26, 1875, effectively shut down mining on South Mountain (ISHS, 1996). In the early 1900's,

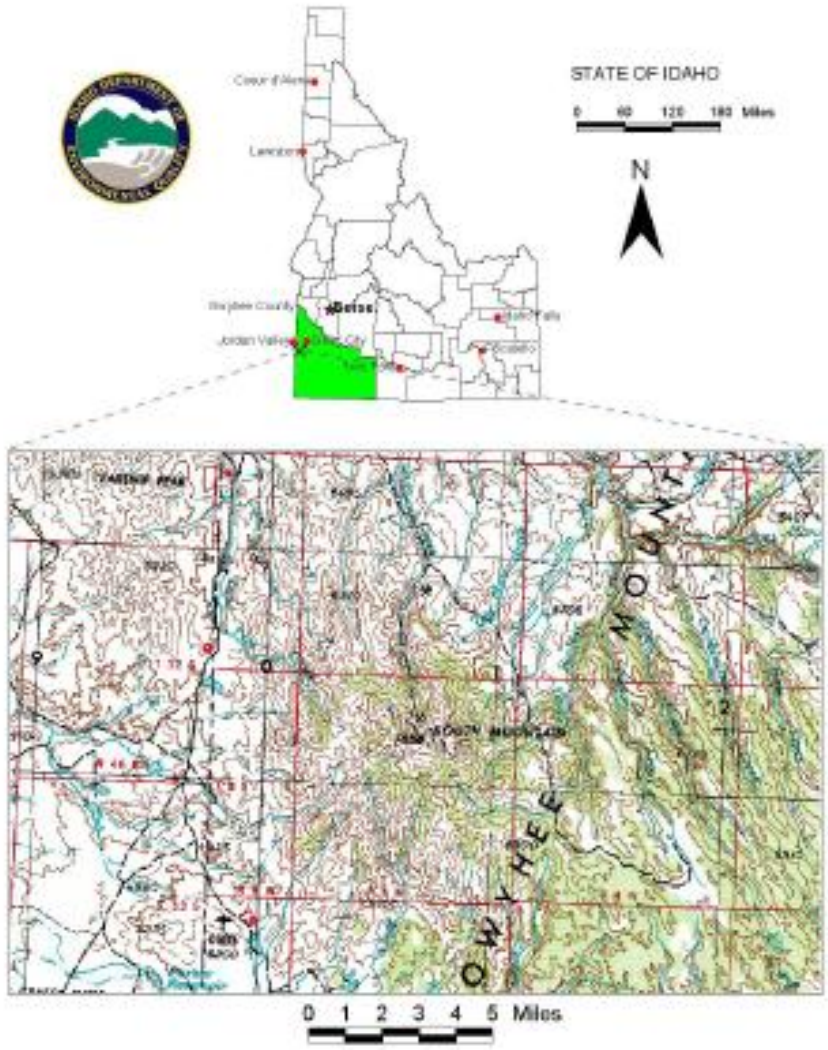


Figure 1

George A. Sonnemann of Spokane, Washington, organized the Golconda Group on patented claims. The Alabama claim encompasses the old Golconda Tunnel and Golconda stope while the Kentuck and Queen of the Mountains claims contain the Sonnemann Mine and Mill site.

In 1926, the Uida Consolidated Mines Company held the bond and option on the property of the South Mountain Mining Company, but records fail to show any mining operations conducted by the new company. Between August 9, 1940, and November 30, 1946, the South Mountain Mining Company was operating the mine. During this period, a mill was built adjacent to the Sonnemann adit. Between 1950 and 1955, the mine was operated with poor results. Higher silver prices in 1977 sparked additional work to develop ore and reopen the mine.

L. Heagney of Spartanburg, South Carolina owned all of the patented claims (17) within the South Mountain Mining District during the initiation of this project. In the Fall of 2007 ownership changed to

Thunder Mountain Gold represented by Jim Collord.

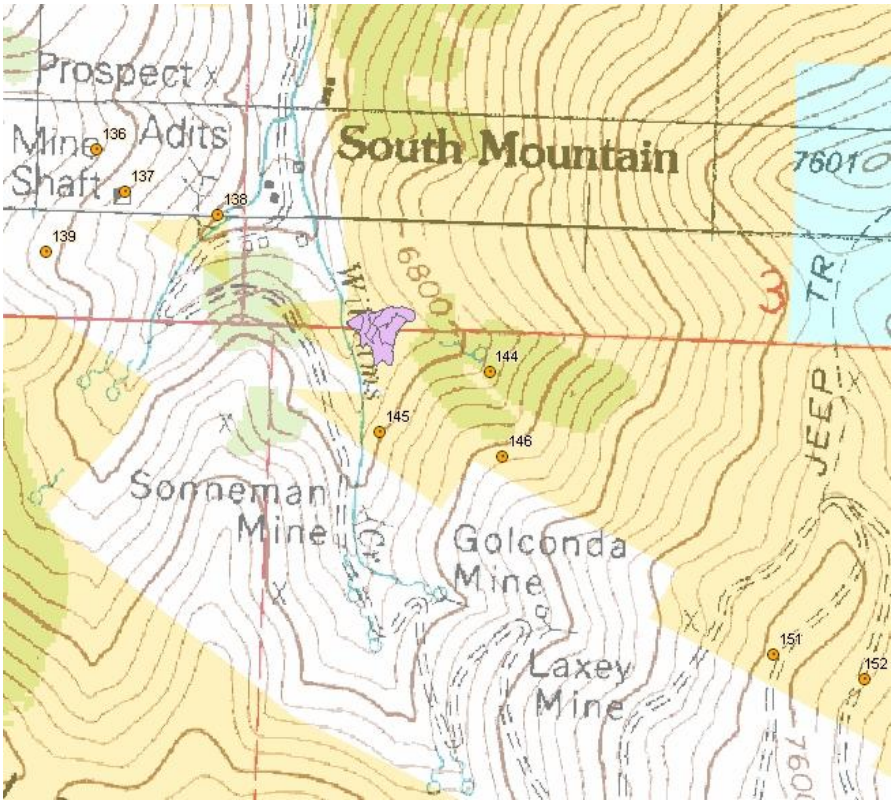


Figure 2

The mineral deposits in the Sonnemann Mine consist chiefly of lead, zinc, silver and copper with an appreciable amount of gold (Sorenson, 1927). Sulfide ore appears to have been the primary mined and processed material from the Sonnemann Mine. Historical records lack detail, but it is believed the majority of the estimated $1.67 million recovered from the South Mountain claims between 1940 and 1945 were extracted from the Golconda Group of mines, including the Sonnemann Mine. Operations between 1950 and 1955 only yielded an estimated $120,000 (ISHS, 1996). The primary minerals encountered within the Golconda Group were tetrahedrite, galena, hedenbergite-ilvaite, sphalerite, chalcopyrite, arsenopyrite, pyrite, calcite and quartz (Sorenson, 1927).

Sediment sampled from the tailings impoundment during an Idaho Geological Survey Abandoned Mine Lands (AML) inventory (Bennett et. al., 2000) showed a "significant tendency for leaching…[from] arsenic, cadmium, chromium, mercury, and selenium." During this same study, the downstream sample from Williams Creek exceeded all water-quality standards for cadmium and exceeds both aquatic life standards for zinc in the dissolved metals screen. The sample also exceeded both aquatic life standards for zinc in the total recoverable metals screen, and all standards for mercury (ICP cold vapor test).

The main access road to the site passes through patented lands.

Resident red band trout, a BLM sensitive species, have been identified in Williams Creek. Williams Creek is a tributary to Jordan Creek which is a 303(d) listed reach.

B. Removal Site Evaluation

DEQ (2005) constitutes the Removal Site Evaluation that is in the Administrative Record located at the Idaho BLM State Hazmat/AML Center and is available at the following ftp site:

ftp://ftp.blm.gov/pub/ID/aml/Sonneman_Administrative_Record/

Sonnemann Mine & Mill is the official CERCLIS site name with and EPA ID of IDN001002433. The site is not on the National Priorities List. According to Mr. Ken Marcie of EPA Region 10, the site has been remanded to the State of Idaho DEQ for action. EPA will not remove the site from further action until the State of Idaho recommends this action.

C. Threats to Public Health or the Environment and Statutory and Regulatory Authorities

The BLM determined that threats to public health or welfare and the environment at the Sonnemann Mine site necessitated a time-critical removal action pursuant to CERCLA Section 104(a) as documented in DEQ (2005).

A time-critical removal action was necessary at the Sonnemann Mine Reclamation Project to prevent human and ecological exposure to heavy metals and to prevent the continued migration of the contaminants into adjacent watersheds and ground water. The removal action is intended to reduce or eliminate the threats from the contaminants to public health or welfare and the environment.

A CERCLA Action Memorandum for the Sonnemann Mine Reclamation Project was completed and approved on June 15, 2007 and can be found at the above FTP site.

D. Maps, Pictures and Other Graphic Representations

Additional maps and pictures for this project can be accessed at the BLM Boise District Office and the BLM State Office. Some are also located on the above FTP site.

III. PROJECT DESCRIPTION

The Sonnemann Mine Removal Action was completed in the fall of 2007. An important component of this action was working with the existing private property land owner, South Mountain Mines, Inc., in gaining both access to the site and developing an agreement for use of the private lands for staging of the operations, and more critically, a borrow material source for the top soil needed to complete the cap. These actions were all finalize prior to any work on the ground.

The BLM contracted with North Wind, Inc. to complete the Design Report for the Sonnemann Mine Removal Action in the fall of 2006. On-site work was started on September 18, 2007 and completed on October 15, 2007. Details of the project are presented below:

Establish Access Route – The access route into the mine site is by means of a dirt road that runs along Williams Creek. The road has had minimal maintenance over the years but is generally in passable shape. Two stream crossings had to be improved by installation of rocked drain dips in order to accommodate heavy equipment crossing. The main stream crossing at the project site was improved by means of cleaning out and making functional the existing culvert and then rearmouring the crossing over the culvert with soil and rock in order to allow multiple passes with heavy equipment. The existing access route up to the tailings pile was bladed and water bars installed. The spring and seep area at the end of the access road were armored and a culvert installed to more efficiently move water into the existing channel and off the road area. Silt fences and other erosional measures were installed.

Tailing Pile Re-grading – On September 20, 2007 the tailing pile re-grading and rough-in work was initiated using a CAT D6R dozer (See Figure 3). The first step involved pulling the lower terrace tailings back from the flood plain and incorporating them into the main body of the tailings. Then the main body of the tailings pile was reshaped and contoured in such a way as to minimize the area of the original footprint and blend the area into the hillside. The final dimensions of the tailings foot print were 225 ft. in length and 165 ft. in width with a finished slope of 3.5:1. The final grooming was completed on October 3, 2007. Along with the re-grading work an anchor trench was completed around the upper and side perimeters of the tailings pile for securing the liners.



Figure 3 – Sonnemann tailings pile re-grading operation.

Borrow Source Operations – On September 25, 2007 the boundaries for the borrow source on private lands were established with the private land owner. Borrow source operations consisted of grubbing the area, staking the area out, and then cover soil excavation and stockpiling. This operation continued up to the time the top soil haul operation commenced. Figure 4, below, shows the borrow source area.



Figure 4 – Borrow source area excavation and top soil stockpiling.

Hydrologic Controls Implementation - A properly graded and geotextile-lined soil cap atop a tailing pile inherently protects the tailings from moisture infiltration and interior pile erosion from stormwater runoff. Additional hydrologic controls were implemented into the final tailing pile configuration to mitigate risks associated with stormwater run on, erosion at the tailing pile boundaries from adjacent streams, and topsoil erosion. These included construction of run-on control ditches around the tailings pile, the redirecting of the springs overland flow back into its original channel and away from the tailings pile, and the installation of a straw/coconut erosion control mat atop the seeded tailings pile.

Soil Cap Construction – A geotextile-lined soil cap was constructed atop the tailings pile. A geotextile-lined soil cap provides far more positive control against moisture infiltration into the tailings below (lessening any opportunities for contaminant leaching) and utilizes a significantly smaller volume of borrow soils when compared to an evapotranspiration cap. In addition, performance of a geotextile-lined soil cap is not subject to either changing climate factors or the health of its cover crop, lessening the likelihood of long-term maintenance requirements. This work was subcontracted out to NorthWest Linings & Geotextile Products, Inc. who started the installation on October 5, 2007 and completed the

installation the next day. A 30 mil LLDPE PVC geomembrane liner was laid down over the entire surface of the tailings pile and into the anchor trenches (See Figures 5 and 6). The seams of the liner were heat welded and checked with a high pressure air wand for weld integrity. Then a 12 oz. non-woven geotextile cushion fabric was laid down over the geomembrane with all seams heat sealed with a torch (See Figure 7). Extra material that was left over was used for a second layer over the center 2/3 of the tailings pile. The anchor trench surrounding the lined tailings pile is then backfilled, securing the liner system in place (See Figure 8)



Figure 5 – Geomembrane construction over the graded and reconfigured tailings pile.



Figure 6 – Geomembrane detail.



Figure 7 – Constructing the geotextile liner over the geomembrane.



Figure 8 – Liner edges in anchor trench before covering and securing.

On October 7 the top soil haul operation began using an articulated off-road haul truck. Loads were averaging 25-30 cubic yards per load. Cover soil was loaded via combination of loader (when loading from the stockpiles) and excavator (when loading from banked soil). Cover soil was transported to the top of the graded tailings pile, dumped, and then spread using a low ground pressure dozer (See Figure 9). Stakes, marked at 18 inches and placed at intervals atop the liner, were used to confirm cover soil depth. A total of 2,700 cubic yards of top soil was utilized to complete the soil portion of the cap with soil coverage atop the entire liner area being a minimum of 22 inches thick and an average of 24 inches thick. This portion of the project was completed on October 9. The entire tailings project area was then seeded with a grass/fobs mixture containing species such as mountain brome, pubescent wheatgrass, streambank wheatgrass, orchard grass, and western columbine.



Figure 9 – Top soil operations. Spreading and shaping top soil cap.

Ancillary Actions – The access route up to the project site was ripped, seeded, and covered with a certified weed-free straw mulch (See Figure 10). The borrow source area was re-graded into a stable configuration as requested by the private landowner, seeded, and mulched with straw. All straw mulched areas had the straw spread and then tracked in with the dozer. The armoring at the main stream crossing was removed, the area recontoured, seeded, and a mulch applied. A four-strand barb wire fence was constructed around the project area in order to keep livestock from accessing the site. Fencing was completed on October 15. Figure 11, below, shows the finished tailings pile with the erosion matting in place over the seeded top soil layer.



Figure 10 – Access road rehabilitation. Ripped, seeded, and mulched.



Figure 11 – Finished cap with straw/coconut erosion cloth over seeded tailings pile.

IV. FUTURE ACTIONS

The Sonnemann Mine reclamation project area will be monitored on a yearly basis as part of the ongoing AML/Hazardous Materials site monitoring program. Yearly visits will be made to document the health of the seeding and the integrity of the soil cap. The function ability of the run-on diversions will also be part of this monitoring. Starting in the summer of 2008, and for a few years after, sediment sampling will be conducted in Williams Creek both up stream and down stream from the project site. Analysis for the most prominent heavy metals (arsenic and lead) will be conducted.

V. APPRECIATION

The BLM would like to thank South Mountain Mining Company, especially their representative Mr. Kenneth Henderson, for their cooperation in this project.

They provided access, a staging area, and a much needed source of top soil. With out any of these items the project would have been nearly impossible to do. In addition, Jim Collard and G. Peter Parsley of Thunder Mountain Gold ,were in the process of acquiring the private lands from the South Mountain Mining Co. during the start up of the on-the-ground implementation. They were very helpful during the staging and construction phase.

Appreciation goes out to North Wind and their Project Manager, Mark Feldman, who did an amazing job putting the work plans together and completing the on-the-ground work in a timely and cost efficient manner. Considering the weather factor at the work site during the operation (snow, cold, and wet ground conditions) the crew did an amazing job keeping within time frames and doing high quality professional work.

VI. PROJECT COSTS

Sonnemann Mine Tailings cleanup costs are shown in table 1 and 2 below. Costs in table 1 include all costs incurred by BLM in implementation and management of the project. Table is represents the construction phase costs incurred in 2007.

Table 1. Sonnemann Project Costs (Management Information System, BLM, 3/3/08).

FY	Project Code	Project Name	Expended
2006	DAE3	Sonnemann Mine Tailings	$22,700.33
2007	DAE3	Sonnemann Mine Tailings	$185,431.50
2008	DAE3	Sonnemann Mine Tailings	$4,515.59
		Total to Date:	$212,647.42

Table 2. Construction phase costs of the Sonnemann Tailings Cleanup (Northwind, Inc., 3/5/08).

Project Task	Labor	Equip/Mat'ls	Safety	Travel
Mobilization and Access Improvements (includes haul road prep)	$11,744	$15,255	$146	$1732
Re-grade Tailing Pile	$11,744	$15,255	$146	$1732
Borrow Source Operations	$5219	$6780	$65	$770
Tailing Pile Liner and Cap Install	$13,049	$66,446	$162	$1925
Ancillary actions: hydrologic controls, fence, haul road removal, borrow source rehab, demobe, etc	$10,438	$15,861	$130	$1539
Subtotals	$52,194	$119,597	$649	$7698
Total Construction Costs	$180,138			

VII. COST AVOIDANCE

The negotiated access agreement enabled BLM and contractors to access the site on public land and use borrow materials for the tailings cover from private lands owned by South Mountain Mining Company/Thunder Mountain. Without this cooperation, the project would not have been practical to complete. We estimate that costs of approximately $40,000 were avoided by the good will cooperation of the South Mountain Mining Co./Thunder Mountain Mining Company.

VIII. REFERENCES

DEQ
ISHS, 1996
Sorenson, 1927
Northwind, 2008