

CASE STUDY

Copper Basin Polk County, Tennessee

August 2010

**Prepared by
The Interstate Technology & Regulatory Council
Mining Waste Team**

Permission is granted to refer to or quote from this publication with the customary acknowledgment of the source. The suggested citation for this document is as follows:

ITRC (Interstate Technology & Regulatory Council). 2010. *Copper Basin, Polk County, Tennessee*. Mining Waste Treatment Technology Selection Web. Washington, D.C.: Interstate Technology & Regulatory Council, Mining Waste Team. www.itrcweb.org.

Acknowledgements

The ITRC Mining Waste Team would like to acknowledge Carrie L. Stokes and Mark Bowers and Ben Falkner, who completed the April 2008 Mine Waste Case Study Survey, from which the information in this case study is taken.

TABLE OF CONTENTS

1. SITE INFORMATION 1
 1.1 Contacts..... 1
 1.2 Name, Location and Description 1
2. REMEDIAL ACTION AND TECHNOLOGIES 2
3. PERFORMANCE..... 3
4. COSTS 4
5. REGULATORY CHALLENGES 4
6. STAKEHOLDER CHALLENGES 4
7. OTHER CHALLENGES AND LESSONS LEARNED 4
8. REFERENCES 5

LIST OF FIGURES

Figure 1-1. Copper Basin Mining District 2

COPPER BASIN, POLK COUNTY, TENNESSEE

1. SITE INFORMATION

1.1 Contacts

Carrie L. Stokes, CHMM, P.E. (CS #2)

Telephone: 615-252-4343

E-mail: cistokes@bwsc.net

Mark Bowers, CIH (CS #2)

Telephone: 919-552-9675

E-mail: mbowers@nc.rr.com

Ben Falkner (CS #27)

Telephone: 304-487-2886

E-mail: bratfarm@pol.net

1.2 Name, Location and Description

Copper Basin Mining Site is in the Lower Potato Creek Watershed near Ducktown, Polk County, in southeastern Tennessee near the North Carolina and Georgia borders and comprises an area of approximately 50 square miles adjacent to lands administered by the Cherokee National Forest (Figure 1-1). The Copper Basin, north of the Ocoee River, is drained by North Potato Creek and Davis Mill Creek, which empty into the Ocoee River. The basin has been host to 150 years of copper mining, beneficiation and mineral processing, sulfuric acid, and other chemical production that have left a legacy of environmental degradation. Deep mining was the primary method, with a few surface-mining operations. In addition to mining and related operations, associated support infrastructure (railroads, equipment storage, and other waste processing facilities) can be found throughout the basin. Remnants of these mining practices remain scattered throughout portions of both North Potato Creek and Davis Mill Creek watersheds. The affected media are soil, sediment, surface stream water, surface pool water, and groundwater.

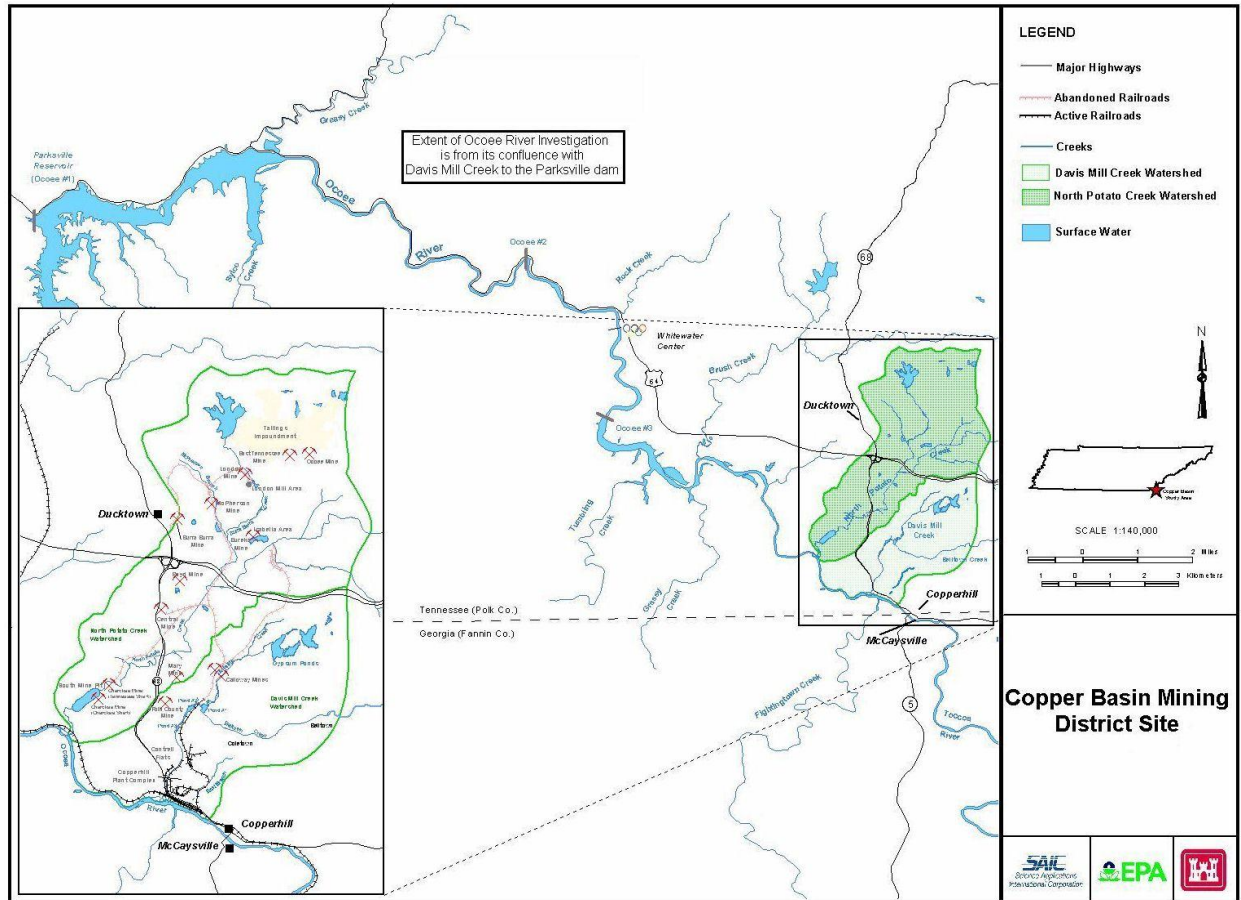


Figure 1-1. Copper Basin Mining District.

2. REMEDIAL ACTION AND TECHNOLOGIES

The site comprises 50 square miles with acidic waters, providing aluminum, copper, iron, manganese, and zinc as the primary contaminants. Secondary contaminants include arsenic, cadmium, cobalt, copper, lead, mercury, selenium, and sulfate. Remedial actions at these sites are overseen and must comply with the Clean Water Act, CERCLA, and the Tennessee Voluntary Cleanup program. The site cleanup goal is mitigation of human health risk and ecological risk in the stream environment and is evaluated using the contaminant concentrations in water.

This large site has used multiple technologies:

- **Backfilling and subaqueous disposal.** A hydraulically isolated mine collapse is used for disposal of materials with high acid-generating potential. Supernatant is pumped for classic precipitation treatment. This type treatment has operated for four years and is anticipated as a permanent solution.
- **Bioreactor.** Anoxic trenches were installed between mine waste pile and creek at MCP restored stream segment.

- **Capping, covers, and grading.** Impermeable caps (PVC liner over excavated tailings at the London Mill) and geosynthetic clay liner (GCL, used over waste material at the London Mill Plant site) have been used where residual materials may still continue to be a significant potential source of acid and/or metals. Covering and grading have been used extensively along with lime stabilization for low acid rock drainage–potential areas. This type of treatment has operated for 10+ years and is considered to be a long-term solution with possibility of becoming a permanent solution.
- **Chemical PPT.** Conventional lime treatment is conducted in a traditional water treatment plant as well as in a system using a 20-acre former open-pit mine as the settling basin. This type of treatment has operated for 10+ years. The operating life of this treatment was undetermined at the time the case study information was reported. Because of the unique drainage at the site (a diversion dam once conveyed the entire 10,000-acre watershed through a tunnel to another watershed), storm-water flows are attenuated by the dam. There is also a 20-acre pit situated in the general vicinity of the of the unique drainage system. This pit is situated in stream and serves as the clarifier. The layout of the treatment plant is efficient. The treatment plant mixes the relatively mild acid drainage in the creek with the mine drainage from the bottom of the pit to produce high-density sludge in the rapid mix tank. This arrangement required intense modeling and design and constant monitoring with automation and process control.
- **Chemical stabilization.** Lime treatment and revegetation of mine waste.
- **In situ treatment.** In situ treatment has been restricted to lime neutralization of materials in place prior to grading and covering. This type of treatment has operated for 10+ years and is a long-term solution and may become a permanent solution.

Secondary treatment technologies include the following:

- **Anoxic limestone drain (ALD).** A single standard ALD was installed for one low-flow source. This type of treatment has been operated for 10+ years (limited effectiveness). The longevity of this treatment is undetermined.
- **Constructed treatment wetlands**
 - Bench- and pilot-scale pilot anaerobic wetland (SRB-mediated) treatment testing has been used to show the capabilities of the technology. This treatment has operated for 10+ years and is a permanent treatment. A GCL liner was used to bottom line the anaerobic wetland which was placed over waste material.
 - 1-acre aerobic wetland with 0.25-acre manganese biofilter.

3. PERFORMANCE

Human health criteria are based on $10E-5$ cancer risk, noncancer hazard index <1 , and blood lead concentrations below protective levels based on IEUBK and/or ALM modeling for future land uses. The ecological criterion is biological integrity in site streams as represented by the benthic

macroinvertebrate community. Specific quantitative objectives were established based on bioregion reference streams. Water quality criteria and benchmarks are used to gauge progress and to monitor specific treatment system performance.

4. COSTS

Cost of activities:

- Capital: Variable
- Operation and maintenance: Variable

5. REGULATORY CHALLENGES

No significant regulatory barriers have been encountered with technologies applied to date. The Copper Basin project benefits from a strong industry/agency/public stakeholder organization that has helped facilitate the expedited implementation of remedial solutions. Use of biological integrity rather than numerical water quality criteria was a major advance in the application of water quality regulations. It acknowledges the fact that fauna in the basin may be uniquely adapted to establish health communities even if concentration-based criteria are not met in all cases.

Land use controls will be required upon completion of remedial/restoration activities. This need is primarily associated with waste materials that will remain in place although physical hazards will also affect how the property will ultimately be used.

6. STAKEHOLDER CHALLENGES

The public has participated in the process and has been pleased with progress. Glenn Springs Holdings has worked closely with the public to improve the quality of life, health and human safety, recreational and educational offerings, and property value protection in the historic and unique Copper Basin.

7. OTHER CHALLENGES AND LESSONS LEARNED

An effective industry/regulatory working group has been the key to success. Regular meetings and intervening conference calls and general correspondence built a remarkable amount of credibility and trust between the parties. As a consequence, there has been a willingness on the part of all parties to carefully consider remedial technology proposals, render constructive (rather than antagonistic) feedback, reach decisions quickly, and work together to optimize design/implementation strategies, which has allowed the project to proceed at a fast pace.

Deed restrictions will limit development in lined and sensitive areas. Five miles of specially constructed fence limits access to mine subsidence areas.

The success of the Copper Basin project is a long and complicated story. It began with industry, academia, and agencies working together to restore vegetation to a uniquely scarred area. Glenn Springs has focused on land restoration and water quality enhancement by employing adaptive management in an iterative approach. Working closely with Tennessee Department of Environment and Conservation and USEPA, Glenn Springs has used the following general approach: Characterize the drainage and environmental influences, divert unaffected drainage, capture and treat affected drainage, sequester acid-producing materials, mitigate remaining problems with passive systems, and evaluate with biologic indicators.

8. REFERENCES

U.S. Environmental Protection Agency. n.d. “Copper Basin Mining District.”
<http://www.epa.gov/region4/superfund/sites/npl/tennessee/copbastn.html>.