

Providing unique  
engineering and  
technology solutions



solutions

**Need for Balance**

Mining is essential to life as we know it today, however, significant knowledge and resources are required to mitigate the effects of mine waste on our environment. MSE is committed to the development, evaluation, and deployment of technologies that provide innovative, sustainable solutions to successfully treat and control mine waste cost effectively. These technologies are diverse and customized to meet client requirements.



**We Provide Solutions/Services**

**Acid drainage/water treatment**

- Prediction/Characterization
- Biological Treatment
- Passive Treatment
- Active Treatment
- Lime Treatment
- Modeling
- Computer Simulator for Design of Bioreactors
- Economic Cost Evaluations
- Sulfate Removal

**Source Control**

- Caps/covers
- Biological Cover
- Grouting (underground workings, tailings, waste rock, high wall)
- Passivation (tailings, waste rock, highwall)
- Electrochemical Cover
- Chemical Bioavailability Reduction
- Modeling
- Characterization

**Heap Detoxification/Closure**

- Biological Cyanide Destruction

**Trace Contaminant Removal**

- Selenium
- Arsenic
- Thallium

**Pit Lakes**

- In-situ Treatment
- Biological Treatment
- Characterization/Remediation
- Limnocorrals/Algae
- Berkeley Pit Lake Research
- Anchor Hill Pit Lake Treatment
- Modeling

**Sustainability**

- Revegetation of Mining Impacted Lands
- Acid/Heavy Metal Tolerant Plants
- Evaluation of Remediation Strategies
- Biomonitors
- Life Cycle Cost Evaluations
- Carbon Footprint Evaluations

**Remote Locations**

- Passive Treatment
- Remote Data Acquisition
- Remote Analytical Monitor
- Meteor Burst Technology



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Mine Waste Treatment and Control

### Biological Treatment of Acid Rock Drainage

For the past 10 years, a sustainable passive treatment using sulfate-reducing bacteria (SRB) has significantly improved the quality of water emanating from the Lilly/Orphan Boy Mine, a remote, abandoned mine in Montana. MSE applied the organic nutrient to stimulate the naturally occurring SRBs only the first year — *the treatment has become self-sustaining*. We used the physical features of the mine as part of the treatment to eliminate the need for capital investment in equipment — *the treatment has virtually no annual operating costs*.

The technology has also been implemented at various U.S. Forest Service Sites and has led to several other related projects:

- Sulfate-Reducing Bacteria Reactive Wall at the Calliope Mine - Butte, Montana, USA;
- SRB-Driven Sulfide Precipitation at Golden Sunlight Mine-Whitehall, Montana, USA;
- Gas-Fed SRB Berkeley Pit Treatment - Butte, Montana, USA;
- Sustainability of Substrates for SRB Barriers, Blackhawk, Colorado, USA;
- Integrated Passive Biological Treatment System at the Sure Thing Mine, Montana.



**Mining Environmental Remediation Capabilities:** MSE has completed more than 100 remedial action projects, totaling millions of dollars. Using this broad and diverse experience, we can manage any remedial action, regardless of complexity.

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## Mine Waste Treatment and Control

### Selenium Removal

**Selenium Treatment Technologies -** MSE's selenium removal technology involves using metallic iron as a reductant under specific process conditions to reduce all forms of selenium to the elemental state. Originally developed by Dr. Larry Twidwell of the Metallurgical Engineering Department at Montana Tech in Butte, MT, MSE refined and demonstrated the process. MSE and Dr. Twidwell have worked together for more than a decade, developing and demonstrating technologies for arsenic, thallium, and selenium removal from water. The selenium process is very robust in that it is unaffected by the presence of high concentrations of competing anions, and works well for all forms of selenium and arsenic. Currently, MSE is designing treatment processes for multiple clients in the United States.

### Trace Metal Removal

**Arsenic Removal -** An arsenic removal technology, developed by MSE and internationally recognized experts (Dr. Larry Twidwell of Montana Tech and Dr. Bob Robins, Professor Emeritus, University of New South Wales, Australia), was deployed at a Sherwin-Williams facility in Emeryville, California. Sherwin-Williams selected MSE to design and build a system to treat 30 gpm of arsenic-con-

taminated ground water at a site near San Francisco Bay. The customer was facing potential fines at \$10,000/day for noncompliance. The MSE system has successfully met discharge requirements since the plant began operation in 1999.

**Arsenic Removal -** Another arsenic project involves the Ten Mile Creek Superfund Site near Helena, Montana. This site has several abandoned mines sending gallons of arsenic-contaminated water every minute to the drinking water source. This project is successfully treating the water emanating from the Susie Mine to reduce the arsenic load to the Ten Mile Creek.

### Treatability Study

**Horseshoe Bend Project -** MSE, along with Veolia North America (formerly U.S. Filter), was contracted by ARCO Environmental Remediation to design a water treatment plant to address the metallic contaminants associated with the acid rock drainage at Horseshoe Bend and within the Berkeley Pit in Butte, Montana. For the project, we conducted a large number of static and continuous flow treatability studies, and performed facility design work including feed systems, reactor systems, solid/liquid separation systems, and discharge and influent pipelines. (at our Test Facility).

### Pit Lakes

The Anchor Hill Pit at the Gilt Edge Mine NPL site near Deadwood, South Dakota, was the site of a joint effort by the U.S. Environmental Protection Agency's (EPA) Region 8 Superfund Remedial Program, EPA's National Risk Management Research Laboratory, and the United States Department of Energy (DOE). The project goal was to demonstrate and evaluate an innovative in-situ process to treat approximately 70 million gallons of acidic mine water containing high levels of dissolved metals, selenium nitrate, and sulfate. EPA and DOE estimated the technology could avoid 20-50% of the operational costs associated with a conventional water treatment plant. To date, 40 million gallons have been successfully discharged--the water discharged meets South Dakota's strict surface water quality standards.

### Heap Detoxification

MSE implemented Cyanide Heap Biological Detoxification at Barrick Gold's Cortez Gold Mine in northeastern Nevada. Biological heap detoxification is a process that uses bacteria to detoxify a spent heap leach pad by destroying cyanide, nitrates and sulfates and removing metals. This project provided a cost-effective, environmentally compatible solution and resulted in reduced bonding costs for Barrick.

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