

# ABANDONED MINE LANDS: A DECADE OF PROGRESS RECLAIMING HARDROCK MINES



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**A DECADE OF PROGRESS**  
**RECLAIMING HARDROCK MINES**

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# A Word From the BLM and the Forest Service

It is with great enthusiasm and appreciation that we celebrate 10 years of hardrock abandoned mine lands (AML) program success addressing the impacts of abandoned mines on public lands. Over the last decade, the U.S. Department of the Interior's (DOI) Bureau of Land Management (BLM) and U.S. Department of Agriculture's (USDA) Forest Service hardrock AML programs have grown and matured through the dedication and hard work of many people. As Federal land management agencies, our success comes through the strength of our commitment to Cooperative Conservation principles, and the transparency, accountability and innovation that occurs through the exchange of ideas and ongoing dialogue with partners.

The BLM and Forest Service hardrock AML programs operate to improve the quality of public lands placed in our care through similar missions:

- To mitigate hazards present at abandoned mine sites;
- To restore watersheds for natural resources; and
- To protect public health and safety, recreation, fish, and wildlife.

We implement a risk-based approach to encourage watershed-wide cleanups that leverage resources through collaboration with other stakeholders. We also work to mitigate hazards at AML-affected watersheds in western, arid climates where water is scarce and the need to improve water quality for human and aquatic resources use is critical. Addressing AML impacts is becoming increasingly important as more and more people choose to live near and recreate in our public lands.

We have expanded our outreach efforts to increase awareness and educate the public about the serious dangers that exist at abandoned mine sites. We improved our information and technology transfer through avenues such as our newly redesigned Web sites (see <http://www.blm.gov/aml> and <http://www.fs.fed.us/geology/aml-index.htm>) and project highlights. In addition, we continue to work with the commercial sector, such as off-highway vehicle distributors, to increase education and awareness as more remote sites are being developed and accessed for recreation.

We are committed to fostering innovation and work closely with our Federal, State, tribal, and non-governmental partners to address the highest priority sites first. Together, we coordinate lessons learned and share best practices to integrate decision-making, improve accountability, and advance cleanup technologies across agency programs.

As we look to the future we know there is still work to be done. We renew our commitment to address high-risk and high-priority abandoned mine sites to protect public health and safety. We will cultivate existing relationships and pursue additional partnerships to further reduce risks and liabilities, share information and ideas, and leverage additional funding. Furthermore, we will seek out new and innovative means to implement sustainable mining practices.



**James M. Hughes**  
Bureau of Land Management,  
Acting Director



**Abigail R. Kimball**  
Forest Service Chief

## **THE BLM AML PROGRAM MISSION**

To support core BLM programs by addressing degraded water quality, hazardous materials, and other environmental impacts on or affecting lands administered by the BLM, and to mitigate physical safety hazards of abandoned mine sites on public lands.



## **THE FOREST SERVICE AML PROGRAM MISSION**

To minimize the environmental, human health, and safety hazards at abandoned mines, while preserving the historic and wildlife habitat resources that they provide.

# Table of Contents



- Introduction.....** 2
  - The Impact of Abandoned Hardrock Mine Lands on America’s Landscape..... 2
  - The Challenge of Reclaiming Abandoned Mine Lands..... 3
  - Benefits of Abandoned Mine Land Reclamation..... 3
- Program History.....** 4
  - Early Efforts To Address AML Sites..... 4
  - The BLM and the Forest Service Launch AML Programs in 1997..... 5
- Pilot Success.....** 8
  - Animas River Watershed..... 8
  - Boulder River Watershed..... 12
  - Cottonwood Wash Watershed ..... 16
- Progress Through Collaboration.....** 20
  - Forming Innovative Partnerships To Clean Up Private Lands..... 20
  - Improving Public Safety and Water Quality by Collaborating With State Agencies ..... 21
  - Partnering on Voluntary Cleanups..... 21
  - Ensuring Continued Collaboration..... 22
- Restoring the Environment.....** 23
  - Returning Life To Dead Lakes and Streams..... 23
  - Using Innovative Cleanup Methods..... 24
  - Restoring Watersheds and Protecting Endangered Species..... 25
  - Continuing To Protect the Environment..... 25
- Ensuring Public Health and Safety.....** 26
  - Protecting Human Uses of Water..... 26
  - Making Recreation the Future of Former Mining Sites..... 26
  - Addressing Mine Closures..... 27
  - Protecting Public Health and Safety Into the Future..... 28
- Improving Quality of Life.....** 29
  - Increasing Community Pride Through Reclamation Efforts..... 29
  - Building Capacity To Further Environmental Progress..... 30
  - Supporting a Local Economy Through Reclamation..... 30
  - Helping Communities To Turn the Tide..... 31
- Looking Forward.....** 32
  - Enhancing Site Inventories and Prioritizing Reclamation Projects ..... 32
  - Leveraging Resources and Results Through Cooperation and Partnership..... 32
  - Transferring Technological Innovations To Ensure Effective and Efficient AML Site Cleanups..... 33
  - Solving the Long-Term AML Problem Through Prevention and Sustainable Practices..... 33

# INTRODUCTION



Acid mine drainage leaching from the Mozart Mine in Colorado.

Ten years ago, the Department of the Interior's (DOI) Bureau of Land Management (BLM) and the U.S. Department of Agriculture's (USDA) Forest Service embarked on mutual efforts to address the impacts of hardrock abandoned mine lands (AML). Although both DOI and USDA have coordinated with States to clean up abandoned coal mines under the Surface Mining Control and Reclamation Act (SMCRA) of 1977, the need for a national strategy to address abandoned hardrock mines was the driving force behind both agencies initiating AML programs. Since 1997, these AML programs have addressed physical and environmental hazards at thousands of abandoned hardrock mines. Through cooperative efforts, the BLM and Forest Service have learned lessons about the complexities and obstacles associated with cleaning up these sites. The purposes of this report are threefold: 1) to shed light on abandoned mining sites and their impacts on public lands; 2) to highlight the accomplishments of the BLM, the Forest Service, and project partners in addressing AML problems; and 3) to describe the outlook for future AML reclamation efforts. Examples throughout the report offer insight into the environmental, health, safety, and economic effects often associated with these sites and illustrate the lasting and positive impacts of reclamation activities on formerly mined lands.

## The Impact of Abandoned Hardrock Mine Lands on America's Landscape

The historic mining of hardrock minerals such as gold, lead, copper, silver, and uranium was a powerful incentive for exploration and settlement of the American West. Mineral development often provided the economic base on which many remote communities were established. However, when ore bodies were mined out and miners left to find new deposits, they often left behind a legacy of abandoned mines, structures, safety hazards, and contaminated land and water.

Today, approximately 47,000 abandoned mine sites have been identified on more than 450 million acres of Federal land managed by the BLM and the Forest Service. An estimated 20 to 30 percent of these mines have dangerous human safety hazards such as open mine shafts and adits, deadly gas and lack of oxygen, as well as unstable explosives and toxic chemicals. As many as 10 percent may be releasing toxic heavy metals, acidity, and radioactivity into rivers, lakes, and streams from underground and open pit mines, waste rock storage, and mill tailings facilities.

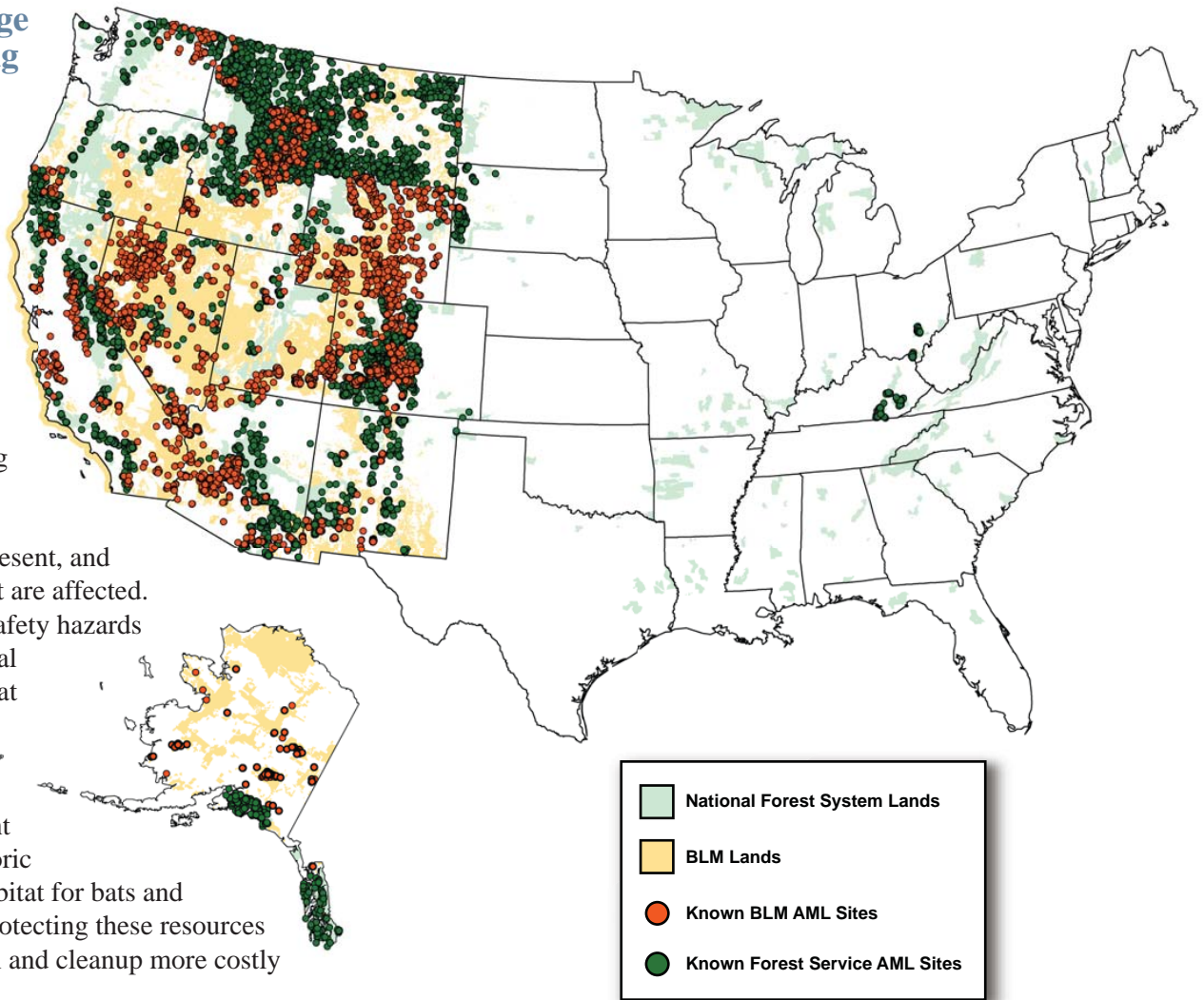
Currently, more than 63 million people live in the West and this number is increasing. More than 22 million people live within 25 miles of public lands in the West. Once remote sites are becoming ever closer to new population centers. In the Eastern United States, abandoned coal mines on National Forest System lands pose similar hazards to an even greater number of people. There is a strong emphasis on the cleanup of abandoned mining sites due in part to this increased exposure.



Recreational vehicles in the California Desert District.

## The Challenge of Reclaiming AMLs

The cost of reclaiming a single abandoned mine may range from tens of thousands of dollars to tens of millions of dollars depending on size, location, the nature of contamination present, and the resources that are affected. Aside from the safety hazards and environmental contamination that may exist, abandoned mines can also be significant cultural and historic resources and habitat for bats and other wildlife. Protecting these resources makes mitigation and cleanup more costly at these sites.



Currently no single source of funding, whether it be Federal, State, tribal, or private, is adequate on its own to address the magnitude of the problem that exists. To remediate a particular site, the BLM and Forest Service may work with Federal, State, and private partners who are able to apply funding from a variety of programs and authorities, including SMCRA; the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); and the Clean Water Act Grant Program.

## Benefits of AML Reclamation

Although the work is costly and difficult, the benefits of cleaning up abandoned mine lands make the effort worthwhile. Onsite soil and water quality is often returned to premining conditions. Visitors to public lands are protected from health and safety hazards. Nearby communities enjoy cleaner water, a more diverse and healthy economy, and a better quality of life. Habitat for plants and wildlife is restored, and the aesthetics for both visitors and residents who live nearby are improved.

This report demonstrates how the BLM and the Forest Service's AML programs are achieving these and other benefits with the support and help of many stakeholders at the local, State, and Federal levels. With further support, the BLM and Forest Service will continue their abandoned mine programs that restore natural resources, protect public health and safety, and improve the quality of life for nearby communities and visitors to public lands. □

# PROGRAM HISTORY

Federal land management agencies, such as the BLM and the Forest Service, are charged with managing the public lands in their care, including those disturbed by past mineral extraction activities. Throughout the 1990s, awareness of the environmental, human health, and safety risks posed by abandoned hardrock mines was growing along with the realization that a unified Federal approach to the problem was needed.



A former mill in the Boulder Basin of Idaho's Sawtooth National Forest.

## Early Efforts To Address AML Sites

In the beginning, the sheer number of abandoned mining sites in the United States was daunting, with estimates ranging from tens of thousands to hundreds of thousands. To determine the extent of the problem, the BLM and the Forest Service began to inventory abandoned mines in the early 1990s. Built on inventory data previously compiled by other Federal, State, and tribal entities, the effort focused on hardrock and noncoal abandoned mines and produced estimates of approximately 65,000 BLM sites and 39,000 Forest Service sites.

In 1994, an interagency task force was formed consisting of Federal land management agencies, including the BLM, the Forest Service, the National Park Service (NPS), and DOI science bureaus, including the U.S. Geological Survey (USGS) and the former Bureau of Mines. Known as the Interdepartmental Watershed Cleanup Initiative, this task force worked closely with the Environmental Protection Agency (EPA) to develop a “watershed approach” for the cleanup of abandoned hardrock mines on public lands. This approach focused on working within the geographic boundaries of a watershed with partners (including applicable Federal, State, private, and tribal entities) to jointly resolve problems that affect the physical, chemical, and biological quality of that watershed. The goals of the watershed approach are to foster coordination and collaboration across Federal and State agencies, facilitate solutions to address mixed ownership issues on sites within watersheds, address important problem sites first, and reduce costs through fund leveraging and avoiding duplication of efforts and conflicting actions.

In 1997, two top priority watersheds were selected as pilot projects for remediation:

- The Upper Animas River watershed in southwestern Colorado
- The Boulder River watershed in western Montana

These watersheds were chosen based on criteria that included: the interest and participation of State officials, availability of existing data on ore bodies, mining history, existing AML sites, water quality, heavy metal concentrations, geologic conditions, Federal land partners, extent of Federal lands in the watershed, and cleanup





A contractor sealing a Cottonwood adit.

work already in progress. In consultation with the EPA, interagency preparation began to compile data and watershed information that would build on ongoing work in the Upper Animas River and complementary efforts (e.g., site inventory work) in Montana.

### The BLM and the Forest Service Launch AML Programs in 1997

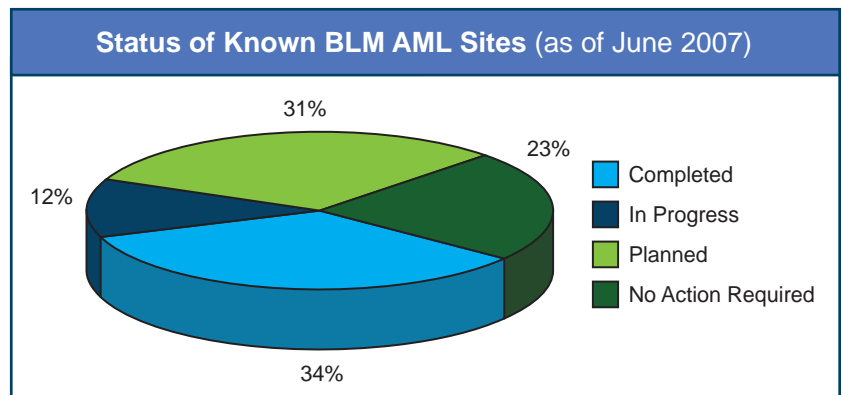
Riding the momentum of the interagency AML initiatives, the BLM and the Forest Service launched formal AML programs in 1997. The positive results of early AML initiative partnerships and commitment to reclamation efforts in these two pilot watersheds eventually led to Federal funds that were specifically directed at AML programs. In 1997, Congress appropriated \$1 million to the BLM for work in the Animas and Boulder watersheds. In 1998, the BLM’s appropriation increased to \$3 million and the Forest Service was appropriated \$4.6 million for the watershed initiative. This funding allowed AML programs to expand to include a third top priority pilot in 1998, the Cottonwood Wash watershed in southeastern Utah. Since then, the BLM and the Forest Service have continued to fund the cleanup of abandoned hardrock mines using a variety of approaches that are designed to meet multiple objectives, including addressing physical safety hazards, as well as hazardous substances and nonhazardous sources of pollution and contamination.

**CERCLA Authorities**

CERCLA provides broad Federal authority to mitigate contamination from the release of hazardous substances. CERCLA also authorizes Federal agencies to recover cleanup costs from persons responsible for the release of hazardous substances. The law authorizes removal actions to reduce pollution on an interim basis, and long-term remedial actions that are intended to result in permanent cleanups.

Between 2000 and mid year FY 2007, the BLM:

- Inventoried 5,500 sites. In addition, took mitigation actions at safety hazards at many of these sites;
- Remediated physical safety hazards at more than 3,000 sites; and
- Restored water quality at 281 sites through FY 2003 and at more than 3,000 acres since FY 2004.

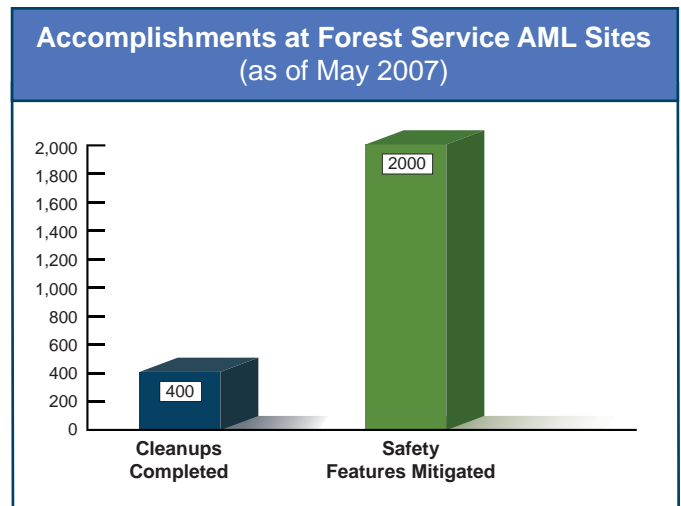


# PROGRAM HISTORY

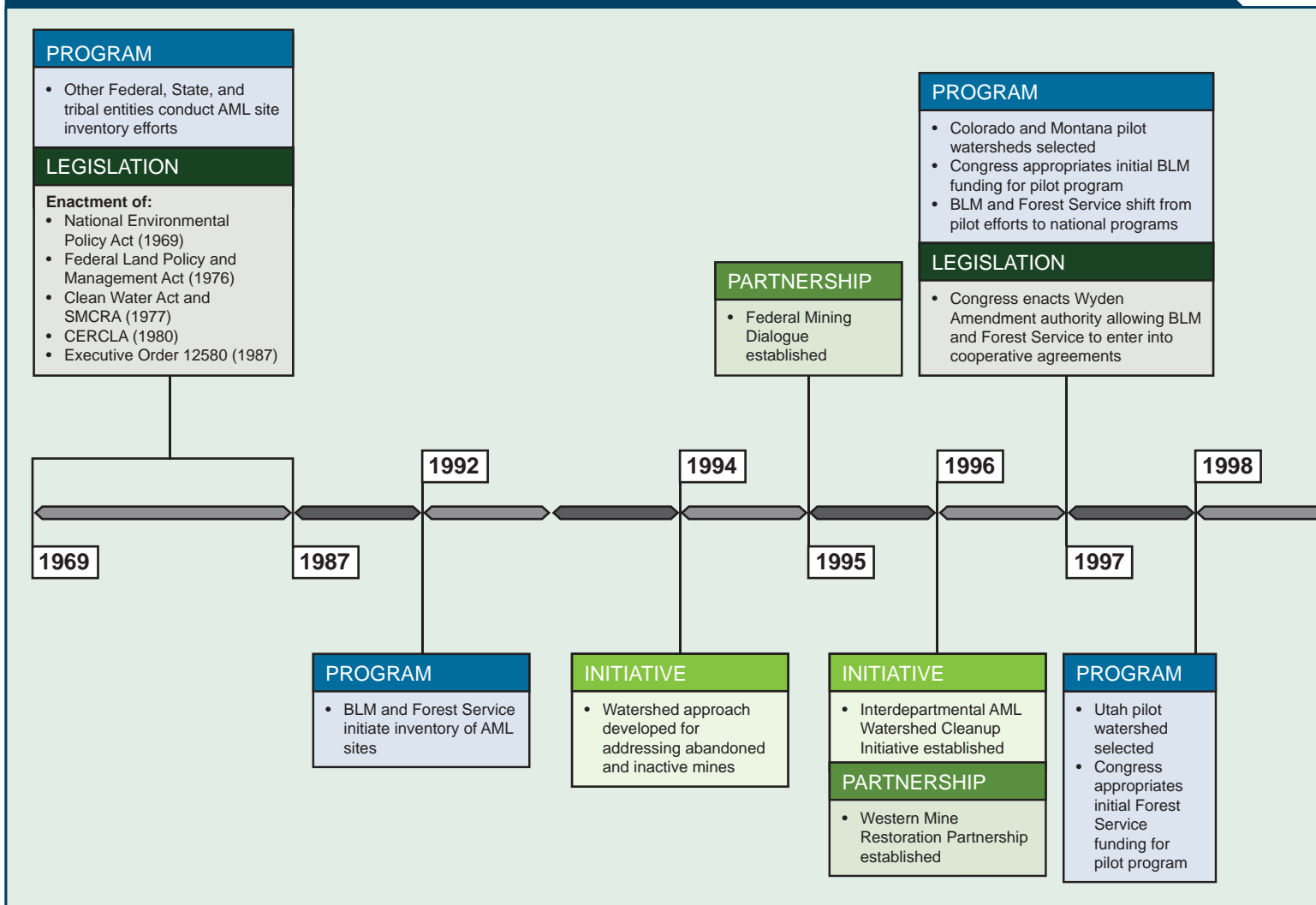
Since 1998, the Forest Service has:

- Inventoried 20,000 sites;
- Mitigated more than 2,000 AML safety hazards; and
- Cleaned up hazardous substances at more than 400 abandoned mines, with 150 hazardous substance cleanups in process.

Abandoned mine lands are now at the forefront of reclamation issues and more visible due to Federal abandoned mine programs and active participation of grass-roots organizations such as Trout Unlimited and the Animas River Stakeholders Group. These groups



## Historical Milestones in Prioritization and Cleanup of Hardrock AML Sites in the United States



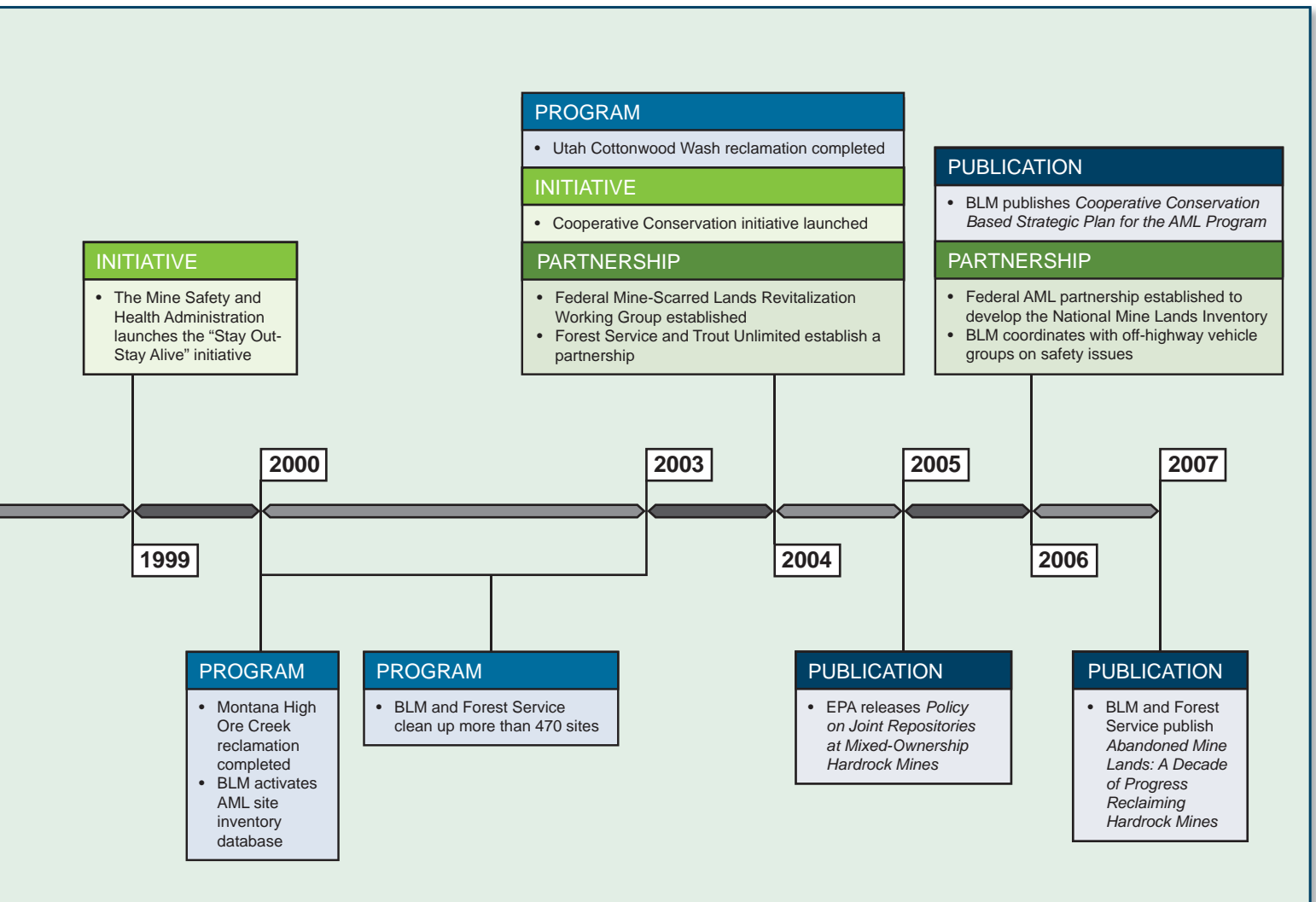
actively support watershed initiatives and provide much needed resources, including education, awareness, and volunteer labor during reclamation projects.

Land and resource management agencies are faced with evaluating risks associated with thousands of potentially harmful mine sites, and this level of effort is not always feasible for every affected watershed. The detailed work described in this report can help Federal land management agencies decide which characterization efforts would be most useful in the characterization of other affected watersheds. Although there is more to do, AML programs have demonstrated continued success through leveraged funding, strong partnerships, and innovative methods to address abandoned mine lands. □

## Scientific Support from the U.S. Geological Survey



The U.S. Geological Survey (USGS) conducted an AML Initiative in 1997-2001 to provide technical assistance in support of Federal Land Management Agency (FLMA) actions to remediate contamination associated with abandoned hardrock mining activities. The USGS supported assessment activities at the Boulder River and Animas River watersheds by inventorying historical mines, defining geological conditions, assessing and analyzing aquatic life and indicators of physiological stress, collecting and chemically analyzing water and sediment samples, and defining hydrological regimes.

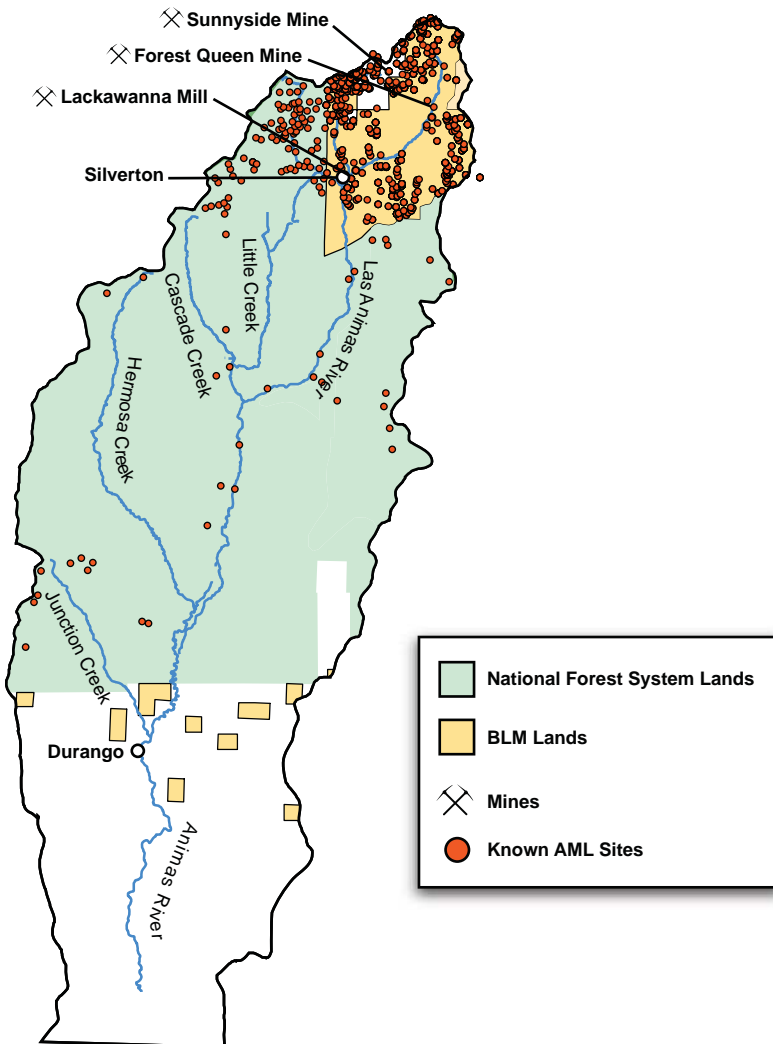


# PILOT SUCCESS

## Animas River Watershed

### Pilot Profile

Reaching across 186 square miles of Colorado's San Juan Mountains, the Animas River watershed is a place of rich mineral deposits, recreational opportunities, and historic interest. Communities that call the Animas home, like the town of Silverton, are transitioning from a once thriving mining industry to an economy based on tourism and recreation. The Animas River Stakeholders Group (ARSG) is assisting this transition through its efforts to address the environmental impacts of mining within this watershed, a high priority for restoration in the State of Colorado.



### The Ecological Impacts of Historic Mining:

Over time, the impacts of contaminants including aluminum, cadmium, copper, iron, lead, and zinc emanating from historic mines and natural sources became environmentally and economically visible; acidity levels in the water rose to levels impairing many fisheries and leaving some streams devoid of fish. Project stakeholders faced the challenge of improving water quality not only for the benefit of local residents and aquatic life, but to ensure the well-being of the town's tourist and recreational trades.

### Impediments to Local Economic Prosperity:

The area served as a mineral-rich region for metal mining as far back as the late 1800s. When the Sunnyside Mine closed in 1991, more than 300 jobs were lost. Silverton and its surrounding communities have since relied primarily on the seasonal tourism industry, with the scenic narrow-gauge railroad between Durango and Silverton serving as its anchor by attracting train, history, and outdoor enthusiasts. Yet, lingering blight and environmental problems due to the area's historic mining legacy have impeded efforts to fully capitalize on the Animas' significant opportunities for recreation, tourism, and business expansion.

# Strategies for Environmental and Economic Restoration

Though barriers were encountered along the way, stakeholders were able to develop successful methods to reclaim the Animas River watershed.

## Formulating a New Approach to Cleanup Through Collaborative Partnerships

While several mining-impacted communities have used the EPA Superfund designation to gain resources for complex and costly cleanup efforts, a broad group of partners—including the BLM and the Forest Service—formed the ARSG in 1994 to leverage the necessary expertise and resources for mine reclamation.

In the early 1990s, the State conducted initial studies that revealed environmental contamination in the watershed—enough that EPA considered listing the area as a Superfund site. Concerns that this designation might impact the area’s transition to a tourist-based economy led to an alternative approach. The ARSG represents a volunteer collaborative effort to improve water quality and aquatic habitats in the watershed through assistance from mining companies, elected officials, local citizens, landowners, environmental groups, and State and Federal agencies. Because so many partners engaged in the project, EPA agreed not to take any formal Superfund action as long as reclamation was ongoing. The ARSG continues to demonstrate that a highly engaged, active, and patient stakeholder group can make critical progress toward cleanup and reclamation goals.



Recreational fishing has returned to the Animas.

## Identifying Priority Sites in a Large Watershed

Addressing abandoned mine lands within a watershed can be difficult due to the considerable size of the affected area. Through strategic planning, however, the ARSG partners were able to prioritize cleanup activities by characterizing the watershed to identify the most significant contamination sources.

With approximately 1,500 former mining sites in the watershed, the ARSG partners, utilizing expertise from a number of State and Federal agencies, conducted an analysis of factors such as amount of each contaminant; physical attributes; accessibility to power; and proximity to streams, wetlands, and avalanche paths. Eventually, 400 sites were identified as priorities. Further analysis revealed that 67 of these former mining sources accounted for 90 percent of the metals contamination from mining sources. This comprehensive prioritization approach proved successful and led the Colorado Department of Public Health and Environment (CDPHE) to implement 27 realistic Total Maximum Daily Load standards based on partial remediation of the priority sites.



A former mining structure near the Elk Tunnel Mill in Colorado.

## Reclaiming Mine Sites With Mixed Ownership

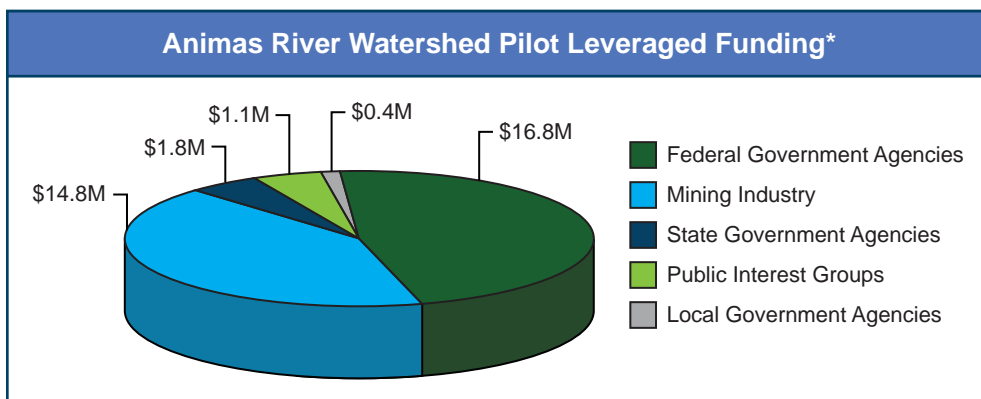
Through collaboration among its Federal, State, and local partners, the ARSG overcame the types of complicated ownership issues that often prevent mining communities from reclaiming sites, such as difficulty in identifying and engaging owners.

Within the watershed, land ownership is mixed among Federal and private owners. The formation of the ARSG creates a forum for all property owners, remediation experts, and local community members to provide input into cleanup priorities and identify resources. This collaborative effort promotes an effective cleanup process by leveraging the best resources from each ARSG partner and avoiding a piecemeal approach to cleanup, which can be prohibitively expensive.

## Leveraging Funding Through Partnerships

By forming partnerships during the reclamation process, project stakeholders collectively maximize and pool resources that would not have been readily available if only one entity was involved.

The partnerships formed through the ARSG allowed for the successful leveraging of more than \$35 million for remediation activities and more than \$3 million worth of in-kind volunteer support. Various partners including the BLM, Forest Service, State and local agencies, public interest groups, and mining industry representatives contributed much needed financial resources to enable successful reclamation of the former mining sites in the watershed.



\*Funding amounts (provided by BLM Colorado) are approximations as of March 2007

## Project Results

Approximately 50 mining remediation projects, which addressed draining adit and waste site concerns, were successfully completed within the Animas River watershed. Of the completed projects, which includes the completion of remediation activities for 19 priority sites, mining companies addressed approximately one-half, Federal land management agencies addressed approximately one-quarter, and the ARSG addressed approximately one-quarter. The BLM has completed seven projects and the Forest Service has completed four. The community is reaping the benefits of these cleanup efforts, including overall increased water quality and two reproducing species of trout that did not exist before in downstream areas. This, in turn, is beginning to entice more visitors seeking recreation to the area.

## Looking Forward

As the community continues to work together to address the remaining sites, the focus has begun to shift towards improving the economy by revitalizing a 2-mile stretch of the Animas River corridor through Silverton. The Brownfields Federal Partnership Mine-Scarred Lands Initiative—a collaboration among six Federal agencies including the BLM—assisted the community with outlining next steps for land cleanup and reuse activities and identifying the technical and financial resources to implement them. This partnership recognizes the community's value on tourism as it promotes aesthetic and quality-of-life improvements to the area.

Through the collaborative efforts of the ARSG partners, significant environmental and economic accomplishments have been made in the Animas River watershed. And as time goes on, more and more people will be able to appreciate the beauty and opportunity of an area whose mining legacy can now be defined in historical terms, rather than by negative environmental impacts. □

## Community Impact

### Preserving San Juan County's Mining History

Mining served as the backbone of San Juan County's economy since the 1800s, holding a special place in residents' lives. While the ARSG has focused on cleaning up the watershed, other community groups have focused on preserving mining relics, providing an opportunity for residents and tourists to relive history. Beverly Rich of the San Juan County Historical Society described her passion for mining history by stating, "My father and husband were miners and Silverton would not be here without mining. It is a part of our heritage that is quickly disappearing and so it needs to be preserved." The BLM and Forest Service support historical preservation efforts by preserving historic elements during mine reclamation activities—for instance, helping to stabilize and preserve a facility that once housed miners working at the Old Hundred Mine.

### Animas River Project Partners

#### Federal Partners

- Army Corps of Engineers (USACE)
- BLM
- Bureau of Reclamation
- EPA
- Forest Service
- USGS

#### State Partners

- CDPHE
- Colorado Division of Mining Reclamation and Safety
- Colorado Division of Wildlife
- Colorado River Watch

#### Local Agencies

- City of Durango
- San Juan County Commissioners
- San Juan County Historical Society
- San Juan Resource, Conservation and Development
- Southwestern Water Conservation District
- Town of Silverton

#### Citizen Groups

- Friends of the Animas River
- River Watch Network, Inc.
- San Juan Citizens Alliance
- Taxpayers for the Animas River
- Western Colorado Congress

#### Private Entities

- Alpine Environmental Services
- Durango and Silverton Narrow Gauge Railroad
- Gold King Mining Company
- Mining Remedial Recovery Company
- PanEnergy Corporation
- Root and Norton Assayers
- Salem Minerals, Inc.
- Silver Wing Co., Inc.
- Sunnyside Gold Company
- Tusco, Inc.

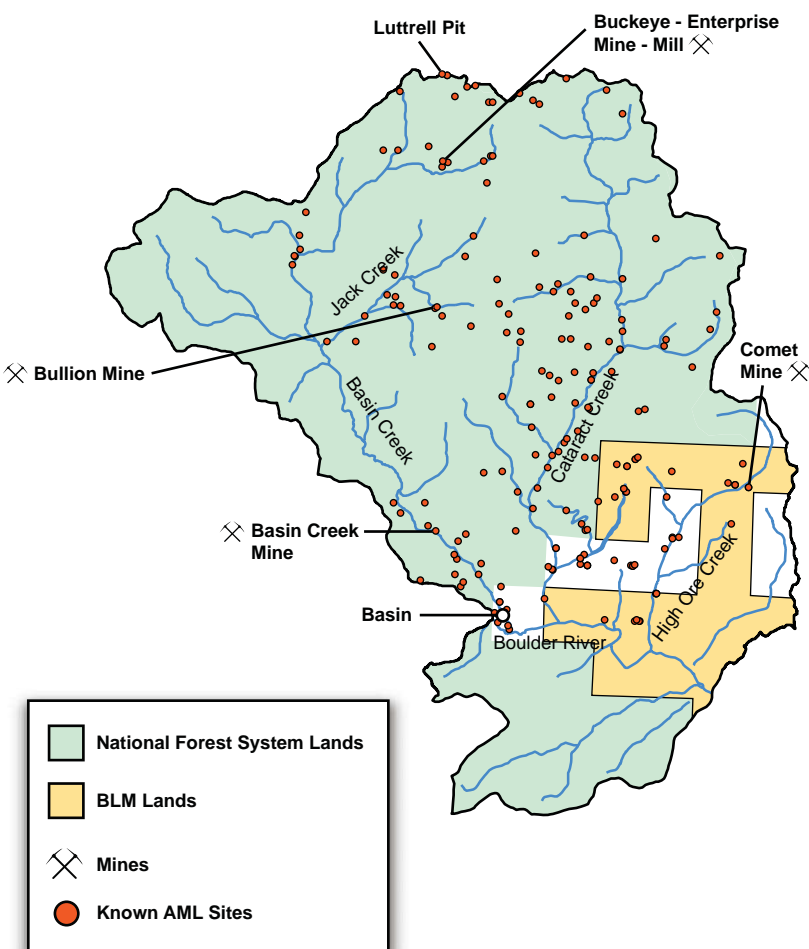
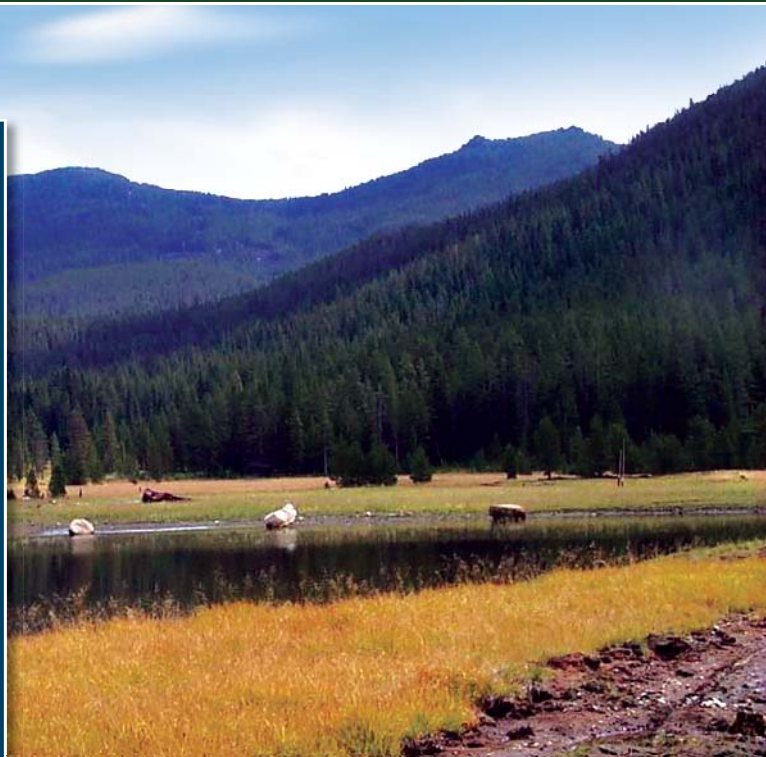


Stakeholders discussing future revitalization plans for the Animas River corridor.

## ▪ Boulder River Watershed

### Pilot Profile

Located in Jefferson County, Montana, the 90-square-mile Boulder River watershed is home to 22 miles of stream. As surrounding communities transitioned to an economy based on agriculture, tourism, and recreation, stakeholders needed to work together to design a cleanup approach that would not only restore recreational fishing in the area, but protect the health and safety of area residents.



### The Ecological Impacts of Historic Mining:

Primarily at fishing sites and campgrounds, recreational users have considerable access to the Upper Boulder and East Boulder Rivers. More than 80 years of mining gold, silver, lead, copper, and zinc left a legacy of degraded water quality from the heavy metals in mine waste and mill tailings, contaminated water supplies in local communities, and the drastic reduction or complete elimination of fish populations as far as 55 miles downstream. Surrounding communities faced the challenge of reversing this damage to improve water quality and restore impacted fish populations.

### Impediments to Local Economic Prosperity:

During times of mining prosperity, the Town of Basin's population reached as high as 8,000. Today, Basin has as few as 220 residents as a result of closing mining operations. Spurred by a transitioning economy and impacts to local drinking water supplies, area stakeholders took action to improve water quality, restore local fish populations, and improve public health and safety by addressing mining-impacted water supplies and contaminated land.



# Strategies for Environmental and Economic Restoration

Given the challenges associated with the watershed's location, stakeholders were able to develop solutions that increased overall project efficiency.

## Implementing a More Targeted Remediation Approach

Since the effects of past mining activities can be spread across an expansive area, it is essential that the cleanup approach prioritize areas of higher contamination first. In the Boulder Creek watershed, stakeholders, including the BLM and the Forest Service, utilized state of the art information collected by the USGS and others to create a more efficient and focused remediation plan.

For example, in the High Ore Creek area of the watershed, the BLM and other stakeholders utilized X-Ray Fluorescence Spectrometry, an analytical technique used to identify and determine the concentrations of elements present in solid, powdered, and liquid samples. This method greatly increased project efficiency, allowed the remediation team to work side-by-side with the contractors excavating the material, and ultimately minimized the amount of soil and sediment requiring removal. The increased efficiency was particularly important due to the geographic location of the area, which has a long winter and consequently a fairly short construction season. This approach was innovative at the time of remediation and is now a common method employed at AML sites across the country.



## Collaboration as a Tool To Overcome Remediation Boundaries

When addressing contamination on abandoned mine lands, potential issues include mixed ownership and the question of where mining waste should be deposited during cleanup. In the Boulder River watershed, the BLM and the Forest Service developed a unique and efficient approach that promoted the use of partnerships.

Within the Basin Creek area of the watershed, abandoned mine land ownership is divided among the BLM, the Forest Service, EPA, and the State of Montana, all of whom planned to move the area's mining waste to individual repository areas. Through the use of collaborative partnerships, the partners drafted an agreement in 1999 that allowed them to use the Luttrell Pit, the first regional joint mine waste repository in the United States. This innovative approach

reduced costs and increased safety by requiring maintenance of only one large repository instead of many throughout the watershed. This project set precedents for the storage of abandoned mine waste by multiple Federal and State land management agencies and was a successful demonstration of addressing Superfund sites in the Western United States.

### Joint Repositories: A Model for Collaborative Cleanup



The Luttrell Pit was the first regional joint mine waste repository to be established in the United States. This approach to disposing of mine wastes in a mixed-ownership watershed became a model for future mine reclamation projects, resulting in a multiagency agreement signed by EPA, the Forest Service, the BLM, and private and local partners for the Boulder River watershed cleanup. Individual agencies, including EPA and the BLM, subsequently developed policies to encourage partnerships with other agencies for establishing new joint waste repositories at other sites.

## An Alternative to the National Priorities List



Stream side tailings impacting High Ore Creek.

CERCLA provides the BLM, Forest Service, and EPA with legal authorities and access to funds that are not otherwise available to these agencies. One aspect of the CERCLA process, listing of an AML site on the National Priorities List (NPL) by EPA, may lead to benefits or drawbacks for a cleanup depending on the situation. While NPL listing provides access to EPA-administered Superfund resources, it also requires use of CERCLA remedial cleanup procedures that can be time consuming and limit the use of certain funds.

High Ore Creek and the Comet Mine were excluded from the Basin Mining Area NPL site, allowing the BLM and the Montana Department of Environmental Quality to take the lead in cleaning up these areas using procedures and funding that allowed them to respond more quickly. The BLM used its authority under CERCLA to conduct non-time-critical removal actions at the Comet Mine to address the streamside tailings in High Ore Creek on a faster schedule than would have occurred if it had been included as part of the NPL site. To complete this project in June of 2000, the BLM spent approximately \$2 million and collaborated with several State agencies on cleanup activities, including improving access roads, excavating and transporting approximately 40,000 cubic yards of mine waste, backfilling the flood plain with topsoil, stabilizing streambanks by planting 5,000 native trees and shrubs, and constructing a streambed and two sediment ponds for settling out toxic chemicals. Fish sightings have been documented in wetlands and key fishing locations where no fish were present prior to remediation.

## Project Results

In addition to the BLM and State cleanup efforts in High Ore Creek, other characterization and cleanup actions have taken place in the Boulder River watershed. EPA spent approximately \$4 million in cleanup activities on the Town of Basin in 2004, and approximately \$3.4 million on cleanup activities at the Buckeye-Enterprise, Crystal, and Bullion Mines. The USGS completed its geochemical characterization of the drainage that was used to prioritize cleanup efforts at a cost of \$3.2 million. The Forest Service spent \$5 million using its CERCLA authority to conduct time-critical removal actions at the Buckeye-Enterprise, Bullion, Bullion Smelter, Hector, Lower Hector, Jack Creek, and Daly West mine and mill sites.

This unprecedented group of agencies—including the Montana Department of Environmental Quality, and local agencies and organizations—coordinated efforts to bring a watershed approach to fruition. In doing so, they enhanced the natural resources in the area and protected the residents of the Basin Creek area from exposure to contaminated water, sediment, and mine waste.



## Looking Forward



Water quality monitoring activities in High Ore Creek.

As project partners continue to monitor the effects of cleanup in the Boulder River watershed, they plan to address remaining sites within the Basin Creek area that contribute to contamination. Additionally, the Forest Service plans to begin work in the Cataract drainage area in 2008, with the goal of addressing all Basin Creek area sites located on National Forest System land by fall of 2009. Over the years, Federal and State agency partners have succeeded in addressing the area's surface contamination, but they are still looking to develop a technological solution for acid mine drainage being released from underground mines. For example, in the High Ore Creek area, the waste materials and dumping grounds have been cleaned up, but contaminated water from underground mine tunnels still discharge into area streams.

Thus far, the Boulder River watershed reclamation project has successfully demonstrated the efficiency of approaches that use innovative cleanup methods and collaborative partnerships. Local communities continue to benefit from the area's environmental improvements, and the region's recreational opportunities may increase in years to come. □

## Community Impact

### The Return of the Westslope Cutthroat Trout

Prior to mining, the fisheries in the drainages that make up the Boulder River watershed would have been optimal. Historic mining activities created an environment that few, if any, fish were able to survive. But as a result of initial reclamation efforts, fish species like the Westslope Cutthroat Trout (*Oncorhynchus clarki lewisi*) have begun to return and increase in number. While it is still too early to know the extent of these recent water quality improvements on fish populations, project partners expect that eventually local species and recreational fishing may once again thrive and the watershed could become a premier fishery.

### Boulder River Project Partners

#### Federal Partners

- USACE
- BLM
- Bureau of Reclamation
- EPA
- Forest Service
- USGS

#### State Partners

- Montana Bureau of Mines and Geology
- Montana Department of Environmental Quality
- Montana Department of Fish, Wildlife, and Parks

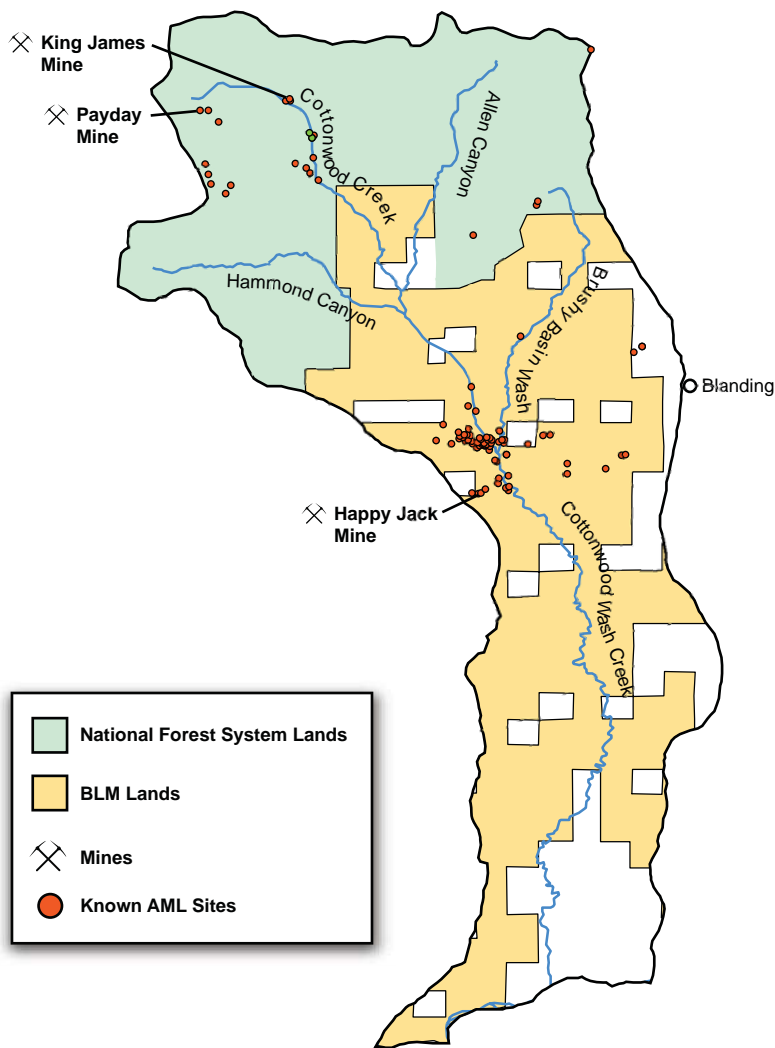
#### Private Entities

- Pioneer Technical Services, Inc.
- Schumaker Trucking and Excavating

## ▪ Cottonwood Wash Watershed

### Pilot Profile

Encompassing approximately 143,000 acres in southeastern Utah's San Juan County, the Cottonwood Wash watershed and its local community are closely intertwined with the mining history that defines them. National market demands for uranium and vanadium dictated the growth of the local economy, as well as its decline, for nearly nine decades. In an effort to improve water quality and protect the health and safety of the community, Federal and State agencies developed a collaborative reclamation strategy to address the area's former mines while preserving the lure of local mining history.

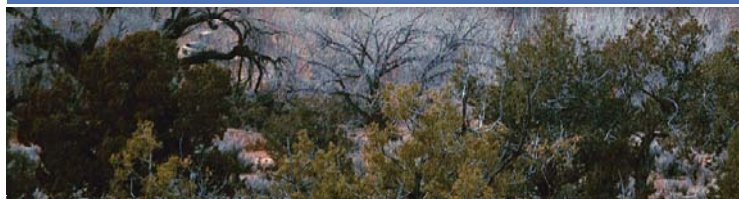


### The Ecological Impacts of a Mining Past:

After decades of vanadium and uranium mining, the waters and sediments in the watershed were left with elevated levels of radiation from mine drainage and waste dumps. Project partners faced the challenge of addressing this contamination, which impacted the use of local water for drinking, recreation, aquatic life, wildlife, grazing, and agriculture.

### Impediments to Local Economic Prosperity:

Nationwide economic demands ranging from steel production to national defense drove the local vanadium and uranium mining industry and dictated the growth and decline of San Juan County's economy. Although the local economy took a downturn after mining operations ceased, the community remains attached to its mining history.



# Strategies for Environmental and Economic Restoration

The Cottonwood Wash watershed area posed several challenges, but through the formation of collaborative partnerships, Federal and State agency partners were able to successfully complete remediation efforts.

## Protecting the Local Community From Degraded Water Quality

The Technical Committee, comprised of Federal and State partners, focused on radioactive minerals impairing the watershed in conjunction with developing an efficient reclamation plan to address the physical safety hazards left behind as reminders of the local mining history.

Results of an inventory conducted in the late 1990s revealed dangerous levels of radon emissions in mine openings and elevated radiation levels in waterways caused by sediment, heavy metals, and uranium particles from mine waste dumps. This contamination affected drinking water, recreation, wildlife, grazing, and agriculture. The Technical Committee developed a reclamation approach that mitigated the area's physical and environmental hazards in one step: portions of uranium mine dumps located in stream channels were removed and used as backfill material for hazardous openings and face-up areas.



Upper reaches of Cottonwood Wash.

## Stimulating the Local Economy Through a Reclamation Strategy

Most former mining communities are left with weakened economies once mining activities cease. The Technical Committee took a twofold approach to assisting the local community not only through cleanup efforts, but by bolstering the local economy as part of its reclamation strategy.

As the demand for local vanadium and uranium ore dwindled to near nonexistence, mining operations shut down in the area, negatively impacting the local economy. In efforts to stimulate the local economy, the BLM and the Forest Service recognized the importance of dividing project construction work—which included closing off mine openings and removing waste dumps—into seven phases over 5 years. This allowed small and local contractors to bid on projects, benefiting the local economy, increasing competition, and reducing overall project costs. Ultimately, three local companies were selected to conduct the construction work, which returned \$800,000 to the local economy.



Closing one of many mine openings in the Cottonwood Wash area.

## Preserving Local Mining History During Reclamation

Many former mining communities become worried about losing a part of their identity during reclamation. Partners such as the BLM and the Forest Service were sensitive to these concerns and made every attempt to include the local community in the planning process.

When reclamation discussions were initiated in the Cottonwood Wash area, the community felt protective of the mining structures they felt represented their livelihood, history, and community. By working with local residents,



Payday mine circa 1960.

Photo by Patsy Shumway

the Technical Committee found a balance between keeping the community safe from elevated radiation levels and hazardous mine openings and allowing them to hold on to their memories. A cultural survey and inventory was conducted, and included the collection of oral histories from area residents. These efforts, supported by the BLM and the Forest Service, contributed to three issues of *Blue Mountain Shadows* magazine, dedicated to the mining history and reclamation efforts in the Cottonwood Wash watershed.



Photo by David Kimberle

Engineer McBride at the Kimmerle mill circa 1944.

## Project Results

Reclamation activities included sealing 219 adits and shafts, removing 39 hazardous structures, plugging 225 drill holes, and removing more than 250 waste dumps. These activities—in addition to approximately \$2 million leveraged from the BLM, Forest Service, and the State of Utah—allowed the Technical Committee to protect and benefit the local community, while acknowledging the area’s mining history. The partnerships formed during this reclamation project were critical to its success and led to continued reclamation efforts in the State of Utah.

## Looking Forward

Although reclamation activities are complete in the Cottonwood Wash area, additional efforts are ongoing to ensure that the mining history so treasured by the local community is not lost. An onsite informational kiosk and an educational pamphlet are being developed, both of which will explain the mining history and reclamation work completed in the watershed. Prior to sign installation, an environmental assessment must be conducted to ensure that no additional negative environmental impacts result.

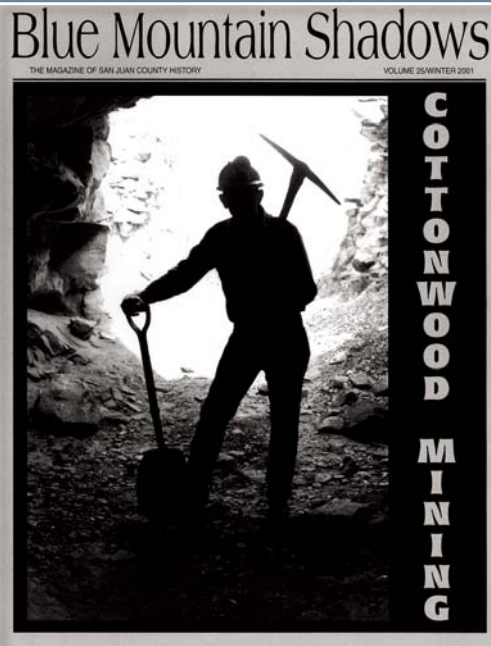
By directly addressing the environmental, economic, and cultural needs of the local community, the Technical Committee has achieved success in the Cottonwood Wash watershed. And as reclamation efforts move forward in other areas of Utah, this former mining community can continue to celebrate the positive influences of the mining industry without concern for environmental impacts for years to come. □

### Understanding the Historic and Prehistoric Importance of Cottonwood Wash

The Four Corners area in the southwestern United States attracts sightseers from far and wide every year to explore the ruins of early Native American civilizations. The Cottonwood Wash area, first inhabited by the people of the Puebloan Culture, is rich in artifacts; potsherds and other remnants from almost 7,000 years of human inhabitants are apparent with nearly every turn of a shovel. Historic relics of the area’s mining legacy are also scattered throughout Cottonwood Wash. Notably, some of Madam Curie’s early radiation experiments were possible due to the samples she reportedly collected from the area. Additionally, vanadium and uranium from Cottonwood Wash supported the Nation’s steel and atomic endeavors.

# Community Impact

## Remembering the Local Mining History



Cover of the first issue of *Blue Mountain Shadows* magazine dedicated to mining in the Cottonwood Wash area.

Photo by Colleen Black Hawks

Dating back to the early 1900s, vanadium and uranium mining was more than just a job to many locals, it was a way of life that defined who they were. Fathers and sons would work side-by-side down in the mine shafts. Young boys would run around searching for arrowheads that provided a glimpse into the area's prehistoric past. Former miner Cleal Bradford recalled, "My first experience with the Cottonwood mines was when my father was working as foreman of the Blanding mines. During the Second World War I would go with him as a youngster and be out around and about. I didn't do any mining at that time. But I did travel with him out and spend the day exploring and doing other things while he would be involved." Through an oral history collection effort supported by the BLM; the Forest Service; Utah Division of Oil, Gas, and Mining; and the San Juan County Historical Commission, the community was able to memorialize personal mining experiences like these in three issues of *Blue Mountain Shadows* magazine.

### Cottonwood Wash Project Partners

#### Federal Partners

- BLM
- Forest Service

#### State Partners

- Utah Division of Oil, Gas, and Mining
- Utah Division of Water Quality

#### Local Agencies

- San Juan County Historical Commission

#### Private Entities

- Crowley Construction
- KSUE Corporation
- VCM Construction





# PROGRESS THROUGH COLLABORATION

Communication and collaboration among project partners are essential to overcoming the complexities of restoring abandoned mine lands. Not only can formerly mined lands be large enough to stretch over multiple jurisdictions, but their contaminant runoff can also affect streams, watersheds, individual landowners, and communities far beyond a site's actual borders. For a single agency or organization with limited resources, it is often impossible to carry out effective restoration activities without partners.

The BLM and the Forest Service recognize that collaborative partnerships are essential to increasing efficiency and enhancing resources in AML restoration projects. As part of its ongoing policy of cooperative conservation, the BLM works with the Forest Service to apply a "Service First" approach to AML program coordination. Examples of this approach range from joint field operations on specific AML sites, technical training, and development of shared policies and strategies. The examples provided in this section demonstrate the success that results from partnerships among the BLM, the Forest Service, and other entities that complement each other's efforts, are open and communicative, and indicate a willingness to work with all stakeholders.

## Forming Innovative Partnerships To Clean Up Private Lands

Addressing contamination on AMLs can be a costly process for Federal and State agencies that often have limited resources, making leveraging support a critical part of the process. In Utah's American Fork Canyon, valuable partnerships were formed with nonprofit and private entities that provided needed technical and financial support.

Migrating from the Pacific Mine Site in American Fork Canyon, water with lead concentrations 10 times higher than the Federal Clean Water Act standard was harming fish like the native Bonneville Cutthroat Trout in the American Fork watershed. After significant progress toward the cleanup of six sites within the American Fork Canyon, the Forest Service found itself at an impasse because two of the former mining sites were owned by Snowbird Ski and Summer Resort and beyond the agency's jurisdiction. Through negotiations with EPA, Trout Unlimited, a nonprofit organization dedicated to conserving and protecting fishing areas, obtained an Administrative Order of Consent that limited long-term liability and provided the legal authorization for cleanup work on private land. Diamond retailer Tiffany & Co. provided \$50,000 a year through a conservation fund, and in 2006 awarded Trout Unlimited a \$450,000 grant for additional watershed restoration efforts. The collaborations formed among Trout Unlimited, the Forest Service, EPA, Snowbird, and Tiffany & Co., proved integral to the cleanup of the mine tailings on privately owned land affecting the American Fork watershed. The project has since been recognized by EPA and the State of Utah for its success.





## Improving Public Safety and Water Quality by Collaborating With State Agencies

Partnering with State agencies provides Federal land management agencies with additional resources for addressing not only safety, but environmental concerns on abandoned mine lands. By working with State agencies, industry, private firms, and diverse volunteers in Nevada and Washington State, BLM has made great strides in transforming AML sites into safer and healthier environments for humans and wildlife to enjoy.

With approximately 25 fatalities in the United States related to abandoned mines every year, these sites can pose imminent danger to humans and animals. According to the Nevada Division of Minerals estimates, the State of Nevada has more abandoned mining sites than all other Western States combined—approximately 200,000 to 300,000 sites. To remove the threats these mines pose, the BLM Nevada State Office formed a partnership with the Nevada Division of Minerals and the Nevada Mining Association in 1999 to permanently close abandoned mines. The Abandoned Mines Permanent Closure Program uses fences, warning signs, and, most effectively, seals mine openings with bat gates, expanding foam, and backfill to prevent access and exposure to associated hazards, including falls into openings, rotten timbers, bats, toxic air, and forgotten explosives. In its first year, the program closed six mines. In 2006, the program set a national BLM record of 118 abandoned mine closures. Additional volunteers have come forward to provide support for the program, including university researchers and graduate students, professional archaeologists, Eagle Scouts, Girl Scouts, and prospecting clubs. The program now serves as a model for other States looking to address their own hazardous, abandoned mining sites through closure.



Members of the 2005 backfill team in Southern Nevada during a week of intense AML shaft backfilling.



Reclamation work underway at the Cleveland Mine site in Washington.

In Washington, BLM partnered with the Washington State Department of Ecology to reclaim land impacted by the Cleveland Mine and Mill site in Stevens County, Washington. Mills adjacent to Hunters Creek had discharged contaminated tailings directly into the creek or into tailings ponds constructed directly in the creek's stream channel. To address these environmental concerns, BLM worked with the Washington State Department of Ecology to restore two saturated tailings areas a quarter of a mile downstream of the site. Reclamation activities included removing most of the saturated tailings in the stream channel to repositories, armoring the channel and repositories with cabled concrete blocks to reduce erosion, restoring the stream's natural meander, capping the repositories and constructing French drains around them to divert water away, and revegetating the site with grass and trees.

## Partnering on Voluntary Cleanups

Involving parties that are potentially responsible for contamination on former mining sites can be challenging. But when these parties agree to address any remaining environmental issues, an ideal situation can result that avoids litigation for all stakeholders, which was the case in Colorado's Bonanza Mining District.

The approximately 30-square-mile Bonanza Mining District was home to intermittent mining operations between the 1890s and 1970s. This caused an 18-mile stretch of Kerber Creek to become devoid of aquatic life decades before restoration work began in 1994. In response to potential CERCLA litigation, the remaining five potentially responsible parties formed the Bonanza Group and signed an official voluntary cleanup agreement with CDPHE. This was an

innovative arrangement at the time, taking place before the State's own voluntary cleanup program emerged. CDPHE signed a memorandum of understanding with the Forest Service to jointly oversee cleanup, and EPA agreed to put any Superfund designation of the area on hold pending cleanup results.

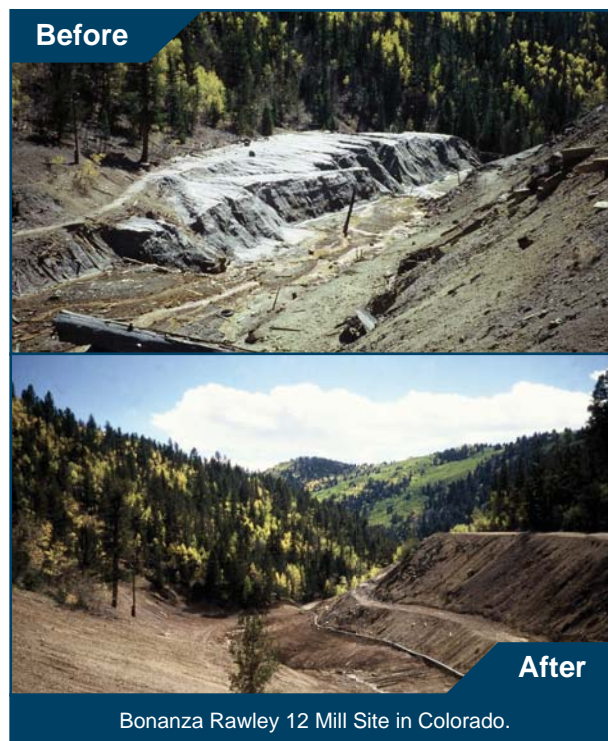
The cleanup effort began only 16 months after the formation of the Bonanza Group, and has led to aquatic life, including fish, returning to the formerly dead section of Kerber Creek. To complement this effort, EPA provided nearly \$300,000 to CDPHE to clean up orphaned mining sites just outside the Bonanza Mining area and the BLM began to address additional abandoned mining sites in the region.

## Ensuring Continued Collaboration

The last 10 years of the BLM and the Forest Service's AML programs have provided countless lessons learned and confirmations about the value of partnerships and cooperation. As part of their continued efforts to collaborate with other partners, both agencies play key roles in the Federal Mining Dialogue, which provides a forum for coordinating and building upon AML-related approaches among participating Federal agencies.

The BLM entered into a Statement of Mutual Intent agreement with the National Association of Abandoned Mine Land Programs, an association of States and tribes with AML programs. Under this agreement, members agree to collaborate and communicate with each other, share abandoned mine data, and encourage efforts to establish and implement effective partnerships with other organizations to increase the awareness of abandoned mine problems nationwide. In 1998, the Forest Service established a formal partnership agreement with Trout Unlimited, which developed the institutional framework for volunteer opportunities in restoration, education, and research activities on Forest Service lands and developed 44 State-specific partnership agreements.

Partnerships like these help keep lines of communication open—not just among AML Federal partners, but among all potential State and local stakeholders. They also encourage trust between project partners and affected communities, and often produce the types of specific knowledge and expertise that can only be found at the local level. They allow Federal partners to determine the ways in which they can contribute the greatest value. They eliminate confusion by making individual goals apparent early in the process. And, they generate resources—technical as well as financial—far beyond what independent efforts can produce. □



Bonanza Rawley 12 Mill Site in Colorado.

## Federal Agencies Actively Collaborate To Address AML Issues

Established in 1995, the Federal Mining Dialogue is a cooperative initiative among Federal environmental and land management agencies aimed at addressing contamination from abandoned mine sites, primarily on Federal lands. Participating agencies including DOI, EPA, USDA, the Department of Justice, and USACE, provide a “toolbox” of resources that can be adapted depending upon circumstances, such as agency jurisdiction and land management protocol for a given area. In some cases, actions are coordinated with State agencies, and State laws, regulations, and environmental standards play significant roles. In recent years, the Federal Mining Dialogue has increased its emphasis on long-term sustainability through sound land management practices.



# RESTORING THE ENVIRONMENT

Abandoned mine lands are often located in beautiful, scenic areas, such as the mountainous regions of the Western United States. In some instances, the historical quaintness of an empty mine site can create a strong tourist draw, but more often, the legacy of these former mines is the environmental contamination caused by residual mining wastes.

Former mining activities may result in the formation of acid mine drainage (AMD), production of waste rock, and sediment erosion. Mine shafts, drill holes, and other mining methods may alter natural ground water flow patterns and carry contaminants like heavy metals to surface and ground water bodies, which can poison aquatic life and area wildlife. These effects not only can inhibit reuse of the affected land for recreation and other purposes, but they can also potentially impact communities far outside a mining site's borders.

Over the past 10 years, the BLM and the Forest Service have developed different techniques for the varied mining sites that fall under their jurisdictions. The examples provided in this section illustrate the approaches undertaken by the BLM and the Forest Service and demonstrate the positive environmental impacts that result from the reclamation of former mining sites.



White King Pond in Lakeview County, Oregon.

## Returning Life to Dead Lakes and Streams

Pit lakes, formed when ground water flows into an open mining pit, are a common feature at hardrock mining sites. The water quality is typically very poor at these sites, with pH values ranging near 2.0 in some lakes, a dangerous level for people and wildlife. In some areas, pit lakes are accessed by the public for recreational bathing and swimming, and the acidic water can cause skin irritation and other ailments. In addition, the acidic water can cause significant fish kills and harm other wildlife that ingests the water.

At the White King Mine located in rural Lakeview County, Oregon, the Forest Service and other partners cooperated to clean up contamination resulting from years of underground and open-pit uranium mining. To correct the high acidity of the site's pit lake, the Forest Service and other partners used an in-situ neutralization process, adding hydrated lime to stabilize the water's pH. The success of this treatment soon became apparent, as organic matter began to flourish in the formerly dead lake. The quick return of life points to a bright future for this body of water and its surrounding ecosystem.

In the case of Blue Joe Creek, which crosses the border between northwestern Idaho and Canada, international collaboration was necessary to successfully address contaminants leaching from mine tailings that affected water and

### Acid Mine Drainage: A Threat to Humans and Wildlife

The sulfide minerals contained in mine waste tailings piles react with rain, surface, or ground water to form an acidic runoff called AMD, which leaches metals like lead, copper, and mercury from the native rock. When AMD reaches rivers and streams, it can wipe out all aquatic life, impact wildlife in the area, and contaminate the sources of drinking water for entire communities. AMD is particularly hard to clean up and, if left untreated, can require centuries for water to return to its premining condition.

# RESTORING THE ENVIRONMENT

wildlife in both countries. A lead and copper mining operation in Idaho created a tailings-pile dam that burst in the 1940s, sending large amounts of contaminated water and sediment pouring into Blue Joe Creek. As a result of this and continued erosion of remaining tailings, the creek was devoid of fish and had low levels of invertebrates. Sampling conducted by the U.S. Fish and Wildlife Service (FWS) indicated extremely high levels of lead in wildlife around the mine site and along Blue Joe Creek. Forest Service sampling revealed highly contaminated sediments in areas of the flood plain. Surface water testing showed levels of lead in the creek at 960 times the Idaho Chronic Aquatic Standards just below the mine and 162 times the standard 7 miles downstream at the Canadian border. In order to adequately address the contamination, the Forest Service and Canadian authorities shared sampling data and established an agreement allowing the Forest Service to sample portions of Blue Joe and Boundary Creeks in Canada as part of its monitoring program.



Cleanup activities conducted from 2003 to 2006 included the EPA mitigating more than 120,000 tons of mine tailings at the site and reconstructing nearly 900 feet of Blue Joe Creek, and the Forest Service removing nearly 47,000 tons of tailings from the flood plain and reconstructing nearly 2,000 feet of the creek. A follow-up study conducted by the Idaho Department of Environmental Quality in 2006 verified that aquatic life had returned to long-dead areas of Blue Joe Creek.

## Partnering to Restore Fish Habitats

As part of the “Bring Back the Natives” Program, Trout Unlimited and the BLM have funded and developed inland western native trout projects since 1993. Sponsored by the National Fish and Wildlife Foundation, the program funds large watershed restoration projects on Federal lands managed by the BLM, the Forest Service, and the FWS. Additionally, Trout Unlimited and the BLM have developed a separate cooperative agreement for native trout recovery on BLM lands, covering large-scale projects such as Lahontan Cutthroat in Nevada and Bonneville Cutthroat in Idaho, as well as for Wyoming’s “Strategies for Restoring Native Trout” Initiative.



## Using Innovative Cleanup Methods

Depending on the amount and type of abandoned mine land impacts, reclamation can be complex and require unique solutions. Through the use of an innovative approach, project partners were able to address mercury contamination at the former Boston Placer Mine located northeast of Sacramento, California.

The site’s problems stemmed from the 400-foot sluice tunnel once used to extract gold from mined sediment, which discharged water and sediment with high levels of mercury contamination onto adjoining Forest Service administered lands. Sampling performed by USGS confirmed toxic concentrations of mercury in both the tunnel and the wetlands area. Through the removal of sediments from the sluice tunnel, plunge pool, and sluice tunnel inlet, and then separating the mercury from the sediments, the California BLM AML Team was able to recover and recycle the mercury. This innovative technique helped to preserve approximately 1 billion gallons of potential drinking water.

Completed in 2005, this project became the first successful mercury removal, recovery, and recycling project undertaken in California. For its efforts, the AML Team received a DOI Environmental Achievement Award in 2006. A number of partners, including the Forest Service, Bureau of Reclamation, EPA, USACE, and multiple other Federal, State, local, and private entities, supported the project. By extracting mercury from sediment within the sluice tunnel and the above wetlands, the site was no longer a pollution point source, and the area became safe again for humans and wildlife.

## Restoring Watersheds and Protecting Endangered Species

Past mining can affect not only nearby waterways, but also dependent ecosystems. Project partners created a collaborative cleanup approach for the Monarch Mill mining site in Atlanta, Idaho—an area prized for hiking and fishing—that restored the watershed while protecting endangered wildlife.

During the mill’s operation, tailings discharged directly into the Middle Fork Boise River and its tributaries released high concentrations of toxic metals. In 1990, a neighboring dam failed, washing substantial amounts of remaining mining waste into the river. Studies confirmed that area wildlife—including Bull Trout, an endangered species in Idaho, and Bald Eagles dependent on area fish—were exposed to these toxic metals. In 2006, the Forest Service signed a memorandum of agreement with EPA to clean up the former mill site. Each agency contributed \$365,000, while Trout Unlimited provided hands-on support from volunteer members. Cleanup included transporting contaminated tailings to a safe repository, reshaping and reconstructing the floodplain to original free-flowing conditions, stabilizing the Middle Fork Boise River utilizing “earth burritos” and rip rap, constructing rock barbs for streambank protection, reshaping the site to control runoff, and revegetating to control erosion and stabilize remaining tailings. To further protect Bull Trout, freshwater pools were created along the river, restoring natural habitat that had been lost to flooding and erosion. In 2007, fencing the site, installing an irrigation system, enhancing vegetation, incorporating signage, and installing an informational kiosk will complete the project.



Volunteers conducting watershed rehabilitation work along the Boise River in Idaho.

Reclamation activities stemmed the migration of toxic metals into the river. The once bleak outlook for the area’s Bull Trout is now promising, as aquatic and other dependent wildlife are safe in this restored watershed. Visitors to this recreational area can enjoy unspoiled land and water for hiking and fishing in the years to come.

## Continuing To Protect the Environment

Environmental impacts of mining can linger decades and even centuries after active mining has ceased. The BLM and the Forest Service are working hard to clean up mining sites to ensure continued enjoyment and use of public lands and the protection of watersheds and life within them. The BLM and the Forest Service are protecting wildlife—from the bears that hunt fish to every animal that drinks from a stream. And the communities living downstream—that may be unaware that a decades-closed mining operation located miles uphill could ever affect their drinking water—are protected by these actions. The BLM and the Forest Service are ensuring that the repercussions of exposed mining waste are safely addressed through continued efforts to identify new cleanup tools and methods. They are protecting the well-being of the environment, and of all of the creatures—human and otherwise—who depend on these lands and waters to survive. □

### Bats: Protecting Endangered and Threatened Species

Abandoned mines house significant colonies of bats, many of which include threatened and endangered species. Bats are important and valued members of the environment; they can eat up to half their weight in insects each night and are instrumental in pollination and seed dispersal. Because many natural bat habitats have been disturbed or destroyed, bats have found new homes in abandoned mines. Bat Conservation International, the BLM, the Forest Service, FWS, and National Park Service have partnered to help protect vulnerable bat species in abandoned mines.





# ENSURING PUBLIC HEALTH AND SAFETY

The remnants of abandoned mining sites tell an alluring story about an adventurous time in the Nation's past. Unfortunately, they can also be the subject of distressing news about injuries and fatalities. One of the main goals of the BLM and Forest Service AML programs is to address the health and safety hazards that exist in these formerly mined areas.

While surface water contamination presents a common challenge on AML sites, addressing physical safety issues is another major priority during BLM and Forest Service reclamation work, as dozens of people every year are injured or killed in and around abandoned mine facilities. Over the years, the BLM, the Forest Service, and their partners have worked together to safeguard the lives and well-being of individuals who come into contact with these sites. The following section describes some of their successes toward that goal.

## Protecting Human Uses of Water

In many abandoned mining sites with impacted waters, local residents and visitors are oftentimes unaware of the associated health hazards. In areas like Moon Creek, Idaho, reclamation partners were proactive in their efforts to protect aquatic and human life.

More than 50 years of mining left portions of Moon Creek, and 20 acres of Forest Service land around the Silver Crescent/Moon Gulch site, contaminated with high concentrations of arsenic, lead, mercury, zinc, and other toxic metals, impacting fish and wildlife habitats in the area. One and a half miles downstream from the site, inhabitants of a small residential community, unaware of the contamination, occasionally used water from the creek to irrigate their gardens.

Recreational activities in the area also put visitors at risk from exposure to contaminated water, as well as from the dangers of access to decaying mine facilities. These conditions and events prompted the Forest Service to remove 130,000 cubic yards of contaminated mine tailings and waste rock from the streambed and flood plains, and to recontour and stabilize the channel using native vegetation. Plans are underway to completely restore the creek's ecosystem as part of a pilot project in Idaho, including the addition of habitat for the Westslope Cutthroat Trout, a protected species in the State.

The Forest Service improved this project's efficiency and contributed to a healthier overall watershed by coordinating cleanup efforts with EPA, which was remediating a neighboring site within the same watershed. Now, residents of the Moon Creek area can feel safe watering their backyards, and hikers and backpackers can wade through the creek's fresh, clear waters on a hot summer's day.

## Making Recreation the Future of Former Mining Sites

Many former mining areas are rich in recreational opportunities for hikers, backpackers, off-road vehicle riders, and historical mine buffs alike. Reclamation of these sites makes the land safer and helps to provide a deeper appreciation for an area's mining past through its recreational future.

Blueprints for a prospective Wyoming State Park interpretive trail—with the final destination being a historic mine site with signage and kiosks—put arsenic-laden tailings at the Sturman Quartz Mill Tailings site in the trail's path.



The Silver Crescent/Moon Gulch site in Idaho.

There was a danger that the tailings might contaminate hikers who breathed the arsenic-laden dust or got it onto their clothing. Before the State could move forward, this abandoned mill site on BLM land was reclaimed in 2005 by removing these tailings, re-contouring the topography, and re-seeding the ground. This jointly funded project by the BLM and the State ensures that any visitors who pass through the former Sturman Quartz Mill Tailings site can do so without thinking twice about their health.

In the Town of Lake Valley, New Mexico, several historic houses and buildings are on the New Mexico Register of Historic Places. Two of the town's structures located on BLM land have been stabilized, including a church and a schoolhouse that serves as a repository for historical artifacts. Hiking trails with historic markers have been constructed. The BLM work at this site corrected or protected against 63 safety hazards on BLM land and 21 safety hazards on private land during the summer of 2005.



The historic Sturman Quartz Mill in Wyoming.

Through these successful projects in Wyoming and New Mexico, recreation and history enthusiasts can safely enjoy areas that posed major threats to human health and safety.

## Addressing Mine Closures

Poor air quality, unstable structures, cavernous shafts, maze-like adits and tunnels, and leftover chemicals and explosives can present significant threats to humans and wildlife at abandoned mine sites. The Forest Service, the BLM, and their partners have developed innovative methods in their endeavors to protect the lives of visitors to their great expanses of land in the West.



One of several open vertical shafts addressed at the Reef Gulch site in Colorado.

The Colorado Division of Reclamation, Mining and Safety (DRMS) joined forces with the Forest Service in 1999 to set up a 50/50-cost-share program to safely close open mines on National Forest System land in the State. Through an annual prioritization process involving the BLM and the NPS, 20 closure projects are selected to be undertaken each year. Often, sites are prioritized if an area has numerous mines that can be addressed at once, or if they are of concern to citizens nearby. This unique funding mechanism and partnership has created a cost-effective and efficient manner to address treacherous mine openings. In the fall of 2002, 26 mine openings at the Reef Gulch site were backfilled, sealed, and gated. In a matter of months spanning the summer and fall of 2006, 33 adits at the Mosquito Gulch site were secured. Both of these successes represent extraordinary undertakings in their scope, and with every mine opening properly closed, the Forest Service and Colorado DRMS decreased the chance that someone might be seriously injured or killed at an abandoned site.

In California, the formation of a Bat Gating Workshop was prompted by the existence of dangerous mine openings inhabited by bats in prominent recreation areas and the need for personnel with the knowledge and skills to address these openings. In April 2006, representatives from the BLM, the Forest Service, the California State Department of Conservation, and the NPS met for a hands-on seminar to learn techniques for constructing bat gates on open mine adits and shafts that are home to bats. The discussions between the various agencies facilitated creative measures for funding the closures of these dangerous sites. Guided by an engineering contractor, the group successfully surveyed and closed two openings using angled iron bars with gaps large enough for bats to pass



Bat Gating Workshop students on top of a successfully closed vertical shaft.

through, but small enough to keep people out. The adits and shafts that were addressed posed major safety hazards, as they were easily accessible by road and close to motorcycle trails in the surrounding area. At the same time, these high-priority sites were home to several bat species, which are an important link in the food chain. The gates addressed both of these issues.

Encompassed by the Coronado National Forest in Arizona, the Alum Gulch watershed area is used heavily for hiking, camping, picnicking, and riding off-road vehicles. However, past mining operations left behind mining waste rock and tailings piles, open mine shafts, and leaking adits. To ensure the safe closure of all open adits and shafts at former mining sites, including the Humbolt, Chief, and World's Fair Mines, the Forest Service used innovative, polyurethane foam plugs to seal openings. These plugs are produced by mixing two liquid reagents that are then poured into adit and mine entrances; the resulting chemical reaction creates a foam that expands to fill all openings and cracks. Once this foam hardens, it is covered with dirt and rock, creating a permanent, weatherproof seal that safely prevents access by humans and wildlife. In addition, the Forest Service undertook an elaborate campaign to preserve the local bat population, by installing bat culverts and grates in the hillsides to provide new habitat once adits and mine shafts were filled. While long-term monitoring of water quality and contaminant sources will continue, the cleanup of former mining sites in the Alum Gulch watershed was completed in the spring of 2007.



Foam closure at the Humbolt Mine.

The successes of the programs in Colorado, California, and Arizona are notable achievements on the road to a safer back country. They highlight the mindful techniques used by the BLM and the Forest Service to keep their constituents—human and otherwise—safe while approaching their tasks in a cost-effective manner.

## Protecting Public Health and Safety into the Future

As part of their AML program goals, the BLM and the Forest Service have saved and continue to help save countless lives and prevent innumerable injuries, all while taking into consideration the wildlife and historic landmarks that frame the landscape. As a result of efforts made over the past 10 years, many formerly impacted local communities, nature lovers, and recreational enthusiasts can fully enjoy these former mining sites without fear for their lives and safety. As their AML programs continue to grow, both agencies will continue supporting the “Stay Out-Stay Alive” campaign launched by the Mine Safety and Health Administration (MSHA). Over time, exposure to AML sites will likely increase and put more lives at risk. In response, the BLM and the Forest Service strive to minimize this exposure by conducting education and outreach activities that inform the public about the potential health and safety concerns associated with AML sites. □



The **Stay Out-Stay Alive** campaign, launched in 1999 by MSHA, is a collaborative effort between more than 70 agencies and organizations, including the BLM and the Forest Service. “There are about 500,000 abandoned mines and another 14,000 active operations throughout the United States,” said Richard E. Stickler, assistant secretary of labor for MSHA. “Many of them contain hidden hazards and, for those not trained to work in mines, the outcome can be deadly. That’s why we urge hikers, bikers, rock hounds, and swimmers to ‘Stay Out and Stay Alive.’”



# IMPROVING QUALITY OF LIFE



Volunteer high school students conducting stream sampling in Monday Creek in Ohio.

Mining activities were historically the backbone of surrounding communities, and in many cases towns were developed solely to house miners. When mine closures occur, a significant number of jobs are lost and communities are forced to identify a new economic livelihood, which can be complicated by their remote locations. Many communities are left with high unemployment rates and small populations, as residents are forced to leave in search of other opportunities.

By working closely with residents and providing a range of related training opportunities, Federal and State partners have increased the capacity of local communities to tackle environmental problems and create new jobs. The examples provided in this section demonstrate the positive effect the BLM and the Forest Service have had on local economies and residents' quality of life.

## Increasing Community Pride Through Reclamation Efforts

It can be a daunting task for communities to revitalize their abandoned mine lands because lives revolved around mining and residents cannot imagine a different landscape. This is particularly true in the Appalachian coal belt. By taking the initiative to improve their surroundings through collaborative partnerships, residents of the Monday Creek watershed in Ohio's Wayne National Forest were able to expand their opportunities and increase community pride.

Large portions of Monday Creek and its tributaries were dead due to AMD left behind from a century of coal mining. In 1990, EPA rated it an unrecoverable stream. In 1994, local residents formed the Monday Creek Restoration Project group, which sought to restore 27 miles of the creek. While initially concerned with correcting flooding issues, the group focus has since expanded—it now coordinates the efforts of more than 20 partners, including grassroots organizations, universities, State offices, the Forest Service, EPA, USACE, OSM, and FWS. This collaboration has been critical as each partner provides unique technical expertise and resources. The Forest Service, for example, provided support for CERCLA actions, cleanup design, and geographic information system (GIS) analysis. At last report, partners had invested approximately \$5 million toward creek cleanup, and the Forest Service contributed a similar amount of work and funding.

Since reclamation projects began in the forest, community pride in the project has grown. Residents have been involved in activities such as conducting stream sampling, trash cleanups, and the painting of murals depicting coal mining and restoration work. The hard work of all partners has begun to pay off; the creek's water quality has improved

*“Over the years, it has been the concern and involvement of citizens that has made the Monday Creek Restoration Project a reality. Local citizens have participated in planning meetings, volunteered for stream sampling and litter cleanups, provided management plan input, and become involved in Friends of Monday Creek events.”*

- Mike Steinmaus  
Monday Creek Watershed Coordinator

substantially, people are using the area for recreation, and EPA reversed the creek's unrecoverable rating in 2004. With additional cleanup, the stream could someday be used as a warm water fishery to support recreational fishing.

## Building Capacity To Further Environmental Progress

When empowered with the right skills, local community members can have a substantial impact on improving their environment and economy. In Alaska, the BLM provided funding for the Yukon River Inter-Tribal Watershed Council (YRITWC) to remediate a small abandoned mine site and build local capacity for future projects.

The YRITWC was established in 1997 by a group of tribal elders concerned about cancer and other health issues caused by contamination of the Fortymile watershed, a tributary of the Yukon River that flows through an area including Alaska and Canada. The BLM provided \$250,000 and partnered with the Yukon Territory Division of Indian Affairs and Northern Development, YRITWC, and others to create a 5-year cooperative agreement to remediate the watershed's Steel Creek site.

By 2006, the YRITWC reclaimed the site within budget and schedule. Through the process, more than 15 Tribes were trained in water quality monitoring and mapping, which led to a collaborative, 3-year water quality monitoring project with USGS and creation of a comprehensive contaminant database. The BLM's support also helped YRITWC leverage more than \$900,000 in funding and in-kind support. These capacity-building efforts led to new jobs and job retention for tribal members; for instance, the EPA Indian General Assistance Program provides funding for two environmental jobs in each community.

The support that partners provided to YRITWC enabled tribes to expand their environmental efforts to cover a wide range of issues. Some of these efforts include removing and recycling more than 3.5 million tons of wastes, developing a brownfields inventory and conducting environmental assessments, monitoring water quality, and initiating renewable energy pilot projects. YRITWC is scheduled to begin its second mining project, using an additional \$150,000 from the BLM to address mining impacts on Hausa Tribal lands.

## Supporting a Local Economy Through Reclamation

Although the Red River area near the town of Questa, New Mexico, has a history of gold and copper mining, it successfully transitioned to a tourism economy based on skiing and other recreational activities. The Forest Service helped promote this new economic base by ensuring the safety of Federal lands.

When visiting Questa, many visitors hike on surrounding National Forest System lands. There were four abandoned mine sites on these lands, causing safety concerns associated with exposed adits, AMD, and erosion. One of the sites identified as a cleanup priority was adjacent to a creek situated upstream of the City of Red River's water system.



A YRITWC leadership meeting taking place at a bi-annual summit in Fort Yukon, Alaska.



YRITWC members searching for macro-invertebrates from the Yukon River.



Waste rock being removed from the area below a newly constructed recreational path in Red River, New Mexico.

The Forest Service worked closely with partners such as the State, EPA, FWS, Trout Unlimited, and ski resort owners to improve the safety of the area by consolidating contamination from these sites into a single, capped repository. For example, a local ski resort owner contributed by donating the use of equipment to dry out the soil for construction of an access road. Throughout the reclamation process, the community was supportive, recognizing that the Forest Service's work was designed to improve the safety of the area and promote the local tourist industry.



Waste rock from the Buffalo Mine in New Mexico being dumped in the repository.

## Helping Communities To Turn the Tide

The BLM and the Forest Service have had a positive impact on people's lives through reclamation of abandoned mine lands over the past 10 years. As part of their efforts to promote community involvement, both agencies will continue to work closely with local communities throughout the reclamation process by involving them in decision-making regarding cleanup and reuse options, providing a range of training opportunities, and involving local contractors in remediation work. Through these efforts, the BLM, the Forest Service, and their partners plan to continue to help communities and their residents transition into economies that offer brighter futures. □

### Office of Surface Mining Works Together with the BLM and the Forest Service



The Office of Surface Mining's (OSM) AML program mitigates the effects of past mining by aggressively pursuing reclamation of abandoned mines. While most abandoned mines involve coal, OSM has the authority to allow AML funds to be spent to reduce threats to public health and safety from noncoal mines. BLM and the Forest Service have leveraged funding from OSM in situations where a State or tribe, particularly in the West, has certified that all abandoned coal sites have been reclaimed.



Monday Creek Watershed camp participants.

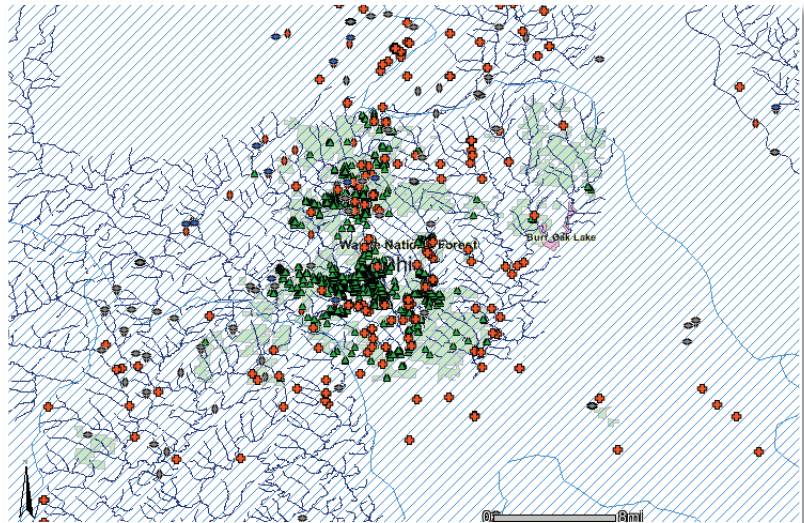


The Golden Butte Mine site in Nevada.

As this report demonstrates, much progress has been made in reclaiming AMLs and revitalizing the impacted watersheds and communities that are on or near public lands. With more than 12,000 abandoned mining sites on the BLM lands, more than 39,000 sites on National Forest System land, and hundreds of thousands of more sites yet to be identified and characterized, more progress must be made. While these AML sites may represent environmental and safety threats, these lands also present opportunities for new ecological, economic, and other assets. Through continued funding, the BLM and the Forest Service can build on 10 years of progress and support the next phases of reclaiming the AML sites on public lands. In looking forward, the BLM and the Forest Service expect to focus on several key areas.

## Enhancing Site Inventories and Prioritizing Reclamation Projects

Building on their existing site inventories, the BLM and the Forest Service can enhance their AML inventories to enable more optimized program planning and prioritization of sites for reclamation. Although initial inventories provide solid baseline information, additional data collection is necessary to ensure that all sites that pose significant health and safety threats are prioritized appropriately. Furthermore, priorities have changed since initial inventories were first developed and there have been significant shifts in population centers and recreation intensity. In an effort to coordinate and consolidate AML activities, the BLM has embarked on an effort to develop a National Mine Lands Inventory that will show AML and mine site locations on all Federal lands. Providing these site locations in a GIS platform along with other data layers (e.g., recreation facilities, impaired watershed boundaries, property lines) will allow for better communication and coordination between State and Federal agencies and the public, promoting better use of scarce resources to produce the greatest positive impact from reclamation. Additionally, the Forest Service is in the process of putting its regional AML data into a national database, making it available for use for the first time for land use planning and other resource management activities.



National Mine Lands Inventory: A compilation map of mining sites for multiple land management agencies.

## Leveraging Resources and Results Through Cooperation and Partnership

Past partnerships show that collaboration and coordination result in more efficient use of limited funding. Looking beyond the traditional intergovernmental partnerships to private sector, academia, and nonprofit alliances will tap

new capabilities in technology transfer, funding sources, and knowledge management. Developing interagency training courses and technology lessons learned will help Federal partners stay apprised of emerging and innovative technological and scientific advances. Future AML site successes depend on initiating and building long-term relationships with local individuals and organizations that are in tune with the local wildlife, traditional culture, and character of the community.

## Transferring Technological Innovations To Ensure Effective and Efficient AML Site Cleanups

With more than 50 years of experience cleaning up mining sites, the BLM and the Forest Service know that the greatest savings in cleanup cost savings come from technology improvements and new technologies. Best practices in AML reclamation are continuously being tested and proven by the BLM, other Federal agencies, States, contractors, and mining companies. To bring these technological advancements to bear on public lands, the BLM and the Forest Service must partner with others in training and technical assistance efforts to test their effectiveness in differing site conditions. Over the past 10 years, technologies such as X-Ray Fluorescence metals analysis and sulfate reducing bioreactors have gone from innovative to mainstream. The next 10 years will certainly bring new and cost-effective tools to AML reclamation.

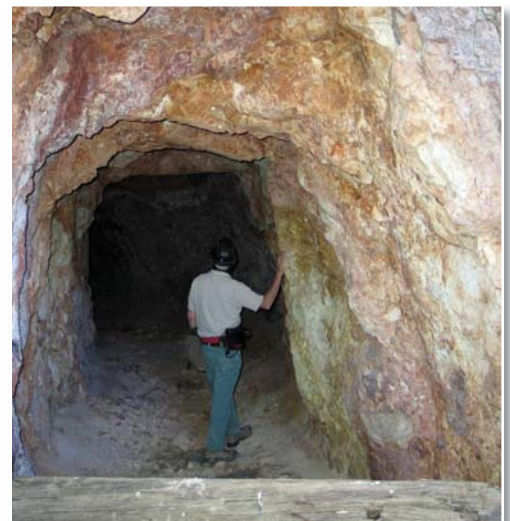


Close up view of an X-Ray Fluorescence Spectrometer.

## Solving the Long-Term AML Problem Through Prevention and Sustainable Practices

With the current estimates of AML sites on public lands in the hundreds of thousands, reclamation will not be completed in the near term. However, preventing future AML sites is a crucial component of any land management agency's AML program. Sustainable mining practices and environmentally protective mine closure planning guarantee against abandonment and public cleanup burdens. Through optimal permitting requirements and financial assurances, land management agencies are encouraging mining companies to operate under a sustainable business model that follows a mine's life from startup to clean closure. These efforts ensure that the inventory of AML sites on public lands continues to shrink.

With adequate funding and other technical resources, the BLM and the Forest Service can meet these future objectives and ensure that mining remains a key component of the economy. The prosperity that mining brings will ensure that the BLM and Forest Service landscape will be safe and environmentally healthy for everyone who lives nearby or benefits from public lands. □



The Sunnyside Adit in Alum Gulch, AZ.



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