

# ABANDONED MINE SAFETY REMEDIATION: CLOSING THE HOLES IN NEVADA<sup>1</sup>

Christopher Ross, PhD.<sup>2</sup>

**Abstract:** Nevada has an estimated 300,000 abandoned mine land (AML) features, of which about 50,000 represent significant risks to public safety. Almost every year there are injuries or deaths related to AML sites, from causes ranging from falls and collapses to drownings, asphyxiations, and motor vehicle accidents. The BLM Nevada State Director has established a goal of securing or eliminating such hazards near population and recreation centers, and other areas of high public use. A GIS project was developed to locate, analyze, and prioritize hazards. A programmatic Environmental Assessment was developed to expedite NEPA compliance.

Extensive clearances for land and mining claim status, bats and other wildlife, protected plants, and cultural resources are required prior to backfilling. Spreadsheets track clearances and resources. The State of Nevada AML program includes inventory and fencing by Nevada Division of Minerals staff, summer interns and volunteers from prospecting organizations and Eagle Scouts, as well as public education (Stay Out and Stay Alive), all of which are integral to the remediation process.

An innovative cooperative effort to do clearances and actual dirtwork for permanent closures includes representatives from the Nevada Division of Minerals, the Nevada Mining Association, the Nevada Natural Heritage Program, Nevada Department of Wildlife, Bat Conservation International, heavy equipment dealers, individual active mines, trucking companies, and others. This team works closely with a minimum of formality to rapidly clear and close dangerous sites. Over 80 backfills were done last year. Options for temporary and permanent mitigation, including gating, will be discussed. Obstacles and the means to overcome them will be presented, with specific lessons learned. Emerging future hazard issues related to pit lakes will be brought forward.

Additional Key Words: Safety, hazard, backfill, NEPA, wildlife

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<sup>2</sup>Christopher Ross, Abandoned Mine Program Lead, Bureau of Land Management Nevada State Office, P.O. Box 12000, Reno, Nevada, 89520 00006 email: [c1ross@nv.blm.gov](mailto:c1ross@nv.blm.gov)  
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## **Introduction**

Nevada has an estimated 300,000 abandoned mine land (AML) features, of which perhaps 50,000 present a significant risk to public safety. Almost every year there are injuries or deaths related to AML sites, from causes ranging from falls and collapses to drownings, asphyxiations, and motor vehicle accidents. The BLM Nevada State Director has established a goal of securing such sites near population centers and other areas of high public use. A GIS project was developed to locate and to analyze and prioritize such sites. A programmatic Environmental Assessment facilitates NEPA compliance. Extensive clearances for bats and other wildlife, protected plant taxa, and cultural resources are required prior to backfilling. Spreadsheets are used to track clearances and resources. The State of Nevada AML program, which includes mine hazard inventory conducted by Nevada Division of Minerals staff, including summer interns, fencing work performed by Division staff, summer interns and volunteers (prospecting clubs and Eagle Scouts) and public awareness education will be summarized.

An innovative cooperative effort to do the actual dirtwork includes representatives from the Nevada Division of Minerals, the Nevada Mining Association, heavy equipment dealers, trucking companies, Bat Conservation International, and area mines and contractor associations. As a result, Nevada leads all other western states in hazard mitigation. Options for temporary and permanent hazard mitigation, including bat gates, will be presented. Obstacles to the work and improvements to the process, with lessons learned, will be discussed.

Abandoned mined land sites (AMLs) are a significant threat to public safety throughout the western United States. Although fencing and posting signs may provide temporary remediation of this threat in some cases, permanent closure is the only positive method for elimination of hazards. Nevada has an estimated 50,000 AML sites which pose a significant public safety threat. Since a majority of these hazards are on BLM-managed lands, we have embarked on a mission to deal with this on a large scale.

### **Environmental Assessment:**

To do so as efficiently as possible, we first prepared a statewide programmatic Environmental Assessment (EA) for the Remediation of Abandoned Mine Safety Hazards. This saves us the considerable task of preparing a separate EA for each closure. The EA follows the standard format for National Environmental Protection Act (NEPA) analysis. Widespread public notification and public meetings were held to identify issues for analysis during the scoping process. A special effort was made to get input from small miners, bat conservationists, and archeological interests.

### **Prioritization of Sites:**

In order to fulfill the Nevada five-year legacy goal of identifying and securing hazardous abandoned mine sites near areas of high public use and population centers, a Geographic Information System was assembled in ArcView.

Known recreation areas such as campgrounds, back country byways, developed recreation areas, foot and mountain bike trails, the Black Rock/High Rock and Red Rocks National Conservation Areas (NCAs), Areas of Critical Environmental Concern (ACECs), emigrant trails and other areas of potentially high public use were entered into the system. A one-mile buffer

area was then created around all sites. The statewide abandoned mine lands inventory was then intersected with the areas and the buffers, identifying 1841 mine sites. Every point in the system can be identified by simply clicking on it, which brings up an extensive attribute table. Information includes location, feature type, and much other information, such as mine type, recreational development features, hazard rank where known, method of securing, bat status, and up to 100 other information fields. Standard digital format topographic maps and land ownership status can be placed under or over the other fields to allow for easy field location and land status determination. Data sets can be updated and edited in the field.

The analysis and adaptability of GIS provide a number of advantages for such a project. No other system could display on demand the vast number of features and data sets involved. Temporary areas of high public use, such as off road vehicle courses or special events can be quickly added, buffered, and examined electronically for known hazards. As mines are discovered, evaluated, or secured, the information can be instantly updated. Cities, highways, and other features can also be added and analyzed quickly. Where sufficient data exists, CDs can be quickly produced for fire teams to take into the field for review during incidents. Buffer zones can be increased or shrunk as desired. Distances from any feature (such as a mine) to any other feature (such as a campsite or hot spring) can be instantly calculated in the field.

The first draft of the GIS project to identify AML hazards near population centers, recreation sites, and other areas of high public use yielded an estimate of 17,150 identified AML sites, an estimated 41,300 actual sites, and 6900 estimated hazardous sites. This was based on a one-mile buffer around ALL recreation sites, ACECs, NCAs, OHV areas and race courses, and other identified public use areas.

The draft project was modified as follows to more tightly identify priority sites:

Buffers were reduced to one-half mile.

Only active OHV race courses were included.

Recreation sites and other identified public use areas were prioritized by Field Office and State Office personnel so that only those which receive significant public visitation were included.

The AML hazard estimates derived from this modified GIS are:

2181 identified sites

6543 estimated total sites

1090 estimated hazard sites,

of which 258 have already been secured.

Leaving an estimated 832 sites to inventory and secure.

This will be further modified as sites are secured to increase the buffer distance around larger urban areas such as Reno and Las Vegas, which will increase the estimated number.

### **Preparing for Closure:**

Information and processing procedures for closure were developed as follows:

Site ranking is conducted (usually by the state's Nevada Division of Minerals) to provide a standardized assessment of the threat posed by the AML site.

Determination of site ownership and responsibility follows to rule out those sites with an owner or active claimant, or sites which are not BLM-managed.

Procedures for archeological/cultural surveys and requirements for monitoring and documentation are done according to an agreement with the State Historic Preservation Officer (SHPO).

Wildlife surveys, including bat, tortoise, and migratory bird investigations, are done in accordance with state and federal guidance.

Threatened and endangered (T&E) species surveys and clearances are conducted.

Other sensitive species, including cacti and yucca, are monitored.

Special notifications are required in wilderness and wilderness study areas.

Visual Resource Management (VRM) is considered so that closure activities do not adversely impact the landscape.

Detailed Performance Measures specify how these procedures are conducted and documented.

The Programmatic EA supports a formal finding of no significant impact (FONSI) for sites which are properly analyzed and cleared under the EA. The result of this NEPA process is that a Documentation of NEPA Adequacy (DNA) form can be quickly and efficiently completed for AML sites slated for closure under the programmatic EA, drastically reducing time and paperwork.

The required clearances and surveys involve considerable field work and are often contracted out to subject experts. This is especially true of bat and archeological survey work. The challenge that emerged was maximizing the efficiency of this work and accurately tracking the progress of clearances. The order in which tasks are accomplished greatly impacts this. Obviously, land status and responsibility are determined first, to eliminate sites that BLM is not responsible for. At this point, topo quads are annotated and copied for further use. A site visit to determine hazard ranking and assign a unique identifier, with a tag at the site, is the next step, if not already done.

A major lesson from our experiences is that the geologists, archeologists, botanists, and biologists should then visit the sites together, preferably in the same vehicle. This spares various specialists from conducting detailed survey work if another specialty finds issues that would preclude permanent closure in any case. Examples might be a cultural site that cannot be disturbed, terrain which precludes access by heavy equipment, or a site which has obvious wildlife value and requires gating rather than backfilling. At the same time, some sites can be quickly cleared for backfilling, for example, a simple shaft with no horizontal development, less than 30 feet deep, with no cribbing, can be ruled out as bat habitat without further survey. (These sites may still have raptors or migratory birds). A powerful (2 to 3 million candlepower)

spotlight which can be charged from a vehicle power source is a major asset, both for shaft/adit examination and for illuminating tortoise burrows. A simultaneous initial visit by all specialists also saves time and confusion on sites which have obscure access or are remote.

Once these initial surveys are completed, sites which will require more intensive clearance can be listed. These may include detailed archeological/cultural documentation, T&E clearances, or bat surveys. At this time, it can be determined whether internal bat surveys are possible, or whether site conditions mandate external surveys. This is important information for the survey contractors, and greatly impacts contract cost and timing. Once the final surveys are done, it is often important to cover the entrances with temporary netting, to prevent entry by animals prior to backfilling, and to allow animals which may be inside to exit. One-inch plastic poultry netting is available from farm suppliers such as TEK, and is easy to cut, handle, and secure with stakes or rock weights.

In some cases it may be important to notify local law enforcement agencies of the intent to close features, since AMLs are popular disposal sites for various criminal activities.

### **Tracking Closure Clearances:**

A major challenge in the clearance process is tracking the status of the various surveys. We use an Excel spreadsheet which includes the site name, number, legal status, geographic coordinates, hazard ranking, topo quad, and other information. Cells are included for notes on the various surveys: access, archeological, botanical, biological, and bats. As each survey is done, the information is summarized in the cell, along with the date and initials of the surveyor, and a clear note on whether or not the site can be closed, with or without further work. Columns or rows which contain information not needed at various points in the process are easily hidden so that the data is not overwhelming. It has proven best to have one person with custody of this sheet, so that multiple versions do not evolve. As each update is made, the sheet is given a new version number, e.g. v3.1, 3.2, 3.3 etc. This makes it easy to make sure that one is in possession of the most up-to-date information. As the spreadsheet is completed, the decision on whether the site should be backfilled, gated, or ignored becomes easy to make. At the same time, any remaining work to be done, such as final wildlife survey, or any mitigation, such as cacti transplanting, is clear. Scheduling is also facilitated, since sites can be easily grouped by access route or jurisdiction, and limitations are noted. For example, in some cases it may be necessary to schedule closure so that nesting birds are not impacted.

An example of a portion of a spreadsheet is presented here (Table 1). Hidden columns not shown here include: Legal description, topo sheet name, hazard ranking, feature type, UTM location, current status of fencing or other securing, and initial access notes, and final disposition.

### **Actual Closure and Logistics:**

After all of the inventory and clearance paperwork, the earthwork involved in closing the shafts and hazards seems relatively simple. Transport, equipment, operator, and even fuel have all been donated by trucking companies, mines, the equipment dealership, and the Nevada Mining Association. Because of the cost of moving from site to site, which involves either a heavy transport truck or “walking” the dozer, every effort is made to minimize travel and waiting time. For an upcoming backfill project, a pair of students in a University GIS class did a

logistical analysis for us for their semester project, producing maps which show the routes and directions of travel which minimize both road and overland travel.

At the AML site, the biologist and archeologist lead the dozer in to avoid protected resources. Smaller cacti and yucca, if present, are dug out, watered, and replanted immediately after the backfilling. Burrows and shafts are given a last check for wildlife, then the dozer operator pushes the waste rock spoil that came from the hole back into it. Because of the swell factor that exists when solid rock is broken up for removal during mining, there is almost always plenty of previously disturbed material for the backfill.

After filling, the site is rephotographed and eventually a report is prepared, with before and after photos, for the State Historic Preservation Officer (SHPO).

The result of this work in 2004 is that we have backfilled over seventy extremely dangerous mine shafts in areas of high vehicle use – some literally in the middle of publicly used roads! (Fig.1) Well over 400 other AML hazards have been fenced and signed this year under the Assistance Agreement with the Nevada Division of Minerals for a total of about 8,000 in Nevada. More sites are continually being identified and cleared for both fencing and backfilling.



Figure 1. Backfilling an “ant lion” shaft in Clark County, Nevada

Table 1. Clearance tracking for proposed backfills.

<b>CLARK COUNTY ORPHANS PROPOSED FOR BACKFILL - 2003</b>				
<b>HAZ ID NO</b>	<b>Cultural Survey, results</b>	<b>Tortoise/biological survey, results,date,intials</b>	<b>Bat Survey results,date, initials</b>	<b>Rec. Closure method</b>
<b>SEARCHLIGHT AREA</b>				
CL-251	OK SR 6/24/03	OK BT 6/24/03 Access from NE	Phoebe but CX for bats CR 6/24/03	
CL-210	Clear 3/28/03 SR	Owl use, nest with 3 eggs; woodrats; 5/6/03; BB	one torpid Townsend's big-eared bat, 5/6/03; BB	A:bat gate
CL-936	Clear 3/28/03 SR	Say's Phoebe Nest 5/6/03 BB	No bats; 5/8/03; PB	Close after wildlife check
CL-1490		OK BT. Old inactive burrow to SW - check before filling. Good access. Cleared for corpse by metro. No wildlife seen; 5/8/03; BB	No bats; 5/8/03; PB	C:close after looking down with light
CL-1522		No wildlife seen; does not connect to CL 164	No bats, 5/6/03; PB	C:close after looking down with light
CL-1523		No wildlife seen; does not connect to CL 164	No bats, 5/6/03; PB	C:close after looking down with light
CL-1544		Connects to CL 164; Say's phoebe nest; 5/6/03; BB	Pallid bats (?) flying in shaft CL 164; 5/7/03; outflight camera; PB	A:Bat compatible closure
CL-1545	NO INFO 6/30/03 SR	No wildlife seen; does not connect to CL164	No bats, 5/6/03; PB	C:close after looking down with light
CL-1429		No wildlife seen, just pigeons; 5/8/03; BB Ok BT 6.24.03 Good access/avoid cacti and yucca	No bats; 5/8/03; BB	C:close after scaring pigeons out.
CL-171	If backfilling, need photo	woodrats 5/6/03 PB	Bat activity on video. Guano thruout mine. EA and V 5/6/03 PB	Gate
CL-255	OK SR 6/24/03	OK BT 6/24/03 Pull back material from top of dump and avoid/salvage cacti Restore site and road in fall	Needs external survey CR 6/24/030	Backfill?
CL-256	Access mandates fence	Access (Yucca) mandates fence BT 6.24.03	CX for bats CR 6.24.03	fence
CL-1528		No wildlife habitat, 5/7/03; PB		D: close

### **Sites for which clearances cannot be obtained:**

Where dangerous sites include cultural/archeological material or are habitat for bats or other protected wildlife, the situation is more complex. A major issue is that there is no consistency among professionals on what constitutes a significant cultural item or site, or on what is significant bat habitat. Some field offices deny permission to backfill if there is even common old trash or glass, or if there is the potential for a single bat while others strike what AML personnel see as a more appropriate balance between preservation and public safety. While some sites near historical remains could be closed through consultation with the SHPO, staffers are reluctant to undertake this time and labor-intensive process. Sites ruled out for wildlife reasons can usually be secured with a bat/wildlife gate, or over shafts, a cupola, but these are very expensive and even when built as strongly as possible by professionals, prone to vandalism. In Nevada we have been seeking grant-type funding to pay for such closure on particularly dangerous AML features.

### **AML Hazards of the Future:**

Remediation of existing historical hazards is not the only responsibility of a comprehensive AML program) Managers should also be considering current activities which will become hazards in the future. While the era of unsecured shafts being left behind by old-time miners is largely in the past, there are new types of hazards which will result from modern mines. These should be identified and remediated as part of mine closure so that they do not fall into the AML program in the future. In Nevada, for example, very large-scale cyanide heap leach mines are leaving massive pits which extend far below the water table. These then fill after pumping ceases, so that a large, deep lake develops (Fig. 2). The steep, ledged, unstable sides and the distance from the rim to waterline will be very hazardous. It is inevitable in an arid climate that such pit lakes will be stocked with fish and used recreationally. Most mine non-mine employee fatalities in the U.S. involve quarry lake accidents in the east. For example, in 1999, MSHA recorded two fatalities from shaft falls (both in the west), three from ATV incidents with AMLs (all in the east), and ten drownings in AML sites (all in the east) ([www.msha.gov](http://www.msha.gov)). Pit lakes, with their tall highwalls, ledges both above and below the water, and sheer, unstable sides will likely be much more dangerous than the abandoned quarries. While backfilling to a level above the predicted water line would be the permanent solution, economic and political realities make this impossible except in a few cases. Mine plans and environmental analyses should not assume that public use will be prevented by simple fencing and signing, and that fish stocking will not occur. If the reality of public use is accepted, access can be designed in and the worst wall instabilities relatively cheaply corrected. It will be ironic if all of our best efforts to remediate AML safety hazards fail to reduce injury and death because we overlook current activities which lead to foreseeable future dangers.

### **Conclusion:**

Despite obstacles to the process, the Nevada AML program has achieved phenomenal success in improving public safety. This success is entirely attributed to the close working relationship between the BLM, the Nevada Division of Minerals, the Nevada Mining Association, and the individual mines, mining suppliers, and operators whose tangible contributions allow the program to exist. (Fig. 3)





Figure 2: Abandoned pit lakes as a chemical and physical safety hazard issue. (Paradise Peak pit, abandoned in bankruptcy). Mineral County, Nevada.



Figure 3: Backfill team: Nevada Division of Minerals and BLM AML leads, archeologist, and biologist, dozer operator, Nevada Mining Association Environmental Director.