

CYANIDE HEAP-LEACH GOLD MINING
AND ITS IMPACTS ON THE ENVIRONMENT

Prepared for:

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Dear Beth,

The purpose of "cyanide heap-leach gold mining and its impacts on the environment" is to introduce alternative mining techniques that will help alleviate wildlife death, and ground and surface water pollution due to cyanide ponds and leaks.

Cyanide heap-leach gold mining is a process where micro-gold is extracted from ore. The ore is spread out in heaps and sprinkled with a dilute cyanide solution. The gold-laden or "pregnant" cyanide is contained under the ore by plastic liners and a layer of clay. The "pregnant" solution is pumped through a series of carbon columns which separates the gold from the cyanide. This cyanide solution is then sent to a "holding pond" where it is restored to its former strength and later reused.

Through library research and personal interviews, I have recommended that the following alternative systems be implemented. They are:

- installing French drains and double liners for the detection of cyanide leaks,
- installing nets and flags, and double fences for wildlife preservation.

Atlas Mining Company's benefits will include improving relationships with environmental agencies, setting a precedent for other mining companies and sustaining profits.

Sincerely,

Diane Young

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Glossary

Heap-leach gold mining:

A process where micro-gold is extracted from ore. The ore is spread out in heaps and sprinkled with a dilute cyanide solution. This solution leaches out the gold. ..

Pregnant pond:

A cyanide pond that contains micro-gold.

Heap-leach pad liner:

A synthetic liner that rests under the ore heap.

Abstract

Cyanide presents many adverse environmental problems. Unfortunately, the impacts of the heap-leach gold mining process extend beyond their immediate borders. The temporary and reactive disposition of cyanide solutions makes it difficult to forecast all the environmental consequences that can occur at the Grassy Mountain project in eastern Oregon. However, this report addresses two major problems associated with this mining process.

- Wildlife death due to cyanide ponds.
- Ground and surface water pollution due to liner leaks.

Library research and interviews with Gary Brown, director of Concerned Citizens for Responsible Mining, has indicated that present appropriate technologies that aid in maintaining a non-polluting stability aren't being utilized to their full capacity. Therefore, the recommendations will outline current practices that will minimize wildlife death and water pollution.

- Installation of French drains beneath the pad liners for detection of cyanide leaks.
- Installation of double liners under all ponds for the containment of cyanide.
- Installation of nets and flags over all ponds for wildlife preservation.
- Construction of double fences around the mining operation so that wildlife is kept out.
- Construction of animal drinking ponds off site which will draw water seeking animals away from the cyanide laced ponds.

Implementing these recommendations will improve Atlas' relationships with environmental governing agencies as well as area residents, set a precedent for other mining companies throughout the United States, and meet environmental standards while sustaining profits.

Introduction

The use of cyanide in the heap-leach gold mining process has become a major concern for residents in eastern Oregon. Cyanide presents many adverse environmental problems that the public is aware of. Yet unfortunately, the impacts of cyanide gold mines extend beyond their immediate borders. The temporary and reactive disposition of cyanide solutions make it difficult to forecast all the environmental consequences. However, related noticeable problems are:

- ground and surface water pollution due to cyanide liner leaks,
- wildlife death due to cyanide holding ponds,
- land scarring resulting from the mining process.

Glen Miller, a Nevada biochemistry professor, warned that if cyanide leaching becomes widespread in eastern Oregon the region's wildfowl, surface and ground water could be at risk. 1

Some studies have suggested that cyanide can survive in the absence of oxygen for more than 40 years. Cyanide, Miller said, also liberates many heavy metals such as lead, cadmium, arsenic and mercury from the rocks. These metals can then be reintroduced into the environment in highly toxic forms. They are potential contaminants for the water supply in eastern Oregon.

For example, in Silver Valley, Idaho, high levels of lead (3,700 parts per million) were discovered in children 15 years ago. The Center for Disease Control pointed out that 500-1,000 parts per million is enough to affect those that are exposed. The lead contamination was caused by the Bunker Hill Company which ran a mining and smelting process from 1917 to 1981. The area has been declared a Superfund site. 4

This report will present a summary of alternative procedures that can be used with your present mining techniques to help alleviate the problems caused by the heap-leach gold mining process. The procedures are:

- Alternative 1: installation of French drains,
- Alternative 2: installation of double liners,
- Alternative 3: installation of nets and flags,
- Alternative 4: construction of double fences,
- Alternative 5: construction of animal drinking ponds.

Alternative practices that reduce cyanide leaks

Because of alternative technology, cyanide leaks can be eliminated. Using the alternative methods will allow the estimated 1 million ounces of gold, that has been located in the Grassy Mountain area near Vale, Oregon, to be mined in an environmental yet feasible manner. 2

Both ground and surface water pollution results from cyanide leaks. The Executive Director of the Montana Environmental Information Center, Jim Jensen stated "every heap-leach pad liner we have investigated (in Montana) has leaked," for engineering doesn't always work.

In South Dakota, the Brohm Mining Corporation's detection system showed that 6,800 gallons of cyanide and other solutions had leaked from a primary liner per day. The pad had been in operation for about one month when the leak was found. 5

Therefore, the incorporation of the French drain and the double liner system is recommended. The drain and liner presents environmental safeguards as well as an important economic incentive: lost cyanide can potentially mean lost gold.

Alternative 1: The French drain system

The use of the French drain system is recommended, for it allows immediate detection of cyanide leaks; whereas, with ground water monitoring a considerable amount of ground water and soil pollution can occur before detection.

The French drains are installed between the soil subbase and the leach pad during the preoperational phase. The drain systems are then individually monitored to detect cyanide leaks. Any leaks that are found can then be pumped to the pregnant pond. 6

Pinson and Superior mining companies have employed the French drain system at active mine operations. They have found that costs of incorporating the French drain system will vary from site to site depending on the topographical features present. Table 1 includes both direct cost items such as earth moving and surveying, and indirect cost items such as design, insurance and bonds. 6

Cost item	Unit cost, \$/unit	Without French drain, \$	With French drain, \$
Direct costs			
Site preparation - clear and grub	0.29/yd ²	2,900	2,900
Remove and stockpile 6 in. of topsoil	1.45/yd ³	2,500	2,500
Remove 12-in. layer of soil	1.45/yd ³	-	5,000
Purchase and place 12 in. of gravel	16.16/yd ³	-	53,900
Install drain pipe	1.72/ft	-	930
Install 18-in. sump	23.05/ft	-	50
Level with a blade	0.44/yd ²	4,400	4,400
Compact base - three roller passes	51/h	410	410
Excavate and haul clay for 6-in. lift	7.81/yd ³	13,300	13,300
Place clay layer	1.34/yd ³	2,300	2,300
Add moisture and compact	1.21/yd ³	2,060	2,060
Construct 2nd and 3rd lifts		35,300	35,300
Subtotal direct costs		63,170	123,050
Indirect costs ^b		20,200	39,400
Total cost		83,400	162,000
Pad cost/ft ²		0.93	1.80

^a Pad is 300 ft x 300 ft.

^b Indirect costs are assumed to be 32 percent of direct costs.

TABLE 1
COST OF CONSTRUCTING A CLAY
LEACH PAD WITH AND WITHOUT A FRENCH DRAIN SYSTEM
1986 DOLLARS

Alternative 2: The double liner system

The double liner system will also help prevent possible cyanide leaks. Therefore, it is recommended that the double synthetic liners replace the standard liner at the Grassy Mountain project. The state of California already requires that double liners be used in the pregnant and barren solution ponds at all mining sites. The double liners will:

- further prohibit the possible threat of cyanide leaks into the ground water table,
- help the underlying clay base meet the permeability requirements,
- serve as double protection from protruding ores and soil debris.

Table 2 shows the cost comparison in constructing a site with a single or double liner. 6

Cost item	Unit cost, \$/unit	Single liner system, \$	Double liner system, \$
Direct costs			
Pond excavation	0.97/yd ³	12,600	12,600
Anchor trench excavation	2.99/yd ³	210	420
Backfill of anchor trench	0.96/yd ³	70	130
Drain excavation	2.99/yd ³	-	240
Placement of 6-in clay bed	1.17/yd ³	1,060	1,080
Primary liner (40-mil HDPE)	0.55/ft ²	28,300	28,600
Secondary liner (40-mil HDPE)	0.55/ft ²	-	29,300
Drainage blanket (HDPE)	0.25/ft ²	-	12,300
2-in. Schedule 40 slotted drain	1.72/ft	-	410
Sump and 2-in. connector	-	-	460
Gravel backfill for drain	9.31/yd ³	-	480
Subtotal direct costs		42,200	86,000
Indirect costs ^a		13,500	27,500
Total cost		55,700	113,500

^a Indirect costs are estimated to be 32 percent of direct cost. Indirect costs include engineering, design, and contingencies.

TABLE 2
COMPARISON OF COSTS OF PROCESS SOLUTION PONDS
CONSTRUCTED WITH SINGLE AND DOUBLE LINERS
1986 DOLLARS

Alternative 3: The net and flag system

The net and flag system will prevent local and migratory birds from using the cyanide-laced ponds as a resting and drinking spot. Because of these ponds, over 6,444 migratory birds and other animals have been killed in Nevada and California mines since 1984. 7

It is a federal offense to kill migratory birds. Two Nevada gold companies, FMC's Paradise Peak mine and Amselco Mineral Company's Alligator Ridge mine, are currently under investigation for violating the Migratory Bird Treaty Act. 7

Great concern has been registered about the area's local and migratory birds that are traveling through eastern Oregon. The Pacific flyway, a major migratory route, is located directly above eastern Oregon. Figure 1 shows the Pacific flyway and its relation to the Grassy Mountain project. 8



FIGURE 1
THE PACIFIC FLYWAY AND ITS RELATIONSHIP TO
EASTERN OREGON

Less than 1 percent of the land west of the Rockies is classified as good waterfowl habitat. A sparkling, blue pond of cyanide-laced water looks very inviting to local and migratory birds in this arid region. A productive resting, drinking and nesting site arises whenever water is located. Because of these factors, all ponds regardless of the cyanide solution should be:

- covered by a synthetic net that sits slightly above the cyanide ponds,
- equipped with bright, plastic flags that will flap in the breeze and scare off approaching birds.

Alternative 4: The double fence protection system

Eastern Oregon is home to many species of deer, coyotes, antelopes and rabbits. Therefore, the construction of a double, 8 ft. high fence around the mining site is recommended.

Gary Brown, director of Concerned Citizens for Responsible Mining, has read of deer drinking from the cyanide-laced ponds and slipping on the synthetic liners that line the sides of the ponds. Many of these animals are often found dead miles away from the site due to cyanide poisoning. 9

The double fences will ensure total protection for animals of this nature. If they do get through one fence, another is there to stop them. The fences will:

- keep animals from entering the mining site,
- stop animals from drinking the pond water,
- stop larger animals from bathing in the ponds.

Alternative 5: The man-made pond system

Eastern Oregon has low rainfall and thus few natural lakes. When rain does occur, it accumulates into ponds. Natural lakes in the Grassy Mountain area are usually 100 by 100 sq. yards or the size of two football fields side by side.

Water developments of any type will eventually be found by migratory and local birds. However, pond locations that are isolated in rough and arid terrains attract more birds.

Therefore, the construction of man-made ponds that will draw wildlife in search of water away from the mining operation is recommended.

The man-made ponds will suit the area's wildlife best if they are:

- constructed in a cluster or group for the sake of visibility,
- constructed about a half mile from the mining site,
- the same size of the natural lakes in the area (100 by 100 sq. yards,)
- constructed with a gentle slope in the shoreline for easy access.

Conclusion

Summary of findings

- Cyanide in the heap-leach gold mining process presents many environmental and wildlife hazards.
- The pregnant and solution ponds leek cyanide into the ground water table and pollution occurs.
- The French drain and double liner systems reduce the ongoing threat of cyanide pollution.
- Leaked cyanide can potentially mean lost gold.
- It is a federal offense to fill or harm migratory birds.
- Many species of migratory birds are killed due to cyanide ponds.
- Many species of wildlife are killed due to cyanide exposure.
- The net and flag and the double fence system can alleviate wildlife deaths.
- Gold can be mined in an environmental yet feasible manner.

Interpretation and recommendations

The track-record of the heap-leach gold mining process is tarnished, for some amount of wildlife death, and ground and surface water pollution always occur when this method is used. The present mining industry standards are incapable of preserving Oregon's natural and migratory resources. The incorporation of the alternative systems will:

- help alleviate wildlife death,
- stop ground and surface water pollution,
- improve your relationships with governing environmental agencies as well as area residents,
- set a precedent for other mining companies throughout the United States,
- meet environmental standards while sustaining profits.

The recommended alternative systems are the:

- installation of French drains beneath the pad liners for detection of cyanide leaks,
- installation of double liners under all ponds for the containment of cyanide,
- installation of nets and flags over all ponds for wildlife preservation,
- the construction of double fences around the mining operation so that wildlife is kept out,
- construction of animal drinking ponds off site which will draw water seeking animals away from the cyanide-laced ponds.

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GETTING READY FOR CYANIDE LEACH GOLD MINING

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Cyanide heap-leach gold mining has arrived in Oregon, bringing with it important environmental concerns which are being ignored in the rush for the gold. This recently developed method of strip-mining low-grade gold ore and using cyanide solutions to leach it is being proposed at several locations in Oregon. It is important that conservation-minded citizens understand the operation and the potentially serious environmental consequences of this activity. This process is being used at scores of mines in Nevada and Idaho. Over 30,000 claims have been filed in Oregon for these gold deposits and more are anticipated if gold prices rise. A new American gold rush is on. Gold production in the US has increased 600% since 1980. Of all the gold that is produced 57% is used to manufacture jewelry. There are at least three mining proposals in Oregon which seem to be progressing: Grassy Mountain and Farewell Bend in Malheur County on Vale District BLM public lands and Quartz Mountain in Lake County on Bly District of the Fremont National Forest public lands. Claims have been filed in Crook County and exploratory drilling is ongoing south of Prineville Reservoir on Prineville District, BLM lands. Claims are being filed in the Siskiyou on southwest Oregon in older gold mining districts. This is potentially an impact for all gold bearing parts of the state, not just eastern Oregon.

Cyanide can, in theory, be used safely and impacts to the environment mitigated, but the record in other states is not good. Mitigation and protection procedures require money and this reduces profit margins for what are usually out-of-state, multinational corporations who must return a profit to their foreign owners.

Enforcement is also an issue. A typical cyanide-leach operation will use three million pounds of cyanide per year. A lot to keep track of. Agencies are hard-pressed to inspect and enforce regulations already on the books. In Idaho, which had one inspector, there were two accidents at the Sunbeam Mine near Stanley, an accident at the Yellowjacket Mine on the eastern edge of the River of No Return Wilderness, a spill at a mine in Idaho City, and a leak at a mine near Elk City which contaminated the water supply of the town. These were only the reported accidents occurring in the Salmon River drainage of Central Idaho. In northern Montana, when Pegasus Gold released cyanide into the ground and surface waters, it was only discovered when a local resident noted a funny smell in his tapwater. Reporting of such spills and discharges is on an "honor system" by the mining companies. Due to the lack of funds and manpower, the mining companies are responsible for monitoring themselves for spills and "self-reporting" them. At the Golden Sunlight mine in Montana 9 million gallons of cyanide-containing water was spilled in 1983 and contaminated the groundwater. Local residents weren't informed until 3 years later. Nevada had 28 spills reported in 1988 and Montana had spills at half of its 30 cyanide leach mines.

Cyanide heap leaching does not have a good track record. However, it could. It takes careful planning and engineering from the early stages of permitting combined with ongoing, rigorous monitoring.

The gold-seekers look for hydrothermal systems in which gold has been deposited by circulating geothermal waters. These deposits are then strip-mined. The pit at the Newmont Mine near Carlin, Nevada will be able to hide the Empire State Building when excavated. The ore is next crushed and piled in heaps many tens of feet high on plastic sheets over an area covering many acres. Highly alkaline fluids containing cyanide are then sprinkled over the heap and subsequently leach down through the ore dissolving and capturing the gold and other heavy and potentially toxic elements such as mercury, cadmium, and arsenic. The resulting solution is collected in ponds and the gold chemically extracted. Attempts are made to recover and recycle the cyanide. Fortunately, the cyanide doesn't usually bioaccumulate like many heavy metals do.

Actual and potential problems become obvious. There is unavoidable and extensive destruction of the landscape, loss of wildlife habitat, destruction of plant and animal communities, and surface water and aquifer impacts. It is a rare system that doesn't leak to some degree. There have even been cases of chronic aquifer pollution. The several ponds near these sites are filled with toxic fluids. The ponds attract birds, deer, and other wildlife. They have perished by the thousands in the Nevada projects. Deer have been trapped in the plastic-sloped sides of the waste ponds and drowned in the toxic waters. Birds which aren't killed outright by the exposure may fly away only to perish off-site. Tragically, trout and anadromous fish are particularly susceptible to cyanide and a spill from a truck or pond could have devastating results.

These mines can cover hundreds of acres. The mining area itself may involve a whole mountain or a pit hundreds of feet deep. The buildings, roads, ponds and other facilities typically could cover hundreds or thousands of acres. The tailings and waste dumps will usually be larger than the original deposits due to expansion of the debris.

Rare and endangered plant species are also of concern. Crosby's Buckwheat was first discovered in Oregon by NPSO member Virginia Crosby. It has since been discovered in Nevada where it has been located in association with gold deposits. Some of these plants have been destroyed by the mining. Areas of mining interest in Oregon have unusual geology and soils. This is especially true in the Siskiyou and in Malheur County. These areas support several rare species which could be threatened by this activity.

Oregon law does not require restoration of the topography as most Appalachian states now do for strip mining of coal. This means that obvious and unnatural pits or stripped hills will remain. Replanting is too often done with non-native species. The tailings piles are treated similarly. In any other industry but mining such refuse would be considered toxic waste. The powerful and wealthy mining industry was able to exempt toxic mining waste from the Environmental Protection Act through its strong lobbying efforts.

Individual counties can control mining through their siting and zoning processes. Rural counties perceive these mines as an economic windfall with increasing employment and tax revenue. When the economic boom is anticipated no one considers the bust and its effects. Nevada has recently instituted new taxes on these mines to help cover reclamation and regulatory expenses. In Idaho school districts have been hit hard when mines closed and permanent local residents had to foot the bill to pay for facilities constructed to educate the miner's children. On private land and in cooperation with federal agencies the state's Department of Geology and Mineral Industries controls mining. However, Oregon has only two inspectors for the entire state. They are charged with overseeing over 500 mines, including these gold mines.

This type of mining uses large amounts of water and power. A typical operation might consume 8 to 10 megawatts of electricity. This is the equivalent of the average usage of Vale, OR and its vicinity. Large amounts of water are required to operate the mines and leaching processes. In several of the proposed sites water is a scarce commodity.

Another problem with the regulation of cyanide leaching needs to be mentioned. On public lands (BLM and USFS) this activity is controlled by the National Environmental Protection Act through Environmental Impact Statements (EISs) and Environmental Analyses (EAs). If public agencies feel they do not have manpower or money to perform these studies they may contract them out to private contractors. Under this scenario, the mining company recommends a contractor to be approved by the federal agency. This contractor will almost invariably be one who the miners have hired before and who frequently will have offices down the street, if not down the hall. In Oregon, Reno-based mining companies have hired Reno-based contractors. To top it off, the mining companies then pay the contractors to do the study! The federal agencies, of course, approve all hirings and sign-off on the final product. It is a cozy relationship and certainly does not avoid the appearance of impropriety.

Oregon had its first heap-leach mine in Baker County. The owners of the Minexco Mine there skipped the state, leaving an inadequate bond. The state then had to finance and take over disposal of the residual toxics and oversee reclamation.

Oregon seems destined for more of this type of activity. We have a unique opportunity to learn from the experiences and mistakes of other states. It seems that here should be certain prudent safeguards in place:

- 1) This mining should be totally banned from certain areas due to their unique geology, special botanic resources, historical importance, cultural values, or wildlife habitat
- 2) If reasonable reclamation is unfeasible then mining shouldn't occur.
- 3) Permits should be adequately bonded and carefully monitored by a beefed-up state staff.

4) Stricter reclamation laws need to be passed at the state level which, among other things, would mandate topographic restoration

5) Absolute protection of water and wildlife should be guaranteed

6) A zero-tolerance policy toward spills and discharges of toxics should be adopted by state and local authorities

7) Oregon should consider passing a severance tax, as many states have, to pay for the long-term environmental and economic consequences of this mining by what are usually out-of-state and out-of-country entrepreneurs

Interested persons should:

1) Contact local USFS or BLM offices where mining may occur and obtain information regarding claims and mining plans in your area

2) Let your county government know how you feel about this activity

3) Make your state senator and representative aware of the inadequacies of Oregon laws and agencies to deal with this problem

4) Contact Concerned Citizens for Responsible Mining, POB 957, Ontario, Ore 97914 who are taking the lead on this issue and are serving as a statewide clearinghouse for cyanide leach mining.

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