



## Teacher Feature

Artwork and associated research by Shelly Fischman.

# RECLAIMING MINED LAND PROVIDES FOR THE FUTURE

The disturbance caused by mining can be minimized by planning and using safeguards during exploration, mining, and reclamation. In general, there are three objectives of reclamation: to eliminate threats to public safety, including threats to people, property, livestock, or wildlife; to protect land and water from erosion, sedimentation, or contamination; and to return the mined land to beneficial use—the pre-mining condition or other beneficial condition. The measures described below are those that apply to mineral development on public lands.

## BEFORE MINING

- *Acquiring the Rights to Mine:* Before disturbing public land, a miner, whether a lone prospector or large company, must obtain the legal right to explore and then to mine (Figure 1).
- *Planning Mining Activity:* The mining company must next prepare a plan explaining how it will mine and how it will reclaim the land disturbed by mining (Figure 2).
- *Conducting Environmental Studies:* The government then conducts an environmental study to gauge the state of the environment before mining operations start and assess what impacts may occur to plants, animals, water, scenery, and people (Figure 3).
- *Addressing Environmental Concerns:* Following the study, the government works with the mining company to identify steps to prevent, eliminate, or mitigate impacts to the environment that are expected (Figure 4).
- *Posting a Reclamation Bond:* To ensure that the disturbed lands will be reclaimed, the government often requires that the miner set aside some or all of the amount of money needed to reclaim the disturbed lands. This is called posting a “reclamation bond” (Figure 5).
- *Approving a Mining Plan:* After the mining plan has been studied and a bond posted, the miner is given the approval to mine in accordance with specified legal requirements (Figure 6).

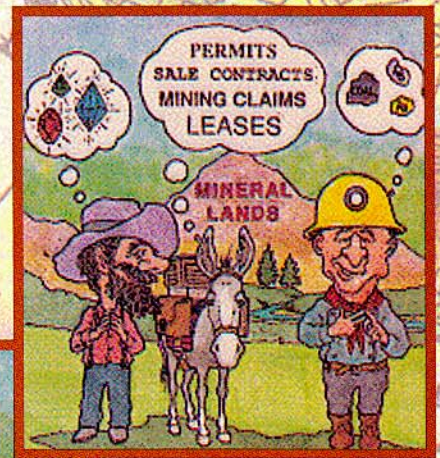


Figure 1

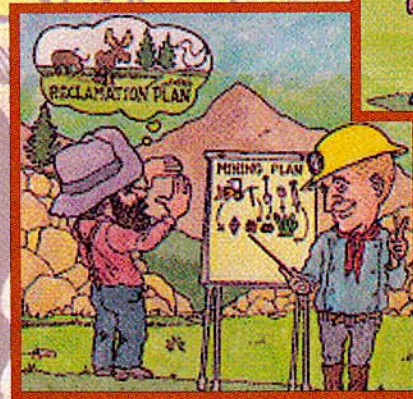


Figure 2

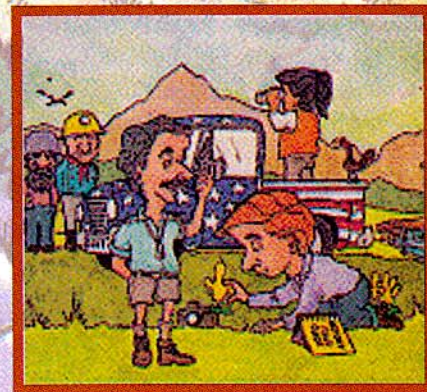


Figure 3

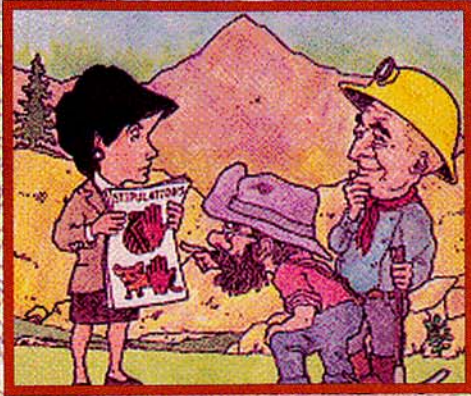


Figure 4

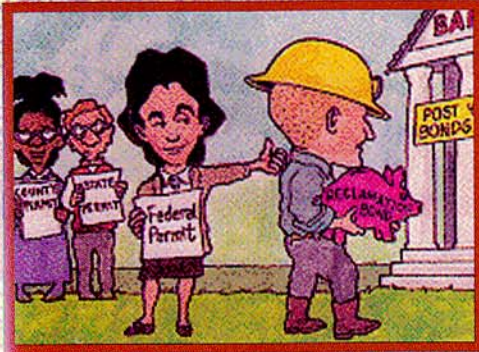


Figure 5

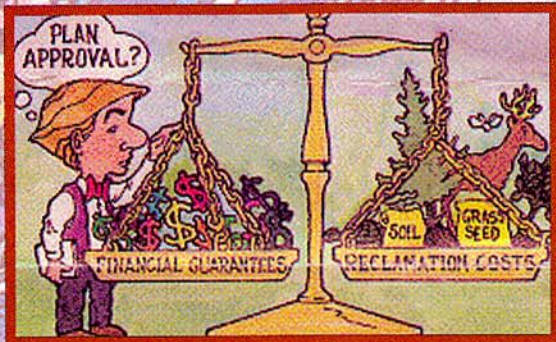


Figure 6



Figure 7

## DURING EXPLORATION AND MINING

- **Mud Pit:** Exploration holes are often drilled by drill rigs and rock samples are removed to determine the geology. Lubrication for the drill bit in the form of mud is frequently used, then stored in pits and reused. It is not introduced into the environment.
- **Topsoil Storage:** Soil is removed prior to mining and stored and temporarily stabilized with grass seed so the disturbed area can be resurfaced after mining activity ceases.
- **Culverts:** Culverts, which are drains crossing under roads, allow water to flow unimpeded. They can be removed when the road is no longer needed.
- **Settling Ponds:** These ponds slow water filled with sediment or other solids, allowing these substances to settle out. The water may then be reintroduced to the stream.
- **Water Quality Monitoring:** Monitoring is conducted during mining and reclamation to detect cyanide, acid drainage, heavy metals, and other substances that may have contaminated surface or ground water. These substances may be harmful to humans, plants, or animals.
- **Stone Embankments:** Rough stone embankments protect stream banks from accelerated erosion that may result from mining.
- **Lined Heap Leaching:** Acids or base solutions, depending on the mineral, are often used to separate the valuable minerals from the host rock. The lining at the bottom of the leach collects the solution that contains the valuable mineral and prevents the leaching solution from leaking into the ground. Minerals are further processed at the plant.
- **Waste Rock Disposal:** Modern mining and reclamation provides for proper disposal of waste rock so the environment is not harmed. In some cases, waste rock from active mining areas is placed where all the minerals have been mined. This helps fill the pit and removes the rock from the landscape. If it is not returned to the pit, it is recontoured and revegetated at an approved nearby site according to the plan.
- **Stair Steps:** The excavations for mining are subject to the same natural processes that erode rugged mountains to more stable rolling hills. An open pit is mined in benches, or stair steps, which model the natural rolling hills, providing stability to the excavation and safety for the miners.
- **Water Bars:** When the soil surface is disturbed, erosion of the exposed area can result in larger amounts of sediment in runoff water. Waterbars help control erosion by slowing sheet runoff and directing water to sediment control ponds (Figure 7).

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## POST EXTRACTION

- **Drill Hole Plugging:** Exploration holes are reclaimed in various ways, often as part of a working mine. Mine-related holes are incorporated into the reclamation. For isolated holes, the primary issue is whether they intersected water. If they did, they may be filled with bentonite or cement. Other holes are usually filled with the original drill hole materials. Engineers reviewing mine plans would help make some of these determinations.
- **Road Removal:** Temporary access roads are reclaimed when they are no longer needed. The work may be done by bulldozers to break up or loosen the upper meter or so of rock which has been compacted by heavy equipment; back-hoes, recontouring with displaced soil; and front-end loaders. Topsoil is replaced on the recontoured surface and seeded.
- **Culvert Removal:** Culverts put in place to allow water to flow under roads are removed when the road is reclaimed.
- **Shaft and Adit Covering or Sealing:** When mines are completely closed, they are sealed by blasting the entrance; in some cases, closures are sealed with grates or cable netting to allow bats access to their homes (Figure 8).
- **Overburden Replacement:** In strip (open cast) mines, the overburden is immediately replaced, recontoured, and revegetated as mining of each section concludes.
- **Topsoil Replacement:** As the critical component of the overburden, topsoil is stored prior to mining in anticipation of the rehabilitation of the disturbed surface. As soon as possible it is respread as the key first step in revegetation (Figure 9).
- **Reforestation and Revegetation:** Disturbed sites are replanted, usually using native species. Revegetation is critical in erosion control and is also aesthetically important.
- **Slope Preservation:** Newly reclaimed slopes that have been revegetated or reseeded are often protected with anchored straw bales. This slows runoff, thereby reducing erosion and subsequent sedimentation of streams.
- **Soil Ridging:** This prevents wind erosion by slowing the wind movement at ground level. It also increases the opportunity for water infiltration (Figure 10).
- **Rock Aging:** A spray-on technique used in arid regions that allows freshly cut rock to blend in with adjoining, undisturbed formations (Figure 11).
- **Second Use:** Sometimes reclaimed lands serve other uses after mining. An abandoned quarry, for example, may be allowed to fill with water for recreational and wildlife use. When a mine is properly reclaimed, habitat is reestablished for wildlife. Some surface operations, in particular those that result in a deep open pit, cannot be economically recontoured to approximate the original topography. Open pits can be used for storage or controlled dumping, but, for the most part, they remain as permanently altered areas that may present ongoing safety and environmental problems.

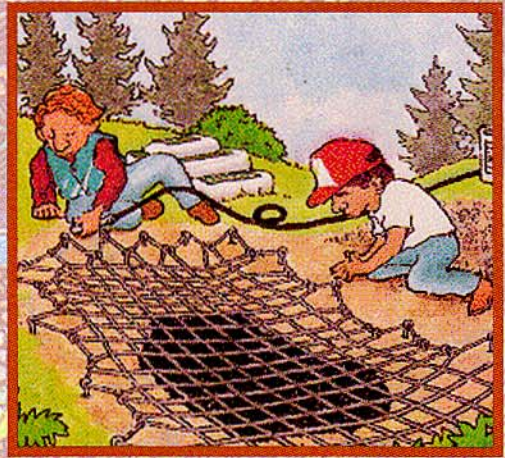


Figure 8

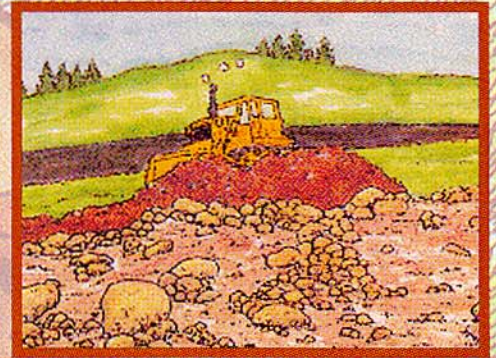


Figure 9

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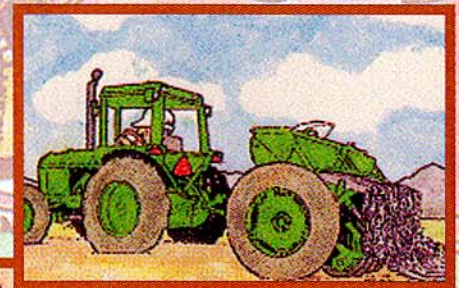


Figure 10



Figure 11