

**TOOLS FOR REGULATING
THE ENVIRONMENTAL IMPACT
OF MINING IN THE
UNITED STATES**

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I. INTRODUCTION

This paper seeks to examine how one country -- the United States -- has tried to balance the need for developing a mining industry with the goal of protecting of the environment. The paper first provides an overview of the mining industry in the U.S., focusing on types of minerals mined, ownership patterns and environmental impacts. The paper next discusses the general framework for regulation of the environmental impacts of mining in the United States. The paper then surveys the different legal tools that have been used in the U.S. for restricting access to public and private lands for mining, for addressing specific environmental impacts such as water and air pollution, soil erosion subsidence and habitat destruction, and for promoting government and private enforcement of the law. The paper concludes with a discussion of options for strengthening certain legal tools.

II. OVERVIEW OF THE U.S. MINING INDUSTRY

A. Types of Minerals

Minerals may be divided into categories defined by their roles in industrial societies. **Metals** - aluminum, gold, copper, and iron, for example - contribute to a variety of industries and end products. **Industrial minerals**, like lime and soda ash, supply the necessary components for particular industrial processes. **Construction materials**, such as sand and gravel, provide the ingredients for concrete and cement. **Energy minerals** like uranium, coal, oil, and natural gas furnish the raw materials for production of energy and nuclear weapons.¹ This paper will concentrate on regulation of the coal and metals mining industries in the United States.

1. *Coal*

Dubbed the "Saudi Arabia of coal", the United States possesses 35 percent of the world's recoverable coal. In raw numbers, this translates to an "estimated 472 billion tons of coal classified as demonstrated reserves".² These reserves are found in 35 states, but currently coal is mined in only 26 states.³ The most common coal is bituminous coal. Mined primarily in the east and the midwest, it is used primarily for generating electricity and making coke (for steel production).⁴ At one time bituminous coal was commonly used for heating. Anthracite, or hard coal, is mined in Eastern Pennsylvania. The Powder River Basin in Wyoming and southeastern Montana yield the dull, black subbituminous coal now heavily used for electric power generation. Lignite, or brown coal, is found primarily in

Texas and North Dakota. At current production rates, U.S. reserves will remain viable for the next few centuries. U.S. coal production was 944 million short tons (856 million metric tons) in 1993.⁵ While mine production rose in western states -- especially Wyoming -- production fell in every eastern state except Maryland.

In 1993 U.S. coal consumption rose to a record level.⁶ Electric utilities accounted for the majority of U.S. coal consumption. Coke production (used, in turn, to fuel the steel industry) constitutes the second greatest use of coal in the United States. Other industrial, commercial, and residential uses continue to fall as public attention focuses on the harmful health and environmental effects of fossil fuel use. Coal exports in 1993 were at their lowest level since 1979.⁷

2 *Metals*

The mining industry extracts metals in various parts of the United States. For example, iron deposits are mined in Minnesota and Michigan, while gold, copper, and silver production occurs in Colorado, Utah, Nevada, California, Idaho, South Dakota, and Arizona among other states. Molybdenum is mined throughout the American west. Lead and zinc mining occurs in Missouri and other states.

The metals industry contributes millions of dollars to the U.S. economy.⁸ The steel industry is the largest metals industry in the U.S. in terms of production and consumption. The industry produced about 99 million tons of raw steel in 1990.⁹ Steel constitutes 90 percent (by weight) of all metals consumed in the United States.¹⁰

B. **Ownership Patterns**

In the United States, mining occurs on private and public lands. Many landowners exercise control over the entire parcel of land: the surface and all that extends below the surface, including the minerals. Owners, however, may divide the property rights in a particular piece of land into surface and mining rights which may be separately sold.¹¹ Thus, a surface owner may not always own the mineral rights. Questions of responsibilities and access (for such things as water, pollutants and unknown minerals) arise from such fragmented ownership.

In most eastern states, the mineral rights are owned privately rather than by the state or federal government. In the west, as federal territories became states, the federal government retained ownership of certain lands and mining rights.¹² Today, the federal government owns most of the land in the west on which mining occurs. In 1991 the federal government's Bureau of Land Management (BLM) regulated 750 active metal mines in eleven western states.¹³ Federal government ownership also accounts for 30 to 40 percent of the nation's coal reserves, mostly in the western United States.

C. Environmental Impacts

Mining significantly changes the environment. Mining operations can alter the landscape, change the underground structure of the land and release pollutants -- including toxic substances -- into the air, water, and soil. At least 48 Superfund sites (federally-funded hazardous waste clean-up sites) are former mineral operations.¹⁴

Whenever a mineral is extracted from the surface or subsurface, a structural element is removed. Unless carefully controlled, surface mining techniques can cause slope instability and soil erosion.¹⁵ In the case of underground mining, the overlying strata of the mined site may shift and/or sink in a geologic movement known as subsidence. On the surface, this may result in sinkholes or troughs. Due to collapse of strata and fractures within rock strata, groundwater may filter through to the mine cavity and lower the water table. Groundwater tables may also be dislocated or eliminated. Pumping required to keep the extraction area clear during mining operations may lower water tables. These disturbed flow patterns cannot necessarily be ameliorated during reclamation.

Mine drainage from overburden or other material removed to access ore can contain sediment, metals, and sulfur. Acid mine drainage results when pyrite decomposes through exposure to atmospheric oxygen and water. Acidic water, in turn, can leach heavy metals from surrounding rock. Water pollution caused by acid drainage or metal contamination can occur at the time of extraction and continue to leak from mines, tunnels, and tailings for hundreds of years after mining has been completed.¹⁶

The processes used to produce mineral concentrate from coal or metallic ores can create or contribute to water pollution. Chemicals substances such as sodium cyanide, acids, and other solutions are used to separate mineral concentrate from metallic ores. Tailings, the waste generated as a result of ore concentration, may often contain these chemicals and thus contribute to the pollution of nearby aquifers and surface waters. Sulfur compounds and metals in waste piles also may generate water contamination. In addition, tailings piles can be a source of windblown dust.

Smelting, the process that separates desired metal from other materials, can produce air pollution through the release of gas and heavy metal-laden dust. Emissions may include sulfur dioxide, arsenic, lead, cadmium, and other toxics.¹⁷ Sulfur produces acid precipitation which subsequently degrades lake and forest ecosystems.¹⁸ Around uncontrolled smelter operations, "dead zones" exist where the land remains barren. In addition, the waste generation from smelting, slag, is rich in calcium silicate.

Other environmental concerns connected with mining include noise pollution from blasting and other mining operations, habitat destruction, loss of productivity of the land, and visual damage to the landscape.

III. OVERVIEW OF THE REGULATORY FRAMEWORK

U.S. law does not provide for one comprehensive program to address the environmental impacts of mining. Separate regulatory schemes apply to coal and hardrock mining¹⁹. Coal mining is comprehensively regulated by a federal statute, the Surface Mining Control and Reclamation Act (SMCRA)²⁰, enacted in 1977, that is primarily administered by the states, subject to federal oversight. Despite its name, SMCRA also regulates the environmental impacts of underground coal mining. Hardrock mining, in contrast, is regulated by a patchwork of federal and state laws.

The U.S. Congress enacted the federal law that governs hardrock mining in 1872, shortly after the Civil War. During this time, the federal government had "launched a program of rapid settlement and development without regard to secondary consequences."²¹ Thus, Congress primarily intended the 1872 mining law to encourage mining and transfer land from government to private ownership.²² At that point in U.S. history, few people understood the significance of the impacts of mining on the environment. Moreover, because the 1872 mining law has been extremely beneficial to the mining industry, it has been difficult to develop the political consensus necessary to change the law. In contrast, Congress enacted SMCRA in 1977 -- a time when environmental protection was widely considered to be an important goal.

SMCRA uses a system known as "cooperative federalism." Under that system, federal law creates minimum environmental standards that apply in all 50 states. States that wish to administer their own regulatory programs, however, may elect to do so. The applicable federal agency will authorize a state to act as the primary regulatory authority within that state's jurisdiction provided that the state's regulatory program is consistent with federal law and is at least as stringent as the federal program. The federal agency maintains an oversight role, but the state assumes responsibility for day-to-day administration. A program of cooperative federalism decentralizes decisionmaking and allows states to be responsive to the needs and concerns of affected citizens. Additionally, the program's minimum federal standards "ensure that environmental concerns are not forgotten as local communities compete for economic benefits" and help "provide a predictable, stable environment in which industry can function."²³ Thus, coal mining requirements under SMCRA for operations on federally-owned, state-owned or privately-owned lands are basically similar whether administered by state or federal regulators.

In contrast, in the absence of a comprehensive federal framework, individual States have initiated many of the permitting and other environmental requirements governing hardrock mining operations on federally-owned, state-owned and privately-owned lands. These requirements vary from state to state. Additionally, the two main federal agencies regulating hardrock mining on federal lands -- the U.S. Forest Service and the Bureau of Land Management -- have developed distinct regulatory regimes for the mining operations on federal lands under their respective jurisdiction.

Under SMCRA, the primary tool for regulating coal mining's environmental impacts is the permit. Through the permitting requirement, the regulatory agency may determine whether mining may occur at all and on what the terms for mining shall be conducted. It also provides the regulatory authority with significant enforcement powers over the mining operation. For hardrock mining, there is no federal permitting requirement; federal agencies primarily rely on the miner's plan of operations to protect environmental resources. A plan of operations must be approved by the federal government for significant hardrock mining operations on federal lands.²⁴ The approval process for a plan of operations allows for the regulatory agency to condition, but not deny, access to federal lands for mining. A number of States have adopted environmental permitting requirements for hardrock mining operations and these vary state to state.

These disparate approaches are linked by the two objectives that underlie all U.S. regulations for mining operations. The first objective is to minimize the environmental impact of current mining practices. The second goal is to return mined land to a condition that will allow for productive uses of the land. The following discussion will identify and analyze the various tools that have been developed to achieve these objectives.

IV. LEGAL TOOLS FOR RESTRICTING ACCESS TO LAND FOR MINING

Certain ecosystems -- because of climate, geological conditions, types of flora and fauna or other factors -- may be more sensitive than others to the environmental impacts of mining. Moreover, mining may be inconsistent with the desired use of a particular parcel of land. In these cases, rather than relying on tools for controlling the environmental impact of mining operations, the U.S. has chosen to restrict access. The mechanisms for restricting access include the establishment of bans on mining or buffer zones for certain categories of land, as well as the establishment of procedures for examining the suitability of the land for mining on a case-by-case basis.

To understand how these mechanisms function, it is necessary to review the general framework governing access to minerals. The basic legal framework governing access of the public to federal lands is different for coal and hardrock mining operations. The federal government leases coal located on federal lands by competitive bid and collects a gross royalty on the coal mined. In contrast, the 1872 Mining Act provides two ways by which the public may secure rights to hardrock minerals on federal lands: marking and working the claim or purchasing the land (the latter method is sometimes referred to as "patenting" a claim).²⁵ The federal government does not impose a royalty in connection with hardrock mining on federal lands. Access to private lands for hardrock or coal mining is generally granted under private arrangements regulated by applicable state or federal laws.

A. Mining Bans and Buffer Zones

The U.S. Congress has prohibited mining on a variety of federal lands. For example, the laws that established most national parks ban mining within the parks' borders. The 1976 Mining in National Parks Act prohibits mining within the entire national park system (except for prior existing rights). Congress also banned mining within specific wilderness areas. As of January 1, 1984, Congress blocked access to unclaimed minerals in all wilderness areas and prohibited their disposition under mineral leases.²⁶ Similarly, Congress prohibited mining in national wildlife refuges on federally-owned lands.²⁷ Additionally, under the Federal Coal Leasing Amendments Act (FCLAA) and SMCRA, Congress banned coal mining in the national park system, the national wildlife refuges, national wilderness areas, the national wild and scenic rivers system and the national recreation areas.²⁸

In some cases, the desired level of environmental protection may require the creation of buffer zones to distance mining operations from sensitive resources or special land uses. For example, the U.S. Congress prohibited mining operations within one-quarter mile of federally-designated wild rivers.²⁹ Congress further prohibited surface coal mining operations within one hundred feet of any public road or cemetery, and within three hundred feet from any occupied dwelling, public building, school, church, community, institutional building, or public park.³⁰

For hardrock mining, federal land is generally open to exploration and mineral development unless specifically closed to those uses by an act of Congress or the executive branch, as in the examples above. Under its authority for managing federal lands for hardrock mining, however, the U.S. Bureau of Land Management ("BLM") can "take any action necessary to prevent unnecessary or undue degradation of the lands."³¹ But, this authority has not been used to develop categories of land off-limits to hardrock mining or procedures for examining suitability on a case-by-case basis. Rather, the focus has been on regulating operations to minimize environmental impacts. Similarly, regulations governing hardrock mining on federal lands managed by the U.S. Forest Service focus on minimizing the adverse environmental impacts on National Forest surface resources rather than proscribing mining on certain environmentally sensitive lands.

In addition to federal controls, local zoning ordinances and land-use plans may regulate the location and permissibility of both coal and hardrock mining operations.

B. Procedures for Determining Suitability of Land for Mining

U.S. law sets up a process for determining the suitability of other federal and private land for surface coal mining.³² The Secretary of Interior must determine whether there are areas on federal lands that are unsuitable for surface coal mining operations. Pursuant to this authority the Secretary has established a land-use planning process for federal land

managers that includes criteria for designating lands for environmental purposes that would be inconsistent with such mining. Once land receives such a designation, coal leasing is precluded because any leasing must be compatible with the land-use plan.

For coal mining on private lands, SMCRA requires each state to establish a planning process for designating lands that are unsuitable for surface mining. The criteria for making this determination include environmental factors such as whether operations could result in significant damage to important resources, aesthetic values and natural systems. States must also have a process to review petitions from any person seeking to have any public or private area designated as unsuitable for surface coal mining. State and federal regulators have made several dozen designations under this petition process.³³

The permitting process for surface coal mining operations also involves a review of the suitability of land. The burden is on the operator to show that mining and subsequent reclamation of the land will be successful. If the land subject to coal mining cannot be reclaimed, the permit must be denied.³⁴

In contrast to the permitting process for surface coal mining operations, the federal government does not use the environmental suitability of the land as grounds for disapproving the plan of operation required for certain hardrock mining operations. Neither the Forest Service regulations nor the BLM regulations provide government officials with the option of denying a plan of operations. Similarly, although an environmental assessment is required for significant mining activities on federal lands, the process does not allow for denial of access because of the environmental unsuitability of the land.

C. Third Party Consents

Third parties may be in a position to restrict access to certain lands for environmental or other purposes. When the surface property rights are in private ownership and the federal government owns the interest to the coal under such land, the consent of the surface owner is required before the land can be leased.³⁵ On tribal lands, the consent of the tribe is required for any mineral development; any leases of these lands for mineral development are subject to the approval of the Secretary of Interior.

V. LEGAL TOOLS FOR CONTROLLING ENVIRONMENTAL IMPACTS

A. Productivity of the Land

Land that is subject to mining may have other actual or potential productive uses, including farming, forestry, recreation, and tourism. Many of the processes involved in mining operations can interfere with the long-term productivity of the land. For example, improper soil removal and replacement may damage the long-term productivity of farmland. Assuring the continued productivity of the land requires an understanding of the character-

istics of the land that contribute to its productivity as well as an understanding of how the mining process should be managed to maintain those characteristics.

One of the main objectives of the permitting process for surface coal mining operations is assuring the continuing productivity of the land.³⁶ As part of the reclamation plan,³⁷ the operator is required to include in the reclamation plan a description of the land prior to mining, including any uses at the time of the application or -- if there is a previous history of mining -- the uses which preceded mining. The statement must characterize (i) the capability of the land prior to mining to support a variety of uses and (ii) the productivity of the land. This means that the statement must identify prime farm lands, as well as describe the average yield of food, fiber, forage, or wood products from the lands obtained under high levels of management.

The plan must also describe the post-mining use to which the land will be returned and the steps and timetable for achieving that use. The permit will only be granted if the applicant affirmatively demonstrates, and the regulatory authority finds, that the proposed reclamation plan will successfully restore the land so that it is at least as useful as it was before.

If the area to be mined is prime farmland, the regulatory authority must find that the operator has the technological capability to restore the mined area within a reasonable time to a level of yield at least as high as that of non-mined prime farmland in the surrounding area under equivalent levels of management. The regulatory authority must also find that the operator can meet applicable soil reconstruction standards.

The permit for surface coal mining operations requires the operator to conduct operations in compliance with certain environmental standards.³⁸ Topsoil is to be removed in a separate layer and replaced on the backfill area. If not immediately used, it must be segregated and protective measures to avoid deterioration, such as planting vegetation, must be taken. For prime farmlands, the operator must comply with specific regulations concerning the removal, storage, replacement and reconstruction of the soil.

Federal regulations concerning hardrock mining only indirectly conserve the productivity of the land. Operations on lands managed by the Forest Service must be conducted "so as, where feasible, to minimize adverse environmental impacts on National Forest surface resources."³⁹ Operations are also subject to additional standards concerning road construction, control of erosion and landslides, water runoff, toxic materials and reshaping and revegetation. Operations on lands managed by the BLM are to be conducted "to prevent unnecessary or undue degradation of the Federal lands."⁴⁰ Neither set of regulations requires the land to be returned to the same or a higher use as before mining nor establishes any performance standards for post-mining yield. In some cases, however, state regulations may fill these regulatory gaps.

B. Surface and Groundwater Contamination and Depletion

Surface and groundwater contamination and depletion problems remain linked with U.S. mining operations. Disposal of mining wastes in or near surface or groundwater may contribute to water pollution. Contamination can result from water coming into contact with naturally-existing chemicals in the waste or with chemicals added to separate out the ore. Water depletion problems may occur as a result of mine dewatering or the use of water in the production process.

There are several tools available under U.S. law for controlling surface and groundwater contamination and depletion from mining operations. The approval process for a plan of operations for hardrock mining operations on federal lands includes an environmental assessment of the project. For operations that significantly affect environmental resources, an environmental impact statement must be prepared. This process may result in the incorporation of mitigation measures to protect water resources. In addition, federal regulatory authorities may require operators to take steps to prevent surface and groundwater contamination as conditions to the approval of a plan of operations.⁴¹

In the permitting process for surface coal operations on both federal and private lands, the permit applicant is required to submit an analysis of the overburden, coal seam, and underlying stratum to identify potential acid or toxic forming substances.⁴² The permit application must include a reclamation plan that describes the measures to be taken during mining and the reclamation process to protect the quality of surface and groundwater.⁴³ The mining permit must contain performance standards to minimize disturbances to the prevailing hydrologic balance at the mine-site and in associated off-site areas and to the quality and quantity of water in surface and ground water systems.⁴⁴ Coal mines must take measures to avoid acid or other toxic mine drainage. This performance standard can be interpreted to require that permits for operations that cannot permanently avoid acid mine drainage (i.e., operations that can only prevent acid mine drainage by permanent treatment) be denied.⁴⁵

The permit approval process also requires consideration of the impacts of surface coal mining operations on water quantity,⁴⁶ and the reclamation plan must address how the quantity of groundwater and surface water operations will be protected during mining and reclamation.⁴⁷ If such measures are not possible alternative sources of water must be provided.

Under the Federal Clean Water Act, discharges from any "point source" -- including sources associated with hardrock or coal mines -- into the waters of the United States are prohibited without a permit.⁴⁸ A point source is a discrete conveyance, such as a pipe, ditch or gully. The permit sets the limits of the level of contaminants that are permissible to be discharged in mine wastewater. For metals, there is usually both a daily and monthly average limit that cannot be exceeded. Clean Water Act permits may also set pH limits to

control acid mine drainage and alkaline mine drainage associated with coal mining operations.⁴⁹

In 1990 the U.S. launched a limited program to address contamination caused by stormwater runoff from mining operations. Inactive and active mining operations, including abandoned mines, that discharge stormwater contaminated by contact with any manufacturing, processing or waste material onsite must obtain a stormwater permit.⁵⁰ Only point source discharges (defined and contained flows through ditches, culverts, pipes, etc.) are covered; non-point source discharges are not subject to this program. Coal and hardrock mines that have been reclaimed in accordance with applicable federal or state standards may be exempt from this requirement.

To obtain a stormwater permit, the applicant must submit information about the site, prior stormwater drainage, operations of the facility, as well as a plan for monitoring and reporting on stormwater drainage conditions. Upon permit approval, the operator is required to develop a plan that uses best management practices to control stormwater pollution; these plans are not required to be approved as a condition of permit approval. The plans must be available for inspection and the permittee must implement the plan. The stormwater regulations do not establish specific effluent limitations for stormwater runoff. Monitoring of stormwater discharges is required. Violations of the permit conditions may result in fines, shut down of operations, or permit revocation.

Mining activity in wetlands and coastal zone areas may be subject to special regulation. A permit may be required for certain mining operations that involve dredging or filling in wetlands.⁵¹ Similarly, special environmental restrictions may be imposed on mining activities in coastal zone areas. For example, under the California Coastal Act, any person undertaking mining activities in the State's coastal zone must secure a permit from the State Coastal Commission. Through the permitting requirement, the State may impose environmental regulations concerning water quality, erosion, air pollution, and environmentally sensitive habitat.⁵²

In addition, contamination of surface and groundwater from mining operations may be addressed through portions of the Superfund program.⁵³ Under Superfund, mine operators are required to notify the National Response Center of the release of a hazardous substance into the environment.⁵⁴ This could include, for example, cyanide spills. If the release results in "imminent and substantial danger" to the public health or welfare, the mining operator may be required to undertake remedial action.⁵⁵

State authorities have developed a variety of additional programs and specific tools for protecting water resources from mining pollution. In Arizona, for example, discharging facilities are required to obtain an aquifer protection permit.⁵⁶ In the permit application, the applicant must describe the "best available demonstrated control technology" to be used to achieve the greatest degree of discharge reduction and demonstrate that the facility will not cause or contribute to a violation of aquifer water quality standards at the applicable

point of compliance.⁵⁷ The applicant must also provide evidence of technical capability to carry out the permit conditions and may be required to provide a hydrogeological study which defines the discharge impact area, demonstrates that aquifer water quality standards will not be violated at the applicable point of compliance and documents existing water quality in the aquifers. To assist mining operations in preparing the optimal design for achieving the applicable aquifer standards, the state has developed design recommendations for general mining activity components, such as tailings and leachate operations, as well as recommendations for specific mining segments and systems.

Finally, there are a number of several state law tools that may be available for property owners to privately address environmental problems created by mining operations. For example, state nuisance laws may allow private property owners to address diminished water supply or acid-contaminated water.⁵⁸ In cases where the private property owner is leasing mineral rights, contract law may allow the owner to impose of environmental restrictions on mining operations.

C. Air Pollution

There are a variety of forms of air pollution resulting from mining operations. Fugitive dust -- that is dust not coming from a centralized emission point -- is produced by rock crushing operations, truck and other machinery operation on dry roads, earth removal and other activities. Ore smelters also add pollutants to the air.

The federal national ambient air quality standards set limits on the amount of particulate matter in the air. Individual states are responsible for developing plans (referred to as "state implementation plans" or "SIPs") to meet these standards. States implement these plans through state laws and regulations that may regulate fugitive dust emissions from mining operations. Nevada, for example, requires fugitive dust to be controlled and particulates from numerous named mineral processing facilities are specifically regulated in the Nevada air regulations.⁵⁹

The states may also regulate the emission of pollutants in connection with smelting process through their SIPs because several of the pollutants either used in, or produced as a result of, the smelting process are subject to national ambient air quality standards.

The federal air pollution program also limits emissions through the prevention of significant deterioration program. This program creates a three-tiered classification of lands, designed to protect the high air quality in special areas such as national parks and wilderness areas. For each category the program sets specific limits on air quality levels and allowable increases of certain pollutants. New major emitting facilities in these areas must follow certain procedures prior to construction. Again, the implementation of this program may vary by state. For example, Wyoming requires surface coal mines to obtain state prevention of significant deterioration permits before operating and counts proposed fugitive

emissions by these operations in determining whether the limit for the allowable increase under the prevention of significant deterioration program has been met.

Pollutants produced by mining activities -- particularly smelting -- may also be subject to national emission standards for hazardous air pollutants.⁶⁰ Among the substances now identified as hazardous air pollutants are cobalt compounds, lead compounds, nickel compounds and fine mineral fibers. Most major sources of these pollutants will be required to install the maximum achievable control technology. States may develop their own procedures for implementing these standards.

Air pollutants from the smelting process may also be regulated by the new source performance standards. Again, the States may develop their own procedure for implementing new source performance standards. In Arizona, for example, copper smelters are subject to a set of general performance standards applicable to all smelters as well as standards applicable to the specific facility.

Health-based standards also play a role in regulating air pollution in the mining environment. The Federal Mine and Safety Health Act (FMSHA)⁶¹ establishes safe levels of methane for coal mines.⁶² Through the permitting process and follow-up monitoring requirements, FMSHA assures the proper implementation and operation of ventilation structures to maintain these established levels. Standards and monitoring procedures are also established for respirable dust in coal mines.⁶³

D. Soil Erosion and Subsidence

Soil erosion and ground subsidence may be two of the most devastating effects of mining on the landscape if unregulated. Structural changes in the land's contour and removal of vegetation can contribute to soil erosion. Underground mining techniques may lead to ground subsidence.

The major tool for addressing these impacts in the context of coal mining is the SMCRA permit. The permit requires the submission of a reclamation plan. The performance standards for coal mine reclamation require the operator to return the land to its approximate original contour, eliminating all highwalls, spoil piles and depressions.⁶⁴ In addition all surface areas, including spoil piles, are to be stabilized and protected to control erosion. Topsoil must be restored and the area must be revegetated. For the most part, reclamation must be conducted simultaneously with mining.⁶⁵ The operator remains liable for maintaining the vegetation for a period of five years (ten years in more arid parts of the country).

SMCRA contains specific provisions for dealing with subsidence.⁶⁶ The permit requires each operator to adopt measures consistent with known technology to prevent subsidence causing material damage (to the extent technologically and economically feasible). In addition, mine stability is to be maximized. This does not prohibit the use of

planned subsidence in a predictable and controlled manner or the standard mining method of room and pillar mining. State regulatory officials are directed not to permit underground mining that would cause imminent danger from subsidence to overlying towns.⁶⁷

Federal law governing coal operations now requires repair of and compensation for damage caused by subsidence.⁶⁸ Operators in some states are also required to obtain the consent of the surface owner for underground mining that would cause subsidence.⁶⁹

There is no general federal law setting out specific reclamation standards for hardrock mining operations. Operations on Forest Service lands must be conducted so as to "minimize adverse environmental impacts on National Forest Resources."⁷⁰ More specifically, roads must be constructed so as to minimize erosion and watershed impacts.⁷¹ During or after operations, operators are to, where practicable, take reclamation measures to prevent or control onsite or off-site damage to the environment and forest surface resources, including measures to control erosion and landslides.⁷² Operations on BLM lands are generally required to avoid "unnecessary and undue degradation" of public lands.⁷³ As for operations on over five acres of federal land managed by the BLM, reclamation requirements require land to be returned to an appropriate contour and revegetated where necessary to provide a diverse vegetative cover.⁷⁴ Neither Forest Service nor BLM regulations address prevention or control of subsidence.

State laws specify the regulatory requirements, if any, for erosion and subsidence control measures for hardrock mining. In Colorado, for example, an operator proposing to engage in a new mining operation is required to obtain a reclamation permit.⁷⁵ Reclamation standards require all surface areas of the affected land, including spoil piles to be stabilized and protected so as to control erosion and attendant air and water pollution.⁷⁶ Revegetation efforts are to create a diverse, effective and long-lasting vegetative cover capable of self-regeneration and at least equal in extent of cover to the natural vegetation of the surrounding area. The reclamation standards also specify topsoil handling practices.

E. Protection of Flora and Fauna and Endangered Species

Mining operations may present a number of threats to local wildlife and vegetation, including destruction of habitat, contamination and depletion of the water supply, and soil erosion.

To address some of these concerns, Congress prohibited leasing for coal mining on certain federal lands that contain important habitat, including national parks and monuments, national wildlife refuges, recreation areas, and wilderness areas. In addition, surface mining is prohibited in the eastern national forests. The land use planning process used by federal managers may also preclude leasing of certain land for coal mining purposes. Among the designations that federal land managers may specify is priority habitat

for migratory and game wildlife species.⁷⁷ Such a designation would then prohibit leasing because the leasing would not be compatible with the federal land use plan.

Protective measures for vegetation are required as part of the reclamation measures required under SMCRA. Operators are required to use the same native seasonal variety except introduced species may be used to achieve the approved post-mining land use.⁷⁸ Operators are also to ensure that the construction maintenance and postmining conditions of access roads into and across the site of operations will control or prevent damage to fish or wildlife or their habitat.⁷⁹

Certain federal lands with critical habitat are also off-limits to hard-rock mining, including most national parks, wilderness areas and national wildlife refuges. Operators on National Forest Service lands are required to take all practicable measures to protect fish and wildlife during operations.⁸⁰ As part of their reclamation efforts, these operators are to take measure to rehabilitate fisheries and wildlife habitat.⁸¹ Similarly, operators on BLM lands are to take actions necessary to prevent adverse impacts to threatened or endangered species and their habitat.⁸²

State laws may proscribe the protective measures for flora and fauna on private lands. In Colorado, for example, mining and reclamation plans must "take into account the safety and protection of wildlife . . . with special attention given to critical periods in the life cycle of those species which require special consideration."⁸³ Prospecting operations must be conducted in a manner that will "minimize adverse effects upon wildlife."⁸⁴ Arizona's Game and Fish Department recommends the use of BLM guidelines for designing cyanide operations to protect wildlife. The methods of protection that are considered effective include: (i) total enclosure of solutions containing lethal levels of cyanide; (ii) treatment of process solutions to sublethal levels; and (iii) netting of solution impoundments. The BLM draft plan⁸⁵ specifically advises that "harassment techniques such as flagging, propane cannons, rock music, etc. have not been shown to be effective." The plan also notes that treatment of cyanide solution has not always been effective in eliminating mortality.

Certain federal laws explicitly directly at the protection of wildlife may indirectly regulate mining practices. For example, the Endangered Species Act ("ESA") prohibits the taking of any listed endangered species, which may include harassing, harming, hunting, killing, capturing or collecting such species, and which also includes significant habitat modifications that actually kill or injure wildlife.⁸⁶ Thus, wastewater ponds, leach piles, and other mining practices may need to be managed to avoid a "taking." Similarly, the Migratory Bird Treaty Act subjects anyone who takes, kills or possesses a migratory bird to a fine of not more than \$500 or imprisonment for not more than six months, or both.⁸⁷ Section 7 of the ESA prohibits federal agency action that would jeopardize a designated species. This may require the federal government to deny a permit for coal mining.

VI. ENFORCEMENT MECHANISMS

U.S. policymakers have developed a number of enforcement mechanisms to ensure compliance by the regulated community with the various federal and state programs regulating coal and hardrock mining in the U.S.

A. Permit Bar and Revocation

A "permit bar" refers to the regulatory practice of denying a permit because of uncorrected violations or a history of noncompliance. Permit revocation refers to the withdrawal of the permit for noncompliance with the terms and conditions of the permit.

A "permit bar" promotes compliance in two ways. First, the permit bar process screens "bad actors" from engaging in the activity allowed by the permit. Second, the possibility of permit denial at the time of renewal or modification of an existing permit or upon application for an additional permit encourages ongoing compliance and rapid correction of violations by current permit holders.

Under SMCRA, a permit applicant is required to file a schedule listing any and all notices of violations of SMCRA or any air or water protection provision incurred by the applicant or any of its affiliates, officers, or directors in connection with any surface coal mining operation during the three-year period prior to the date of the application, as well as a description of the resolution of such notice of violation.⁸⁸ The permit may not be issued if this or any other information available to the government indicates that any surface coal mining operation owned or controlled by the applicant or affiliated with the applicant is currently in violation of SMCRA or the other specified laws, until the applicant submits proof that the violation has been corrected or is in the process of being corrected. In addition, no permit may be issued if there is a finding that the applicant, or the operator specified in the application, controls or has in the past controlled mining operations with a demonstrated pattern of wilful violations of SMCRA of such nature and duration with such resulting irreparable damage to the environment as to indicate an intent not to comply with SMCRA. When permits are renewed every five years or modified, or new permits sought, the applicant is subject to the same scrutiny.

Federal regulatory programs governing hardrock mining on federal lands do not incorporate permit bar provisions. Although operators must receive approval of a plan of operations for significant projects on both Forest Service and BLM lands, the regulations only authorize government officials to condition, but not deny approval of, a plan.

A variety of state permitting processes applicable to hardrock mining facilities contain permit bar provisions. Arizona's aquifer protection permit program requires applicants to describe in the application any enforcement action relating to protection of the environment instituted during the five preceding years, and provide evidence of compliance with applicable zoning laws.⁸⁹ In addition, Arizona's general environmental statute provides

that all companies engaged in activities subject to Arizona's environmental laws and regulations must submit a certificate of disclosure of felony convictions and court judgments for environmental law violations nationwide.⁹⁰ The permit may be denied if the applicant has provided false or misleading information or has failed to demonstrate that the operation of the facility will satisfy applicable statutory and regulatory requirements.⁹¹ In addition, the permit may be withheld if the applicant is incapable of complying with the permit terms and conditions based on the applicant's past performance of technical and financial competence.⁹²

Under SMCRA a permit may be revoked if there is a "pattern of violations" of the terms of SMCRA or the permit.⁹³ The permittee has an opportunity for a public hearing to show cause as to why the permit should not be suspended or revoked. If the permittee fails to show cause as to why the permit should not be suspended or revoked, the permit must be suspended or revoked.

Again, federal regulations governing hardrock mining operations on federal lands do not provide for revocation of the approval of a plan of operations as an enforcement tool in cases of non-compliance. Certain states, however, allow for permit revocation in cases of noncompliance by hardrock mining operations. Montana, for example provides that if after notice of compliance a mine operator fails to comply with the requirements of the Metal Mine Reclamation Act, the operating permit may be revoked.⁹⁴

B. Monitoring, Reporting and Inspection Requirements

Monitoring, reporting and inspection requirements can contribute to the enforcement process in a number of ways. Information regarding compliance can be used by the regulated entity to take precautionary measures or correct violations. Depending on the nature of a violation, regulatory authorities and private citizens may use information reports as the basis of an enforcement action against the violator.

Permittees under SMCRA must: establish and maintain appropriate records; make monthly reports to the regulatory authority; install, use, and maintain necessary monitoring equipment; evaluate results in accordance with such methods, at such locations, intervals and in such manner as a regulatory authority shall provide; and provide other information deemed reasonable and necessary.⁹⁵ Government inspectors must conduct at least one partial inspection per month and one complete inspection per calendar quarter for the surface coal mining and reclamation operation covered by each permit.⁹⁶ Inspections must occur without prior notice to the permittee or permittee's representatives except for necessary onsite meetings with the permittee. Inspection reports adequate to allow for enforcement of the law are to be filed. Violations must be reported to the operator in writing and reported in writing to the regulatory authority.⁹⁷ Any records, reports and information obtained by the regulatory authority must be immediately made available to the public at central and sufficient locations in the county, multicounty and state area so that they are conveniently available to residents in the areas of mining.⁹⁸

In certain instances the federal government may undertake inspection of surface coal mining operations regulated by state authorities.⁹⁹ Upon receipt of information concerning a violation of SMCRA or a permit condition, the federal government must notify the appropriate state authority. If within ten days the state authority fails to take appropriate action to correct the violation or to show good cause for such failure, the federal government must inspect the surface mining operation at which such alleged violation is occurring. The ten-day notice period may be waived upon adequate proof that an imminent danger of significant environmental harm exists and that the state has failed to take appropriate action. When the inspection results from information provided by a person, that person is to be notified by the federal government as to when the federal inspection is proposed to be carried out and allowed to accompany the inspector during the inspection.

Both hardrock and coal mining operations are subject to standard monitoring, inspection and recordkeeping requirements under the federal Clean Air Act, the federal Water Pollution Control Act, Resource Conservation and Recovery Act (solid and hazardous waste) and the Comprehensive Environmental Response, Compensation and Liability Act ("CERCLA"). For example, mining operators must prepare and make available discharge monitoring reports for effluents regulated under the federal Water Pollution Control Act.

U.S. Forest Service and BLM regulations for hardrock mining operations on federal lands do not impose specific monitoring, inspection or record keeping requirements on operators. In the case of BLM lands, authorized officers may periodically inspect operations to determine compliance.¹⁰⁰ Forest Service officers are required to periodically inspect operations for compliance.¹⁰¹

C. Administrative and Civil Actions

Administrative and civil actions allow regulatory authorities to bring violators into compliance as well as to deter and punish noncompliance. Most administrative options allow the regulatory authority to act quickly and directly. The authority to bring civil actions provides the regulatory authority with a backup enforcement mechanism when administrative actions fail to work.

When a federal or state inspection reveals conditions, practices or violations creating or reasonably expected to create an imminent danger to the health or safety of the public or significant, imminent environmental harm to land, air or water resources, the government inspector must immediately order cessation of surface coal mining and reclamation operations or the operation of operations relevant to the condition, practice or violation. If this action does not completely abate the imminent danger to health or safety of the public or the significant imminent environmental harm to land, air or water resources, the government must require the operator to take whatever step are necessary to abate the imminent danger or the significant environmental harm.¹⁰²

In the case of SMCRA violations that do not create an imminent danger to the health or safety of the public or cannot be reasonably expected to cause significant, imminent environmental harm to land, air or water, resources, the government inspector must issue a notice to the permittee fixing a reasonable time (but not more than 90 days) for the abatement of the violation.¹⁰³ The permittee must be provided an opportunity for a public hearing. If upon expiration of the 90-day period, the violation has not been abated, the government inspector must immediately order the operator to cease surface coal mining and reclamation operations or that portion of operations relevant to the violation. The order must specify the necessary measures to abate the violation in the most expeditious manner possible.

The federal or state government may also institute a civil action for relief, including a permanent or temporary injunction, restraining order, or other appropriate order when the SMCRA permittee fails to comply with an order or decision, interferes or delays the carrying out of the program, refused to allow inspection of the mine, refuses to provide information or allow access to or copies to be made.¹⁰⁴

If a hardrock mine operator on Forest Service lands fails to comply with the applicable regulations or approved plan of operations and the noncompliance is "unnecessarily or unreasonably causing injury, loss or damage to surface resources," then the operator is to receive a notice of non-compliance.¹⁰⁵ The notice is to describe the violation, the actions necessary to remedy the violation and the time period for compliance (which is generally not to exceed 30 days).¹⁰⁶

Operators on BLM lands who fail to follow their approved plan of operations may be subject to a notice of noncompliance.¹⁰⁷ The notice must specify the violation, the actions necessary to correct the violation and the time period, not to exceed 30 days, within which corrective action shall be started (as opposed to completed under Forest Service regulations). Operators who fail to undertake the compliance actions specified within the time specified in the notice may be enjoined by appropriate court order from continuing such operations and be liable for damages for such unlawful acts.

CERCLA authorizes federal cleanup of abandoned hazardous waste sites and allows the government to seek reimbursement of its costs and recovery of natural resource damage's from the site's owners, operators and others who were responsible for the presence of the hazardous waste at the site.¹⁰⁸

CERCLA Section 106 and RCRA Section 7003 allow the U.S. Environmental Protection Agency to issue orders for abatement of almost any waste-related situation that "may present an imminent and substantial endangerment to health or the environment," whether or not the risks at issue stem from violation of government regulations. The courts have interpreted the "imminent and substantial endangerment" language to refer to any significant, potential risk of eventual environmental harm.¹⁰⁹ In addition, RCRA Section 7002(a)(1)(B) allows citizens to sue for abatement of such potential endangerments.

On the state level, the use of administrative and civil actions to achieve compliance by hardrock mining operations varies widely. In Arizona, for example, a compliance order may be issued for violation of any water quality standard or aquifer protection permit.¹¹⁰ In addition, a compliance order may be issued if a person is creating "an imminent and substantial endangerment to the public health, or environment."¹¹¹ Authorized officials may also seek injunctive or other relief if a person is creating "an actual or potential endangerment to the public health or environment" because of water quality control violations.¹¹² Other states, such as South Carolina, first require written notice to the operator of the violations.¹¹³ The operator then has a period of 30 days to commence "diligently" to correct the violations. If these violations remain uncorrected then the state can issue notice of uncorrected deficiencies, subject to an administrative hearing.

The abatement provisions of CERCLA and RCRA discussed above are consistent with the common law of most states. In general, the common law makes every person responsible, not only for complying with statutes, but also for avoiding injury to their neighbors' health and welfare.¹¹⁴

D. Civil and Criminal Penalties

Civil and criminal penalties serve as additional mechanisms for deterring and punishing violators. These mechanisms rely on economic and social incentives to promote compliance.

The government may assess a civil penalty for a violation of any permit condition or requirement of SMCRA.¹¹⁵ If such violation leads to a cessation order, a civil penalty must be assessed. The penalty is not to exceed \$5,000 per violation; each day of a violation may be deemed a separate violation for purposes of calculating the amount of the penalty. Other factors that may be considered are: the permittee's history of previous violations at the particular operation; the seriousness of the violation, including any irreparable harm to the environmental; and whether the permittee was negligent, and demonstrated good faith in achieving compliance after notification of the violation. The penalty may be assessed only after the person charged has had an opportunity for a public hearing.

Willful and knowing violations of a SMCRA permit condition or cessation order are punishable by a criminal fine of not more than \$10,000 or by imprisonment for not more than one year, or both.¹¹⁶ For corporate permittees, any director, officer, or agency who willfully and knowingly carried out a permit violation or failed or refuse to comply with a cessation order is subject to the same civil penalties, fines and imprisonment as an individual who conducted such activity.¹¹⁷

Forest Service and BLM regulations governing hardrock mining operations on federal lands do not provide for the use of civil or criminal penalties for noncompliance. The Federal Land Policy and Management Act does provide for limited criminal penalties of no

more than \$1,000 or imprisonment of no more than twelve months or both for "knowing and willful" violations of regulations issued pursuant to the Act.¹¹⁸

The major federal environmental laws governing air pollution, water pollution, and hazardous waste all provide for the use of civil and criminal penalties.

State hardrock mining regulatory programs authorize a range of civil and criminal penalties. Penalty amounts under state water pollution control programs tend to be higher than those under general reclamation programs. As an example, for pollution of surface waters California provides for administrative and civil penalties of up to \$5,000 per day and judicial civil penalties of up to \$15,000 per day, with provision for additional per gallon penalty charges.¹¹⁹ Montana's Metal Mine Reclamation Act provides for penalties of not less than \$100 nor more than \$1,000, with an additional penalty in the same amount for each day of violation.¹²⁰

In addition, many state regulatory programs authorize the use of criminal penalties. For example, in Arizona, criminal liability may be imposed for: discharging without a permit, failing to monitor, sample or report discharges as required by a permit, violating a discharge limitation in a permit or violating a water quality standard.¹²¹

E. Financial Assurance Mechanisms

Financial assurance mechanisms work by requiring the operator to provide a financial guarantee of performance prior to undertaking a certain regulated activity. If the level of performance does not meet required standards, then the regulatory authority is entitled to collect the amount of the guarantee.

SMCRA requires all permit applicants to furnish a performance bond prior to approval of the permit.¹²² The bond is to cover the area of operations subject to the permit and is to be increased to cover additional increments. The amount depends on the reclamation requirements and is to reflect the probable difficulty of reclamation taking into consideration such factors as topography, geology, hydrology and revegetation potential. The amount is to be sufficient to assure that the regulatory authority may complete reclamation if necessary and in no event is the amount for one permit be less than \$10,000. The operator may deposit cash, negotiable government bonds or negotiable certificates of deposits in lieu of a surety bond in an amount equal or greater than the amount of the bond required.

SMCRA permittees may file a request with the regulatory authority for release of a performance bond. The operator must place an advertisement in a local newspaper at least once a week for four successive weeks describing reclamation work performed and results achieved. The permittee also has to notify adjoining property owners, local government bodies, planning agencies and sewage and water treatment authorities of his intention. The regulatory authority must conduct an inspection and evaluation of the reclamation work.

The regulatory authority may release the bond or deposit in whole or in part if it is satisfied that the appropriate effort of reclamation has been accomplished. Any person with a valid legal interest which might be adversely affected by the release of the bond or government official who has jurisdiction regarding any environmental impact has the right to file written objections. If written objections are filed and a hearing requested, interested parties must be informed and the hearing held within thirty days of request.

Operators on Forest Service lands may be required to furnish a bond to assure compliance with reclamation requirements prior to approval of a plan of operations¹²³ Alternatively, the operator can supply cash or negotiable U.S. securities with a market value in the amount of the bond, or a blanket bond covering nationwide or statewide operations. The amount of the bond will be determined taking into consideration the "estimated cost of stabilizing, rehabilitating and reclaiming the area of operations." If the plan of operations is modified, the amount of the bond is to be adjusted accordingly, if necessary. When reclamation has been completed, the authorized officer will notify the operator that performance under the bond is complete. The amount of the bond may be reduced proportionately in the event a portion of reclamation has been completed.

Operators on BLM lands who conduct operations under an approved plan of operations may also be required in the discretion of the authorized officer to furnish a performance bond.¹²⁴ The BLM regulations state that the authorized officer may determine not to require a bond "in circumstances where operations would cause only minimal disturbance to the land." The amount of the bond will be determined taking into consideration "the estimated cost of reasonable stabilization and reclamation of areas disturbed." BLM policy requires all operators with a record of noncompliance to submit a reclamation bond for 100 percent of the cost of reclamation for all activities in excess of casual use which are conducted on public lands managed by the BLM.¹²⁵ In lieu of the bond, the operator can provide evidence of an existing bond under state law with similar coverage, cash, negotiable U.S. securities with a market value of not less than the amount of the bond, or a blanket bond covering state or nationwide operations. If the plan of operations is modified, the amount of the bond is to be adjusted accordingly. When all or a portion of the reclamation is completed, the operator may notify the government officer. The government officer will then promptly inspect the reclaimed area with the operator. The officer will give notice to the operator in writing as to whether the reclamation is acceptable. If any portion of reclamation is acceptable, the officer will authorize the bond to be reduced proportionately to cover the remaining reclamation to be accomplished.

Performance bonds and other financial assurance mechanisms for hardrock mining operations vary state to state. States require financial assurance for the cost of reclamation, contingencies and/or closure. In calculating the amount of financial assurance, some states take into consideration actual reclamation costs while others set maximum per acre limits. Montana's Metal Mine Reclamation Act, for example, requires a bond in an amount of not less than \$200 per disturbed acre nor more than \$2,500 per disturbed acre or fraction thereof. In any event the bond is not be less than "the estimated cost to the state to

complete reclamation of the disturbed land."¹²⁶ States allow a variety of forms of financial assurance to be used.

F. Citizen Suits

Citizen suits function by allowing individuals to institute legal action against violators directly or against the government for failure to take action.

Under SMCRA, persons having an interest which is or may be adversely affected may commence a civil action on their own behalf against the U.S. or another government agency or person when such entity is in violation of any rule, regulation, order or permit under SMCRA or against the federal or state regulatory authority where there is a failure to perform any non-discretionary act or duty.¹²⁷ In the case of actions for violations, notice in writing must be given sixty days prior to the filing of suit to the federal government, the State in which the violation occurs and to any alleged violator. In addition, no such action may be filed if the federal government of state has commenced and is diligently prosecuting a civil action to require compliance; however, any person may intervene as a matter of right in any such action. No action for failure to perform a non-discretionary duty may be brought until sixty days after notice, except where the violation or order complained of constitutes an imminent threat to the health or safety of the plaintiff or would immediately affect a legal interest of the plaintiff.

For hardrock mining operations, citizens are limited to seeking review of U.S. Forest Service and BLM actions under the procedures of the Administrative Procedure Act. Generally, any person suffering a legal wrong or adversely affected or aggrieved by an agency action may seek judicial review of that action.¹²⁸ The major federal environmental statutes governing air pollution and water pollution allow for citizen enforcement of their provisions on terms similar to those available under SMCRA.¹²⁹

State laws provide a variety of citizen suit mechanisms. Montana's Metal Mine Reclamation Act authorizes the initiation of citizen suits against the state for failure to enforce the act by "any person having an interest that is or may be adversely affected."¹³⁰ Prior to the initiation of the suit, the citizen must bring the failure to enforce to the attention of the responsible official by affidavit.¹³¹ If the officials fails to take the enforcement action sought for an "unreasonable" time after the affidavit, then the citizen may seek an injunction mandating enforcement. Any person whose interests may be adversely affected may also commence a civil action directly against a violator. The government must be given 60 days prior notice; if the government acts and diligently prosecutes a civil action for compliance, then the suit is barred, although the interested party may intervene as a matter of right in the government suit.¹³²

VII. OBSERVATIONS

Although this report did not seek to evaluate the success of U.S. regulatory efforts to control the environmental impacts of mining, some general observations can be made. Particularly in the field of coal mining, the environmental impacts of mining have been dramatically reduced and the art of reclamation has been substantially advanced by the 1977 Act. The record for hardrock mining operations is more mixed, reflecting the less coherent regulatory structure.

A limited number of current hardrock and coal mining operations continue to be a source of significant pollution of the environment. In recent years, the Summitville mine - a high altitude cyanide heap leach operation in Colorado -- progressed in less than a decade from the initial permitting stage to an emergency response site. The cost of cleanup of contaminated groundwater and surface water could reach \$120 million dollars.

Acid mine drainage in particular continues to be a major source of pollution from some existing coal and hardrock operations. In 1980 one of the largest coal mines in the United States launched operations under a series of permits calling for sophisticated "state of the art" technology for controlling acid mine drainage, including materials-handling plans, overburden mixing, use of phosphate precipitants, and water exclusion barriers. Despite the use of this technology, substantial acid mine drainage resulted. The annual cost of what appears to be a need for permanent treatment is estimated at over \$500,000. Some other "reclaimed" coal mines continue to produce acid even though they appear visually acceptable.

Abandoned hardrock and coal mines have left a legacy of environmental and safety hazards spread well across the landscape of the country. Thousands of abandoned mines present serious acid mine drainage, toxic spoil, and revegetation problems. The number of abandoned hardrock mining sites is estimated 557,650 and no comprehensive federal program to address these sites exists.¹³³ And although SMCRA created the Abandoned Mine Lands Program to reclaim lands which were coal mined prior to the Act's passage (August 3, 1977), even at the outset the responsible regulatory agency estimated that only 10 percent of the nation's pre-1977 abandoned mine land problems would be corrected over the life of the program.¹³⁴

The United States has come a long way in the regulatory effort to turn mining into a sustainable industry, but additional reform remains to be undertaken before the U.S. can claim to have achieved this goal.

VIII. REGULATORY REFORM OPTIONS AND CONCLUSION

Policymakers may wish to consider the following options for addressing environmental problems which continue to be associated with mining operations:

1. *Requiring reclamation as part of ongoing operations and not deferring it until operations cease.*

For reclamation of mined lands to be successful, planning for reclamation and post-mining land use needs to start well in advance of operations. Legal regimes could require detailed baseline studies of geological and ecological conditions to determine if, and how, reclamation can be accomplished. If existing technology cannot achieved the desired level of reclamation, legal regimes could bar operations until the existence of such technology can be satisfactorily demonstrated.

The applicable permit or plan of operations could specify, step - by - step, the actions and stages for reclamation. Operators could be required to report any variation in existing conditions or to seek approval of any modification of the permit/plan of operations approval sought. The request for modification of the permit/plan of operations could be made subject to the same degree of scrutiny as the initial application.

2. *Ongoing Monitoring of Operations by Key Stakeholders*

Because of the large scale and highly toxic character of many mining operations, serious environmental problems requiring expensive clean-ups can develop quickly. The possibility of human error, technology failure or an "Act of God" is always present. Legal regimes could require mining operations to set in place comprehensive monitoring and reporting systems. Government inspectors could periodically verify that a company is complying with its monitoring and reporting obligations and conduct independent monitoring where necessary. The public could be provided with access to these records (with adequate mechanisms to protect trade secrets in place) to assure that both the government and the regulated industry are complying with their obligations.

3. *Financing Mechanisms could adequately provide for programmatic obligations*

Federal and state regulatory programs need substantial funding to develop and maintain the staff and technical resources necessary to run their programs. A number of mechanisms including permit fees, royalties, and administrative and civil penalties could be used to secure these funds. Directed funds, rather than funds from the general treasury, will be less subject to discretionary budget cuts. Funding mechanisms need to take into account that some of the pollution problems created by mining operations may require perpetual treatment.

4. *Reclamation costs could be correctly estimated and adequately covered by financial assurance mechanisms.*

Any number of unforeseen causes can lead to a mining company defaulting on its reclamation obligations and, to avoid environmental disasters, the government needs to have sufficient financing to quickly pick up where the operator left off. In calculating the amount of financial assurance mechanisms for reclamation, realistic estimates of reclamation costs (including costs of treating long-term pollution problems) could be required and the financial assurance could be for the full amount of such estimate. In addition, the security underlying the financial assurance could be readily collectible and cover the full amount of the obligation.

SMCRA's coal mining regime and several state hardrock mining programs have sought to incorporate many of these principles. These regimes still fail to adequately address long-term pollution problems. The federal regulatory program for hardrock mining remains weak in most of these areas. Efforts to reform the 1872 Mining Law to incorporate strong environmental safeguards have met with little success in the past and future reform looks equally unlikely at this point.

ENDNOTES

1. John E. Young, World Watch Institute, *Mining the Earth: World Watch Paper 109*, at 8 (1992).
2. Larry McBride & John Pendergrass, *Coal*, in *SUSTAINABLE ENVIRONMENTAL LAW* 993, 996 (Celia Campbell-Mohn et al. eds., 1993).
3. James M. McElfish, Jr. & Ann E. Beier, *Environmental Regulation of Coal Mining: SMCRA's Second Decade* 9 (1990).
4. Energy Information Administration, U.S. Department of Energy, *Quarterly Coal Report: July-September 1994*, at 144 (February 1994).
5. Energy Information Administration, U.S. Department of Energy, *Quarterly Coal Report: October-December 1993*, at 1 (May 1994).
6. 1993 coal consumption was 926 million short tons (840 million metric tons), which constitutes a four percent increase over consumption in 1992. *Id.* at 2.
7. *Id.* at 1.
8. The dollar value of metals consumption rose from \$38,600,000 in 1986 to \$48,500,000 in 1990. Barry Breen & Celia Campbell-Mohn, *Metals*, in *SUSTAINABLE ENVIRONMENTAL LAW* 1197, 1200 (Celia Campbell-Mohn et al. eds., 1993).
9. *Id.* at 1199.
10. *Id.* at 1200.
11. Stephen E. Kessler, *Economics and the Environment* 82 (1994).
12. *Id.* at 83.
13. Breen & Campbell-Mohn, *supra* note 8, at 120. This figure does not include mining claims and exploration projects.
14. Young, *supra* note 1, at 8.
15. McElfish & Beier, *supra* note 3, at 15.
16. *Id.* at 131.
17. Young, *supra* note 1, at 19.

18. McBride & Pendergrass, *supra* note 2, at 997.
19. The general definition of "hardrock mining" is "the extraction of metals (*e.g.*, copper, gold, iron, lead, magnesium, silver, uranium, zinc) and nonfueled minerals (*e.g.*, asbestos, gypsum, phosphate rock, sulfur) by surface or underground mining methods. Mineral Policy Center, *Burden of Gilt*, 62 n.1 (1993).
20. Surface Mining Control and Reclamation Act (SMCRA) §§ 101-908, 30 U.S.C. §§ 1201-1328.
21. J. William Futrell, *The History of Environmental Law*, in SUSTAINABLE ENVIRONMENTAL LAW 3, 16 (Celia Campbell-Mohn et al. eds., 1993).
22. Breen & Campbell-Mohn, *supra* note 8, at 1206.
23. J. William Futrell, *The Administration of Environmental Law*, in SUSTAINABLE ENVIRONMENTAL LAW 93, 118 (Celia Campbell-Mohn et al. eds., 1993).
24. On lands managed by the Bureau of Land Management, a plan of operations is required for activities that would cause a disturbance on more than 5 acres of land per year. 43 C.F.R Section 3809.1-4 (1994). On lands managed by the U.S. Forest Service, a plan of operation is required for operations that would disturb the ground. 36 C.F.R. § 228.4(a)(2) (1994).
25. Under the first method, a prospector establishes his right to newly discovered minerals by marking the boundaries of the claim, filing with the Bureau of Land Management office and continuing to diligently work the claim. In 1990, a \$100 per year fee was substituted for the work requirement. Under the second method, a prospector can purchase the land provided that the prospector can show discovery of a valuable mineral in commercial quantities. The current rate, is \$2.50 per acre for placer claims and \$5.00 per acre for lode claims. Mining may occur with or without patenting of the land.
26. Wilderness Act § 4, 16 U.S.C. § 1133(d)(3) (1988).
27. If the refuge was acquired by purchase -- rather than designated out of previously owned federal lands -- mining may be permitted in the refuge if it is compatible with the major purposes of the refuge. National Wildlife Refuge System Administration Act of 1966 § 4, 16 U.S.C. § 668dd(d)(1)(A) (1988).
28. SMCRA § 552(e), 30 U.S.C. 1272(e) (1988).
29. Wild and Scenic Rivers Act § 9(b), 16 U.S.C. § 1280(a)(iii) (1988).
30. SMCRA § 522(e)(4)-(5), 30 U.S.C. § 1272(e)(4)-(5) (1988).

31. Federal Land Policy and Management Act § 302(b), 43 U.S.C. § 1732(b) (1988).
32. SMCRA § 522, 30 U.S.C. § 1272 (1988).
33. SMCRA § 522(a), 30 U.S.C. § 1272(a) (1988); *See* McElfish & Beier, *supra* note 3, Chap. 10.
34. SMCRA § 510(b)(2), 30 U.S.C. § 1260(b)(2) (1988).
35. SMCRA § 714, 30 U.S.C. § 1304 (1988).
36. SMCRA § 508(a), 30 U.S.C. § 1258(a) (1988).
37. To ensure that miners return land to productive uses, SMCRA requires operators of coal mines to submit a "reclamation plan" as part of the permitting process. That plan sets forth the information and activities required to "reclaim" -- i.e., return to productive use -- the specific land that the coal mining permit will cover.
38. SMCRA § 515, 30 U.S.C. § 1265 (1988).
39. 36 C.F.R. § 228.8 (1994).
40. 43 C.F.R. § 3809.2-2 (1994).
41. *See supra* note 24.
42. SMCRA § 507(b)(15), 30 U.S.C. § 1257(b)(15) (1988).
43. SMCRA § 508(a)(13)(A), 30 U.S.C. § 1258(a)(13)(A) (1988).
44. SMCRA § 515(b)(11), 30 U.S.C. § 1265(b)(11) (1988).
45. McElfish & Beier, *supra* note 3, Chap. 6.
46. SMCRA § 507(b)(11), 30 U.S.C. § 1257(b)(11) (1988).
47. SMCRA § 508(a)(13)(C), 30 U.S.C. § 1258(a)(13)(C) (1988).
48. Federal Water Pollution Control Act §§ 301, 402, 33 U.S.C. §§ 1311, 1342 (1988).
49. 40 C.F.R. § 434.30-.35, 434.40-.45 (1994).
50. 40 C.F.R. § 122.26 (1994); *See generally* West ET AL, Mineral Policy Center, *Mines, Stormwater Pollution, and You: a Citizen's Handbook to Stopping Water Pollution From Mines* (1995).

51. FWPCA § 404, 42 U.S.C. § 1344 (1988).
52. California Coastal Commission v. Granite Rock Co., 480 U.S. 572; 17 ELR 20563 (1987).
53. Comprehensive Environmental Response, Compensation, and Liability Act, as amended 42 U.S.C. § 9601-9675 (1988).
54. CERCLA § 103(a), 42 U.S.C. § 9603(a) (1988).
55. CERCLA § 104, 42 U.S.C. § 9604 (1988).
56. Ariz. Rev. Stat. Ann. § 49-241 (1994). Features or activities that qualify a facility as a discharger include surface impoundments, solid waste disposal, injection wells, tailing piles and ponds, leaching operations, wastewater treatment facilities, addition of pollutants to underground caves or mines, or point source discharges to navigable waters.
57. Ariz. Comp. Admin. R. & Regs. R18-9-108 (1994).
58. Nuisance laws may also allow property owners to address air pollution or other environmental problems created by mining operations.
59. Nev. Admin. Code §§ 445.734, .736 (1993).
60. Clean Air Act § 112, 42 U.S.C. § 7412 (1988).
61. Federal Coal Mine Health and Safety Act of 1969 §§2-318, 30 U.S.C. §§ 801-878 (1988).
62. 30 C.F.R. Part 75 (1994).
63. 30 C.F.R. Part 70 (1994).
64. SMCRA § 515(b)(3), 30 U.S.C. § 1265(b)(3) (1988). A variance to the approximate original contour restoration requirement may be granted in certain limited circumstances when, among other conditions, the potential post-mining use constitutes an equal or better use of the land. SMCRA § 515(e), 30 U.S.C. § 1265(e) (1988).
65. SMCRA § 515(b)(16), 30 U.S.C. § 1265(b)(16) (1988).
66. SMCRA § 516, 30 U.S.C. § 1266 (1988).
67. 30 C.F.R. § 817.121(f) (1994).
68. SMCRA § 720, 30 U.S.C. § 1309a (1988).

69. MD. Regs. Code tit. 08, § 08.20.13.10 (1993).
70. 36 C.F.R. § 228.8 (1994).
71. 36 C.F.R. § 228.8(f) (1994).
72. 36 C.F.R. § 228.8(g) (1994).
73. 43 C.F.R. § 3809.2.2 (1994).
74. 43 C.R.F. § 3809.0-5(j) (1994).
75. Colo. Rev. Stat. § 34-32-109(2) (1994).
76. Colo. Rev. Stat. § 34-32-116(7) (1994).
77. 43 C.F.R. subpart 3461 (1994).
78. SMCRA § 515(b)(19), 30 U.S.C. § 1265(b)(19) (1988).
79. SMCRA § 515(b)(17), 30 U.S.C. § 1265(b)(17) (1988).
80. 36 C.F.R. § 228.8(e) (1994).
81. 36 C.F.R. § 228.8(g)(5) (1994).
82. 43 C.F.R. § 3809.2-2(d) (1994).
83. Colo. Mining R. & Regs. R3.1.8(1) (1995).
84. Colo. Mining R. & Regs. R5.3.2 (1995).
85. Bureau of Land Management, Arizona State Office, *Cyanide Management Plan* (April 1992).
86. Endangered Species Act § 9, 16 U.S.C. § 1538 (1988).
87. Migratory Bird Treaty Act § 6, 16 U.S.C. § 707(a) (1988).
88. SMCRA § 510(c), 30 U.S.C. § 1260(c) (1988).
89. Ariz. Comp. Admin. R. & Regs. R18-9-108 (1991).
90. Ariz. Rev. Stat. Ann. § 49-109 (Supp. 1994).
91. Ariz. Comp. Admin. R. & Regs. R18-9-121 (1991).

92. Arizona Department of Environmental Quality, *Aquifer Protection Permits Application Guidance Manual* (Draft for Review and Discussion dated February 1, 1990).
93. SMCRA § 521(a)(4), 30 U.S.C. § 1271(a)(4) (1988).
94. Mont. Code Ann. § 82-4-362(1)-(2) (1994).
95. SMCRA § 517(b), 30 U.S.C. § 1267(b) (1988).
96. SMCRA § 517(c), 30 U.S.C. § 1267(c) (1988).
97. SMCRA § 517(e), 30 U.S.C. § 1267(e) (1988).
98. SMCRA § 517(f), 30 U.S.C. § 1267(f) (1988).
99. SMCRA § 521(a)(1), 30 U.S.C. § 1271(a)(1) (1988).
100. 43 C.F.R. § 3809.3-6 (1994).
101. 36 C.F.R. § 228.7 (1994).
102. SMCRA § 521(a)(2), 30 U.S.C. § 1271(a)(2) (1988).
103. SMCRA § 521(a)(3), 30 U.S.C. § 1271(a)(3) (1988).
104. SMCRA § 521(c), 30 U.S.C. § 1271(c) (1988).
105. 36 C.F.R. § 228.7 (1994).
106. *Id.*
107. 43 C.F.R. § 3809.3-2 (1994).
108. CERCLA §§ 105, 107, 42 U.S.C. §§ 9605, 9607 (1988).
109. The court in Lincoln Properties, Ltd. v. Higgins, 23 ELR 20665, 20671 (E.D. Cal. 1993), noted:

First, it is significant that the word "may" precedes the standard of liability: "[t]his is 'expansive language,' which is 'intended to confer upon the courts the authority to grant affirmative equitable relief to the extent necessary to eliminate any risk posed by toxic wastes.'" . . .

Second, "endangerment" means a threatened or potential harm and does not require proof of actual harm . . . When one is endangered, harm is threatened; no actual injury need ever occur . . .

Third, a finding of "imminence" does not require a showing that actual harm will occur immediately so long as the risk of threatened harm is present . . . even though the harm may not be realized for years. Finally, the word "substantial" [does not require quantification of the risk if there is some cause for concern that someone may be exposed to risk] . . . However, injunctive relief should not be granted "where the risk of harm is remote in time, completely speculative in nature, or de minimis in degree."

Emphasis added.

110. Ariz. Rev. Stat. Ann. § 49-261 (1994).
111. *Id.*
112. Ariz. Rev. Stat. Ann. § 49-262 (1994).
113. S.C. Code Ann. § 48-20-130 (1993).
114. People who violate this duty are known as "tortfeasors." People who are injured because of a tortfeasor's violation of his or her duty to act reasonably may bring common-law lawsuits. Such lawsuits typically are based on allegations of "negligence," "nuisance," or "trespass." See e.g., Restatement (Second) of Torts §§ 519-20, 839 (liability for, respectively, "abnormally dangerous" activities and "artificial conditions" on property). In some cases, states have modified their common law by statute.
115. SMCRA § 518, 30 U.S.C. § 1268 (1988).
116. SMCRA § 518(e), 30 U.S.C. § 1268(e) (1988).
117. SMCRA § 518(f), 30 U.S.C. § 1268(f) (1988).
118. SMCRA § 518(f), 30 U.S.C. § 1268(f) (1988).
119. Cal. Water Code § 13350 (West 1992).
120. Mont. Code Ann. § 82-4-361 (1994).
121. Mont. Code Ann. § 82-4-361 (1994).
122. SMCRA § 509(a), 30 U.S.C. § 1259(a) (1988).
123. 36 C.F.R. § 228.13 (1994).
124. 43 C.F.R. § 3809.1-9 (1994).

125. U.S. Bureau Land Management, Instruction Memorandum 90-582, August 14, 1990.
126. Mont. Code Ann. § 82-4-338 (1994).
127. SMCRA § 520(a), 30 U.S.C. § 1270(a) (1988).
128. Administrative Procedure Act § 702, 5 U.S.C. § 702 (1994).
129. *See supra* Section VI.C discussion of RCRA citizen suits.
130. Mont. Code Ann. § 82-4-354 (1994).
131. *Id.*
132. *Id.*
133. James S. Lyon ET AL Mineral Policy Center, *Burden of Gilt* (1993).
134. McElfish & Beier, *supra* note 3, at 253.