EPA's National Hardrock Mining Framework

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1.0 Purpose and Organization of the Framework

1.1 Purpose of the Hardrock Mining Framework

This Framework has been developed to help the U.S. Environmental Protection Agency (EPA) implement a multi-media, multi-statute approach to dealing with the environmental concerns posed by hardrock mining. Although the Framework focuses on understanding and improving the use of existing EPA authorities it does so with a clear recognition of the role of other parties. Building effective working relationships with other mining stakeholders is a key element of EPA's efforts to improve the effectiveness of its own programs.

In developing the Framework, EPA invited input from a number of mining stakeholders, including other Federal agencies, States, Tribes, local government, industry, and environmental groups. The final Framework presented here reflects many of the ideas provided by these groups on two earlier drafts.

For the purposes of the Framework, mining refers to proposed, active, and inactive and abandoned mines (IAMs) and mills from the metal, phosphate, uranium, and industrial mineral sectors; it does not include coal mining, crushed stone quarrying and mining, or aggregate mining.

1.2 Why develop an EPA National Mining Framework Now?

1.2.1 Need For Program Integration

Environmental policies are increasingly focusing on integrating media protection (air, water, and land) and emphasizing multi-statute education, research, permitting, and enforcement to more effectively implement single-media statutes mandated by Congress. For example, EPA's Office of Enforcement and Compliance Assurance (OECA) has developed a number of industry profiles (including a Profile of the Metal Mining Industry) to encourage an integrated approach towards designing environmental policies for facilities within an industrial sector.

As the Agency faces increasing demands on limited resources, it becomes even more critical that EPA continue to manage its responsibilities efficiently, including those related to mining. The collective experience of EPA Regional offices and Headquarters in addressing the environmental concerns posed by mining should be shared and serve as a basis for development of consistent Agency policies for mine sites.

1.2.2 The Environmental Impacts of Mining

Mining has played a significant role in the development of this country. The industry has, and continues to be, an important contributor to both national and regional economies and is critical to national defense (See Appendix A). Mining, and the industries it supports, are among the basic building blocks of a modern society.

The benefits of mining to this country have been many, but have come at a cost to the environment. As the country has matured there has been increasing recognition that environmental protection is as fundamental to a healthy economy and society as is development. The challenge is to simultaneously promote both economic growth and environmental protection.

The historic impacts of mining on the environment are significant. While estimates vary it is generally recognized that there are over 200,000 inactive and abandoned mines (IAMs) nationwide. Only a fraction of these are believed to contribute significantly to environmental problems, but the aggregate impact is substantial and in specific cases there are serious localized environmental impacts (see Appendix B).

A 1993 survey by the U.S. Forest Service estimates that 5,000 to 10,000 miles of streams and rivers are impacted by acid drainage from mines on National Forests. The U.S. Geological Survey estimates that over 60 million tons of contaminated sediment cover the bottom of Lake Coeur d'Alene in northern Idaho as a result of historic mining in the Coeur d'Alene mining district. There are approximately 60 mine, or mining related, sites on the Superfund National Priorities List (NPL). Identifying, prioritizing, and implementing necessary cleanup actions at IAMs across the country is expected to take many years. Much of the cleanup cost will likely be borne by the public.

As mines have increased in size and complexity, environmental controls have become increasingly sophisticated. Mine operating plans must address stringent water quality standards, increased emphasis on protection of endangered species, requirements for mitigation of habitat losses, and concerns about long term reclamation and closure. Modern mines are required to more fully evaluate environmental concerns at the earliest stages of mine planning and design. Environmental controls are now considered as an integral part of overall mine management.

In recent years environmental practices employed by the mining industry have improved considerably. Installation of Best Management Practices (BMPs) for control of storm water runoff, improvements in treatment of wastewater, better management of tailings and wasterock, and more efficient metal recovery technologies have all contributed to reduced environmental impacts from mining projects.

However, in spite of these improvements, nearly 20 percent of the mining facilities inspected by EPA and the States between August 1990 and August 1995 were subject to enforcement actions. About 90 percent of the actions involved the Clean Water Act, the Clean Air Act, or the Resource Conservation and Recovery Act. Acid mine drainage and acid drainage from waste rock and tailings disposal areas continue to create environmental concerns at some sites. A number of mines that were designed to be zero discharge are now coming to regulatory agencies requesting discharge permits. The Summitville Mine in Colorado is perhaps the best known example of a modern mine with significant environmental problems; the cleanup costs for this site are expected to be over $100 million.

On August 16, 1994, EPA's former Deputy Administrator Robert Sussman convened a Senior EPA Management retreat to discuss Agency activities regarding hardrock mining. This meeting was used to identify key questions the Agency must face in addressing environmental and human health concerns and improving EPA's program delivery. Attendees included several Assistant

Administrators and Regional Administrators. In an October 17, 1994 memorandum, Deputy Administrator Sussman directed the Office of Water (OW) to lead a multi-program, cross-organizational workgroup to draft an Agency-wide mining framework. The workgroup was comprised of staff from the Regions, Office of General Counsel (OGC), Office of Solid Waste and Emergency Response (OSWER), Office of Enforcement Compliance and Assurance (OECA), and other affected programs.

1.3 Goals of EPA's Mining Framework

In developing this Framework EPA began with three principal goals. First was environmental protection. EPA's environmental goal is to protect human health and the environment through appropriate and timely pollution prevention, control, and remediation at proposed, active, and inactive and abandoned mine and mill sites (on both Federal and non-Federal land, consistent with Agency statutory authorities). The Agency's administrative goal is to foster efficient use of available resources and authorities on the highest priority concerns, using a multi-media/multi-statute geographic approach (watershed), and working closely with other Federal, State, Tribal, and local stakeholders. Finally, EPA is seeking to promote fiscal responsibility in managing environmental concerns at mine sites. This goal includes efforts to promote cost effective environmental controls at existing facilities, as well as historic mining sites. The need to minimize both current and future environmental and fiscal costs borne by the public provides a backdrop for each of these three goals.

1.4 Guide to the Framework

This EPA Hardrock Mining Framework is intended primarily to assist EPA staff in implementing an effective multi-media/multi-statute mining program. It was developed by a diverse group of EPA geologists, engineers, scientists, researchers, economists, and others to identify important issues in the mining sector, and to suggest improvements in how EPA does its business.

The Framework is divided into two parts. This first section (Chapters 1-5) provides a brief problem statement, then focuses on how EPA can improve its mining program. The second section of the Framework is a set of Appendices that provide the reader with a more thorough discussion of specific issues that provide greater context for the Framework's recommendations.

2.0 Current Status

2.1 Overview of Regulatory Framework for Mining

Regulation of mining activities occurs via a complex web of sometimes overlapping jurisdictions, laws, and regulations covering several environmental media. Land ownership and tenancy issues further complicate regulatory issues. Each mine faces a somewhat unique set of regulatory requirements, depending upon State statute or regulation; whether it is on State, Federal, Tribal, or private land; local regulations; the kind of mining and metal recovery operation proposed; and the specific environmental considerations unique to the site.

States and Tribes have often been leaders in mining regulation. While no federal legislation specifically addressing the environmental impacts of mining has been passed, many States have established their own statutory programs. In addition, all States have general environmental statutes that provide coverage to mining operations. Many states have been authorized to implement federal environmental programs, such as the hazardous waste program under the Resource Conservation and Recovery Act (RCRA) and the National Pollutant Discharge Elimination System (NPDES) program under the Clean Water Act (CWA). The role of States and Tribes in mining regulation cannot be overstated; it is imperative that EPA understand these programs in order to improve its own program implementation (see Appendix E).

There are a number of statutes and associated regulatory programs that govern Federal land management programs as well as the disposition of minerals on federal lands. Through the 1872 Mining Law, Congress has encouraged the development of mineral resources on Federal lands for well over a century. In the Federal Land Policy and Management Act of 1976 Congress provided that the Bureau of Land Management is to take any action necessary to prevent unnecessary or undue degradation of Bureau-administered lands. Federal land management agencies recognize the legitimacy of mining on Federal land and administer claims consistent with environmental statutes and agency regulations. The Bureau of Land Management (BLM), U.S. Forest Service (FS), U.S. Fish and Wildlife Service (FWS), National Park Service (NPS), Bureau of Indian Affairs (BIA), Bureau of Reclamation (BR), Office of Surface Mining (OSM), and Departments of Energy (DOE) and Defense (DOD) all play a role in influencing environmental outcomes at mine sites where they have ownership or jurisdiction (see Appendix D).

2.2 EPA Statutory Authority

The principal environmental statutes that EPA has used to regulate and clean up releases to the environment as a consequence of mining over the past decade are the Clean Water Act (CWA) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The Resource Conservation and Recovery Act (RCRA) has been used by the Agency to examine the environmental impacts of mining. EPA's role in the National Environmental Policy Act (NEPA) process has been important in mine site evaluation and planning. These statutes are discussed briefly below.

Clean Water Act

Over the past decade CWA Section 402 (NPDES permitting authority) has gradually shifted from control of single point sources of pollution, based on a relatively small number of conventional pollutants (biological oxygen demand, total suspended solids, pH, fecal coliform), to more complex permitting strategies that consider multiple sources of pollution and multiple pollutant parameters, including non-conventional (ammonia, chlorine, color, iron, and total phenols) and toxic pollutants.

The 1987 CWA amendments provided a mandate for establishing water quality standards for toxic pollutants and for developing NPDES permits that ensure that such standards are attained. In addition, those amendments provide a stronger basis for control of point source discharges associated with storm events, including those at mine sites. Increasingly, permits issued by State and Federal regulators pursuant to CWA authorities include limitations necessary to meet specific in-stream water quality criteria. Such limits often go beyond technology based permit requirements. For example, whole effluent toxicity testing is a compliance parameter included in many NPDES permits.

An important Section 404 (dredge and fill permitting) regulatory development is implementation of the Administration's Wetlands Plan, a set of 40 initiatives to make Federal wetland policy more flexible for the landowner and more effective in protecting valuable wetlands. The initiatives, many of which have been implemented, emphasize: improving wetland science; streamlining the permit process; increasing cooperation with private landowners; and increasing participation by States, Tribes, local governments, and the public in wetland protection.

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA or Superfund)

The Superfund program has been used to respond to environmental threats at a number of major mineral mining and processing sites over the past decade. Anaconda, Bunker Hill, East Helena, California Gulch, Blackbird, and Summitville are all sites addressed by Superfund. Each of these sites has posed a significant threat to human health or the environment. Many other smaller mine sites have also been addressed under Superfund authorities. Response actions have been funded by both the government and private parties liable under CERCLA; some sites have included funding by both government and private parties.

Although Superfund authorities can potentially be applied to a broad range of mining sites, EPA has generally used it only at significant sites where other regulatory tools have not achieved needed environmental protection goals. For the largest, most complex cases EPA has placed mine sites on the Superfund National Priorities List. In many instances EPA has used CERCLA to implement response actions at sites not on the National Priorities List, commensurate with the risk posed by the site.

The use of CERCLA authorities is not limited to EPA. Other federal agencies, under the authority of Executive Order 12580, have used CERCLA to implement cleanup activities on their lands. Recently, the President (by Executive Order 13016) expanded the ability of other federal agencies to use CERCLA to achieve mine site cleanup.

The liability provisions of CERCLA, coupled with the availability of federal funding (largely from a tax on the chemical industry) for implementing response actions, make it a powerful tool for achieving mine site cleanup where other statutes or programs have proven ineffective. States have also played an important role in CERCLA implementation at mine sites, both in support of EPA efforts, and in leading cleanup initiatives.

Resource Conservation and Recovery Act

Much of RCRA's history in mining regulation has involved rulemaking designed to determine which mining waste streams should be regulated as "hazardous waste". In October, 1980, Congress amended RCRA by adding the Bevill exclusion, for "solid waste from the extraction, beneficiation, and processing of ores and minerals". The Bevill amendment excluded these mining waste from regulation as a hazardous waste under Subtitle C of RCRA, pending completion of a study and a report to Congress. As a consequence of EPA's analysis and subsequent regulatory interpretations and rulemakings, relatively little mining waste is currently subject to RCRA regulation as hazardous waste.

After most mining waste was exempted from Subtitle C regulation, EPA began work on development of a mine waste management program under RCRA Subtitle D. Though the effort, commonly referred to as "Strawman", was never adopted as regulation, it helped provide a basis for mining regulation at the State level.

National Environmental Policy Act (NEPA)

Under NEPA, Federal agencies prepare environmental impact statements (EISs) for major federal actions significantly affecting the quality of the human environment. Other agencies, including EPA, can comment on EISs. In addition, EPA has a unique role under Section 309 of the Clean Air Act (CAA) to review and comment in writing on the environmental impact of any matter, including those relating to the duties and responsibilities within the authority of the Administrator, those contained in any Federal action subject to NEPA's EIS requirement, and other Federal actions.

Actions specifically related to mining that may require EISs include federal land management agency approval of Plans of Operations for hardrock mining and/or milling operations on federally managed lands (or tribal lands), approval of mineral leases and sales on federal or tribal lands or federal mineral estates, and certain federal permits such as NPDES wastewater discharge permits issued by EPA for mines subject to new source performance standards, or Section 404 (dredge and fill) permits issued by the Army Corps of Engineers (COE).

For new mining projects requiring federal permits, NEPA offers the opportunity to identify environmental concerns that are to be addressed in evaluating the proposed action, as well as alternatives that may be available to the applicant. EPA has been actively involved in NEPA as a lead agency, a cooperating agency, and a reviewer. The NEPA process offers an opportunity to understand the potential direct, indirect, and cumulative impacts of mining projects and to identify permit conditions that may be appropriate to manage, or mitigate, environmental concerns.

2.3 Partnerships

In developing this Framework EPA recognized that programs influencing the environmental impacts of mining were administered by many parties. States, Tribes, other federal agencies, and local government each have a role in mine regulation. Non-regulatory efforts to improve environmental conditions at mine sites are also an integral part of mine site management and include an even broader group of stakeholders, including industry and environmental groups.

Effective stakeholder partnerships have proven themselves to have tremendous value in addressing mining issues. Efforts in the Clear Creek Watershed in Colorado and the Coeur d'Alene Basin in Idaho are two examples where partnerships in addressing environmental impacts from historic mining have yielded greater benefits than any single party could have achieved. In instances where successful partnerships were not established environmental goals have been more difficult to realize.

Understanding the tools available to each of the stakeholders involved in a particular mining issue is critical to forging an effective partnership (see Appendix C). Developing a clear understanding of what each party needs or has to offer helps to clearly define the roles and responsibilities of each party, minimizes overlap, and makes the most of available resources.

3.0 Improving How We Do Business

The preceding sections provide a brief background on EPA's role in mine site management to give perspective for the recommendations in this section. The Recommendations and the Tasks identified in the Implementation section that follows, provide a strategy for improving EPA's mining program. The reader is encouraged to refer to the appendices for a more complete discussion of specific issues of interest.

3.1 Key Considerations

EPA recognizes that a number of tools are available to address mining issues. Many are administered by others, including Tribes, States, other Federal agencies, and local government. Industry and environmental groups also have a valuable role to play. In developing the Recommendations in this section EPA is focusing primarily on how to fulfill agency responsibilities more effectively, but it does so with the understanding that EPA must work in partnership with others.

This document has been developed to assist EPA staff working on mining issues, and a number of the recommendations offered can be implemented independently by EPA. However, many suggestions for improving program delivery require the agency to work more effectively with others. Obviously that requires cooperation, improving existing relationships, and in some cases building new ones.

To the extent that these recommendations rely on some change in the way EPA works with others**,** the Agency recognizes that it is incumbent upon EPA to seek other stakeholder's support. Nothing in this document is intended to suggest that EPA can redefine the role of other stakeholders, or set their agenda for them. However, EPA believes the recommendations and principles they represent are sound, and welcomes the opportunity to work with other mining stakeholders to move forward with their implementation.

In developing these recommendations EPA focused on working more effectively within the context of existing regulatory and programmatic responsibilities. Comments received on earlier drafts of the Framework suggested that EPA was seeking to broaden the scope of its responsibilities beyond legislative mandates. The Agency believes that all the recommendations provided are within the scope of EPA responsibilities and existing authorities.

When the workgroup began to develop the National Hardrock Mining Framework it was envisioned that the document would foster improvements in the way EPA delivers its mining program responsibilities. The Agency has already seen results. The process of developing the Framework has improved communication within EPA and facilitated new dialogues with States, other federal agencies, Tribes, environmental interests, and industry. The Framework recommendations emphasize continued efforts to strengthen communication among stakeholders.

Framework recommendations were developed to be responsive to the goals identified in Section 1.3; to achieve improved environmental protection, to foster more efficient utilization of agency resources and authorities, and to promote fiscal responsibility in managing environmental concerns at mine sites.

3.2 Recommendations

Achieving Improved Environmental Protection

Fundamental to achieving improved environmental protection is identification of potential environmental concerns early in mine site planning, developing appropriate environmental management controls, and assuring implementation both during the operating life of the mine, and post-closure management. It is essential that this work be done in cooperation with stakeholders; specific recommendations follow:

1. EPA should promote improvement of scientifically based predictive tools used in evaluating the environmental impacts of mine sites. This includes collaborative research, participation in information exchanges and training opportunities, and technology development. Tools to better predict acid mine drainage and metals mobility would be a priority. Other subjects would include; site characterization and monitoring, fate and transport, treatment and remediation technology development and evaluation, and risk assessment (including both human health and ecological risk).

2. In States where EPA retains NPDES responsibilities the Agency should integrate permitting and NEPA site evaluation functions. These cases provide an opportunity to streamline the regulatory process for mine site evaluation and planning, while assuring that permits include appropriate provisions requiring that the preferred alternative be implemented as presented in the EIS.

3. EPA should promote an adequate consideration of environmentally protective standards and preferred alternatives at proposed mine sites during the EIS development. An appropriate range of environmentally sound alternatives should be included in each mining EIS.

4. The Agency should evaluate the adequacy of current mine waste management practices and promote standards of practice that achieve appropriate risk based, long term, environmental protection goals.

Using Our Resources More Efficiently

Agency resources can be more effectively utilized in two ways. EPA can do a better job in direct program implementation, and the Agency can foster more effective partnerships with others.

5. The Agency should promote utilization of a geographic/risk-based approach to determining priorities for Inactive and Abandoned Mine (IAM) reclamation. Setting priorities and selecting appropriate cleanup strategies (including tools for implementation) should be conducted in cooperation with appropriate stakeholders (see Appendix F).

6. EPA should use targeted enforcement and compliance approaches as a tool to better focus resources on the highest priority mining operations. These approaches should emphasize compliance assistance as a priority, but may also include traditional enforcement mechanisms.

7. EPA should work with the Corps of Engineers to develop a consistent approach to defining "fill material" (in the context of Section 404 permitting) and determining the applicability of the waste treatment exclusion to certain mining activities.

8. EPA should prepare guidance and provide training to State and Federal agencies on the use of CERCLA site assessment, investigation, and screening tools for mine sites.

9. EPA should a compile, and periodically update, information regarding grants available to fund mining remediation projects for distribution to mine site management partners.

Promoting Fiscal Responsibility

Promoting cost effective strategies for management of environmental concerns at mine sites, and assuring that mine planning includes consideration of mechanisms for implementation of necessary environmental controls (both during the operating life of the mine and through reclamation and closure) are included in the following recommendations.

10. EPA should encourage development of cost-effective environmental control technologies for both active and inactive mine sites.

11. EPA should evaluate the adequacy of EISs for mining operations in predicting the long-term environmental impacts of mining operations. Assessment of financial assurance mechanisms that will be utilized to provide funding of required long term environmental management systems is critical to this analysis.

12. EPA should encourage reprocessing of historic mine wastes in conjunction with, or as a component of, site cleanup.

13. EPA should develop (or support) legal and administrative mechanisms to encourage implementation of environmentally beneficial response actions at mines sites, such as the good Samaritan provisions being considered as an amendment to the CWA.

14. In the interest of reducing uncertainty for the regulated community, EPA should work with other mining stakeholders, to develop standardized methods for characterizing and analyzing environmental impacts at mine sites, predicting and verifying acid mine drainage and metals

mobility, and establishing environmental performance standards.

4.0 Implementation Actions

4.1 Putting the Framework into Action

Implementation of the recommendations provided above requires improved coordination and cooperation within EPA Regions, between Regions and Headquarters, among various programs at EPA Headquarters, and with partners in mine site management. In many instances Regions are in the best position to understand local environmental concerns, stakeholder needs and capabilities, and opportunities for program improvement. However, Headquarters will play a critical role in supporting implementation of the Framework's recommendations. The following action items were identified to support implementation of the Framework:

1. Regions with significant mining activity should establish Regional Mining Coordinators and cross program mining teams to optimize internal EPA program delivery, enhance technical capabilities, and serve as a focal point for mining program improvement and delivery.

2. EPA Headquarters should establish a cross-program mining team to foster effective working relationships with stakeholders at the National level (including other federal agencies), provide appropriate support to Regions, promote coordination among Headquarters program staff, and communicate with Senior EPA management.

3. Each Region with significant mining activity should develop (and periodically update) a Regional Mining Profile to assess the scope of proposed, active, and inactive and abandoned mines in the Region, identify environmental issues of concern, and understand the concerns and capabilities of key Regional stakeholders. Meetings with States, other federal agencies, industry, environmental groups, and mining communities will be an essential element of developing a Regional Mining Profile.

4. Regions with significant mining activity should develop Regional Mining Strategies to guide mining program improvements. Development of such strategies is key to implementation of Framework recommendations at the Regional level. EPA Headquarters should provide support to Regional efforts where feasible.

5. The National Interagency Coordinating Committee on mining should be promoted as a forum for development of consensus approaches to critical technical and policy issues (e.g. evaluating financial assurance concerns related to long term environmental compliance at mine sites) on Federal lands.

6. Regions and Headquarters should sponsor periodic workshops on the "toolbox" approach to foster innovative problem solving, technology transfer, and stakeholder cooperation.

7. Regions should sponsor workgroups (including appropriate stakeholders) to develop methodologies for mine site characterization, EIS development, wastewater treatment

strategies, and reclamation and closure standards.

8. Regions should hold workshops for identifying legal and administrative obstacles, and recommendations for promoting, good Samaritan mine site cleanup and reprocessing/ re-mining of inactive and abandoned mines.

9. Regions should screen upcoming mining EISs to determine priorities for agency involvement. EPA should be actively involved in all major EISs for mining projects, participating as a cooperating agency where appropriate.

10. EPA Headquarters should request comment on whether a reexamination of high risk Bevill wastes is warranted with the possibility of bringing some high-risk waste streams under Subtitle C in a future rulemaking. The Agency should consider revival of the Policy Dialogue Committee or another group to discuss this issue.

4.2 Next Steps

The Recommendations and Implementation Actions above provide a strategy for improving EPA's work in the mining sector. Carrying out the above steps are critical to improving our relations with other agencies. Clarification by EPA of its expectations for environmental performance for mining operations facilitates communication and coordination with other federal and state agencies. By working with others to establish a common vision for mine site management EPA can improve the effectiveness of Agency programs.

Regional staff will play a major role in Framework implementation at the field level. However, Headquarters commitment to implementing the Framework's recommendations will be critical to making long term program improvements, particularly with respect to working relationships with other federal agencies.

Fundamental to many of the ideas presented for improving EPA's mining programs is recognition of the critical role of others in managing the environmental concerns posed by mining. Building effective partnerships, both at the National and Regional levels, are among the most important elements of this Framework.

5.0 Introduction to the Appendices

In earlier versions of this Framework much of the information in the Appendices was contained in the body of the Framework. To make the Framework more useable this information was consolidated in the Appendices.

The EPA Hardrock Mining Workgroup devoted considerable effort to development of this material and the reader is strongly encouraged to review the Appendices for additional information on topics of interest. The Appendices provide a Profile of the Mining Industry, background on the Environmental Impacts of Hardrock Mining, a discussion of Regulatory and Non-Regulatory tools available to address mining issues, information on other Federal agencies role in mining, a Summary of State Programs, ideas for Priority Setting, and a summary of comments on earlier versions of the Framework.

APPENDIX A

MINING INDUSTRY PROFILE

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1. OVERVIEW

This overview provides summary information on 11 commodities (10 non-fuel and uranium) that are produced from the most important metalliferous and fertilizer ores in the United States. The combined value of these minerals (copper, gold, iron ore, lead, molybdenum, phosphate rock, platinum, potash, silver, uranium, and zinc) was $12.15 billion in 1993, accounting for less than 1 percent of gross national product (GNP) (U.S. Department of Commerce, 1994).

This appendix is intended to provide an *overview* of mining activities and the mining industry, not a comprehensive examination. It is necessarily simplistic, but should give a snapshot of the industry as it existed in 1992. This framework recognizes the dynamic nature of this vital industry and the market, technological, and other factors that drive its performance, environmental and otherwise.

These metals and minerals are the primary raw materials used in many industrial applications and thus are essential to the American and world economies. Copper, for example, is essential to the electronics and construction industries, while iron ore provides the base material for the steel, automotive, and transportation industries. Molybdenum is used in steel production, machinery, electrical and chemical manufacturing. Potash and phosphate rock are used in fertilizers and chemical manufacturing. Gold, while primarily used in jewelry and the decorative arts, is also used in the electronics industry and dentistry. Table 1 provides a more detailed list of the consumptive uses for these minerals.

The minerals industry also contributes to the national economy by virtue of its production of exports and its reduction of industrial dependence on certain minerals that the United States would otherwise import. For example, the U.S. exports 8% of the lead and 75% of the molybdenum it produces. Conversely, the U.S. imports 22% of the iron ore it consumes (Bureau of Mines, 1995). See Table 2 for detailed national production data (including import and export information) for these minerals.

The extraction and beneficiation of these minerals necessarily lead to the generation of large quantities of waste. Total waste (waste rock and tailings) produced during the extraction and beneficiation of minerals can range from 10% of the total material removed from the earth (potash) to more than 99.99% (gold). As for total amounts of waste generated in 1992, the gold mining industry generated about 540,661,000 metric tons and the copper mining industry generated 731,065,000 metric tons; potash, on the other hand, generated 197,000 metric tons (Bureau of Mines, 1992a). To put these quantities in perspective, about 200,000,000 metric tons of municipal solid waste are generated in the United States each year.

TABLE 1. Number of Mines, Total Production and Uses of Commodities of Concern, 1992

Commodity	Number of mines[1]	Major uses	Total U.S. mine production (metric tons)	Production as % of consumption
Copper	50	Building construction, electrical and electronic products, Industrial machinery and equipment, transportation equipment, and consumer and general products	1,765,000	75%
Gold	212+[2]	Jewelry and arts, industrial (mainly electronic), dental	329	300%
Iron Ore	22	Steel	55,593,000	74%
Lead	23	Transportation (batteries, fuel tanks, solder, seals, and bearings); electrical, electronic, and communications uses	398,000	32%
Molybdenum	10	Iron and steel production, machinery, electrical, transportation, chemicals, and oil and gas industry uses	49,000	287%
Phosphate Rock	16	Wet-process phosphoric acid, fertilizers	46,965,000	109%
Platinum group metals	1	Automotive, electrical and electronic, chemical, dental, medical	8,300	12%
Potash	12	Fertilizers, chemical manufacturing	1,705,000	32%
Silver	150	Photographic products, electrical and electronic, electroplated ware, sterlingware, and jewelry	1,800	NA
Uranium	17	Energy (fuel rods)	522	NA
Zinc	25[3]	Chemical, agricultural, rubber, and paint industries	524,000	41%

NOTES:

1 Due to the nature of the mining industry, the exact number of mines is difficult to discern. For instance, several of the commodities are produced as co-products or by-products from other commodity mining operations (e.g., gold as a result of copper production). Therefore, the number of mines for individual commodities includes both actual commodity mines and those mines from which the commodity is a co-product or by-product. These uncertainties result in inconsistent numbers throughout the BOM sources.

2 This includes 200 lode mines and 12 large placer mines. It does not include the hundreds of small placer mines throughout the west.

3 Account for 99% of production.

Sources:

U.S. Bureau of Mines. *Mineral Commodity Summaries 1994*.
U.S. Bureau of Mines. *Minerals Yearbook, Volume I: Metals and Minerals*. 1992
U.S. Bureau of Mines. *Minerals Yearbook, Volume II: Area Reports: Domestic*. 1992.

TABLE 2. National Mining and Beneficiation Data (by Commodity), 1992

Commodity	Number of Mines[1]	Value of Commodity Produced ($1,000,000)	Total Commodity Produced (1,000 mt)	Tailings Generated[2] (1,000 mt)	Other Waste Handled (1,000 mt)	Number of Employees	% of GDP[3] (Value of Commodity Produced/GDP)	Consumption (1,000 mt) Exports (% of Total Produced)[4]	Consumption (1,000 mt) Imports (% of Total Produced)[5]
Copper	50	4,200	1,765	337,733	393,332	13,600	.07%	679 (38%)	593 (34%)
Gold	212+[6]	3,700	.329	247,532	293,128	14,700	.06%	0.369 (112%)	0.174 (53%)
Iron Ore	22	1,700	55,593	80,204	106,233	8,000	.004%	5,003 (9%)	12,230 (22%)
Lead	23	308	398	6,361	W	1,700	.005%	72 (18%)	5 (1%)
Molybdenum	10	190	49	<3,926[7]	<6,751[7]	750	.003%	36 (73%)	3 (6%)
Phosphate rock	16	1,100	46,965	104,831	-	5,600	.02%	3,723 (8%)	1,530 (3%)
Platinum group metals	1	38	8.3	<3,926[7]	<6,751[7]	500	.001%	57.8 (696%)	132 (1,588%)
Potash	12	325	1,705	197	-	1,004	.005%	663 (39%)	4,227 (248%)
Silver	150	229	1.8	2,822.2	W	1,600	.004%	1.7 (97%)	4.9 (277%)
Uranium	17	12.2	.522	NA	NA	682 (person years)	.0002%	NA	NA
Zinc	25[8]	673	524	4,227	W	2,300	.01%	388 (74%)	45 (9%)

NOTES:
1 Due to the nature of the mining industry, the exact number of mines is difficult to discern. For instance, several of the commodities are produced as co-products or by-products from other commodity mining operations (e.g., gold as a result of copper production). Therefore, the number of mines for individual commodities includes both actual commodity mines and those mines from which the commodity is a co-product or by-product. These uncertainties result in inconsistent numbers throughout the BOM sources.
2 Tailings generated = total crude ore handled - total commodity produced.
3 1992 Gross Domestic Product (GDP) was $6,020.2 billion.
4 Exports may include nonfuel minerals from U.S. Government stockpiles.
5 Imports may include nonfuel minerals imported for processing.
6 This includes about 200 lode mines and about 12 large placer mines. It does not include the hundreds of small placer mines throughout the west.
7 Includes bauxite, beryllium, molybdenum, nickel, platinum group metals, and rare-earth concentrates.
8 Account for 99% of production.
W Information withheld by the Bureau of Mines for proprietary reasons.
NA Information not available.

SOURCES: U.S. Bureau of Mines. *Mineral Commodity Summaries 1994*
U.S. Bureau of Mines. *Minerals Yearbook, Volume I: Metals and Minerals*. 1992a. See Table 4 for sources of data in Commodity Produced, Tailings Generated, and Other Waste Generated columns.

2. LOCATION OF MINING ACTIVITIES

Tables 3 and 3a show the distribution of hardrock mining activities in the United States (1992 Bureau of Mines data for number of mines and state-by-state production for each commodity). The following discussion briefly summarizes location information for each sector. The information presented below focuses on primary production. However, significant volumes of some minerals are produced as byproducts (e.g., molybdenum as a byproduct of copper flotation). For the purposes of this discussion, primary production refers to the major mineral extracted at the mine. Byproducts are the ancillary minerals that are found in and recovered from the same ore as the primary mineral, although the presence of that byproduct is not the primary target.

Copper. As shown in Tables 3 and 3a, southern and central Arizona copper mines produce nearly two-thirds of U.S. copper. Among other primary copper producers, several large copper mines are located in New Mexico near the Arizona border (close to smelter facilities) and one of the largest copper mines in the country, Kennecott Utah Copper, is located near Salt Lake City. An additional medium-size underground mine, Copper Range's White Pine facility, is near Lake Superior on the Upper Peninsula of Michigan. The copper mines in other states identified in Table 3 either are small operations or represent limited byproduct production at gold, molybdenum, and other mines (Bureau of Mines, 1992a, 1992b, and 1995; EPA, 1994a).

Gold. With the widespread application of heap leaching technology, most of the U.S. gold production now occurs in Nevada. Nevada mines account for more than 60 percent of the total production, with most mines located along the Carlin Trend in northwestern Nevada. Most other gold mining operations are located throughout the western United States, including Alaska, although four gold mines are located in South Carolina (Bureau of Mines, 1992a; 1992b; EPA, 1994c).

Iron. Nearly all of the iron mined in the United States is produced from taconite ore found in Northern Minnesota and Michigan. The largest mining operations (all open pits) are found along the Mesabi Range in Minnesota, which extends from Hibbing to north of Duluth (Bureau of Mines, 1992a; 1992b; EPA, 1994f).

Lead/Zinc. The Viburnum area of southeastern Missouri is the center of U.S. lead production. The lead mines in this area also produce significant quantities of zinc (as a byproduct from smelter operations). Alaska is the largest zinc producer in the United States (with associated lead byproducts) at the Red Dog and Greens Creek Mines (the Red Dog Mine is the primary producer). Central Tennessee and northern New York State are also major sources of zinc ore (Bureau of Mines, 1992a; 1992b; EPA, 1994g).

TABLE 3. Location of Mining Activities, 1992

State	Copper		Gold		Iron Ore		Lead		Phosphate Rock	
	# mines[1]	% U.S. Production	# mines[1]	% U.S. Production	# mines[1]	% U.S. Production	# mines[1]	% U.S. Production	# mines[1]	% U.S. Production
United States	50	1,765,000 metric tons	212+[3]	329 metric tons	22	55,593,000 metric tons	23	308,000 metric tons	16	46,965,000 metric tons
Alaska			13	1.5%			2	15.6%		
Arizona	16	65.3%	14	2.1%			1	W		
California			19	10%	NA	W				
Colorado	2[2]	W	7	1.2%			2	W		
Florida									9	68.6%
Idaho	3[2]	W	11	1%			1	W	7	11.1%
Illinois							1	W		
Michigan	3	W			2	23.2%				
Minnesota					7	76.2%				
Missouri	2	0.6%			NA	0.03%	7	75.6%		
Montana	3	W	9	4.3%	1	W	2	W	1	NA
Nevada	1	W	61	61.7%						
New Mexico	7	12%	5	W			2	W		
New York							2			
North Carolina									1	W
Oregon	1	0.01%	2	W						
South Carolina			4	2.1%						
South Dakota			5	5.8%	1	W				
Tennessee							2	W		
Texas					2	W				

(continued)

TABLE 3. Location of Mining Activities, 1992 (continued)

State	Copper		Gold		Iron Ore		Lead		Phosphate Rock	
	# mines[1]	% U.S. Production	# mines[1]	% U.S. Production	mines[1]	% U.S. Production	# mines[1]	% U.S. Production	# mines[1]	% U.S. Production
United States	50	1,765,000 metric tons	212+[3]	329 metric tons	22	55,593,000 metric tons	23	308,000 metric tons	16	46,965,000 metric tons
Utah	1	W			2	W			1	NA
Vermont			NA	W						
Washington			4	2.7%			1	W		

NOTES:
NA = Information not available.
W = Information withheld by the Bureau of Mines for proprietary reasons.
1 Due to the nature of the mining industry, the exact number of mines is difficult to discern. For instance, several of the commodities are produced as co-products or by-products from other commodity mining operations (e.g., gold as a result of copper production). Therefore, the number of mines for individual commodities includes both actual commodity mines and those mines from which the commodity is a co-product or by-product. These uncertainties result in inconsistent numbers throughout the BOM sources.
2 At all of these mines, copper is produced as a byproduct of other commodity operations.
3 This includes about 200 lode mines and about 12 large placer mines. It does not include the hundreds of small placer mines throughout the west.

SOURCES:
U.S. Bureau of Mines. *Mineral Commodity Summaries 1994* .
U.S. Bureau of Mines. *Minerals Yearbook, Volume I: Metals and Minerals*. 1992.
U.S. Bureau of Mines. *Minerals Yearbook, Volume II: Area Reports: Domestic*. 1992.

TABLE 3a. Location of Mining Activities, 1992

State	Molybdenum		Platinum[2]		Potash		Silver		Uranium		Zinc	
	# mines[1]	% U.S. Production	# mines[1]	% U.S. Production	# mines[1]	% U.S. Production	# mines[1]	% U.S. Production	# mines[1]	% U.S. Production	# mines[1]	% U.S. Production
United States	10[3]	49,000 metric tons	1	8,300 metric tons	12	1,705,000 metric tons	150	1,800 metric tons	17	522 metric tons	25	524,000 metric tons
Alaska							15	15.8%			3	47.5%
Arizona	5	W					15	9.2%				
California	NA	W			2	W	14	1%				
Colorado	2	W					4	W			1	NA
Florida									2[4]	NA		
Idaho	1	W					12	14.1%			2	NA
Illinois							NA	NA			NA	NA
Michigan					1	W	1	NA				
Minnesota							NA	1.8%				
Missouri							NA	NA			4	8.4%
Montana	1	W	1	100%			9	10.9%			1	3.9%
Nebraska									2	35%		
Nevada							1	34.1%				
New Mexico	1	W			6	84%			1	10%		
New York							1	NA			2	W
North Carolina												
Oregon							1	.06%				

(continued)

TABLE 3a. Location of Mining Activities, 1992 (continued)

State	Molybdenum		Platinum[2]		Potash		Silver		Uranium		Zinc	
	# mines[1]	% U.S. Production	# mines[1]	% U.S. Production	# mines[1]	% U.S. Production	# mines[1]	% U.S. Production	# mines[1]	% U.S. Production	# mines[1]	% U.S. Production
United States	10[3]	49,000 metric tons	1	8,300 metric tons	12	1,705,000 metric tons	150	1,800 metric tons	17	522 metric tons	25	524,000 metric tons
South Carolina							3	NA				
South Dakota							4	0.3%				
Tennessee							NA	NA			10	W
Texas									2	NA		
Utah	1	W			3	W	4	W	1	NA		
Vermont												
Washington							4	W			1	NA
Wyoming									2	>12%[5]		

NOTES:

NA = Information not available.

W = Information withheld by the Bureau of Mines for proprietary reasons.

1 Due to the nature of the mining industry, the exact number of mines is difficult to discern. For instance, several of the commodities are produced as co-products or by-products from other commodity mining operations (e.g., gold as a result of copper production). Therefore, the number of mines for individual commodities includes both actual commodity mines and those mines from which the commodity is a co-product or by-product. These uncertainties result in inconsistent numbers throughout the BOM sources.

2 The numbers for platinum include all the platinum-group metals. Those metals include platinum, palladium, rhodium, ruthenium, iridium, and osmium.

3 Of the 10 molybdenum mines, only three are in business to mine molybdenum. The other seven produce molybdenum as a result of other commodity operations. Of the three true molybdenum mines, two are located in Colorado and one in Idaho.

4 Uranium was produced at these two sites as a byproduct of phosphate processing.

5 One of the two mines in the state reported production of 61 metric tons of uranium. Production data for the other mine was not available.

SOURCES:

U.S. Bureau of Mines. *Mineral Commodity Summaries 1994*.

U.S. Bureau of Mines. *Minerals Yearbook, Volume I: Metals and Minerals*. 1992.

U.S. Bureau of Mines. *Minerals Yearbook, Volume II: Area Reports: Domestic*. 1992.

Phosphate Rock. The Tampa/Bartow area of central Florida is the major phosphate rock producing area of the United States. The recent introduction of a heavy media separation process at IMC's Four Corners mine has led to possibly increased phosphate recovery from types of ore that previously could not be beneficiated (i.e., the potential for additional production in the area). Beyond the Florida operations, TexasGulf operates a large phosphate facility along the North Carolina coast near New Bern, and smaller phosphate mines are located in Idaho, Montana, and Utah (Bureau of Mines, 1992a; 1992b; EPA, 1994h).

Molybdenum. Recent market conditions have limited molybdenum production in the United States, especially primary production. In 1994, Cyprus' Henderson Mine in central Colorado was the only active primary molybdenum operation in the country (compared with three in 1992). Byproducts represent the remainder of U.S. production, mostly as a byproduct of copper ore flotation at mines and mills in Arizona and Utah (Kennecott) (Bureau of Mines, 1992a and 1992b).

Platinum. Only one platinum mine is active in the United States, the Stillwater Mine operated by the Stillwater Mining Company near Nye, Montana (Bureau of Mines, 1992a and 1992b).

Potash. New Mexico produced almost all potash produced in the United States in 1992. In the state, five producers operated six mines, all of which mined potash in underground bedded ore zones. The other potash-producing states (California, Michigan, and Utah) produced potash by two-well solution mining, solar evaporation, and selective crystallization (Bureau of Mines, 1992a and 1992b).

Silver. Silver is mined primarily in the Western United States both through primary and byproduct production. Primary silver production generally occurs in Montana, Idaho, and Nevada. Silver is also recovered as a byproduct from copper, lead/zinc, and gold production. In Alaska, silver is a significant byproduct at the Green Creek and Red Dog Mines. In Nevada, much of the total silver production is derived as a byproduct of the state's extensive gold mining industry (Bureau of Mines, 1992a and 1992b; EPA, 1994 and 1994c).

Uranium. The total amount of uranium produced in 1992 (522 metric tons) was more than 70 percent less than the quantity produced in 1991 and the lowest amount produced since 1951. The decreased demand for uranium (and the resulting decrease in price) shut down several mines and put others on standby. According to the Bureau of Mines, Nebraska produced nearly 35 percent of the uranium produced in the United States. Texas was second producing more than 12 percent. Of the 17 mines in operation in 1992, five were conventional mines (both underground and open pits), four were *in situ*, and eight were reported as "other" (heap leach, mine water, mill tailings, or low-grade stockpiles). In Florida, uranium has also been produced as a byproduct of phosphoric acid production (Bureau of Mines, 1992a and 1992b; EPA, 1994 and 1994j; U.S. Department of Energy, 1993).

3. MINING PRACTICES AND PRODUCTS

Overall, as shown in Table 4, hardrock mining operations handle large quantities of material, the vast majority of which becomes waste in most industry sectors. Although it varies by commodity, the amount of product per ton of ore is generally very small for most of these commodities. Overall, the quantities and characteristics of the wastes are largely beyond the control of the industry, since they are the direct product of the material being mined.

Conventional underground and surface mining techniques account for most of the hardrock mining in the United States. Until recent decades, nearly all mining occurred underground, but with the advent of large earthmoving equipment and cheaper energy sources, surface mining has become prevalent in most industry sectors. The relatively lower cost of surface mining has allowed much lower-grade ores to be exploited economically in some industry sectors (EPA, 1994). In addition, *in situ* leaching has been used for about two decades in uranium and copper mining.

Primary iron and phosphate ores are mined almost exclusively by surface mining methods. Open pit mining is also the predominant extraction method used in primary gold and copper production, although there are several significant exceptions. For example, Homestake's facility in Lead, South Dakota, and Copper Range's White Pine mine in Michigan are large underground gold and copper mines, respectively. An additional mining practice used during the past 20 years in the copper and uranium sectors is *in situ* leaching. Lead/zinc and the only platinum mine in the United States, on the other hand, are industry sectors where nearly all primary production occurs at underground mines (Bureau of Mines, 1993; 1992a; 1992b).

The major wastes generated by mines include mine water, waste rock, tailings, and overburden. Mine water is produced when the water table is higher than the underground mine workings or the depth of an open pit surface mine. When this occurs, the water must be pumped or drained out of the mine. Alternatively, water may be pumped from wells surrounding the mine to create a cone of depression in the ground water table, thereby reducing infiltration. Mine water may be used in milling operations as makeup water, used for dust suppression, or discharged. When mining ends and pumping stops, groundwater will usually recover to its pre-mining level, although this can take decades or centuries.

Surface mines generate greater volumes of waste rock than underground operations. Waste rock is typically managed in angle-of-repose piles, either within or near the pit/mine. Waste rock also can be used on-site for road construction, in tailings dams, and to backfill mined-out areas. The differentiation between waste rock and ore (i.e., the cutoff grade) is generally an economic distinction, and can vary significantly over time depending on economic conditions; thus, what is disposed as waste rock (or sub-ore) at one time during a mine's life may be ore at another time. In addition, the development of new technologies can lead to economically viable mineral recovery from historic waste rock piles. Sub-ore is often stored in freestanding piles until economic conditions favor its beneficiation or until the mine reaches the end of its active life (EPA, 1994).

TABLE 4. Solid Waste Generated by Mines, 1992

Commodity	Material handled[1] (thousand metric tons)	Waste rock[2]		Ore: Tailings[3]		Ore: Product		Total waste (waste rock + tailings)	
		Thousand metric tons	% of material[4]	Thousand metric tons	% of material[4]	Thousand metric tons	% of material[4]	Thousand metric tons	% of material[4]
Copper	732,831	393,332	53.7%	337,733	46.1%	1,765	0.2%	731,065	99.8%
Gold	540,661	293,128	54%	247,533	46%	.329	.00006%	540,661	99.99%
Iron Ore	242,029	106,233	43.9%	80,204	33.1	55,593	23%	186,437	77%
Lead	> 6,759	W	NA	6,361	94.1%	398	5.9%	6,361	94.1%
Molybdenum, Platinum group	<10,677[5]	<6,751[5]	<63%	<3,926[5]	<37%	49	0.5%	<10,677[5]	99.5%
Phosphate Rock	151,796	-	-	104,831	69.1%	46,965	30.9%	104,831	69.1%
Potash	1,902	-	-	197	10%	1,705	90%	197	10%
Silver	> 2,824	W	NA	2,822	99.9%	1.8	0.1%	2,822	99.9%
Uranium	NA	NA	NA	NA	NA	.522	NA	NA	NA
Zinc	4,751	W	NA	4,227	89%	524	11%	4,227	89%

NOTES:
1 Total Material Handled = Crude Ore Handled + Waste Handled + Total Commodity Produced.
2 In BOM sources, this category is simply classified as "Waste." Here, it is categorized as "Waste Rock."
3 Tailings = Total Crude Ore Handled - Total Commodity Produced.
4 Calculated as a percentage of the Material Handled column.
5 Includes bauxite, beryllium, molybdenum, nickel, platinum group metals, and rare-earth concentrates.
W Information withheld by the Bureau of Mines for proprietary reasons.
NA Information not available.

Source for Materials handled, Waste rock, and Crude ore tonnages: "Mining and Quarrying Trends in the Metals and Industrial Mineral Industries," Table 2 ("Material Handled at Surface and Underground Mines in the United States in 1992, by Commodity and State," p. 82). In: Bureau of Mines, 1992a.
Source of Product tonnage: "Survey Methods and Statistical Summary of Nonfuel Mineral", Table 1 ("Nonfuel Mineral Production in the United States," p. 5) In: Bureau of Mines, 1992a.

Waste rock piles are generally designed to drain freely to minimize the potential for unstable conditions. Therefore, these piles are often located in natural drainages and now frequently have drainage systems installed during construction (e.g., French drains). Due to the potential for contamination of water flowing over or through waste rock piles, many mining facilities are now installing systems or taking steps to prevent or reduce the infiltration of precipitation. Contamination from piles may include sediments and solids, and also acid mine drainage or toxic pollutant loadings, depending upon the mineralogy of the waste rock. Systems used to reduce or prevent drainage into, or over, waste rock piles include uphill diversions, sloped and compacted surfaces, drains, and covers (EPA, 1994).

Except for the gold and copper sectors, in which leaching is increasingly prevalent, beneficiation of most other metal and phosphate ores occurs by conventional milling technologies. These include crushing, grinding, autoclaving, roasting, chlorination, calcining, and reagent flotation, by which a chemical reagent causes the target mineral to stick to air bubbles. In these cases, the ore is crushed and ground and the target mineral(s) are recovered, leaving very fine "tailings" as a waste to be disposed of. Tailings can be dewatered and disposed of in piles or used as backfill in the mine; more commonly, they are pumped as a slurry (typically 30 to 65 percent solids) to impoundments. In tailings impoundments, the solid component of the tailings settles out behind embankments and the ponded water is either reused in the process or discharged to surface water. The volumes of water discharged and reused are dependent on site-specific conditions, including water availability and evaporation rates. Tailings embankments/dams can be constructed of concrete, earthen materials, and/or waste rock or tailings (EPA, 1994 and 1994e; Bureau of Mines, 1995).

Table 5 is a summary of mining methods and beneficiation waste management practices for the various industry sectors.

While conventional flotation involves a wide range of flotation reagents (oils, xanthates, lime, etc.), depending on the industry sector and site-specific geology residual reagents comprise a diminishing fraction of the total amount of waste. One exception is in the phosphate industry where flotation occurs in conjunction with "washing" stages that use both ammonia and sulfuric acid; even there, at least one company now uses a substitute reagent that both increases recovery efficiency and reduces the toxicity of discharges (EPA, 1994 and 1994h).

Cyanidation technologies, some of which have been available for more than 100 years, are widely used for gold beneficiation. Higher-grade ores ("higher-grade" is relative; the highest grades are generally in the tenths of an ounce of gold per ton of ore) are crushed and ground, then the ore slurry passes through a series of tanks or vats that contain a sodium cyanide solution that dissolves the gold values; then the gold is recovered from the solution via Merrill-Crowe zinc precipitation or carbon adsorption, electrowinning, melting, and refining. The slurry of fine tailings is then disposed of, typically in impoundments (EPA, 1994, 1994c, and 1994i).

TABLE 5. Predominant Mining Methods and Waste Management Practices

Commodity	Number of mines[1]	Predominant mining methods	Predominant Beneficiation Methods	Major beneficiation waste management practices
Zinc	25	Underground	Flotation	Tailings impoundments
Copper	50	Underground, open pit, *in situ*	Flotation, Leaching, SX/EW	Tailings impoundments, spent ore dumps
Iron	22	Underground	Gravity, magnetic separation, flotation	Tailings impoundments
Gold	200 lode	Most open pit Several underground	Cyanidation: heap, tank, vat leaching	Tailings impoundments (tank, vat), dumps and heaps (heaps), spent ore dumps
	100s placer	Open pit, dredge, etc.	Gravity, some cyanidation	Tailings back into mine cut
Molybdenum	10	Underground Open pit	Flotation	Tailings impoundments
Lead	23	Underground	Flotation	Tailings impoundments
Phosphate	16	Most by surface mining	Flotation, heavy media separation	Backfilling and clay ponds
Platinum	1	Underground	Flotation	Tailings impoundment
Potash	6	Underground, solution mining, lake brine	Flotation, heavy media separation, dissolution - recrystalization	
Silver	150	Open pit, underground, placer, by-product	Flotation (base metal ores), Smelting (copper ores), Cyanidation (gold/ silver ores), precipitation (silver ores)	Tailings impoundments Tailings used as backfill

Note:

1 Due to the nature of the mining industry, the exact number of mines is difficult to discern. For instance, several of the commodities are produced as co-products or by-products from other commodity mining operations (e.g., copper as a result of gold production). Therefore, the number of mines for individual commodities includes both actual commodity mines and those mines from which the commodity is a co-product or by-product. These uncertainties result in inconsistent numbers throughout the BOM sources.

Source: Various

Lower grade gold ore (down to two hundredths of an ounce of gold or less per ton of ore), which may be crushed, is piled onto lined “pads,” and a “barren” cyanide solution is applied to the surface. The cyanide solution percolates through the heap, dissolving gold values. This “pregnant” solution is recovered from the base of the heap, gold is recovered from the solution, and the “barren” solution is refortified with cyanide and reapplied. The pregnant and barren solutions are generally stored in lined ponds. Following leaching, spent ore may either be left in place (with new ore added over it) or removed for disposal (after detoxification/neutralization) in a spent ore pile/dump. Where spent ore is managed in place, neutralization of the residual cyanide occurs after the heap has reached the maximum height (EPA, 1994, 1994c, and 1994i).

The process of using cyanide to extract gold works most effectively on oxide ores. (Oxide ores are those exposed to weathering and the action of water, and that have little or no sulfur content.) As the sulfur content of the ore increases, the efficiency of gold recovery decreases. As shallow oxide deposits are mined out, gold mines are beginning to extract ores with ever higher concentrations of sulfur bearing minerals. In response, operators are treating these sulfide ores with a variety of techniques to reduce their sulfur content. Such techniques include roasting and biological treatment. The trend towards greater exploitation of sulfide ores is of concern in that these ores contain potentially acid generating sulfide minerals, as does the waste rock (EPA, 1994c and 1994i).

In addition, copper ores are increasingly being leached, primarily in very large dumps (e.g., Cyprus Minerals Col, ASARCO, Inc., and Magma Copper Co.) but also *in situ*. Leaching of copper ores has occurred since the 1950s and 1960s, but the use of dump leaching for copper recovery has only become viable during the past decade, with the acceptance of solvent extraction/electrowinning (SX/EW) technology. In this process, oxide ores and low grade sulfide ore (those that cannot be economically milled and recovered by flotation) are placed in lined heaps or unlined dumps, typically with no crushing or grinding. Leaching solution is applied to the surface and collected at the base. Ore can also be leached *in situ*, with leach solution injected into the ore body through wells and recovered in underground workings or through recovery wells. The pregnant solution from these leach operations is collected and conveyed to the SX plant, where the copper is extracted by a proprietary organic chemical dispersed in a kerosene diluent. The copper is then extracted from the organic base with a strong sulfuric acid solution that then becomes the electrolyte for electrowinning. In the electrowinning tankhouse, the copper is plated out of solution onto a cathode suitable for sale. The entire SX/EW process is almost exclusively closed-looped. For low-grade sulfide ores, water is the lixiviant; for oxide ores, sulfuric acid is used to make up leaching solution. To facilitate collection of pregnant solution, dump leach units are typically located within a pit or a natural drainage. Dump leach units (and *in situ* operations) are not always designed to ensure maximum collection of pregnant solution; there are technological limits to containment, but the more important factor is the balance struck between the economics of facility design/construction and the anticipated efficiency of solution recovery. (Another factor, state regulation, is increasingly important: Arizona’s new regulations, for example, have led to increased attention on improving solution containment there (EPA, 1994 and 1994a).)

Mineral processing operations generally follow beneficiation and include techniques that often change the chemical make-up of the ore or mineral by chemical attack or digestion, electrolytic refining, and pyrometallurgical/thermal processes. In contrast to extraction and beneficiation wastes, processing operations generate waste streams that generally bear little or no resemblance to the materials that entered the operation.

When mineral processing operations are co-located with extraction and beneficiation operations, commingling of extraction and/or beneficiation and mineral processing wastes (both Bevill and non-Bevill) may occur. Most often, the volume of processing waste is very small compared with the total waste quantity managed on-site (e.g., co-disposing a few thousand tons per year of wastewater treatment sludge with millions of tons of mill tailings). In these cases, management of the mixed waste streams usually occurs in a land disposal unit, such as a tailings pond or other surface impoundment, or, in some industry sectors, a gypsum stack.

Environmental Performance

Mining operations can be and have been sources of widespread environmental impacts, with more than 60 sites on the National Priorities List. During the past 20 years, however, there has been significant improvement in environmental performance at many hardrock mining operations. This is due to many factors:

- Increasing environmental awareness and commitment to environmental protection by many mining companies.
- Better techniques to predict and detect potential environmental effects before damage occurs.
- Continually developing technologies to prevent, mitigate, or remediate environmental impacts.
- Broader state and federal regulatory requirements, including post-mining liability.

Many of the largest mining companies have set up extensive environmental programs. They have begun to incorporate environmental concerns into all phases of mining operations, from exploration to mining planning, through development, operations, closure and reclamation. At some mines, management performance standards now include environmental accomplishments. Other mining companies have set up comprehensive environmental auditing programs. Therefore, environmental costs are now being characterized during the earliest stages of mine planning as part of the economic evaluation of recovering target minerals (EPA, 1994).

The most significant environmental threats posed by mine sites are often complex and highly dependent on site-specific factors. Acid generation potential and water balances, for example, can be very difficult to predict, but also can be very difficult, and expensive, to deal with once problems occur. Poor understanding of water balances, or site hydrology, can contribute to making uninformed decisions about control technologies, and that in turn can result in environmental problems. During the past decade, predictive tools have been greatly improved; this reduces uncertainty and provides more reliable information to develop and carry out mitigation measures. Uncertainty does remain, though, and unanticipated environmental impacts continue to occur at some sites, which emphasizes the need for continued development and refinement of site characterization and mine planning tools (EPA, 1994 and 1994k).

Along with better predictive tools, technologies also continue to be developed to reduce potential environmental threats and address impacts where they do occur. Mining companies have learned to build better, more efficient, and more environmentally safe operations. Advances in liner and other containment systems, piping and spill control, and reclamation techniques are all examples of such improvements. It is important to recognize that the economic costs of environmental controls are a significant element, as is the concentration of the target mineral in the ore body, in the planning and economic evaluation of a site for mine development and operation. Environmental controls must be affordable, cost-effective, and meet certain standards. Where there are potential or actual releases to the environment, treatment and remedial technologies also continue to evolve. For example, nearly 20 years ago, the Homestake Mining Company developed an innovative biotreatment technology for cyanide destruction at the company's gold mine in Lead, South Dakota. Other biotechnologies are being started and improved for cyanide heap leach detoxification and acid drainage control, among other environmental applications. Information management and process controls are also improving environmental performance at many mine and mill sites. By better classifying ore grades and by improving mineral recovery from ore, mines and mills can improve productivity and thus generate somewhat less waste rock or tailings for every pound of metal recovered. (Better classification and recovery, however, have finite limits imposed by the absolute amount of the valuable mineral in the ore and the technologies that are available for recovery.) Because of the high waste-to-product ratios and the volume of wastes generated, however, any improvement in recovery can reduce wastes by substantial amounts (but generally only by small proportions) (EPA, 1994 through 1994k).

Historic mining operations were often unregulated, resulting in extensive uncontrolled environmental releases. In recent decades, particularly since the early 1970s, state and federal agencies have established broad regulatory requirements that generally address all phases of mine operations. During mine planning, operators may be required to complete baseline studies and assess the potential effects of and risks associated with proposed operations. Mine units frequently have to meet specific design standards (liner requirements, stability standards, overflow protection, etc.). Environmental statutes and regulations, such as the Clean Water Act, Clean Air Act and corresponding state requirements, are intended to address environmental releases. Bonding requirements are imposed to ensure that reclamation will be successfully completed. In some states, bonding also serves to protect against environmental problems.

4. MINING AND THE ECONOMY

All non-fuel mineral beneficiation and extraction activities accounted for approximately 0.23% of GNP (Commerce, 1995a) and 0.85% of total employment (Commerce, 1995c) at the national level in 1993. In contrast, the manufacturing industries accounted for 17.63% of GNP (Commerce, 1995a) and 19.2% of total employment (Commerce, 1995c) during the same year. The apparently small portion of the national economy attributed to mining can be traced to several factors: 1) the national economy of the United States is the largest, and most diverse, in the world; 2) improvements in productivity, technology, and mechanization have reduced the need for a large workforce; and 3) the mining sector of the economy has not grown at the same rate as other major sectors of the economy (U.S. Department of Commerce, 1995a).

Although basic non-fuel metal mining occupies a statistically small position in the overall national economy, the mining sector provides basic raw materials for major sectors of the U.S. economy, and thus is more important then the mere numbers suggest. Copper is essential to the electronics and construction industries. Iron ore provides the base material for the steel, automotive, and transportation industries. Molybdenum is used in steel production, machinery, electrical and chemical manufacturing. Potash and phosphate rock are used in fertilizers and chemical manufacturing. Gold, while primarily used in jewelry and the decorative arts, is also used in the electronics industry and dentistry. These minerals are essential to the operation of a modern, industrialized economy. Without a domestic iron ore industry for example, the unit cost to produce automobiles in the United States would be significantly different. Copper, molybdenum, phosphate rock, gold, silver, lead, and zinc play similar roles. The amount of raw materials produced by the U.S. mining industry has provided and will continue to provide raw materials necessary to drive the diverse U.S. economy.

Other important contributions of the minerals industry to the national economy are its value as a producer of exports, and in reducing industrial dependence on certain minerals that would otherwise be imported. For example, in 1994 the United States exported 8% of the lead and 75% of the molybdenum it produced. Conversely, the United States imported 22% of the iron ore it consumed in 1994.

While mining is a small part of the national economy, the importance of mining to state economies varies widely (See Table 6). Of the twelve states producing significant amounts of minerals, there exists a large difference in the percentage of GSP (gross state product) contributed by mining. Generally, states with large, diverse economies (Florida, Missouri) reflect the same trend as is evidenced at the national level: mining is responsible for a very small percentage of GSP. This is even true in Arizona, which is ranked first in terms of dollar value of copper produced, yet whose mining sector accounts for “only” 2.32% of GSP. However, in states with smaller, less diverse economies, mining has a much greater role in the state economy. This is notable in Montana and New Mexico, where mining accounts for 7.39% and 9.38% of GSP, respectively (U.S. Department of Commerce, 1995b). Mining at the state level is similarly important to overall employment. As shown in Table 7, the percentage of state employment in the mining sector is small in the five states that are the major producers of their respective commodities.

Table 6. Percentage of GSP Derived from Mining (1992)

State	% GSP
Arizona	2.32
Florida	0.31
Minnesota	0.86
Missouri	0.40
Michigan	0.61
Montana	7.39
Nevada	8.58
New Mexico	9.38
South Carolina	0.25
South Dakota	2.00
Utah	5.15
Wisconsin	0.16

On average, the hardrock mining industry is a viable industry. However, some firms and individual

Table 7. Economic Status of Mining in Major Producing States (1991)

Leading State	Commodity	Value of Commodity ($)	# of Employees	% State Employment	% State GSP
Nevada	Gold	2.1 billion	11,730	1.86	8.58
Arizona	Copper	2.7 billion	11,800	0.74	2.32
Minnesota	Iron	1.22 billion	6,200	0.27	0.86
Florida	Phosphate Rock	W	W	-	0.31
Missouri	Lead	240 million	4,700	0.18	0.40

Note:
W Data withheld by Bureau of Mines to protect proprietary sources

Sources:
U.S. Department of the Interior, Bureau of Mines. 1993. *State Mineral Commodity Summaries, 1993*.
U.S. Department of Commerce. 1993. *Statistical Abstract of the United States*.

mines, particularly small ones, have financial difficulties. Assessing the financial health of individual commodities is difficult because many firms produce various commodities from various countries. Reports by Standard and Poor's, Moody's and the Value Line assess the finances for the mining companies, which includes non-American holdings. In addition, publicly available financial statements for companies are consolidated, and include the assets, liabilities, and operating accounts of the parent company and its subsidiaries. This creates a problem in trying to understand the financial health of the American hardrock mining industry because the consolidated financial statements include financial information from operations outside of the United States. Therefore, it becomes a problem in distinguishing the financial health of the American mining industry from the world's mining industry.

The discussion below covers the major industry sectors, as reported by Standard & Poor's, Moody's, and the Value Line. Individual commodities not discussed indicates that Standard & Poor's or Moody's did not compile information. Note that the latest financial information reported by Standard & Poor's, Moody's, and the Value Line includes information ending before the economic recovery of the mid-1990s. It should also be noted that the industry's, and individual companies', financial health can be quite volatile over relatively short periods of time, so the discussion that follows is necessarily only a snapshot in time.

Copper. Three financially viable producers dominate the copper mining industry (ASARCO Incorporated, Cyprus Amax Mining Company, and Phelps Dodge). However, other firms are not as financially healthy. From 1989 to 1992, the copper mining industry was characterized by decreasing operating revenues, net income (including some companies with negative net income), asset-use efficiency, average share prices, and earnings per share. Short-term and long-term liabilities have increased for some companies but are stable. Overall the industry is financially secure.

Lead and Zinc. For purposes of its analysis, Standard & Poor's combined the lead and zinc industries. Leading lead producers include The Doe Run Company, ASARCO, and Cominco, while leading zinc producers include Cominco, Doe Run, Jersey Miniere Zinc, and the Green Creek mine (Kennecott, Hecla, and others). From 1988 to 1991, decreasing operating revenues, net income (including some companies with negative net income), asset-use efficiency, average share prices, and earnings per share characterized the lead and zinc mining industry. The industry began a modest improvement in 1992. Short-term and long-term liabilities have remained constant, but decreasing sales has reduced the industry's ability to meet short-term and long-term obligations. Companies focusing on the lead and zinc industry may be problematic.

Gold. The gold mining industry is dominated by a few firms (Barrick Gold Corporation, Echo Bay Mines Limited, Homestake Mining, Lac Minerals Limited, and Newmont Mining Corporation) that are gaining an increasing portion of the market share. None of these firms have a problem meeting either short- or long-term debt. Decreasing operating revenues, net income and increasing liability characterize smaller firms. In the gold mining industry, the major producing companies are financially strong, although other firms within the industry are not as healthy and some have a problem meeting short-term debt.

Silver. Many companies that produce gold also produce silver. Therefore, much said about gold can also be repeated for silver. However, Standard & Poor's classifies a few firms as primarily silver producers (Coeur d'Alene Mines Corporation, Hecla Mining Corporation, and Sunshine Mining Company). Net income for silver producers has continued to decline with the three major silver producers having negative net income during 1991 and 1992. However, the companies do not have liquidity problems. Based on current ratios (current assets divided by current liabilities), the three companies have had consistently large cash reserves.

Miscellaneous sectors. In the metals-miscellaneous category, Standard & Poor's used financial data from several selected companies that mine diverse commodities. On average, for the companies in the miscellaneous category sales, operating income, profit margin, cash flow, and earnings have all decreased. All of the indicators started to decrease in 1988 and continued until 1992. However, based on measures of liquidity for selected companies there does not appear to be a problem meeting short- and long-term liabilities.

Capital Expenditures for Pollution Abatement. The U.S. Bureau of the Census does not separate capital expenditures for pollution from companies identified by SIC codes 10, 11, 12, or 14, but reports them together (those SIC codes include metal mining, industrial minerals mining, and coal mining). In 1991, capital expenditures for pollution abatement equipment was a combined $273.6 million for these four major groups. This included expenditures of $117.5 million for air pollution control, $119.6 million for water pollution control, and $38.5 million for solid waste control (U.S. Department of Commerce, 1993).

5. INACTIVE AND ABANDONED MINES

The number of inactive and abandoned mines in the United States is simply not known. (Although "inactive and abandoned mines," or IAMs, has become a commonly used term, the mines so categorized may be better described as abandoned mines; most mines that are temporarily inactive are still considered "active" by state and federal regulators.) Many federal agencies and others have made estimates of the number of mines, with little consistency and unknown accuracy. There are several areas of agreement among most sources and commentators. First, nearly all agree that the total number of abandoned mines is very large. In addition, there is some agreement that only a minority cause environmental damages--the size of the minority is uncertain, however. Also, many have noted that some mines pose a threat to safety but otherwise pose little or no risk to human health or the environment. Finally, there is also some agreement that the costs of remediation dwarfs available resources, at whatever level.

Major areas of disagreement include the extent to which resources should be devoted to detailed inventories instead of remediation (the ultimate issue is how sites should be ranked), what the cleanup goals should be, and who should be the responsible party (e.g., federal or private land owners or prior claimants/lessees). If additional resources were made available for remediation, the major issue would likely become establishing priorities among sites (Frieders and Raney, 1994).

6. TRENDS

Commodity prices are generally set or at least strongly influenced by the global economy. In addition, there are alternative sources for every commodity mined in the United States, many at lower or marginally higher costs. Thus, increases in production costs in the United States compared with other sources could reduce U.S. production of any commodity.

Future trends in the United States mining industry are almost entirely dependent on various aspects of the domestic and world economies. As such, they are extremely difficult to predict with any degree of certainty. The following are observations (taken largely from Bureau of Mines, 1992a, 1992b, 1993, and 1995) on trends that are likely to occur or that have been predicted.

To some extent, changes in the environmental requirements can affect future trends in the domestic mining industry that are applicable to mining operations. Industry reports (including annual reports and other filings) and Bureau of Mines commentaries nearly always note the uncertainty of future environmental requirements and the impacts those requirements may have on the cost of production. The most commonly cited areas of uncertainty are possible requirements under a RCRA program and possible liability under Superfund. The actual effects of existing regulations (including the many new state requirements), not to mention possible future effects, have not been well assessed.

Gold. Contrary to prices of most metals and other commodities (e.g., copper), gold prices increase in uncertain times. No major economic expansions or retractions are being predicted, so gold production worldwide is likely to hold steady or increase slowly in coming years. Prices should do the same, although increased production from the former Soviet Union could drive prices down somewhat. Unless gold prices increase dramatically, however, U.S. production is likely to decline over time as higher grade deposits are mined out in the contiguous states. Many gold mines that opened in the late 1970s and early 1980s have reached or are nearing the end of their active lives. Thus, unprecedented numbers of mines are (or will be) closing and being reclaimed under “modern” environmental requirements. In addition, future production will come increasingly from lower-grade ores (which will increase waste generation, even as production declines) and ores with higher sulfide content.

Copper. Copper prices and production are very sensitive to global and domestic economic health. Expansions trigger increases in demand and prices, which drive production upward. Increasingly, U.S. mines are leaching copper from lower-grade ores, which significantly increases the waste-per-product ratio. This trend will likely continue, as several major U.S. copper operations have announced major expansions of SX/EW production. State reclamation requirements have only recently been developed and imposed on operations in Arizona and New Mexico, where most copper production occurs, and the impacts of those requirements are not clear.

Lead. Although domestic demand for lead grew an average of 4 percent per year from 1985 to 1989, the Bureau of Mines predicts that the growth in domestic lead demand will range from 0.5 percent to 1.5 percent per year during the 1990s. The availability of scrap lead will influence production increases and decreases in the U.S. secondary industry (Jordan, 1994). The most probable world growth in lead use until the end of the century is forecast to average about 1.5 percent per year. In recent years, the United States has increasingly relied on secondary sources (e.g., scrap batteries), and concern over lead exposure has reduced lead consumption.

Phosphate Rock. World production and consumption have declined steadily since 1989. After 1993, a modest increase was forecast. The long-term growth in phosphate rock production is forecast to average about 1.3 percent annually beginning in 1997.

Iron Ore. The domestic iron ore industry is entirely dependent on the steel industry for sales (molybdenum also is used primarily in the steel industry, and molybdenum trends should follow iron). Dependence is not expected to change in the near future. For the long-term there is little expected growth in the domestic steel industry or countries with highly developed economies. In contrast to the United States, the demand for iron ore is expected to increase, especially in Asia. The increase in iron ore consumption in Asia is expected to benefit Australia rather than the United States

Uranium. Uranium mines within the United States produced 522 metric tons (1.4 million pounds) of U_3O_8 equivalent in 1992. Production figures from 1992 showed a drop of more than 70 percent from 1991 levels and the lowest level of production since 1951. Uranium prices and production are down. In 1992, the average price per pound of uranium oxide equivalent was $8.70, down from an average of $13.66 in 1991 (U.S. Department of Energy, 1993). Uranium requirements in the next two decades are forecast to increase at less than 1 percent per year. Decreases are possible in the near term, as premature shutdowns of existing reactors balance the few new additions. Development of new projects without most or all of the production from the new projects being committed will not occur. In addition, future uranium supplies for nuclear power will contain 15 percent converted weapons material by the year 2000 (Pool, 1994).

Platinum. Platinum sales are dependent largely upon the automobile industry, since platinum is used in catalytic converters. The automobile market is expected to continue growing until 1997 and then to slow (Federal Reserve, 1994).

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APPENDIX B

POTENTIAL ENVIRONMENTAL IMPACTS OF HARDROCK MINING

TABLE OF CONTENTS

1. Introduction: The Nature of Mining Sources

Hardrock mining, as described in Appendix A, is a large-scale industrial activity that takes place in the natural environment potentially disturbing large amounts of material and land area. Large volumes of mining waste are generated because of the high waste-to-product ratios associated with producing most ores. "Waste" is defined as the leftover material generated as a result of mining and benefication activities used to recover a target mineral. Most of the materials handled in mining are wastes, or non- marketable products, distinguishing the industry from others that generate less waste in comparison to those materials used in the final product. Consequently, operations at some of the larger mine sites handle more material and generate more waste than many entire industries.

This appendix describes potential environmental effects of hardrock mining. EPA recognizes that some of the discussion in this appendix may not accurately reflect the environmental conditions at modern hardrock mining operations that are well designed, well operated, and well regulated. The intent of the discussion is to highlight environmental problems at (predominantly historic) mining sites and to suggest that these are potential problems that could occur at existing and future sites. In addition, there is some repetition in the following sections resulting from the inter-related nature of impacts (for example, the fact that erosion and sedimentation are relevant both to water quality and aquatic ecosystem quality). Following a brief section that recaps some of the discussion from Appendix A, successive sections describe several of the major impacts of mining operations.

Overview of operations and major pollutant sources. At mining sites, the major pollutant sources of concern include waste rock/overburden disposal, tailings, heap leaches/dump leaches, and mine water. Waste rock/overburden is the soil and rock mining operations move during the process of accessing an ore or mineral body. It also includes rock removed while sinking shafts, and accessing or exploiting the ore body and rock bedded with the ore. The size of the waste rock ranges from small clay particles to boulders. Waste rock can be used as backfill in previously excavated areas or transported off-site and used at construction projects. However, most of the waste rock generated is disposed of in piles near the mine site.

Tailings are the waste solids remaining after beneficiation of ore through a variety of milling processes. After the ore is extracted from the mine, the first step in beneficiation is generally crushing and grinding. The crushed ores are then concentrated to free the valuable mineral and metal particles from the less valuable rock. Beneficiation processes include physical/chemical separation techniques such as gravity concentration, magnetic separation, electrostatic separation, flotation, solvent extraction, electrowinning, leaching, precipitation, and amalgamation. Conventional beneficiation processes generate tailings, which generally leave the mill as a slurry consisting of 40 to 70 percent liquid and 30 to 60 percent solids. Most mine tailings are disposed of in onsite impoundments, such as tailing ponds.

Leaching is another beneficiation process commonly used to recover certain metals, including gold, silver, copper, and uranium, from their ores. In dump leaching, the material to be leached is generally placed (or is already located) directly on the ground and a leaching solution is applied to the material. The type of leaching solution used depends on the characteristics of the ore and the mineral. As the liquid percolates through the ore, it leaches out metals. Leaching may recover economic quantities for years or decades. Dump leach piles can be very large, often covering hundreds of acres. Heap leaching (as distinguished from dump leaching) is used for higher trade (more valuable) ores and is generally smaller than dump leach operations. Almost invariably, there are one or more impermeable liners under the leach material to maximize recovery of the leachate. Heap leaching often takes place over months rather than years. When leaching no longer produces economically attractive quantities of valuable metals, the spent ore is left in place (or nearby) after rinsing or other detoxification.

Long-Term Nature of Mining Impacts. Closure of a mining operation occurs during temporary shutdown of operations or permanent decommissioning of the facilities. During downturns in metals markets and cash flows, temporary shutdowns can reduce the expenditures necessary to maintain environmental controls (roads and diversions erode, siltation ponds and spillways deteriorate even as they are filling and losing treatment capacity). Although reclamation is often thought of as involving only regrading and revegetation, permanent closure now includes such actions as removal/disposal of stored fuels and chemicals, structure tear down, removal of roadways and ditches, sealing of adits, capping of tailings, waste detoxification and final removal of sediment control structures and/or reestablishment of drainage ways. Long-term maintenance is required in many closure situations, such as equipment fueling and lubrication after normal maintenance facilities have been removed, water diversions, dam stability, water treatment, and treatment sludge management. Without accrued funds or other cash flows to cover these expenses, there can be substantial risk of inadequate attention to proper site closure. Reclamation cost estimates--and bonds--are still sometimes based primarily on regrading and revegetation, and thus can easily underestimate true closure expenses.

The long-term nature of mining impacts requires that predictive tools, design performance, monitoring, and financial assurance be effective for many decades. For example, negative changes in geochemistry over time can occur when a materials' environment changes (e.g., going from a reducing environment to an oxidizing one) or buffering capacity is exceeded (such as when the total neutralizing capacity of a rock mass is exceeded by acid generation). When these conditions are present, problems can develop well into, or after, a facility's operating life. Predictive tools can help mitigate potential problems by factoring control measures into facility designs and operating plans, while design/operation can be modified based on monitoring. Financial assurance helps ensure that resources will be available to address long-term mine water and site management.

Complicating the effective environmental control at mining sites is the interrelationship between the extraction, beneficiation, and processing of the ore material and the waste materials generated from each of these operations. Together, mining operations and the pollutant sources of concern can affect surface and ground water quality, create hydrologic impacts, decrease air quality, contaminate soils, and diminish ecosystem quality. The major categories of environmental problems encountered from mining are discussed briefly below. The following sections describe surface water quality, ground water quality, hydrologic impacts, physical stability, air quality, soils, and terrestrial and aquatic habitat/ecosystem quality issues.

2. SURFACE WATER QUALITY ISSUES

One of the problems that can be associated with mining operations is the release of pollutants to surface waters. Many activities and sources associated with a mine site can contribute toxic and nontoxic materials to surface waters. Open pits, tailings ponds, ore and subore stockpiles, waste rock dumps, and heap and dump leach piles are all potentially significant sources of toxic pollutants. The mobility of the pollutants from these sources is magnified by exposure to rainfall and snowfall. The eventual discharge of surface runoff, produced from rainfall and snow melt, is one mechanism by which pollutants are released into surface waters. Seepage from impoundment areas and ground water originating from open pits and mine openings is another example by which heavy metals can be mobilized and eventually released to surface waters. Releases of pollutants to surface waters may also occur indirectly via ground water that has a hydrological connection to surface water.

Impacts to surface waters include the buildup of sediments that may be contaminated with heavy metals or other toxics, short- and long-term reductions in pH levels (particularly for lakes and reservoirs), destruction or degradation of aquatic habitat, and contamination of drinking water supplies and other human health issues.

Acid Drainage. It is generally acknowledged that a major environmental problem facing the U.S. mining industry is the formation of acid drainage and the associated mobilization of contaminants. Commonly called acid mine drainage (AMD) or acid rock drainage (ARD), acid drainage primarily depends on the mineralogy of the rock material and the availability of water and oxygen. Acid drainage is generated at both abandoned and active mine sites. Although testing methods used to predict AMD have improved in recent years, there is often substantial uncertainty, and new mines can develop unpredicted AMD after only a few years of operation.

The potential for a mine or its associated waste to generate acid and release contaminants depends on many site-specific factors. AMD occurs at mine sites when metal sulfide minerals are oxidized. Metal sulfide minerals are common constituents in the host rock associated with metal mining activity. Before mining, oxidation of these minerals and the formation of sulfuric acid is a (slow) function of natural weathering processes. Natural discharge from such deposits poses little threat to aquatic ecosystems except in rare instances. Mining and beneficiation operations greatly increase the rate of these same chemical reactions by removing sulfide rock material and exposing the material to air and water. Once acid drainage has occurred, controlling the releases is a difficult and costly problem, so prediction is becoming an important tool for regulators and operators.

Materials and wastes from metal mining activities that have the potential to generate acid drainage include spent ore from heap and dump leach operations, tailings, waste rock, and overburden material. Equally or more important at some sites are the pit walls at surface mining operations and the underground workings associated with underground mines.

Acid generation is largely the result of oxidation of metallic sulfides. The major metallic sulfide of concern is iron sulfide (FeS_2), or pyrite. All metal sulfides and reduced mineral species can potentially contribute to acid generation. Metal sulfides besides pyrite that contribute to acid generation include galena (lead sulfide), sphalerite (zinc sulfide) and chalcopyrite (iron copper sulfide).

Both water and oxygen are necessary to generate acid drainage. Water serves as both a reactant and a medium for bacteria to catalyze the oxidation process. Water also transports the oxidation products. A ready supply of atmospheric oxygen is required to drive the oxidation reaction. Oxygen is particularly important to maintain the rapid bacterially catalyzed oxidation at pH values below 3.5. Oxidation is significantly reduced when the concentration of oxygen in the pore space of mining waste units is less than 1 or 2 percent. The type of bacteria and the population necessary to catalyze oxidation change as pH levels, chemical and physical characteristics of the soil and water environments change (Ferguson and Erickson, 1988).

Other factors affecting acid drainage are the physical characteristics of the material, the placement of the acid-generating and any acid-neutralizing materials (whether naturally occurring in the material or supplemental), and the climatologic and hydrologic regime in the vicinity. The physical characteristics of the material, such as particle size, permeability, and weathering characteristics, are important to the acid generation potential. Particle size is a fundamental concern since it affects the surface area exposed to weathering and oxidation: smaller particles have more surface area and therefore more reactive sites than larger particles. The relationships between particle size, surface area, and oxidation play a prominent role in acid prediction methods.

The hydrology of the area surrounding mine workings and waste units is important in the analysis of acid generation potential. Wetting and drying cycles in any of the mine workings or other waste units will affect the character of any produced acid drainage. Frequent wetting will generate a more constant volume of acid and other contaminants as water moves through and flushes oxidation products out of the system. The buildup of contaminants in the system is proportional to the length of time between wetting cycles. As the length of the dry cycle increases, oxidation products will accumulate in the system. A high magnitude wetting event will then flush the accumulated contaminants out of the system. This relationship is typical of the increase in the contaminant load observed following heavy precipitation for those areas having a wet season. In underground mines, however, the acid generating material occurs below the water table and the slow diffusion of oxygen in water can retard acid production.

During acid generation, the pH values of the associated waters typically decrease to values near 2.5. These conditions result in the dissolution of the minerals associated with the metallic sulfides and release of toxic metal cations (e.g., lead, copper, silver, manganese, cadmium, iron, and zinc). In addition, the concentration of dissolved anions (e.g., sulfate) also increases.

Acid generation and drainage affect both surface and ground water. The sources of surface water contamination are leachate from mine openings, seepage and discharges from waste rock or tailings or spent ore, ground water seepage, and surface water runoff from waste rock and tailings piles. It should also be noted that mined materials--waste rock or tailings--used for construction or other purposes (e.g., road beds, rock drains, fill material) or off a mine site can also develop acid drainage.

The receptors of contaminated surface water include aquatic birds, fish and other aquatic organisms, and humans. Direct ingestion of contaminated surface water or direct contact through outdoor activities such as swimming can affect humans. Fish, birds, and other aquatic organisms are potentially affected by bottom foraging and direct exposure to surface water.

No easy or inexpensive solutions to acid drainage exist. Two primary approaches to addressing acid generation are 1) avoiding mining deposits with high acid generating potential and 2) isolating or otherwise special-handling wastes with acid generation potential. In practice, avoiding mining in areas with the potential to generate acids may be difficult due to the widespread distribution of sulfide minerals. Isolation of materials with the potential to generate acids is now being tried as a means of reducing the perpetual effects to surface water and ground water from mining wastes. Control of materials with a potential for acid generation can be implemented by preventing or minimizing oxygen from contacting the material, preventing water from contacting the material, and/or ensuring that an adequate amount of natural or introduced material is available which can neutralize any acid produced. Techniques used to isolate acid generating materials include subaqueous disposal, covers, waste blending, hydrologic controls, bacterial control, and treatment.

Acid generation prediction tests are increasingly relied upon to assess the long-term potential of a material, or waste, to generate acid. Mineralogy and other factors affecting the potential for AMD formation are highly variable from site to site, and this can result in difficult, costly, and questionable predictions. In general, the methods used to predict the acid generation potential are classified as either static or kinetic. These tests are not intended to predict the rate of acid generation, only the potential to produce acid. Static tests can be conducted quickly and are inexpensive compared with kinetic tests. Kinetic tests are intended to mimic the processes found in the waste unit environment, usually at an accelerated rate. These tests require more time and are much more expensive than static tests.

Cyanide Heap Leaching. For over a century, the mining industry has used cyanide as a pyrite depressant in base metal flotation and in gold extraction. Continued improvements in cyanidation technology have allowed the economic mining of increasingly lower-grade gold ores. Together with continued high gold prices, these improvements have resulted in increasing amounts of cyanide being used in mining. The mining industry now uses much of the sodium cyanide produced in the United States, with more than 100 million pounds used by gold/silver leaching operations in 1990.

Aqueous cyanide (CN^-) has a negative valence and reacts readily to form more stable compounds. Aqueous cyanide complexes readily with metals in the ore, ranging from readily soluble complexes such as sodium and calcium cyanide, to the complexes measured by weak acid dissociable (WAD) cyanide analytical methods, to strong complexes such as iron-cyanide. At a pH below 9, weaker cyanide compounds can dissociate and form HCN, a volatile poison gas that rapidly evaporates at atmospheric pressure. The stronger complexes are generally very stable in natural aqueous conditions.

Unsaturated soils provide significant attenuation capacity for cyanide. Within a short time and distance, for example, free cyanide can volatilize to HCN if solutions are buffered by the soil to a pH below 8. Adsorption, precipitation, oxidation to cyanate, and biodegradation can also attenuate free (and dissociated complexed) cyanide in soils under appropriate conditions. WAD cyanide behavior is similar to that of free cyanide except WAD cyanide also can react with other metals in soils to form insoluble salts.

Many other constituents besides cyanide may be present in the waste material, creating potential problems following closure and reclamation. Nitrate (from cyanide degradation) and heavy metals (from trace heavy metals in the ore) migrations are examples of other significant problems that can be faced at the closure of cyanide operations.

Water balance is a major concern at some sites. In arid regions, with limited water resources, the amount of water necessary to rinse heaps to a required standard could be a significant concern. Conversely, in wet climates like South Carolina, excess water from heavy precipitation and/or snow melt can place a strain on system operations and may make draining or revegetating a heap or impoundment very difficult.

In addition, the chemistry of a spent heap or tailings impoundment may change over time. Although effluent samples at closure/reclamation may meet state requirements, the effluent characteristics may be dependent on the pH. Factors affecting chemical changes in a heap or tailings impoundment include pH, moisture, mobility, and geochemical stability of the material. The principal concerns with the closure of spent ore and tailings impoundments are long-term structural stability and potential to leach contaminants. The physical characteristics of the waste material (e.g., percent slimes vs. sands in impoundments), the physical configuration of the waste unit, and site conditions (e.g., timing and nature of precipitation, upstream/uphill area that will provide inflows) influence structural stability.

The acute toxicity of cyanide, and many major incidents, have focused attention on the use of cyanide in the mining industry. When exposure occurs (e.g., via inhalation or ingestion), cyanide interferes with many organisms' oxygen metabolism and can be lethal in a short time.

Overall, cyanide can cause three major types of environmental impacts: first, cyanide-containing ponds and ditches can present an acute hazard to wildlife and birds. Tailings ponds present similar hazards, but less frequently (because of lower cyanide concentrations). Second, spills can result in cyanide reaching surface water or ground water and cause short-term (e.g., fish kills) or long-term (e.g., contamination of drinking water) impacts. Finally, cyanide in active heaps, ponds and in mining wastes, primarily spent ore heaps, dumps and tailings impoundments, may be released and present hazards to surface water or ground water. Geochemical changes can also affect the mobility of heavy metals.

Through the 1980s, as cyanidation operations and cyanide usage proliferated, many incidents occurred where waterfowl died after using tailings ponds or other cyanide-containing solution ponds (e.g., pregnant or barren ponds). Operators in Nevada, California, and Arizona reported to regulatory authorities more than 9,000 wildlife deaths, mostly waterfowl, that had occurred on federal lands in those states from 1984 through 1989. In addition, many major spills have occurred, the most significant occurring in South Carolina in 1990, when a dam failure resulted in the release of more than 10 million gallons of cyanide solution, causing fish kills for nearly 50 miles downstream of the operation.

The heightened awareness of the threat to wildlife presented by cyanide-containing ponds and wastes led federal land managers and states to develop and implement increasingly stringent regulations or, more often, non-mandatory guidelines. These regulations and/or guidelines address the design of facilities that use cyanide (e.g., requiring/recommending liners and site preparation for heap leach piles or tailings impoundments), operational concerns (e.g., monitoring of solutions in processes and in ponds, and sometimes treatment requirements for cyanide-containing wastes), and closure/reclamation requirements (e.g., rinsing to a set cyanide concentration in rinsate before reclamation can begin). Operators are generally required to take steps either to reduce/eliminate access to cyanide solutions or to reduce cyanide concentrations in exposed materials to below lethal levels. Regulatory requirements and guidelines as to the allowable concentration of cyanide in exposed process solutions are widely variable (when numeric limitations are established, they generally range around 50 mg/l), as are the means by which operators comply. Operators reduce access in several ways, including covering solution ponds with netting or covers, using cannons and other hazing devices (e.g., decoy owls) to scare off waterfowl and other wildlife, and/or installing fencing to preclude access by large wildlife.

Closure and reclamation measures are becoming increasingly well established for cyanide heap leaching operations but are not entirely proven because of their recent use. Closure entails those activities conducted after a cyanide unit ceases operating in order to prepare the site for reclamation. Closure essentially consists of those activities required to remove a hazard or undesirable component, whether it is chemical or physical, to the extent required by states or federal land managers. It can entail detoxification/

neutralization of wastes, treatment and/or evaporation of rinse liquids and pond water, dismantling associated equipment and piping, removal or treatment of waste, reconstruction, grading or stabilizing, and/or chemical testing. Reclamation consists of those activities undertaken to return the site to a condition suitable for the future uses specified by the state or federal land manager. Reclamation may involve regrading; backfilling ponds; removal of wastes; site drainage control such as diversions, channels, riprap, and collection basins; perforating liners to allow drainage through heaps; capping to reduce infiltration and/or to provide a substrate for revegetation; and revegetation to establish ground cover and protect against erosion.

Metals and Dissolved Pollutants. Dissolved pollutants (primarily metals, sulfates, and nitrates) can migrate from mining operations to local ground and surface water. While AMD can enhance contaminant mobility by promoting leaching from exposed wastes and mine structures, releases can also occur under neutral pH conditions. Primary sources of dissolved pollutants from metal mining operations include underground and surface mine workings, overburden and waste rock piles, tailings piles and impoundments, direct discharges from conventional milling/beneficiation operations, leach piles and processing facilities, chemical storage areas (runoff and spills), and reclamation activities. Discharges of process water, mine water, runoff, and seepage are the primary transport mechanisms to surface water and ground water.

One potential source of dissolved pollutants is chemical usage in mining and beneficiation. Common types of reagents include copper, zinc, chromium, cyanide, nitrate and phenolic compounds, and, at copper leaching operations, sulfuric acid. Except for leaching operations and possibly the extensive use of nitrate compounds in blasting and reclamation, the quantities of reagents used are very small compared with the volumes of water generated. As a result, the risks from releases of toxic pollutants from non-leaching-related reagents are generally limited.

Naturally occurring substances in the ore create a major source of pollutants. Mined ore not only contains the mineral being extracted but varying concentrations of a wide range of other minerals, including radioactive minerals. Frequently other minerals may be present at much higher concentrations and can be much more mobile than the target mineral. Depending on the local geology, the ore (and the surrounding waste rock and overburden) can include trace levels of aluminum, arsenic, asbestos, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, silver, selenium, and zinc, as well as naturally occurring radioactive materials.

The occurrence of specific pollutants, their release potential, and the associated risks are highly dependent on facility-specific conditions, including: design and operation of extraction and beneficiation operations, waste and materials management practices, extent of treatment/mitigation measures, the environmental setting (including climate, geology, hydrogeology, waste and ore mineralogy and geochemistry, etc.) and nature of and proximity to human and environmental receptors.

EPA's 1986 *Quality Criteria for Water* (EPA 440/5-86-001) provides information on the acute and chronic impacts of dissolved pollutants in surface water (including suggested water quality standards). Each state has promulgated water quality criteria for surface waters based on the designated uses of the waters and has established guidelines on how to apply the standards. Regulators and operators have to be aware that, unlike many other types of industrial operations and discharges, toxic constituent loadings from mining operations can be extremely variable, from day to day, over months, and/or years. Furthermore, the receiving water may be particularly sensitive to loadings of toxic pollutants during specific periods (e.g., under certain flow conditions).

Dissolved pollutants discharged to surface waters can partition to sediments. Specifically, some toxic constituents (e.g., lead and mercury) associated with discharges from mining operations are often found at elevated levels in sediments, while undetected in the water column. Sediment contamination may affect human health through consumption of fish that bioaccumulate toxic pollutants. Furthermore, elevated levels of toxic pollutants in sediments can have direct acute and chronic impacts on macroinvertebrates and other aquatic life. Finally, sediment contamination provides a long-term source of pollutants through potential redissolution in the water column.

Erosion and Sedimentation. Because of the large area of land disturbed by mining operations and the large quantities of earthen materials exposed at sites, erosion can be a major concern at hardrock mining sites. Consequently, erosion control must be considered from the beginning of operations through completion of reclamation. Erosion may cause significant loadings of sediments (and any entrained chemical pollutants) to nearby waterbodies, especially during severe storm events and high snow melt periods.

Sediment-laden surface runoff typically originates as sheet flow and collects in rills, natural channels or gullies, or artificial conveyances. The ultimate deposition of the sediment may occur in surface waters or it may be deposited within the flood plains of a stream valley. Historically, erosion and sedimentation processes have caused the buildup of thick layers of mineral fines and sediment within regional flood plains and the alteration of aquatic habitat and the loss of storage capacity within surface waters. The main factors influencing erosion includes the volume and velocity of runoff from precipitation events, the rate of precipitation infiltration downward through the soil, the amount of vegetative cover, the slope length or the distance from the point of origin of overland flow to the point where deposition begins, and operational erosion control structures.

Major sources of erosion/sediment loadings at mining sites can include open pit areas, heap and dump leaches, waste rock and overburden piles, tailings piles and dams, haul roads and access roads, ore stockpiles, vehicle and equipment maintenance areas, exploration areas, and reclamation areas. A further concern is that exposed materials from mining operations (mine workings, wastes, contaminated soils, etc.) may contribute sediments with chemical pollutants, principally heavy metals. The variability in natural site conditions (e.g., geology, vegetation, topography, climate, and proximity to and characteristics of surface waters), combined with significant differences in the quantities and characteristics of exposed materials at mines, preclude any generalization of the quantities and characteristics of sediment loadings.

The types of impacts associated with erosion and sedimentation are numerous, typically producing both short-term and long-term impacts. In surface waters, elevated concentrations of particulate matter in the water column can produce both chronic and acute toxic effects in fish. The buildup of sediment in stream beds also destroys benthic macroinvertebrate habitat by smothering and filling pore spaces between cobbles while simultaneously reducing suitable fish spawning areas. Over the long-term, bio-geochemical reactions in deposited contaminated sediments may result in resuspension of dissolved forms (possibly bioaccumulative) of heavy metals into the water column. Contaminated sediments in surface waters may be a persistent source of toxics thus a chronic threat to aquatic organisms and/or human health. Exposure may occur through direct contact, consumption of fish/shellfish, or drinking water exposed to contaminated sediments. Bioaccumulation of toxic pollutants in aquatic species may limit their use for human consumption. Accumulation in aquatic organisms, particularly benthic species, can also cause acute and chronic toxicity to aquatic life.

Sediments deposited in layers in flood plains or terrestrial ecosystems can produce many impacts associated with surface waters, ground water, and terrestrial ecosystems. Minerals associated with deposited sediments may depress the pH of surface runoff thereby mobilizing heavy metals that can infiltrate into the surrounding subsoil or can be carried away to nearby surface waters. The associated impacts could include substantial pH depression or metals loadings to surface waters and/or persistent contamination of ground water sources. Contaminated sediments may also lower the pH of soils to the extent that vegetation and suitable habitat are lost.

Beyond the potential for pollutant impacts on human and aquatic life, there are potential physical impacts associated with the increased runoff velocities and volumes from new land disturbance activities. Increased velocities and volumes can lead to downstream flooding, scouring of stream channels, and structural damage to bridge footings and culvert entries.

In areas where air emissions have deposited acidic particles and the native vegetation has been destroyed, runoff has the potential to increase the rate of erosion and lead to removal of soil from the affected area. This is particularly true where the landscape is characterized by steep and rocky slopes. Once the soils have been removed, it is difficult for the slope to be revegetated either naturally or with human assistance.

Particulate matter, entrained in water currents, can be toxic to fish. Decreased densities of macroinvertebrate and benthic invertebrate populations have been associated with increased suspended solids. Enhanced sedimentation within aquatic environments also inhibits spawning and the development of fish eggs and larvae, and smothering of benthic fauna. In addition, high turbidity may impair the passage of light, which is necessary for photosynthetic activity of aquatic plants.

Two options exist for reducing erosion and the off-site transport of sediment: end-of-pipe treatment and implementing best management practices to prevent or to eliminate pollution. The selection of the most effective means to control erosion is based on site-specific considerations such as: facility size, climate, geographic location, geology/hydrology and the environmental setting of each facility, and volume and type of discharge generated. Each facility will be unique in that the source, type, and volume of contaminated discharges will differ. The fate and transport of pollutants in these discharges will also vary. Mining facilities are often in remote locations and may operate only seasonally or intermittently, yet need year-round controls because pollutant sources remain exposed to precipitation when reclamation is not completed. At least six categories of best management practice options are available to limit erosion and the off-site transport of sediment, including discharge diversions; drainage/storm water conveyance systems; runoff dispersion; sediment control and collection; vegetation and soil stabilization; and capping of contaminated sources.

3. GROUND WATER QUALITY

Ground water impacts due to mining are not as widespread as surface water impacts because of the much slower velocity of ground water movement, the more limited extent of many affected aquifers, and the lack of available oxygen to continue the oxidation process. Nevertheless, the fact that ground water contamination is extremely difficult to remedy once it occurs makes it a serious concern.

Mining operations can affect ground water quality in several ways. The most obvious occurs in mining below the water table, either in underground workings or open pits. This provides a direct conduit to aquifers. Ground water quality is also affected when waters (natural or process waters or wastewaters) infiltrate through surface materials (including overlying wastes or other material) into ground water. Contamination can also occur when there is an hydraulic connection between surface and ground water. Any of these can cause elevated pollutant levels in ground water. Further, disturbance in the ground water flow regime may affect the quantities of water available for other local uses. Finally, the ground water may recharge surface water downgradient of the mine, through contributions to base flow in a stream channel or springs.

The ability of pollutants to dissolve and migrate from materials or workings to ground water varies significantly depending on the constituent of concern, the nature of the material/waste, the design of the management, soil characteristics, and local hydrogeology (including depth, flows, and geochemistry of the underlying aquifers). Risks to human health and the environment from contaminated ground water usage vary with the types of and distance to local users. In addition, impacts on ground water can also indirectly affect surface water quality (through recharge and/or seepage).

Zinc and other base and precious metals were produced from ores excavated from an underground mine in central Colorado from 1878 to 1977. The resultant wastes consist of roaster piles, tailings ponds, waste rock piles and acid drainage from the mine. Percolation from the tailings ponds has contaminated ground water below and down gradient of the ponds. The ground water discharges to a nearby stream. Runoff from the roaster, waste piles and acid drainage from the mine also discharge directly to the stream. The main parameters of concern are pH, arsenic, cadmium, copper, lead, manganese, nickel, and zinc. In particular, concentrations of cadmium, copper, and zinc exceed water quality criteria in the stream. In addition, levels of dissolved solids are also above background concentrations. At least two private wells previously used for drinking water have been contaminated. The site is currently on the National Priorities List (Superfund) and various remedial actions have been proposed.

4. HYDROLOGIC IMPACTS

Mining operations themselves are a critical part of environmental control because they interact with the site hydrology. Mine design not only impacts day-to-day operations, but also closure and post-closure conditions. Mine design, and location, can affect the following site conditions, which in turn can result affect environmental performance.

- Regional surface and ground water movement.
- Ground water inflow into the mine, with subsequent contact with mining related pollutants.
- Surface water inflow and precipitation related recharge.
- Increases in surface and ground water interaction with the mine workings because of subsidence.
- Loss of surface features such as lakes through subsidence.
- Pathways for post closure flow resulting from adits, shafts, and overall mine design.
- Operational and post closure geochemistry and resulting toxics mobility.
- Overall site water and mass balance.

Specifically, mine water, ground water withdrawal, and land subsidence can potentially create environmental problems that cannot be easily corrected.

Mine Water. Mine water is produced when the water table is higher than the underground mine workings or the depth of an open pit surface mine. When this occurs, the water must be pumped out of the mine. Alternatively, water may be pumped from wells surrounding the mine to create a cone of depression in the ground water table, thereby reducing infiltration. When the mine is operational, mine water must be continually removed from the mine to facilitate the removal of the ore. However, once mining operations end, the removal and management of mine water often end, resulting in possible accumulation in rock fractures, shafts, tunnels, and open pits and uncontrolled releases to the environment.

Ground Water Drawdown. Ground water drawdown and associated impacts to surface waters and nearby wetlands can be a serious concern in some areas, particularly in the Carlin Trend of northeastern Nevada. Several Carlin Trend gold mines are dewatering open pits; one mine is permitted to pump more than 60,000 gallons/minute. Cumulatively, the pumping could curtail flows in the Humboldt River and its tributaries and degrade or eliminate associated wetland areas. For example, Newmont Gold's South Operations project could result in impacts to 1,342 acres of riparian (river bank) habitat, 857 of which are jurisdictional waters of the United States. An additional 10 acres of seeps and springs at 25 different sites could also be affected. Ground water pumping at two of the largest 15 or so mines that are or will be dewatering in the area, the Newmont Gold's South Operations site and the nearby Barrick Gold Corporation's Betze Pit, could cumulatively affect a total of 2,700 acres of wetlands and riparian areas.

Impacts from ground water drawdown may include reduction or elimination of surface water flows; degradation of surface water quality and beneficial uses; degradation of habitat (not only riparian zones, springs, and other wetland habitats, but also upland habitats such as greasewood as ground water levels decline below the deep root zone); reduced or eliminated production in domestic supply wells; and erosion, sedimentation, and other water quality/quantity problems associated with discharge of the pumped ground water back into surface waters downstream from the dewatered area. The impacts could last for many decades. While dewatering is occurring, discharge of the pumped water, after appropriate treatment, can often be used to mitigate adverse effects on surface waters. However, when dewatering ceases, the cones of depression may take many decades to recharge and may continue to reduce surface flows in the Humboldt River and its tributaries. Mitigation measures that rely on the use of pumped water to create wetlands may only last as long as dewatering occurs.

Besides off-site habitat replacement, mitigation may include small-scale ground water pumping projects in the affected area to provide individual wetlands or stream segments with a continuous water supply. However, this must be carefully designed not to affect ground water and surface water adversely in the immediate area of pumping.

Subsidence. Mining subsidence occurs when overlying strata collapse into mine voids. The potential for subsidence exists for all forms of underground mining. Subsidence may manifest itself as sinkholes or troughs. Sinkholes are usually associated with the collapse of part of a mine void (such as room and pillar mining); the extent of the surface disturbance is usually limited in size. Subsidence of large portions of the underground void forms troughs, typically over areas where most of the resource had been removed.

The threat and extent of subsidence is related to the method of mining employed. Typically, traditional room and pillar methods leave enough material in place to avoid subsidence effects. However, high-volume extraction techniques, such as pillar retreat, can increase the likelihood that subsidence will occur. At some mines, waste rock and/or stabilized tailings are backfilled in the mine to minimize subsidence.

Effects of subsidence may not be confined to or even visible from the ground surface. Sinkholes or depressions in the landscape interrupt surface water drainage patterns; ponds and streams may be drained or channels may be redirected. Farmland can be affected to the point that equipment cannot conduct surface preparation activities. Irrigation systems and drainage tiles may be disrupted. In developed areas, subsidence has the potential to affect building foundations and walls, highways, and pipelines. Ground water flow may be interrupted or disrupted as impermeable strata break down, and this could result in flooding of the mine voids. Impacts to ground water include changes in water quality and flow patterns, including surface water recharge.

5. PHYSICAL STABILITY

Physical stability of mine units is an important long term environmental concern because of the amounts of materials involved and the consequences of slope failure. Mining operations can result in the formation of slopes composed of earth, rock, tailings, other mine wastes, or combinations of materials. Other than sheer physical impacts, catastrophic slope failure can affect the environment or human health when toxic materials are released from the failure especially if it occurs in an area where such a release results in a direct pathway to receptors. Ensuring physical stability requires adequate pre-mining design of waste management units and may require long-term maintenance.

Mine slopes fall into two categories: natural or cut slopes and manufactured or filled slopes. The methods of slope formation reflect the hazards associated with each. Natural or cut slopes are created by the removal of overburden or ore which results in the creation of or alteration to the surface slope of undisturbed native materials. Changes to an existing slope may create environmental problems associated with increased erosion, rapid runoff, changes in wildlife patterns and the exposure of potentially reactive natural materials. Dumping or piling of overburden, tailings, waste rock or other materials creates manufactured or filled slopes. These materials can be toxic, acid forming, or reactive. Slope failure can result in direct release or direct exposure of these materials to the surrounding environment.

Slope failure results from exceeding the internal mass strength of the materials composing the slope. This occurs when the slope angle is increased to a point where the internal mass strength can no longer withstand the excess load resulting from over steepening or overloading of the slope. When the driving forces associated with over steepening exceed the internal resisting forces, the slope fails and the materials move to a more stable position.

The most common method of tailings disposal is placement of tailings slurry in impoundments formed behind raised embankments. Modern tailings impoundments are engineered structures that serve the dual functions of permanent disposal of the tailings and conservation of water for use in the mine and mill. The disposal of tailings behind earthen dams and embankments raises many concerns related to the stability and environmental performance of the units. In particular, tailings impoundments are frequently accompanied by unavoidable and often necessary seepage of mill effluent through or beneath the dam structure. Such seepage results from the percolation of stored water downward through foundation materials or through the embankment and the controlled release of water to maintain embankment stability. Impoundment seepage raises the probability of surface water and ground water contamination and, coupled with the potential for acid rock drainage, may require long-term water treatment well after the active life of the facility. Seepage from tailings impoundments can be reduced by construction of lined facilities, which is becoming more common in modern design and construction. Moreover, failure to maintain hydrostatic pressure, within and behind the embankment, below critical levels may result in partial or complete failure of the structure, causing releases of tailings and contained mill effluent to surrounding areas.

Tailings impoundments and the embankments that confine them are designed using information on tailings characteristics, available construction materials, site specific factors (such as topography, geology, hydrology and seismicity) and costs. Dynamic interplay among these factors influences the location (or siting) and actual design of the impoundment.

A primary concern in the design of tailings impoundments is the control of pore water pressure within and beneath the embankment. Excessive pore pressure within the embankment may lead to exceeding the sheer strength of the fill material, resulting in local or general slope failure. Additionally, high pore pressures within or beneath the embankment face may result in uncontrolled seepage at the dam face leading to piping failure. Similarly, seepage through weak permeable layers of the foundation may result in piping or exceeding soil shear strength, causing foundation subsidence and compromising the stability of the overlying embankment.

Embankment drainage systems also create a post-closure environmental concern. Contaminated effluent, possibly including acid rock drainage, may be released from the impoundment after the active life of the project because the impoundment is not designed to be impermeable. If the active pump-back system for the toe pond is no longer in operation, such effluent may be released to area surface water. Accordingly, treatment-in-perpetuity or some alternative passive treatment or containment method may be necessary to prevent surface water releases.

Another trade off between stability and environmental performance is the incorporation of liners. In areas of shallow alluvial ground water, liners may be necessary to prevent intrusion of water into the impoundment. However, such liners will simultaneously increase the retention of impounded water behind the dam and reduce dam stability, all else being equal. On the other hand, the absence of a liner may increase the downward migration of impoundment constituents to shallow ground water.

Surface water controls may be very important in post-closure stability considerations. Surface water runoff diversions are generally employed to limit the intrusion of excessive amounts of water into the impoundment, which reduces dam stability and prevents drying of tailings. Failure of surface water controls after impoundment closure could result in an increase in pore water pressure within the impoundment, threatening the stability of the embankment. Usually, active measures to control surface water runon and runoff during the operative life of the project may require alternative methods or long-term management after closure.

Many systems have been developed for monitoring movement of slopes. Inclinometers and slope indicators can be built into new slopes as part of construction or installed in existing slopes. Frequent monitoring of inclinometers and slope indicators can track the movement or lack of movement within a slope mass. The key becomes assessing the proper locations for monitoring systems and in interpreting the results of the monitoring systems. This monitoring program should be coupled with ground water monitoring to assess seepage or changes of seepage within the slope mass.

6. AIR QUALITY

The primary air pollutant of concern at mining sites is particulate matter. EPA has established National Ambient Air Quality Standards for particulate matter with a diameter of less than 10 microns, and State Implementation Plans must ensure sufficient control of particulate emissions from all sources to allow attainment of the ambient air standard and to meet opacity requirements.

A variety of mining operations emit particulates, usually as fugitive dust (as opposed to emissions from stacks), and relatively simple controls are often sufficient:

- Ore crushing and conveyors can be substantial sources of fugitive dust, and control generally involves water sprays or mists in the immediate area of the crusher and along conveyor routes.

- Loading bins for ore, limestone, and other materials also generate dust. Again, water sprays are typically used for control.

- Blasting generates dust that can be, and is sometimes, controlled with water sprays.

- Equipment and vehicle travel on access and haul roads are major sources of fine and coarse dust. Most mines use water trucks to dampen the surface periodically.

- Waste rock dumping can generate dust, but this generally consists of coarse particles that settle out rapidly with no other controls.

- Venting of shafts can emit dusts.

- Wind also entrains dust from dumps and spoil piles, roads, tailings (either dry as disposed or the dry portions of impoundments), and other disturbed areas. Spray from water trucks are often used when the mine is operating. During temporary closures, particularly after the active life, stabilization and reclamation are aimed in part at reducing fugitive dust emissions. Tailings in particular can be a potent source of fine particulates; temporary or permanent closure great increases the potential for surface tailings to dry out and become sources of dust. Rock and/or topsoil covers, possibly with vegetative covers, can be effective controls.

Tailings and waste rock at metal mines usually contain trace concentrations of heavy metals. Fugitive dust would also contain such metals, and areas immediately downwind could accumulate heavy metals concentrations greater than the background levels as coarse particles settle out of suspension in the air. Occasionally, wind has caused cyanide sprays on heap leach piles to blow short distances and caused very localized damage. Consequently, more operators are turning to drip application of cyanide solutions, a solution with multiple advantages in arid environments since this also minimizes evaporative losses.

The inherent risk from toxic dust depends upon the proximity of environmental receptors, the susceptibility of the receptor, the type and form of ore being mined. High levels of arsenic, lead, and radionuclides in windblown dust would be expected to pose the greatest risk.

Some of the larger copper and gold tailings ponds in the arid west can cover areas over several square miles. The sand-sized tailings particles are especially susceptible to prevailing wind transport due to the lack of moisture and the flat topography. Most tailings ponds are not covered during operation, although some pond water will be near the current tailings disposal pipe, spigot, or cyclone. Most abandoned and inactive tailings ponds do not have any cover.

Particulate from smelter flue stacks may pose significant human health and environmental risks (in general, smelter emissions are no longer a significant concern in the United States). While smelter flue dust collected before stack emission is recycled at most active smelters, windblown flue dust at inactive and abandoned smelters has caused significant environmental damage. For example, air emissions from the Palmerton Zinc smelter in Palmerton, Pennsylvania, contained large quantities of zinc, lead, cadmium, and sulfur dioxides. The emissions led to the defoliation of approximately 2,000 acres on nearby Blue Mountain, and deposited heavy metals throughout the valley. The rate of erosion escalated on Blue Mountain and the mountain side became denuded of all soils, making revegetation impossible.

7. SOILS

Mining operations routinely modify the surrounding landscape by exposing previously undisturbed earthen materials. Erosion of exposed soils, extracted mineral ores, tailings, and fine material in waste rock piles can result in substantial sediment loadings to surface waters and drainageways. In addition, spills and leaks of hazardous materials and the deposition of contaminated windblown dust can lead to soil contamination.

Soil Contamination. Human health and environmental risks from soils generally fall into two categories: (1) contaminated soil resulting from windblown dust, and (2) soils contaminated from chemical spills and residues. Fugitive dust can pose significant environmental problems at some mines. The inherent toxicity of the dust depends upon the proximity of environmental receptors and type of ore being mined. High levels of arsenic, lead, and radionuclides in windblown dust usually pose the greatest risk. The Bunker Hill Superfund site is an example of soil contamination from fugitive dust, stack emissions, and deposition of discarded mine tailings. Soils contaminated from chemical spills and residues at mine sites may pose a direct contact risk when these materials are misused as fill materials, ornamental landscaping, or soil supplements.

As noted above, cyanide may escape from heap sprays at gold facilities. If the cyanide lands on unsaturated soils, free cyanide can volatilize to HCN (this is not usually a problem, however). Adsorption, precipitation, oxidation to cyanate, and biodegradation also attenuate free (and dissociated complexed) cyanide in soils under appropriate conditions. Minor spills of cyanide are common at gold facilities. Spills or leaks of cyanide occur, for example, when portions of a heap leach pile slumps into a drainage ditch or solution pond and cause an overflow of cyanide-containing solution. They can also occur when a pipe carrying pregnant or barren solution, or tailings slurry, fails or is punctured/severed by mining equipment or vehicles. In all but a few major cases, cyanide spills have been contained on-site, and soils usually provide significant attenuation. Facilities routinely store hypochlorite or other oxidants for use in detoxifying such spills.

8. TERRESTRIAL AND AQUATIC HABITAT/ECOSYSTEM QUALITY

By its very nature, mining causes land disturbances. These disturbances can affect aquatic resources, wildlife, vegetation, and wetlands, and can lead to habitat destruction. Surface mining activities directly destroy habitat as a result of removal of overburden to expose ore bodies, deposition of waste and other materials on the ground surface,, and the construction of roads, buildings, and other facilities.

Aquatic Life. Mining operations can have two major types of impacts on aquatic resources, including aquatic life. The first type of impact results from the contribution of eroded soil and material to streams and water bodies and from the release of pollutants from ore, waste rock, or other sources. The second results from the direct disruption of ephemeral, intermittent, or perennial streams; wetlands; or other water bodies. Temporary disruptions occur from road construction and similar activities. Permanent impacts are caused by actual mining of the area or by placement of refuse, tailings, or waste rock directly in the drainageway. More often than not, this is in the upper headwaters of intermittent or ephemeral streams. In addition, lowering of area surface water and ground water caused by mine dewatering can affect sensitive environments and associated aquatic life.

Aquatic life is generally defined as fish and benthic macroinvertebrates; however, phytoplankton and other life forms may also be considered, depending on the type of aquatic habitat and the nature of impacts being assessed.

The impacts of mining operations on aquatic resources can be either beneficial or adverse. Potential impacts also vary significantly with the affected species. For example, increases in stream flow may preclude habitation of certain species of macroinvertebrates and/or fish but may also provide new habitat for other species of aquatic life.

The impacts of mines on aquatic resources have been well documented. For example, a Mineral Creek fisheries and habitat survey conducted by the Arizona Game and Fish and the U.S. Fish & Wildlife Service showed that significant damage was caused by an active mining activity on the shores of Mineral Creek. In summary, the upstream control station showed an overhead cover (undercut bank, vegetation, logs, etc.) of 50% to 75%. The dominant substrate was small gravel, and instream cover consisted of aquatic vegetation. Five species of fish were captured for a total of 309 individual fish. In contrast, the downstream station showed an overhead cover of less than 25%. The dominant substrate was small boulders, and instream cover consisted of only interstitial spaces and very little aquatic vegetation. No species of fish were captured and very few aquatic insects were observed or captured. This Mineral Creek survey shows a significant degradation of habitat quality below the mine. Pinto Creek, which received a massive discharge of tailings and pregnant leach solution from an active copper mine, was also surveyed. The tailings had a smothering, scouring effect on the stream. Pinto Creek is gradually recovering from this devastating discharge through the import of native species from unaffected tributaries. However, the gene pool of the native fish is severely limited as only one age group of fish has repopulated Pinto Creek. A second unauthorized discharge of pollutants to the Creek could eliminate that fish species.

Wildlife. Mining operations can have substantial impacts on terrestrial wildlife, ranging from temporary noise disturbances to destruction of food resources and breeding habitat. Unless closure and reclamation return the land essentially to its pre-mining state, certain impacts to some individuals or species will be permanent.

Biological diversity is often viewed as a way to measure the health of an ecosystem. Noise during the construction phase or during operations, for example, may displace local wildlife populations from otherwise undisturbed areas surrounding the site. Some individuals or species may rapidly acclimate to such disturbances and return while others may return during less disruptive operational activities. Still other individuals may be displaced for the life of the project. Other wildlife impacts include habitat loss, degradation, or alteration. Wildlife may be displaced into poorer quality habitat and therefore may experience a decrease in productivity or other adverse impact. Habitat loss may be temporary (e.g., construction-related impacts), long-term (e.g., over the life of a mine), or essentially permanent (e.g., the replacement of forested areas with waste rock piles).

Vegetation. Vegetation consists of natural and managed plant communities. Native uplands consist of forests, shrublands and grasslands; managed uplands include agricultural lands, primarily croplands and pastures.

Native plant communities perform several functions in the landscape. Vegetation supports wildlife, with the diversity of vegetation strongly related to the diversity of wildlife within the area. Vegetation stabilizes the soil surface, holding soil in place and trapping sediment that may otherwise become mobilized; it also functions to modify microclimatic conditions, retaining soil moisture and lowering surface temperatures. A diverse landscape also provides some degree of aesthetic value.

All vegetation within the active mining area is removed before and during mine development and operation. Vegetation immediately adjacent may be affected by the roads, water diversions or other development. Vegetation further removed from activities may be affected by sediment carried by overland flow and by fugitive dust.

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APPENDIX C

REGULATORY AND NON-REGULATORY TOOLS

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1. INTRODUCTION

Regulation of mining activities involves a complex web of sometimes overlapping jurisdictions, laws and regulations covering several media. In addition, ownership issues at many mine sites further complicate the regulatory process. In order to identify and implement effective actions, it is important to have a thorough understanding of the regulatory and non-regulatory tools that are available to the Agency.

This appendix describes the primary regulatory and non-regulatory tools that are available to EPA to prevent, control, or remediate environmental impacts at active, inactive, and abandoned mines. Appendix describes the major programs of other federal agencies. Appendix E introduces and briefly describes the nature of state regulation of mining activities.

The description of each of EPA's major regulatory tools is presented in outline form which allows comparisons among their salient feature. Descriptions are generally organized into the following categories:

A. Jurisdiction/Applicability/Media/Constituents
B. Implementation Mechanisms (i.e., permits, response authority, standards)
C. Compliance/Enforcement
D. Funding
E. Natural Resource Restoration Provisions
F. Good Samaritan Provisions
G. Tribal Roles/Responsibilities
H. Advantages/Limitations
I. Integration with Other Statutes

Categories for which the particular tools do not contain specific provisions are identified as not applicable (N/A).

2. EXISTING REGULATORY TOOLS

I. NATIONAL ENVIRONMENTAL POLICY ACT

The National Environmental Policy Act (NEPA), 42 U.S.C. §§ 4321 *et seq.*, requires that federal agencies consider the environmental consequences of their actions and decisions as they carry out their mandated functions.

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A. NEPA Jurisdiction/Applicability/Media/Constituents

Pursuant to NEPA, federal agencies must prepare detailed statements assessing the environmental impact of, and alternatives to, major federal actions that may significantly affect the environment. An environmental impact statement (EIS) shall provide fair and full discussion of significant environmental impacts and inform decision makers and the public of the reasonable alternatives and mitigation measures which would avoid or minimize adverse impacts or enhance the quality of the environment. EISs must rigorously explore and objectively evaluate all reasonable alternatives even if they are not within the authority of the lead agency. For lesser actions, the agency may prepare an Environmental Assessment (EA) and/or make a Finding of No Significant Impact (FONSI).

Federal actions specifically related to mining that may require an EIS include activities involving federally managed lands including approval of plans of operation for hardrock mining and/or milling operation and mineral leases and sales. In addition, certain federal permits required by EPA (i.e., new source National Pollutant Discharge Elimination System (NPDES) issued by EPA) or the U.S. Army Corps of Engineers (COE) (i.e., Section 404) may require NEPA assessments.

The scope of impacts to be assessed should include all affected media, such as air, water, soil, biological, visual, recreational, cultural, and economic resources.

B. NEPA Implementation Mechanisms

Under NEPA, a lead agency is designated and is responsible for preparing the EIS. Other agencies may assist as cooperating agencies. For example, the Bureau of Land Management (BLM) may have the lead for an EIS for a hardrock mining plan of operation, and EPA and COE may be cooperating agencies for purposes of the environmental assessment needs for an National Pollutant Discharge Elimination System (NPDES) permit to be issued by EPA and a Section 404 permit by the COE. For new mining projects requiring federal permits, NEPA offers the opportunity to identify permit conditions, including those needed to avoid or minimize impacts or to mitigate for unavoidable impacts.

EPA's review under NEPA assesses mining project alternatives, impacts, and mitigation. Issues may include the potential for acid rock drainage, aquatic and terrestrial habitat value and losses, sediment production, NPDES discharges, air emissions, mitigation and reclamation. Mitigation that is developed should be included as conditions of the NPDES permit to the extent authorized by law. Standards, such as those established under the Clean Water Act (CWA) or Clean Air Act (CAA), serve as thresholds in the NEPA document for determining the acceptability of project-related impacts or mitigation requirements. Therefore, from a procedural standpoint, the NEPA compliance process provides the vehicle for agency consideration of overall project-related impacts prior to the permit decision.

New Source NPDES NEPA Compliance: In those jurisdictions where EPA retains NPDES permitting authority, a NEPA analysis (an environmental assessment or environmental impact statement) must be performed prior to taking action on the NPDES permit for a mine which is subject to new source performance standards. The NEPA review provides information for EPA's decision to issue or deny the permit pursuant to the CWA. NEPA provides authority to consider the overall impacts (i.e., not just discharge-related) of the proposed project and alternatives.

Section 309 of the Clean Air Act: In addition to EPA's obligation to comply with NEPA for certain of its actions, EPA is tasked by section 309 of the CAA to review and comment on the environmental impacts of any legislation submitted by a federal department or agency, major federal actions significantly affecting the environment, newly authorized federal projects for construction, or proposed regulations. In the event that one of the aforementioned are determined to be unsatisfactory from the standpoint of public health, welfare or environmental quality, the Administrator publishes this determination and refers it to the Council on Environmental Quality (CEQ) for its consideration. This referral authority has been used 15 times to date. Thus, pursuant to section 309, NEPA, and the CEQ NEPA Implementation Regulations at 40 CFR 1500–1508, EPA reviews NEPA documents prepared by other federal agencies.

C. NEPA Compliance/Enforcement

EPA's participation in NEPA analysis may influence federal projects that are the subject of these documents in the following ways:

- EPA comments on and rates the environmental impact of the proposed action and the adequacy of the environmental analysis contained in the draft EIS. Based on the Agency's jurisdiction and/or expertise, EPA's comment letter is intended to foster the goals of NEPA by ensuring that EPA's environmental expertise is considered by Agency decision makers. EPA's ratings of other agencies' actions are viewed with considerable interest by stakeholders.

- The EPA Administrator can refer an EIS that is rated as environmentally unsatisfactory to the CEQ. This process provides a potential avenue for elevation of the issues and resolution at higher levels if solutions cannot otherwise be reached between agencies. The CEQ can, among other things, publish findings and recommendations regarding the project, or initiate a dispute-resolution process.

- When EPA gets involved early in the development of a project and associated EIS, it can have more influence over the outcome by ensuring adequate analyses and consideration of environmental goals from the beginning. If it does not review a project until late in the development, it may be more difficult to persuade the lead agency and/or project proponent to make significant changes.

- The Agency's comments on impacts that are regulated by EPA statutes carry considerable influence. Both NEPA and section 309 of the CAA are used in conjunction with other statutes and mechanisms that regulate mining.

D. NEPA Funding

EPA actions carried out under NEPA and section 309 of the CAA authority do not have a specific appropriation. federal agency NEPA compliance is funded on an agency-specific basis and is typically considered to be a normal cost of program operations. Contract or grant funding may also be available through EPA or other federal agencies to assist in the preparation of NEPA-related documents and studies. The federal land management agency or regulatory agency can fund the preparation of the information for the NEPA document through a third-party contract with the applicant for the mining project. The CEQ does have an appropriation to support its role in the interagency NEPA process (currently, $1 million and 10 full-time employees (FTE)).

E. NEPA Natural Resource Restoration Provisions - NA

F. NEPA Good Samaritan Provisions - N/A

G. NEPA Tribal Roles/Responsibilities - N/A

H. NEPA Advantages/Limitations

NEPA mandates that mitigation be analyzed. EISs have to discuss measures to mitigate adverse environmental impacts (40 CFR 1502.16). Records of Decision have to state whether all practicable means to avoid or minimize environmental harm from the alternative selected have been adopted, and if not, why they were not. A monitoring and enforcement program must be adopted and summarized where applicable for any mitigation (40 CFR 1505.2(c)).

The NEPA process may also enable land management agencies and/or states to address performance bonds or trust funds that are established at the start of a mining project and that would not be released at closure. EPA comments could suggest that trust amounts would be based on the level of risk involved in a project and could be used to remediate problems that arise long after the mining company is no longer managing the site. Factors such as number of years project structures would require maintenance (e.g., in perpetuity) would be used in determining the trust amount. Performance bonding and perpetual trust funds should be considered as conditions of the lease or permit.

However, NEPA is primarily limited to providing a procedural framework which requires federal agencies to evaluate and analyze their proposed actions. NEPA does not contain substantive requirements and does not generally compel selection of the environmentally perforate alternative. A further limitation is that conditions, including mitigation identified in the Record of Decision are difficult to enforce unless they are also specifically included a permit or through some other legally binding agreement.

Categorical Exclusions further limit the availability of NEPA to provide for the review and analysis of those federal actions which are determined to be categorically excluded from NEPA. These are determined by the lead agency after there is an opportunity for public comment announced by a notice in the *Federal Register*.

I. NEPA Integration with Other Statutes

NEPA is intended to integrate decision making, under various federal statutes to promote "productive and enjoyable harmony between man and his environment". With respect to new mining projects requiring federal actions, including permits, NEPA offers the opportunity to identify alternatives and mitigation measures in advance of permitting. NEPA provides an excellent vehicle for integrating overall project planning and permitting. Examples of how this integration can occur with respect to the specific statutes are described below.

Clean Water Act NPDES Permits. Mining projects require NPDES permits to discharge wastewater to waters of the United States (see sections 402(a)(2), 402(l)(2)) of the CWA). A NEPA analysis is required before an NPDES permit can be issued by EPA to a mine subject to a New Source Performance Standard. In addition to addressing other impacts, a NEPA EIS should project the quality of the effluent using technically sound methods and representative data. The effectiveness of alternative waste treatment methods can also be examined. Also, under EPA's NEPA compliance regulations, mitigation measures must be included as conditions of the NPDES permit.

Clean Water Act Dredge and Fill Permits. Many mining projects involve some filling of wetlands or other waters of the United States which requires authorization under section 404 of the CWA. Pursuant to Section 404(b)(1) guidelines, only the least environmentally damaging practicable alternative can be permitted. The identification in a NEPA EIS of the environmentally preferred alternative should ideally satisfy the alternatives analysis requirements of section 404. Mitigation described in the EIS to replace unavoidable losses of aquatic habitat can then form the basis for mitigation requirements of section 404 permits. In short, the EIS should provide the information necessary to determine compliance with the requirements of section 404 of the CWA.

Clean Air Act. Where a NEPA document is prepared, compliance with CAA requirements must, to the fullest extent possible, be documented through the NEPA process. This could affect the citing of facilities and thus the overall identification of the environmentally preferred alternative. In non-attainment areas, section 176(c) of the CAA prohibits issuance of a federal permit unless it can be demonstrated that the proposal will conform with the SIP.

Federal Land Policy and Management Act (FLPMA). FLPMA governs the way the BLM and U.S. Forest Service (USFS) administer public lands, including mining on public lands. Under FLPMA, BLM and USFS land use decisions are subject to NEPA. Federal land managers generally require Plans of Operation, which include reclamation plans and describe details of the proposed operation. By describing these plans in a NEPA document, other federal and state regulatory agencies can comment on aspects of the project design that relate to their respective statutory authorities, regulatory requirements, or that pertain to their particular expertise.

Other Federal and State Statutes. Federal, state, and local agencies commenting on NEPA documents can influence the decision process and meet many of their own permitting information needs. Sixteen states have implemented NEPA type statutes.

II. CLEAN WATER ACT

The Federal Water Pollution Control Act, 33 U.S.C.§§ 1251 *et seq*. (Clean Water Act), provides that point source discharges of pollutants to waters of the United States are prohibited unless authorized by a permit. Mining activities often involve activities that result in discharges to waters of the United States. Three separate programs established by the Clean Water Act are significant when reviewing mining activities. These include the establishment of water quality standards pursuant to section 303(c) of the CWA, NPDES permit requirements set forth in section 402, and dredge and fill permit requirements set forth in section 404. Each of these three areas is discussed in the following subsections.

Section 303: The Establishment Of Water Quality Standards

A. Section 303 Jurisdiction/Applicability/Media/Constituents

Jurisdictional conditions. All states, pursuant to section 303(c) and 40 CFR 131.11 are required to establish state water quality standards for waters of the United States within their jurisdictions that take into account the beneficial uses of the water segment, including consideration of downstream uses. Beneficial uses include public water supplies, protection and propagation of fish and wildlife, recreation, agricultural and industrial water supplies, and navigation. State water quality standards must include designated uses of waters, criteria to protect those uses, and an antidegradation policy. NPDES effluent limitations necessary to attain or maintain these standards must also be established in accordance with 40 CFR 122.44(d) where a permitting authority determines that pollutants “are or may be discharged at a level which will cause, have the reasonable potential to cause, or contribute to an excursion above a state water quality standard."

Media. Section 303 is applicable to all waters of the United States.

Constituents: States must review, pursuant to 40 CFR 131.11(a)(2), water quality data and information on discharges to identify specific water bodies where toxic pollutants (the 126 priority pollutants identified under section 307(a) of the CWA) may be adversely affecting water quality or attainment of the designated water use or where the levels of toxic pollutant(s) warrant concern. In such circumstances, states must adopt criteria for such toxic pollutants applicable to the water body sufficient to protect the designated use. Some of these pollutants are likely to be associated with active and abandoned hardrock mines.

Where a state adopts narrative criteria for toxic pollutants to protect designated uses, the state must provide information identifying the method by which the state intends to regulate point source discharges. States must also adopt any other criteria that may be needed to protect the designated use. Criteria are to be based on sound scientific rationale if less stringent than EPA recommended criteria. EPA has issued recommended criteria pursuant to section 304(a) of the CWA. EPA's IRIS database provides up-to-date scientific information on the toxicity and effects of a vast array of chemicals.

B. Section 303 Implementation Mechanisms

Permits: In accordance with 40 CFR 122.44(d), each NPDES permit shall include conditions that attain or maintain water quality standards established pursuant to Section 303 of the CWA, including state narrative criteria for water quality. Permits issued by the COE for discharges of dredged or fill material must similarly ensure compliance with such standards (See 40 CFR 230.10(b)(1)).

Review/approval: State water quality standards must be reviewed from time to time, but not less frequently than every three years, to determine whether any new information has become available for any water segments with standards that do not include the uses specified in Section 101(a)(2) of the CWA (i.e., fishable/swimmable).

Remediation: States are required to conduct and submit to EPA a use attainability analysis where a water body does not have all the uses included in section 101(a)(2) of the CWA (i.e., fishable/ swimmable). Such an analysis could indicate the need for upgrading the us e and attendant water quality criteria for the water segment. This provision may relate to many areas where discharges from mining operations impact use attainability.

Standard Setting: In establishing water quality standards applicable to surface waters associated with mining sites, states may use EPA's gold book criteria (values established as guidance for the section

307(a) pollutants) or develop their own levels in accordance with regulations at 40 CFR 131 and EPA's guidance provided in the *Water Quality Standards Handbook*. NPDES water quality-based effluent limitations protective of state water quality standards for toxic pollutants must be established in accordance with the general provisions of 40 CFR 122.44(d). EPA's guidance for establishing permit limitations for toxic pollutants is provided in the 1991 *Technical Support Document for Water Quality-based Toxics Control*.

Water quality-based effluent limits are applicable where technology-based limits are not sufficiently stringent to ensure that water quality standards are attained or maintained. In developing water quality-based effluent limitations, an NPDES permitting authority must evaluate a discharge to determine whether or not pollutants are or may be discharged at a level which will cause, have the reasonable potential to cause, or contribute to a violation of a state's water quality standard. Water quality-based effluent limitations must be set at a level that attains or maintains a state's water quality standards established pursuant to section 303.

C. Section 303 Compliance/Enforcement

EPA review and approval/disapproval of a state's triennial review of water quality standards provides a mechanism for oversight of state water quality standards and a basis for over-promulgation where states fail to establish appropriate water quality standards. Compliance and enforcement of water-quality based effluent limitations in NPDES permits is performed in the same manner as for other conditions in NPDES permits.

D. Section 303 Funding - N/A

E. Section 303 Natural Resource Restoration Provisions

States may designate waters as outstanding national resource waters where the states want to maintain and protect from degradation high quality waters that constitute an outstanding national resource (ONRW) -- such as waters of national and state parks, wildlife refuges, and waters of exceptional recreational or ecological significance.

F. Section 303 Good Samaritan Provisions - N/A

G. Section 303 Tribal Roles/Responsibilities

EPA may treat an Indian tribe in the same manner as a state for purposes of the water quality standards program if the tribe meets several criteria set forth in 40 CFR 131:

- Tribe is recognized by the Secretary of the Interior and meets the definitions of 40 CFR 131.3(k)(l).
- Tribe has a governing body carrying out substantial governmental duties and powers.
- The water quality standards program to be administered by the tribe pertains to the management and protection of water resources within the borders of the Indian reservation.
- The Indian tribe is reasonably expected to be capable, in the Regional Administrator's judgment, of carrying out the functions of an effective water quality standards program in a manner consistent with the terms and purposes of the CWA and applicable regulations.

H. Section 303 Advantages/Limitations

Historically, there has been some discrepancy in application of the above-described process to ensure that appropriate standards are established, uses maintained, and uses upgraded. EPA's December 22, 1992 rule implementing a portion of the 1987 amendments to the CWA (the so-called National Toxics Rule (NTR)) redressed this imbalance, to an extent, by promulgating standards for toxics where needed.

In addition, current information indicates that water quality standards and corresponding water quality-based effluent limitations are not always adequate in mining areas, where the waters immediately adjacent to active or abandoned mines may be badly impaired, but where downstream water quality is the key determinant.

Another limitation is the limited technical resources available to establish both appropriate water quality standards and water quality-based effluent limitations.

A key issue in connection with water quality standards and water quality-based effluent limitations for heavy metals is the manner in which a metal concentration is expressed. The focus of this issue is how to accurately express the fraction of the metal that is chemically available, and thus able to impair human health or the environment (i.e., the dissolved fraction) in relation to the total recoverable portion of the metal. In section 304(a) of the CWA, the criteria for metals are expressed as total recoverable metal and accordingly, the numeric criteria for metals in the NTR were also based on total recoverable metal. However, shortly after promulgation of the NTR, the Agency issued a policy statement recommending the use of dissolved metal to set and measure compliance with water quality standards. On May 4, 1995, EPA revised the NTR to express the numeric metals criteria in terms of dissolved metal (60 FR 22229). EPA's December 22, 1992, rule provided specific guidance in this respect. Although the water quality standard (and the effluent limitations based on the standards) must be expressed as total recoverable metal, the standard can be based upon a water effect ratio. The water effects ratio is designed to account for the phenomenon of a particular water bodies' ability to effectively bind a portion of the metal, thus making it unavailable. In addition, guidance exists for establishing, on a case-by-case basis, a water effects ratio that can be reflected in site-specific water quality-based effluent limitations.

I. Section 303 Integration with Other Statutes

The water quality standards established under the CWA provide an important baseline for implementing the permitting requirements of the CWA as well as for implementing many of the other federal environmental statutes. (See discussion under NEPA, CERCLA)

Section 402: <u>National Pollutant Discharge Elimination System (NPDES) Program</u>

Over the last several years, implementation of the NPDES permitting program has moved from control of single point sources of pollution, based on a relatively small number of conventional pollutants (biological oxygen demand, total suspended solids, oil & grease, fecal coliform, pH) to more complex analyses that consider multiple sources of pollution and multiple pollutant parameters including non-conventional (e.g., ammonia, chlorine, color, iron, and total phenols) and toxic pollutants.   Increasingly, permits issued by federal and state regulators include limitations necessary to meet specific in-stream water quality criteria (in addition to any applicable technology-based requirements).

Recent national initiatives are directed toward ensuring that point sources of pollution are addressed, to the maximum extent possible, on a watershed basis. This approach emphasizes addressing point and nonpoint sources of pollution in recognition of all other inputs to the basin. It is also designed to ensure that the highest priority sources (with respect to impacts on the basin) are addressed. The watershed approach can be an effective administrative mechanism to provide greater cost effective reductions of pollutant loadings.

A. Section 402 Jurisdiction/Applicability/Media/Constituents

NPDES permits are required for all point source discharges of pollutants to waters of the United States.   The current <u>operator</u> must obtain the permit, but where there is no operator, then the <u>owner</u> must apply. Section 301(a) of the CWA provides that “[e]xcept as in compliance with . . . sections . . . 402 and 404 of this Act, the discharge of any pollutant by any person shall be unlawful.”

Jurisdictional conditions: Section 402 of the CWA applies to discharges of a pollutant from a point source. Under section 502(14) point sources include any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container from which pollutants are or may be discharged to waters of the United States.

Media: Point source discharges must be to waters of the United States. Waters of the United States are defined in 40 CFR 122 to include all surface waters, wetlands, streams (ephemeral, intermittent or constant), rivers, lakes, and ponds which could affect interstate or foreign commerce.

Constituents: Under the CWA pollutant is defined very broadly and generally would include any material that may be discharged to or be placed in a water of the United States as a result of any mining activity.

B. Section 402 Implementation Mechanisms

Permits are required for all point source discharges that are not expressly excluded by Section 402(l)(1) and (2) of the CWA. This includes storm water contaminated by contact with material from mining activities**.** Individual permits may be issued and generally must include numeric end-of-pipe limits (unless not technically feasible to develop those limits, in which case best management practices (BMP) may be required). General permits may be issued to a class or category of mines and may require BMP (including inventorying, assessment, prioritization, and identification and implementation of best management practices) necessary to meet water quality standards. All permits, whether individual or general, must contain the more stringent of technology-based or water quality-based requirements.

The NPDES regulations classify discharges from mine sites as either mine drainage, process water, storm water or unclassified. Those discharges classified as mine drainage or process water are subject to the effluent limitations guidelines restrictions set forth in 40 CFR 440. Those classified as storm water may be permitted pursuant to NPDES general storm water permits if they are not mixed with the two former types. EPA published a table in the September 29, 1995 *Federal Register* (60 FR 50804) to clarify which discharges from mining areas are subject to the effluent limitations guidelines and which may be subject to a general storm water permit. This table has been challenged by the National Mining Association.

General permits are a viable option only where EPA or the state in which the sites are located has issued a general permit for such discharges. EPA has published two general permits which may be applied to storm water discharges from mining related sources. The first is the *Baseline General Storm Water Permit* published on September 9, 1992 (57 FR 41236). The second is the Multi-Sector General Storm Water Permit published on September 29, 1995 (60 FR 50804).

Section 402(p) of the CWA, requires discharges of storm water associated with industrial activity to apply for coverage under an NPDES permit by October 1, 1992. On November 16, 1990 (55 FR 47990), EPA promulgated the regulatory definition of storm water discharges associated with industrial activity. (See 40 CFR 122.26(14)). This definition includes point source discharges of storm water from eleven major categories of industries, including: (I) facilities subject to storm water effluent limitations guidelines and "(iii) facilities classified as Standard Industrial Classifications 10 through 14 (metal mining industry), including active and inactive mining operations. Storm water discharges at mine sites may include those discharges that have come into contact with, or are contaminated by contact with, any overburden, raw material, intermediate products, finished products, by-products or waste products located on the site of such operations which is consistent with section 402(l)(2).

Review/approval: New sources must have a permit before beginning to discharge. Existing sources must presently have a permit or be in violation of the CWA. Forty-one non-federal jurisdictions (42 states and the U.S. Virgin Islands) have been authorized to issue permits.

Remediation: Section 504 of the CWA provides EPA the authority to respond to situations presenting an imminent and substantial endangerment by bringing an action to restrain any person causing or contributing to the alleged pollution to stop the discharge of pollutants or to take such other action as may be necessary. In addition, EPA's policies provide that as part of a resolution of an enforcement proceeding under the CWA, EPA may enter into settlements containing Supplemental Environmental Projects (SEPs) which may involve remediation of source areas.

Standards: Technology-Based Requirements. Technology-based requirements applicable to mining operations are described by national rule, or on a case-by-case basis using Best Professional Judgement (BPJ) where no national rule is applicable. To date, EPA has established national technology-based effluent limitations guidelines (ELG) for 52 categories of industrial activities, including ore mining and dressing (See 40 CFR 440), with separate numeric limits for mine drainage and for mill discharges. In addition, there are three other effluent guidelines which apply to other hardrock mining sectors addressed by this framework: mineral mining and processing (40 CFR 436), nonferrous metal manufacturing (40 CFR 421), and ferro-alloy manufacturing (40 CFR 424). Permits are required to impose effluent limitations reflecting Best Available Technology (BAT) for nonconventional and toxic pollutants (i.e., applicable ELG or limitation based upon BPJ). (See Section 301(b)(2) of the CWA). Technology-based requirements (including zero discharge where found to be technically and economically achievable) must be met regardless of whether they are more stringent than necessary to meet water quality requirements. Water Quality-Based Requirements. Permits are required to assure compliance with all applicable state water quality standards regardless of technological or economic feasibility.

C. Section 402 Compliance/Enforcement

Injunctive relief: The CWA provides authority to seek temporary or permanent injunctive relief under section 309(b) of CWA.

Administrative/compliance orders: The CWA provides authority to issue administrative compliance orders under section 309(a) of the CWA.

Civil penalties: The CWA provides for civil penalties of up to $25,000 per day of violation prior to January 31, 1997 and up to $27,500 for violations after January 31, 1997 and up to one year imprisonment under section 309 of the CWA.

Criminal penalties: The CWA provides for criminal penalties of up to $25,000 per day (and/or up to 1 year imprisonment) for negligent violations and $50,000 per day (and/or 3 years imprisonment) for knowing violations under section 309 of the CWA.

Imminent hazardous authority: Section 504 of the CWA provides authority for EPA to bring suit to restrain pollution that presents an imminent and substantial endangerment to health or economic livelihood pursuant to section 504 of the CWA.

Information collection: The CWA provides broad authority to require submission of information, self-monitoring, entry and inspection, and record keeping under section 308 of the CWA.

G. Section 402 Tribal Roles/Responsibilities

Tribes may be delegated the authority to implement the NPDES program.

H. Section 402 Advantages/Limitations

The NPDES program provides a rigorous program with limited flexibility which, at times, can be difficult to adapt to mining situations. For instance, situations involving high levels of background pollutants are difficult to reconcile with the NPDES program.

Permits issued under the CWA could potentially limit the availability of other statutory authorities to respond to environmental problems resulting from the federally permitted release. For instance, CERCLA provides a defense for federal permitted releases.

II. Section 402 Integration with Other Statutes

See previous subsection.

Section 404: Discharges of dredged or fill materials

Section 404 of the CWA is jointly implemented by EPA and the COE. Section 404 generally requires a permit to discharge dredged and fill material to wetlands and other waters of the United States.

A. Section 404 Jurisdiction/Applicability/Media/Constituents

Geographical Jurisdiction Conditions: The geographic scope of the Clean Water Act is consistent across the Act's programs and covers waters of the United States. The term includes wetlands adjacent to traditionally navigable waters such as interstate rivers and streams and coastal waters, as well as isolated waters and wetlands so long as their destruction or degradation does or could affect interstate commerce. Section 404 defines wetlands in terms of three parameters: wetland vegetation, hydric soils, and hydrology (flooding/soil saturation).

Activities Jurisdiction Conditions: Section 404 regulates discharges of dredged material and of fill material. The term discharge has been interpreted to include both additions and redeposits to wetlands and other waters of the United States. The term discharge of dredged materials includes discharges associated with mechanized land clearing, ditching, channelization, and other excavation activities that destroy or degrade wetlands or other regulated waters. Discharges that have only *de minimis*, or inconsequential, effects are excluded from the definition.

Section 404(f) exempts from regulation discharges associated with certain activities specified in the statute itself. These exemptions include temporary mining roads constructed and maintained in accordance with best management practices. These exemptions are limited and do not allow the exemption of discharges incidental to any activity that converts a waters of the United States to another use and impairs the flow or circulation of the waters of the United States or reduces the reach of such waters.

B. Section 404 Implementation Mechanisms

Permits: Anyone wishing to discharge dredged and fill material to wetlands and other waters of the United States must first obtain authorization from the COE, either through issuance of an individual permit or as authorized under a general permit. General permits are authorized under section 404(e) for categories of activities that are similar in nature and will have only minimal environmental impact. General permits can be issued on a nationwide, regional, or state level. Currently, there are 37 nationwide permits (NWP) listed in 33 CFR 330. NWP 21, for example, authorizes discharges associated with surface coal mining provided they are authorized under the Surface Mining Control and Reclamation Act.

Review/Approval: Discharges to wetlands and other waters of the United States not authorized by general permits must be authorized by the COE through the individual permit process. COE bases its decision upon whether the proposed project (1) complies with EPA 404(b)(1) Guidelines (See 40 CFR 230), and (2) is in the public interest. EPA Regions review COE public notices for individual permit applications and provide comments to the COE regarding the proposed project's compliance with the Guidelines.

Criteria/Mitigation: The guidelines set forth the environmental criteria that the COE applies when reviewing individual Section 404 permit applications. The guidelines provide that a permit should not be issued if the proposed discharge would either: (1) violate state water quality standards, (2) violate toxic effluent standards, (3) jeopardize federally listed threatened or endangered species, or (4) cause or contribute, either individually or collectively, to significant degradation of wetlands or other waters of the United States. Under the guidelines' alternative analysis, consideration is given to whether the proposed discharge is the least damaging practicable alternative.

The Guidelines also require that the discharger undertake all appropriate and practicable mitigation in order to minimize any potential harm to the aquatic resources. COE evaluates permit applications to ensure that mitigation occurs in the following sequence: (1) avoidance of impacts, where practicable through the evaluation of alternative sites, (2) minimization of impacts, and (3) appropriate and practicable compensation of unavoidable impacts through wetlands creation or restoration.

C. Section 404 Compliance/Enforcement

The CWA gives EPA and COE joint authority to enforce the requirements of the Section 404 program. The two agencies have an enforcement Memorandum of Agreement (MOA), that allocates this shared responsibility. Under the MOA, COE is the federal permitting authority with the lead on permit violation cases; while EPA has the lead on many unpermitted discharge violations.

Injunctive Relief: EPA can seek injunctive relief administratively through issuance of an administrative compliance order under section 309(a), or judicially as provided by section 309(b). EPA's most common type of injunctive relief seeks to require a violator to stop illegal fill activity and, where appropriate, to undertake removal of a illegal discharge as well as restore the site to a functioning wetland system.

Civil Penalties: EPA can seek civil penalties in both the administrative and judicial arenas. Under section 309(g), EPA is authorized to administratively assess civil penalties up to $25,000 per violation. Also, EPA can seek civil penalties under a civil judicial action.

Criminal Penalties: Under section 309(c), EPA is authorized to initiate criminal judicial enforcement actions for negligent violations, which are misdemeanors, and for knowing violations which constitute felonies.

Information Collection: EPA can and does avail itself of the various information gathering tools provided for in the CWA. In particular, under section 308, EPA can require the submission of information in order to determine the existence and/or extent of a violation.

D. *Section 404 Funding - N/A*

E. Section 404 Natural Resource Restoration Provisions - N/A

F. Section 404 Good Samaritan Provisions - N/A

G. Section 404 Tribal Roles/Responsibilities - N/A

H. Section 404 Advantages/Limitations

Definition of Fill Material: Historically, EPA and COE have had different definitions of the term fill material. EPA's fill material definition is based on an effects test and considers whether the discharge raises the bottom elevation of a water body or replaces a water body with dry land. The COE definition, in contrast, also includes a requirements that the discharge be for the primary purpose of filling the area, thereby excluding waste disposal. This difference has resulted in disagreements between EPA and COE over whether particular waste discharges, such as mining waste, should be regulated under section 404 or section 402.

Waste Treatment Systems: The CWA's regulatory definition of waters of the United States excludes certain waste treatment systems from the geographic scope of the Act. Efforts to interpret and clarify this exclusion have been underway for many years. The question has arisen as to the circumstances under which basins can be created in waters of the United States for the disposal and treatment of mine tailings. EPA's Office of Water (OW), in consultation with the COE, addressed this issue in a 1992 memorandum in the context of pending section 404 permit applications for two proposed gold mines in Alaska, the A-J Mine and the Kensington Mine. EPA and COE agreed that the mining companies needed a section 404 permit for the discharge of fill materials to create the basins themselves, and that a section 402 permit was needed for any discharges flowing out of the basins following treatment. The two agencies further agreed that the basins created by the discharge of fill material, if permitted pursuant to an individual Section 404 permit for purposes of creating a waste treatment system, would no longer be waters of the United States. This means that these basins could function as waste treatment systems (i.e., discharges into the basins would not have to be permitted under section 402). As part of the Section 404(b)(1) Guideline analysis undertaken during the individual section 404 permit review process, COE would consider the loss of aquatic values resulting from construction of the treatment system, including the physical impacts of the discharge of mine tailings in those systems.

I. Section 404 Integration with Other Statutes

NEPA: In those situations where section 404 is applicable and an EIS must be prepared, there is the opportunity for integration between NEPA and Section 404, especially with regard to decisions relating to the determination of practicable alternatives and requirements for practicable mitigation.

Administration Wetlands Plan: An important section 404 regulatory development is implementation of the Administration Wetlands Plan, a set of 40 initiatives to make federal wetlands policy more flexible for the landowner and more effective in protecting valuable wetlands. The initiatives, many of which have been implemented, emphasize: streamlining the permit process; increasing cooperation with private landowners; improving wetlands science; and increasing participation by states, tribes, local governments, and the public in wetlands protection.

CERCLA: Section 404 can be relevant in certain inactive and abandoned mine situations where CERCLA is applicable. Reference should be made to a guidance document entitled *Guidance for Considering Wetlands and Superfund Sites*. Wetlands issues can arise in the context of whether part of the site contamination involved unauthorized discharges of dredged or fill material to wetlands such that mitigation for such discharges should be obtained. In addition, if the proposed cleanup activities will involve discharges to wetlands or other waters of the United States, determinations need to be made as to whether section 404 is an applicable and relevant and appropriate requirements and, if so, there needs to be compliance with section 404 regulations.

III. COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION AND LIABILITY ACT

CERCLA provides EPA with authority to assess, investigate and cleanup environmental threats resulting from mining activities (42 U.S.C. § 9601 *et seq.*). Although Superfund authorities can potentially be applied to a broad range of mining sites, EPA has generally used it only at those significant sites at where other regulatory tools have not been able to achieve environmental protection goals. During the past decade, the Superfund program has been used to address the environmental threats at a number of major mineral mining/processing sites, include Bunker Hill, Anaconda, East Helena, Cal Gulch, and Summitville. Each of these sites posed a significant human health or environmental risk. Other smaller sites have also been addressed under the auspices of Superfund. Both government and privately funded response actions have been taken at sites to address localized threats to public health and/or the environment.

A. CERCLA Jurisdiction/Applicability/Media/Constituents

Jurisdictional Conditions. CERCLA applies to releases or threatened releases of: 1) a hazardous substance into the environment or 2) a pollutant and contaminant which may present an imminent and substantial danger to public health. The term release is defined broadly in the statute, including any type of emitting or leaking of substances into the environment.

Media. CERCLA is not media specific; thus, it can cover releases to air, surface water, ground water and soils.

Constituents. The definition of hazardous substance is extremely broad, covering any substances, hazardous constituents, hazardous wastes, toxic pollutants, imminently hazardous chemicals or mixtures, hazardous air pollutants, etc., under other federal environmental laws, as well as any substance listed under section 102 of CERCLA. The fact that a substance may be specifically excluded from coverage under one statute does not affect CERCLA's jurisdiction if that substance is listed under another statute or under section 102. A comprehensive list of these substances is provided in 40 CFR 302.4. From a mining perspective, only sulfates are excluded from the broad coverage of hazardous substances. Contaminants such as sulfates, however, can be covered under the more limited provisions of CERCLA relating to pollutants and contaminants, and will be discussed in the following subsections. Although certain wastes are excluded from RCRA Subtitle C regulation (i.e., Bevill wastes), they can be addressed under CERCLA. Thus, CERCLA covers almost every toxic or hazardous constituent found at mining sites. Exceptions include petroleum (that is not mixed with a hazardous substance) and naturally occurring releases. However, this exception does not include any of the releases normally found at mining sites, such as acid mine drainage, waste rock, or any ore artificially exposed to the elements by man.

B. CERCLA Implementation Mechanisms

Permits. CERCLA does not include any permit mechanism. Section 121(e) waives any requirement for a federal, state or local permit for any portion of a removal or remedial action that is to be conducted entirely on-site. However, that action must be performed in accordance with the substantive requirements of federal or state environmental laws. EPA has usually taken the position that on-site includes a discharge to surface water within the site boundaries, even though the water eventually flows off-site. However, this waiver applies to actions conducted as part of the CERCLA response. Whether it overrides pre-existing permit obligations (e.g., the requirements of a permit for a pre-existing discharge) is very uncertain. The section 121(e) exemption is essential for ensuring that EPA can take emergency actions in a timely manner.

Review/Approval. Typically, no review or approval is afforded at new or existing facilities unless there is a release or threat of release addressable under CERCLA. However, once jurisdiction is established, EPA has the capacity to review and approve any plans that address or affect that release or threatened release.

Financial assurance. Section 108(b) gives the EPA Administrator the authority to promulgate regulations which would require adequate financial assurance from classes of facilities that is consistent with the degree and duration of risk associated with the production, transportation, treatment, storage, or disposal of hazardous substances. This provides an extremely useful tool to fill the gap created in RCRA financial assurance requirements by the Bevill Amendment.

Response Authorities. CERCLA's main strength is its response authorities. EPA can either use the Superfund to perform remedial activities (section 104) or order parties to perform such activities (section 106). CERCLA gives EPA the flexibility to cleanup sites based upon site-specific circumstances. EPA's cleanup decisions are based upon both risk assessment and consideration of applicable and relevant and appropriate requirements (ARARs). As long as the jurisdictional prerequisites have been met, CERCLA gives EPA the ability to perform any activity necessary to protect public health and the environment. CERCLA provides EPA with the authority to perform assessments, removal actions, and remedial actions.

Assessments. A CERCLA assessment generally evaluates contaminants of concern, exposure pathways and potential receptors. The assessment process includes the review of all available information as well as sampling for any other necessary information. It is broad in its application and is extremely useful in a multi-media mining program.

Removal Action. Removal actions can be performed on mining sites of any size in an emergency situation (implementation can occur within hours) or over a long period of time. Removal actions are generally subject to time (two years) and money ($2,000,000) limits under the statute.

Remedial Actions. Remedial actions are typically long-term actions performed at those sites placed on the National Priorities List. These actions are not subject to the time or dollar limitations imposed on removal actions, but require a more detailed and formal decision process. Unlike removal actions, however, remedial actions to be implemented with Superfund dollars (when there are no viable parties) require a 10-percent state share in costs and a state assurance of operation and maintenance before remediation can commence.

Standard Setting. Under the current statute, CERCLA has no uniform national standard setting authorities. However, through the use of risk assessment and ARARs analysis, EPA can set site-specific standards for cleanup and maintenance. ARARs can be a very powerful tool, as they give EPA the authority to enforce standards which would not otherwise be applicable, if those standards are relevant and appropriate under the circumstances. For instance specifically related to mining, EPA has the authority to use appropriate parts of RCRA Subtitle C despite the Bevill amendment.

C. CERCLA Compliance/Enforcement

Potentially Responsible Parties (PRPs). CERCLA creates a broad category of persons who may be liable. This includes (1) current owners (including lessees) or operators of the facility; (2) past owner or operator at the time of disposal of hazardous substances in question; (3) anyone who arranged for the treatment, transportation or disposal of the hazardous substances in question; and (4) any transporter of the hazardous substances in question if the transporter chose the disposal location. Liability is strict. That is, if the party falls into one of the above four categories, it is liable, regardless of fault. Liability is joint and several so long as the harm is indivisible (i.e., there is no rational basis for apportionment). The burden of proof as to whether harm is indivisible is on the defendant, not on the government. Both EPA and courts, however, have chosen to apportion liability in appropriate circumstances. Liability is retroactive, thus CERCLA can reach those responsible for disposal activities prior to enactment of CERCLA.

Prospective Purchasers of Contaminated Property. EPA has developed a prospective purchaser policy which affords a party interested in the purchase of contaminated properties with protection from CERCLA liability if that party is willing to provide some benefit to EPA not otherwise available from PRPs at the site.

Administrative and Injunctive Authorities. Section 106 provides for administrative or injunctive relief where: (1) there may be an imminent and substantial endangerment to the public health or welfare or the environment; (2) because of a release or threat of a release; (3) of a hazardous substance; and (4) from a facility. The scope of action that EPA can require under section 106 of is broad. At existing facilities, EPA could enjoin production activities or order changes to those activities (unless the activity is a discharge pursuant to a federally permitted release). Remedies can include institutional controls or removal of hazardous substances. The response action must not be inconsistent with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) as listed in 40 CFR 300.

Cost Recovery. Sections 104 and 107 provide for the recovery of certain costs expended by the government in responding to environmental contamination from responsible parties (as previously defined). These response costs must be incurred as a result of (1) a release or substantial threatened release (2) of a hazardous substance (3) from a facility. In order for the United States, a state or Indian tribe to recover under these provision, the costs incurred have to be not inconsistent with the NCP. Like most recovery provisions in the law, EPA's cost recovery authority does have a statute of limitations. For removal actions, EPA must commence its cost recovery action within three years of completion of the removal action (unless the removal action proceeds into a remedial action). For remedial actions, EPA must commence its cost recovery action within six years of the initiation of physical on-site construction of the remedial action.

Civil Penalties. Under sections 106(b) and 109, EPA imposes a fine of $25,000 per day for failure to comply with an order issued under CERCLA. In addition, if EPA spends Superfund dollars performing work where a responsible party has failed to perform such work under order, that party may be liable for punitive damages in an amount equal to three times the costs incurred by the United States under Section 107(c)(3). When EPA enters into consensual agreements with responsible parties for the performance of work, it may also require stipulated penalties for the responsible party's failure to adhere to the requirements of the agreement.

Criminal Penalties. Criminal penalties only apply to two provisions of CERCLA. The first is for failure to provide notification of a release of a reportable quantity of a hazardous substance, the second for destruction of records which are supposed to be maintained under the Act.

Information Collection. Section 104(b) allows for investigations, monitoring, surveys, testing and information gathering appropriate to identify the existence and extent of release or threat thereof, the source and nature of hazardous substances, pollutant or contaminants; and the extent of danger to public health, welfare or the environment. Studies may include planning, legal, fiscal, economic, engineering, architectural or others necessary or appropriate to plan and direct response actions, recover costs or enforce the chapter.

Section 104(e)(2) provides EPA access to information documents relating to: (1) the identification, nature and quantity of materials generated, treated, stored or disposed at a facility; (2) the nature and extent of a release or threatened release of hazardous substance, pollutant or contaminant; (3) the ability of the person to pay for or perform cleanup. Section 104(e)(3) provides EPA with the authority to enter any place where a hazardous substance, pollutant or contaminant: (1) may have been generated, stored, treated, disposed of or transported from; (2) or from which there is a release or threatened release of a hazardous substance; (3) or any place where entry needed to determine the need for response, appropriate response or to effectuate a response. Section 104(e)(4) gives EPA the authority to inspect, and obtain samples from, any location or containers of suspected hazardous substances, pollutants or contaminants. If a party refuses to consent to EPA's information collecting authorities, EPA may issue orders and/or seek court intervention providing for the collection of information and provision of access. Access may be granted through a warrant (where short-term access is necessary) or by court order (for long-term or intrusive access circumstances).

Section 103 requires any owner or operator a facility, owner at the time of disposal at a facility and transporter who chose to dispose of hazardous substances at a facility to notify EPA of the existence of such facility if storage, treatment, or disposal of hazardous substances has occurred at such facility. Thus, Section 103 provides broad authority for requiring the submission of information necessary to identify the location of sites needing EPA's attention.

D. CERCLA Funding

The Superfund, when not shadowed by its sunset provision, is funded by both a tax on the chemical industry and some smaller contribution of appropriated funds. The Superfund typically has enough money available to perform necessary investigatory and cleanup activities. CERCLA does contain fund-balancing criteria to ensure that the fund does not deplete its resources on any one site. Cost recovery by the government is a critical element of ensuring the adequacy of the Superfund.

E. CERCLA Natural Resource Damage Provisions

Section 107(C)(4) provides for the recovery of damages for injury to, destruction of, or loss of natural resources, including the reasonable costs of assessing such injury, destruction, or loss. Natural resources as defined at Section 101(16) means land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States, any state or local government, any foreign government or any Indian tribe. EPA is not responsible for recovering natural resources damages due the federal government, this responsibility generally lies with those agencies which administer federal lands. (See Section 107(f)(1) and (2))

F. CERCLA Good Samaritan Provisions

Section 107(d) of CERCLA provides exceptions to liability for those rendering care or advice at the direction of an On-Scene Coordinator (OSC) or in accordance with the NCP. A private party who is not otherwise liable at the site, and provides advice or care at the direction of an OSC in accordance with the NCP will be exempt from liability for any costs incurred as a result of actions or omissions by that party unless those actions or omissions are negligent.

State and local governments are exempt from liability under CERCLA for actions taken in response to an emergency created by the release or threat of release of hazardous substances from a facility owned by another person. Such exemption does not cover gross negligence or intentional misconduct. As with private parties, the state or local government cannot take advantage of this provision if it is otherwise liable for the release.

G. CERCLA Tribal Roles/Responsibilities

Section 126 of CERCLA provides that Indian tribes shall be afforded substantially the same treatment as states for certain specific purposes: notification for releases, consultation on remedial actions, access to information, health authorities, cleanup roles and responsibilities under the NCP, and establishing priorities for remedial actions. CERCLA also includes a number of additional provisions which specifically address tribes. For example, Sections 107(f) and 111(b)(1) authorize tribes to act as trustees for tribal natural resources and to seek recovery for damages to such resources. In addition, Section 104(d) authorizes EPA to enter into cooperative agreements with tribes.

H. CERCLA Advantages/Limitations

Federally Permitted Release. EPA's ability to address mine site problems may be limited when a release of concern has been permitted under a federal environmental program listed in Section 101(10). Even though such a release is addressable under Section 104 (i.e., EPA can still perform any necessary remediation), EPA's authority to cost recover for such activities is removed (Section 107(j)) and its authority to order others to do the work is uncertain.

Pollutants and Contaminants. Some contaminants, such as sulfate, do not fall under the definition of hazardous substance. These contaminants can be captured under the definition of pollutant and contaminant in CERCLA, but using the authority afforded the Agency for such contaminants reduces flexibility. EPA may not be able to order responsible parties to address pollutants and contaminants or be able to recover costs incurred in responding to releases of such. A statutory change may be needed to address this uncertainty.

Additional Limitations. EPA's use of CERCLA to address mining sites is not without limitations. First, CERCLA resources are finite. Second, there are legal limitations on the use of the Superfund for remedial actions with respect to federally owned lands. Third, many mining sites may have permits issued under other federal environmental programs identified in section 101(10) of CERCLA. Where the release is subject to a federal permit, there may be constraints on EPA's ability to recover costs for the cleanup.

I. CERCLA Integration with Other Statutes

CERCLA's limitation on judicial review presents limitations on integration with other statutes. Under Section 113(h), CERCLA prevents courts from reviewing any pre-enforcement petitions by respondents. Other federal environmental statutes may provide for such review. CERCLA's limitation on judicial review presents issues to consider in actions that combine CERCLA enforcement with other statutes. Because CERCLA contains an express limitation on pre-enforcement review, it may be more effective to issue CERCLA orders separately from other enforcement actions.

CERCLA's broad authority means that it may be used where other tools are less effective. CERCLA provides positive synergistic effects when combined with other statutes because of its (1) retroactive, joint and several liability; (2) multi-media remedial capabilities; (3) site-specific flexibility through risk assessment and ARARs analysis (and authority to waive ARARs), and (4) the availability of Superfund financing.

IV. RESOURCE CONSERVATION AND RECOVERY ACT

RCRA is the national law governing management of solid and hazardous waste. RCRA divides wastes into one of two RCRA regulatory tracks: Subtitle D (solid waste) and Subtitle C (hazardous waste). In October, 1980, Congress amended RCRA by adding section 3001(b)(3)(A)(ii) (known as the Bevill exclusion) for solid waste from the extraction, beneficiation, and processing of ores and minerals. The Bevill amendment excluded such mining waste from regulation as hazardous waste under Subtitle C of RCRA, pending completion of a study and a Report to Congress.

A. RCRA Jurisdiction/Applicability/Media/Constituents

Jurisdictional conditions. RCRA uses the terms extraction, beneficiation, and mineral processing to describe the Bevill waste which is excluded from regulation under Subtitle C of RCRA. These initial stages of mining (i.e., extraction and beneficiation) involve crushing and grinding of rocks to produce a valuable concentrate and relatively earthen-like large volume wastes. The latter stages of mining involve **mineral processing** which takes the valuable concentrate and uses chemical and heat intensive operations to drastically change the nature of the mineral and produce relatively low volume wastes (with some notable exceptions such as wastes from phosphoric acid production).

All extraction and beneficiation wastes, and 20 special mineral processing wastes are excluded from RCRA Subtitle C regulation by virtue of the Bevill Amendment. (See 40 CFR 261.4(b)(7)). EPA determined that Subtitle C regulation of extraction and beneficiation wastes was unwarranted in a 1986 regulatory determination (51 FR 24296, July 3, 1986) that was subsequently upheld in *Environmental Defense Fund v. U.S. EPA*, 852 F.2d 1309 (D.C. Cir. 1988).

For mineral processing wastes no longer exempt under Bevill, EPA proposed a conditional solid waste exclusion and other requirements (61 FR 2338, January 25, 1996). This proposal establishes land disposal restrictions for newly identified mineral processing wastes and rules regarding Bevill mixtures. EPA intends to refine the proposal in the late spring of 1997, and also will seek comments on the proper scope of the Bevill amendment. A final rule is expected later in 1997 or in 1998.

Media. Subtitle C permits address air, water, and soils releases from regulated units and releases from solid waste management units, which include units that contain Bevill-exempt waste. However, management of Bevill waste does not trigger Subtitle C permitting; a Subtitle C permit could only be issued to a facility that treats, stores, or disposes of non-Bevill hazardous waste.

Constituents addressed. Mineral processing wastes are considered characteristically hazardous if they exceed the toxicity characteristic leachate procedure (TCLP) as defined in 40 CFR 261.24, or if they are corrosive, ignitable, or reactive.

B. RCRA Implementation Mechanism

Subtitle D is intended to assist in developing and encouraging methods for the disposal of solid waste which are environmentally sound and which maximize the utilization of valuable resources including energy and materials and to encourage resource conservation. Subtitle D is designed to be a state-lead program. States may apply to EPA for approval of their solid waste management plans if they wish to obtain funds under section 4007(b). Subtitle D establishes minimal guidelines designed primarily for municipal landfills (See sections 4001 through 4010.) No guidelines have been developed to address mining wastes. Aside from funding incentives, Subtitle D has no practical enforcement authority.

Several years ago, EPA drafted a strawman document covering mine waste management program under Subtitle D which included the following provisions:

- Management programs would include extraction and beneficiation wastes (metallic ores and phosphate) and could cover mineral processing wastes for active and new operations.

- State and tribal programs would not be required to mirror federal requirements, but broad flexibility would be provided to states and tribes to design programs and to use existing state and federal programs as components of state and tribal plans and programs.

- Programs would address all media (ground water, air, surface water, soils) using site-specific risk-based performance standards.

- Permits would include conditions needed to achieve compliance with performance standards.

- Management programs would require monitoring and corrective action for all media, closure and post-closure care, and financial assurance.

Subtitle C applies to hazardous waste transporters, generators, and treatment, storage, and disposal facilities. Subtitle C applies on a limited basis to the 400 mineral processing sites that may generate characteristic hazardous waste. Only a few mineral processing sites have Subtitle C permits; most ship wastes off-site to avoid the stringent Subtitle C requirements.

Permits. Mineral processing and mining facilities rarely seek a Subtitle C permit However, generator requirements, which require notification but no permit, apply to all mines and mineral processing facilities. Subtitle D has no permitting authority.

Remediation. Subtitle C, Part B subjects permitted facilities to corrective action requirements for both hazardous waste and solid waste management units. These corrective action requirements must be accomplished through the permitting process; these apply to both active and inactive waste units. . Closure and post-closure requirements apply to Subtitle C regulated units. Part 258 of Subtitle D has corrective action, closure, and post-closure requirements. Administrative orders through imminent hazard provisions can address remedial concerns

Standard setting. For Subtitle C, a host of standards apply to hazardous wastes including both technical (e.g., liner requirements) and risk based standards. Also, air emission standards, ground water monitoring, record keeping, financial responsibility, corrective action, and closure and post-closure requirements apply.

C. Compliance/Enforcement

Administrative Authorities. For Subtitle C, EPA may issue an administrative order under section 3008(a) requiring compliance or it may file suit in federal district court seeking an injunction mandating compliance. An administrative order may also include revocation of a facility's permit and/or assessment of a civil penalty of up to $25,000 per day of noncompliance for each requirement. RCRA provides for an additional civil penalty of up to $25,000 per day for noncompliance with an administrative order. Section 3008(h) allows EPA to issue administrative orders requiring corrective action at interim status facilities, with specific penalties for noncompliance.

Criminal Penalties. For Subtitle C, RCRA also provides for criminal penalties for knowing violations of Subtitle C requirements including: a term of up to five years in prison for violations of section 3008(d)(1) or (2) and/or a fine of up to $50,000 per day for knowingly transporting or causing the transport of hazardous waste to a facility without a Subtitle C permit or without the required manifest; treating, storing, or disposing of hazardous waste without a permit or in violation of any material requirement of a permit or interim status; misrepresenting information on a required document; destroying, altering, concealing, or failing to file required records; exporting hazardous waste in violation of the requirements of RCRA; or managing used oil in violation of requirements under section 3014 or other RCRA provisions. Fines and sentences may be doubled for repeat offenders. If a person, in committing one of these offenses, knowingly places another person in imminent danger of death or serious bodily injury, that offender may be subject to a $250,000 fine ($1 million for corporations) and/or 15 years in prison.

Imminent Hazards. For both Subtitle C and Subtitle D, section 7003 gives EPA broad authority to abate situations that may present an imminent and substantial endangerment to health or the environment. Section 7003 of RCRA authorizes EPA to obtain cleanups upon receipt of evidence that the past or present handling, storage, treatment, transportation or disposal of any solid waste or hazardous waste may present an imminent and substantial endangerment to health or the environment. The release need not be at a facility otherwise subject to RCRA regulations, and its application to solid waste as well as hazardous waste makes it available for mining waste despite the Bevill exclusion. In many respects, section 7003 order authority is comparable to orders under section 106 of CERCLA and may be issued to current or former handlers, owners, operators, transporters, and generators. EPA may issue an administrative order or seek an injunction in federal district court to stop the practice causing the danger and/or take any other action necessary. Violators of an administrative order under section 7003 may be penalized up to $5,000 per day.

Citizen Suits. Under RCRA a citizen may file one of three types of suits in federal district court: (1) an action against any person (including the United States or a state) in violation of a RCRA permit or other requirement of any RCRA subtitle; (2) an action against any person to abate an imminent and substantial endangerment; or (3) an action against EPA to compel the completion of a nondiscretionary duty under the statute (e.g., a statutory mandate to issue regulations).

D. RCRA Funding

EPA funds substantial portions of state programs, sometimes as high as 75 percent. Under the RCRA program, several hundred thousand dollars of funding is available for mining related training, education, and technical assistance grants and extramural contracts.

E. RCRA Natural Resource Restoration Provisions - N/A

F. RCRA Good Samaritan Provisions

Active management of a grandfathered or historic waste that has lost the Bevill exemption would be considered an activity that generates a non-exempt waste. Even if an operator actively manages a grandfathered waste pile in order to alleviate an environmental release, that person may generated a new waste. In other words, the current Bevill rules may discourage cleaning up a historic waste pile that has lost the Bevill exemption.

G. RCRA Tribal Roles/Responsibilities

RCRA provides no explicit provision authorizing EPA to treat tribes as states. However, EPA has proposed a rule (61 FR 2583, January 26, 1996) that addresses authorization of Indian tribes to administer RCRA Subtitle D solid waste programs in the same manner as states and has also proposed such a rule for Subtitle C hazardous waste programs (61 FR 30471, June 14, 1996).

H. RCRA Limitations

Bevill exclusions have been described in the previous subsections.

I. RCRA Integration with Other Statutes

EPA has a policy that actions conducted pursuant to CERCLA emergency, remedial and corrective actions generally will be considered to satisfy RCRA requirements. Cost recovery is pursuant to CERCLA tools and is limited to cleanups. Section 3005(f) defers regulation of coal wastes to the Surface Mine and Coal Reclamation Act (SMCRA) at 30 U.S.C.A § 1201.

There are several RCRA Subtitle C provisions that are potentially applicable to mining situations but which have not been historically applied. These include section 2002(a) (Authorities), section 3001(b)(3)(B)(iii) (prevention of radiation human health risks from the extraction, beneficiation, and processing of phosphate rock or overburden from the mining of uranium ore), section 3001(b)(3)(C) (promulgation of new regulations under or determination that such regulations are unwarranted), and section 3004(x) (the Administrator is authorized to modify regulations for solid waste from the extraction, beneficiation or processing of ores and minerals, including phosphate rock and overburden from the mining of uranium by taking into account the account the special characteristics of such wastes).

V. CLEAN AIR ACT

The CAA and its amendments of 1990 are codified in the United States Code at 42 U.S.C. §7401 *et seq*. The discussion that follows examines in more detail some of the CAA programs that are most relevant to the mining industry.

A. CAA Jurisdiction/Applicability/Media/Constituents

The CAA contains planning and control requirements that apply to existing stationary sources and provide for preconstruction review of new and modified major stationary sources to attain and maintain national ambient air quality standards. The CAA provides for motor vehicle emission standards, reformulated gasoline and the regulation of fuels and fuel additives. The CAA also provides for the regulation of hazardous air pollutants, contains an acid deposition control program, a program to protect visibility in national parks and wilderness areas, and a stratospheric ozone protection program. The CAA operating permit program promotes regulatory certainty and enforceability. The CAA contains specific enforcement provisions including information collection authorities and civil and criminal penalties.

B. CAA Implementation Mechanisms

Many of the CAA programs are implemented through a cooperative partnership between the states and EPA. While this partnership can take several shapes, generally EPA issues national standards or federal requirements and the states assume primary responsibility for implementing the requirements. As a prerequisite to assuming implementation responsibility, states must demonstrate to EPA that their programs meet minimum federal CAA requirements. EPA has issued proposed rules that would allow federally-recognized tribes to become CAA implementation partners with EPA in virtually the same fashion as states. (See 59 FR 43,956; August 25, 1994).

B.1. Protection of National Ambient Air Quality Standards (NAAQS).

Establishing the NAAQS. A purpose of the CAA is to protect and enhance the quality of ambient or outside air. EPA establishes national ambient air quality standards (NAAQS) for the protection of public health (primary standard) and welfare (secondary standard) under sections 108 & 109. Welfare includes effects on soils, water, crops, vegetation, manmade materials, animals, wildlife, weather, visibility, and climate, damage to and deterioration of property, and hazards to transportation, as well as effects on economic values and on personal comfort and well-being. (See section 302(h)).

EPA has established NAAQS for six pollutants: sulfur oxides, nitrogen dioxide, carbon monoxide, ozone, particulate matter, and lead. (See 40 CFR 50). The NAAQS represent the maximum ambient levels of these pollutants that are allowed in any area of the country. Mining and mineral processing activities are most likely to cause significant emissions of sulfur dioxide, particulate matter, and lead.

The primary NAAQS for sulfur oxides measured as sulfur dioxide are 0.03 ppm, annual mean, and 0.14, maximum 24-hour concentration. The secondary NAAQS is 0.5 ppm, maximum 3-hour concentration. (See 40 CFR 50.4 and 50.5). The primary and secondary NAAQS for particulate matter, measured as particulate matter with an aerodynamic diameter of ten micrometers or less (PM-10), are 150 micrograms per cubic meter, 24-hour average concentration, and 50 micrograms per cubic meter, annual mean. (See 40 CFR 50.6). The primary and secondary NAAQS for lead is 1.5 micrograms per cubic meter, mean calendar quarter. (See 40 CFR 50.12)

Planning and Control Requirements for "Nonattainment" Areas. EPA designates areas nationwide based on their air quality status relative to the NAAQS. (See 40 CFR 81). A nonattainment area is an area that does not meet (or that significantly contribute to ambient air quality in a nearby area that does not meet) the NAAQS for a particular pollutant. States containing areas designated as nonattainment for a particular pollutant are required to develop state Implementation Plans (SIPs) which must bring the areas into attainment with the NAAQS as expeditiously as practicable.

Title I of the CAA contains general planning requirements that states containing nonattainment areas must meet. (See sections 110(a)(2) and 171–193). The requirements include the application of control measures to existing stationary sources and a preconstruction review permit program for new and modified major stationary sources. (See section 173).

SIPs and SIP revisions must be submitted to EPA for review. EPA approves or disapproves (in whole or part) SIP submittals based on its assessment of whether the submittals meet the applicable requirements of the CAA. (See section 110(k)(3).) Federally-approved SIPs and SIP revisions are federally-enforceable (see 40 CFR 52). A state that fails to make a required submission that meets the requirements of the CAA may be subject to certain sanctions. (See sections 110(m) and 179).

Control Measures for Existing Sources. States containing sulfur dioxide, lead, and moderate PM-10 nonattainment areas must provide for the implementation of reasonably available control measures (RACM) (including such reductions in emissions from existing sources in the area as may be obtained through the adoption, at a minimum, of reasonably available control technology). (See section 172(c)(1)). The requirement for RACM applies to mining sources located in sulfur dioxide, lead, and moderate PM-10 nonattainment areas. EPA has issued detailed guidance on the implementation of RACM and other planning requirements that apply in these nonattainment areas. (See 57 FR 13,498; April 16, 1992, 57 FR 18,070; April 28, 1992, and 58 FR 67,748; December 22, 1993).

Moderate PM-10 nonattainment areas that cannot attain the NAAQS or fail to timely attain the NAAQS are reclassified as serious. Additional, more stringent planning requirements apply in serious PM-

10 nonattainment areas. For example, states containing such areas must provide for the implementation of best available control measures (BACM) (including best available control technology) for existing mining sources located in such areas. EPA has issued detailed guidance on the implementation of BACM and other planning requirements in serious PM-10 nonattainment areas. (See 59 FR 41,998; August 16, 1994).

Nonattainment New Source Review (NSR). States containing nonattainment areas must also submit to EPA for approval a preconstruction review permit program for new and modified major stationary sources. (See section 173). For example, affected new and modified sources are required to install control technology that meets the lowest achievable emission rate, as defined in section 171(3), and to obtain enforceable offsetting emissions reductions from existing sources. Implementing regulations at 40 CFR 51.165 have not been updated to reflect changes to the program made in the 1990 Clean Air Act Amendments. EPA has issued interim transitional guidance. (See 57 FR 13,498; 57 FR 18,070; Appendix D of *New Source Review (NSR) Program Transitional Guidance*, dated March 11, 1991; *and New Source Review (NSR) Program Supplemental Transitional Guidance on Applicability of New Part D NSR Permit Requirements*, dated September 3, 1992).

A mining source or processing facility locating in sulfur dioxide, lead, and moderate PM-10 nonattainment areas is subject to NSR if it emits or has the potential to emit 100 tons per year or more of any pollutant subject to regulation under the CAA. (See 40 CFR 51.165(a)(1)(iv)). In serious PM-10 nonattainment areas the applicability threshold is 70 tons per year. (See section 189(b)(3)).

Fugitive emissions[1] are only counted in the major source determination for sources listed in 40 CFR 51.165(a)(1)(iv)(C). The list includes these hardrock mining related sources: primary zinc, copper, and lead smelters; lime plants; taconite ore processing plants; phosphate rock processing plants; sintering plants; and any other source regulated under section 111 or 112 as of 1980 (see following discussion of new source performance and air toxics standards). For all other sources, including surface mines, fugitive emissions are not included for purposes of meeting the 100 ton per year or 70 ton per year thresholds.

B.2. Prevention of Significant Deterioration of Air Quality Program (PSD) and Protection of Visibility in National Parks and Wilderness Areas.

PSD Permit Program. The PSD program provides for preconstruction review of the control technology and air quality impacts associated with new and modified major stationary sources. (See sections 160-169 and 40 CFR 51.166). This preconstruction review is implemented through a permit process, and affected sources are prohibited from beginning construction unless a permit has been issued addressing PSD requirements.

[1] Fugitive emissions are emissions that could not reasonably pass through a stack, chimney, vent or other functionally-equivalent opening. (See 40 CFR 51.165(a)(1)(ix)).

The PSD program applies to new and modified major stationary sources in areas designated as attainment or unclassifiable. (See section 161). Areas designated attainment or unclassifiable are areas that either meet the NAAQS or for which there is insufficient information to reach a conclusion about their air quality status. (See section 107(d)(1)(A)(ii) and (iii)). These areas are commonly referred to as clean air areas or PSD areas. Since all areas of the country meet at least one of the NAAQS, all states are required to have a PSD program for areas within their jurisdiction. EPA administers PSD programs for states that have failed to submit approvable programs. (See 40 CFR 52.21).

All PSD areas are categorized or designated as either class I, II or III. (See section 162). The classification of an area determines the corresponding maximum allowable increases of air quality deterioration (increments). (See section 163). Only a relatively small increment of air quality deterioration is permissible in class I areas and consequently these areas are afforded the greatest degree of air quality protection. An increasingly greater amount of air quality deterioration is allowed in class II and III areas. In all instances the NAAQS represent the over arching air quality ceiling that may not be exceeded, notwithstanding any allowable increment.

New and modified major stationary sources under the PSD program must apply best available control technology (BACT) for each pollutant subject to regulation under the Act. (See sections 165(a)(4) and 169(2)(C)). Another fundamental aspect of the PSD program is an air quality analysis which calls for an assessment of a proposed source's compliance with allowable increments of air quality deterioration and the NAAQS.

The PSD program provides an additional layer of special protection for federal class I areas. (See section 165(d)). Mandatory federal class I areas are national parks greater than 6000 acres in size, national wilderness areas greater than 5000 acres in size and other areas specified in section 162(a) of the CAA. These federal class I areas are mandatory in that they may not be redesignated as any other classification. While all other PSD areas in the country were initially designated as class II areas (See section 162(b)), federal lands not already designated as class I areas under section 162(a) may be redesignated as class I areas. (See section 164).

The federal land manager[2] and the federal official charged with direct responsibility for management of any federal lands within a class I area have an affirmative responsibility to protect the air quality related values (AQRVs) of such lands. (See section 165(d)(2)(B)). AQRVs include visibility impacts, aquatic and terrestrial ecosystem effects such as acid deposition and foliar injury, etc. The land manager protects AQRVs through a prescribed statutory role in assessing the potential impacts of a proposed PSD source. (See section 165(d)(2)(C)). If a proposed source does not cause or contribute to a class I increment violation, the federal land manager may, nevertheless, demonstrate to the satisfaction of

[2] The federal land manager is defined as the Secretary of the department with authority over such lands, i.e., Department of the Interior and Department of Agriculture. (See section 302(I)).

the permitting authority that the source will have an adverse impact on the AQRVs of a specific federal class I area and, if so demonstrated, the PSD permit shall not be issued. Conversely, if the proposed source will cause or contribute to a class I increment violation, then the owner or operator must demonstrate to the satisfaction of the federal land manager that there will be no adverse impact to AQRVs and, if the federal land manager agrees, the PSD permit may be issued. (See section 165(d)(2)(C)(ii) and (iii)).

A major stationary source under the PSD program is any source which emits, or has the potential to emit, 100 tons per year or more of any pollutant subject to regulation under the CAA and is listed in 40 CFR 51.166(b)(1)(I)(a). This list is similar to the list for counting fugitive emissions under the NSR program and includes the same mining facilities specifically listed in part V.B.2. All other sources must have 250 tons per year or more of potential emissions to be major. The PSD rule about counting and discounting fugitive emissions in determining whether a source is major is the same as the NSR rule. EPA has declined to require the consideration of fugitive emissions in determining whether a surface coal mine is a major stationary source subject to PSD. (See 54 FR 48,870; November 28, 1989).

EPA administers the PSD and NSR permit programs for affected sources proposing to locate on lands within the jurisdiction of federally-recognized Indian tribes. (See 59 FR 43,960).

Visibility Protection Program. The CAA contains a visibility protection program for mandatory federal class I areas: certain large national parks and wilderness areas. (See sections 169A and 169B). While these provisions only apply to visibility, they are broader than the PSD program by providing direct authority to require reductions at existing sources that impair visibility in mandatory federal class I areas. In addition, new and modified stationary sources locating in both PSD and nonattainment areas are subject to visibility preconstruction review requirements.

These provisions establish as a national goal the prevention of any future, and the remedying of any existing, manmade impairment of visibility in mandatory federal class I areas. (See section 169A(a)(1)). The visibility protection program applies to mandatory class I areas (certain large national parks and wilderness areas) where visibility has been determined to be an important value. (See 40 CFR 81, subpart D).

In 1980, the EPA promulgated regulations addressing visibility impairment under section 169A of the CAA. (See 45 FR 80,084; December 2, 1980). In broad outline, the regulations required affected states to (1) coordinate development of visibility SIPs with appropriate land managers; (2) develop a program to assess and remedy visibility impairment from new and existing sources; and (3) develop a long-term strategy to assure reasonable progress toward the national visibility goal. (See 40 CFR 51, subpart P).

In the preamble to the 1980 regulations, the EPA stated that it would implement section 169A in phases. Phase I included the control of visibility impairment that can be traced to a single existing stationary facility or small group of existing stationary facilities. (See 45 FR 80,085). The term of art for this type of impairment is reasonably attributable impairment. (See 40 CFR 51.301(s) and 51.302(c)(4)(I)). The EPA deferred addressing other types of impairment such as regional haze (widespread haze from a multitude of sources which impairs visibility in every direction over a large area).[3]

States must determine whether visibility impairment in a mandatory class I area may be reasonably attributable to a single or small group of existing stationary facilities. Visibility impairment means any perceptible change in visibility (visual range, contrast, coloration) from that which would have existed under natural conditions. (See 40 CFR 51.301(x)). Such impairment may be reasonably attributable by visual observation or any other technique the state deems appropriate. (See 40 CFR 51.300(s)). If the impairment is reasonably attributable, the state must analyze the best available retrofit technology (BART) for the source. (See 40 CFR 51.302(c)(4)).

Major stationary sources that may be subject to BART because of their impact on visibility in a mandatory class I area include the following mining and related sources in existence on August 7, 1977, with the potential to emit at least 250 tons per year of any pollutant: coal cleaning plants; primary zinc, copper, and lead smelters; lime plants; phosphate rock processing plants; sintering plants; and taconite ore processing facilities. (See 40 CFR51.301(c)). Fugitive emissions must be counted, to the extent quantifiable, in determining potential to emit. (See 40 CFR 51.301(c)). Sources operating before August 7, 1962, may not be subject to BART.

Minor Source Review. The CAA also contains a minor source permit program that requires SIPs to include a program regulating the modification and construction of any stationary source, regardless of size or attainment status, as necessary to assure that the NAAQS are achieved. (See section 110(a)(2)(D)). Federally-approved minor source permit programs are federally-enforceable.

New Source Performance Standards (NSPS). EPA also issues NSPS that affected new or modified sources must meet in both attainment and nonattainment areas. (See sections 111 and 129 and 40 CFR Part 60). Several mining-related sources are regulated under NSPS, including: primary copper smelters (Subpart P); primary zinc smelters (Subpart Q); primary lead smelters (Subpart R); coal preparation plants (Subpart Y); lime manufacturing plants (Subpart HH); metallic mineral processing (Subpart LL); phosphate rock plants (Subpart NN); nonmetallic mineral processing plants (Subpart OOO); and calciners and dryers in mineral industries (Subpart UUU). These NSPS standards may be adopted by

[3] The CAA, as amended in 1990, provides for the establishment of interstate regions and associated commissions to address the potential interstate transport of visibility- impairing pollutants. (See section 169B). The EPA has established a visibility transport commission for the region affecting the Grand Canyon National Park and the other class I areas in the Golden Circle of national parks and wildernesses on the Colorado Plateau. (See section 169B(f) and 56 FR 57,522; November 12, 1991). The Grand Canyon Visibility Transport Commission is issuing a that examines, among other measures, the promulgation of regulations establishing long range strategies for addressing regional haze in affected Class I areas. (See section 169B(d)(2)).

states and either approved as part of the SIP or delegated by EPA. EPA retains primary enforcement authority if a state fails to enforce a NSPS.

Regulation of Hazardous Air Pollutants (HAPs). Prior to the 1990 Clean Air Act Amendments, EPA issued hazardous air pollutant standards, still effective, for radon from uranium mines (See 40 CFR 61, subpart B), for radionuclide emissions from elemental phosphorus plants (Subpart K), and for arsenic emissions from copper smelters (Subpart O). In many instances states have adopted these standards and they have either been approved by EPA as part of the SIP or delegated by EPA. EPA retains primary enforcement authority.

The CAA, as amended in 1990, contains a list of 189 HAPs and calls for EPA to develop maximum achievable control technology (MACT) standards for all categories of major sources by the year 2000. (See section 112). A major source is any stationary source or group of stationary sources located within a contiguous area and under common control that emits, or has the potential to emit, 10 tons or more per year of one HAP, or 25 tons per year of any combination of HAPs. (See section 112(a)(1)).

New standards will be developed for primary copper smelters, primary lead smelters, primary aluminum processing, steel foundries, and site remediation. Mining does not appear on the list of categories of major HAP sources. States must impose MACT on a case-by-case basis on all new major sources and modified existing major sources until EPA issues standards for the relevant categories. (See section 112(g)). If EPA fails to issue such standards by the relevant deadlines, states must issue permits, under the Title V operating permit program, setting MACT for all major sources in the category for which a standard has not been timely issued.

B.3. Title V Operating Permit Program

Title V of the CAA requires states to develop and submit to EPA an operating permit program.[4] (See sections 501-506). The program calls for permitting of sources by certain deadlines. Operating permits issued under EPA-approved programs to affected sources are to contain all of the applicable CAA requirements and are federally-enforceable. Title V also provides for the collection of fees by the permitting agency that reflect the reasonable cost of the permit program. EPA has issued rules specifying the minimum requirements for state operating permit programs in 40 CFR 70, and has proposed significant revisions to the rules.

C. CAA Compliance/Enforcement

[4] The operating permit program is not the same as the NSR and PSD permit programs described previously that, by contract, require construction permits.

Notices of Violation (NOVs) and Administrative Compliance Orders (ACOs). The enforcement authorities under the CAA include provisions for NOVs and ACOs. (See section 113(a)). These pre-enforcement mechanisms are not subject to judicial review. NOVs are a pre-requisite for any action to enforce a SIP. The CAA imposes a 30-day waiting period after issuing an NOV before taking further action. An NOV may be issued without regard to the period of violation. (See section 113(a)). The CAA provides for civil action when a person has violated or is in violation of a SIP. (See section 113(b)). Thus, EPA can initiate enforcement action for a past violation of a SIP.

Most ACOs are effective only after an opportunity is provided to conference with EPA and all ACOs must require compliance within no more than on year. Permit terms may be enforced by identifying permits specifically as subjects for enforcement. EPA also has authority to prohibit the construction or modification of a source that has received a defective PSD permit, as well as for defective NSR permits. (See section 113(a)(5)).

Civil Enforcement. Section 113(b) authorizes civil enforcement for injunctive relief and monetary penalties up to $25,000 per day per violation.

Criminal Enforcement. For SIP and other listed violations, criminal enforcement action can be brought for a knowing violation that occurs during any period of federally assumed enforcement or more than thirty days after the violator receives an NOV. (See section 113(c)). Section 113(c) also establishes felony offenses, with up to two years of imprisonment, for false statements (which include omission, alteration or concealment of required information) and tampering with a monitoring device or method. Offenses, with heavy penalties, are established for negligent or knowing release of HAPs which puts another person in imminent danger of death or serious bodily injury.

Administrative Civil Penalties. Section 113(d) authorizes administrative penalties for violations of the CAA, when the penalty sought is no more than $200,000 and the first alleged date of violation is no more than twelve months prior to initiating the action. Section 113(d) also authorizes a field citation program for issuing "tickets" on the spot, with penalties no more than $5,000 per day per violation. Regulations for the field citation program have been proposed by EPA.

Penalty Assessment Criteria. Several criteria for assessing penalties are set forth including seriousness of the violation and the violator's ability to pay a penalty, history of compliance and good faith efforts to comply, duration of violation, previous payment of a penalty for the same violation, and the economic benefit of violation (avoided costs of compliance). (See section 113(e)). Section 113(e) allows EPA to establish the duration of violation by any credible evidence (including evidence other than the applicable test method).

In addition, where the source has been notified of the violation and EPA makes a *prima facie* showing that the violation was likely to have continued or recurred after the date of the notice, there is a presumption that the violation continues each day thereafter until the violator establishes that continuous compliance has been achieved, or by a preponderance of the evidence shows that the violation was not continuing in nature. This provision shifts the burden of proof to the violator to rebut the presumption of continuing violation.

Emergency Orders. Upon receiving evidence that a source or combination of sources is presenting an imminent and substantial endangerment to public health or welfare, or the environment, EPA can immediately file suit for a restraining order or other relief, or it can issue an emergency order as may be necessary to protect such values. An order remains in effect for up to sixty days, or longer if a suit is filed. (See section 303).

Citizen Suits. In addition to the EPA enforcement authorities described above, the CAA authorizes citizens who provide the minimum required advance notice to bring a civil action against: (1) any person, including any governmental entity or agency, who is in violation of an emission limit; (2) any person who proposes to construct or constructs any new or modified major stationary source without a NSR or PSD permit that meets the requirements of the CAA; and (3) any person who is alleged to be in violation of such permit. (See section 304). The term person includes an individual, corporation, partnership, association, state, municipality, political subdivision of a state, and any agency, department or instrumentality of the United States and any officer, agent, or employee thereof. (See section 302(e)). The federal district courts have jurisdiction over citizen suits.

Citizen Awards. The CAA authorizes monetary awards, up to $10,000, for information or services that lead to a criminal conviction or judicial or administrative civil penalty. (See section 113(f)).

Information Collection. Record Keeping, Inspections, Monitoring, and Entry. The CAA authorizes EPA to require records, reports, sampling of emissions (including stack tests), and such other information that EPA may "reasonably require." (See section 114(a)(1)). Section 114 information requests may be detailed and extensive in scope. The CAA authorizes inspection by EPA or an authorized representative. (See section 114(a)(2)). The CAA also requires enhanced monitoring and compliance certifications for major sources. Enhanced monitoring and compliance regulations were proposed in 1993 and will be promulgated at 40 CFR 64.

Administrative Subpoenas. The CAA authorizes subpoenas for the testimony of witnesses and production of documents, for the purpose of obtaining information under any investigation, compliance inspection, or administrative proceeding under the Act. (See section 307(a)).

D. CAA Funding - N/A

E. CAA Natural Resources Restoration Provisions - N/A

F. CAA Good Samaritan Provisions **-** N/A

G. CAA Tribal Roles/Responsibilities **-** N/A

H. CAA Advantages/Limitations - N/A

I. CAA Integration with Other Statutes **-** N/A

VI. EMERGENCY PLANNING AND COMMUNITY RIGHT-TO-KNOW ACT (EPCRA)

Passed as Title III of the Superfund Amendments and Reauthorization Act of 1986, EPCRA has two main purposes: to encourage and support emergency planning for responding to chemical accidents, and to provide local governments and the public with information about possible chemical hazards and releases in their communities. The statute requires reporting of information on hazardous or toxic chemicals and substances (defined in section 329) by businesses and government agencies which produce, process, use or store them.

A. EPCRA Jurisdiction/Applicability/Media/Constituents

Jurisdiction Conditions. The statute requires reporting of information on extremely hazardous substances (EHS) by businesses and government agencies that produce, use or store them. Under section 313, which provides the authority for the Toxic Release Inventory(TRI), the law provides citizens as well as local, state, and federal government agencies with access to information on releases of toxic chemicals by manufacturing facilities (i.e., those in Standard Industrial Classification (SIC) Codes 20-39) A release may be to any of the environmental media. EPA has proposed to add SIC code 10 (Metal Mining) (61 FR 33587; June 27, 1996), with a final rule anticipated in mid-1997.

Executive Order 12856 requires all federal agencies to comply with EPCRA and phases in this reporting during 1994-1995. Executive Order 12969 (60 FR 40989; August 8, 1995) requires all federal agencies to require companies that bid on federal contracts to certify that they are in compliance with TRI reporting requirements and that they will continue to comply for the life of the contract if they receive the award.

Media. Most EPCRA provisions cover data on toxic chemicals and releases to all media.

Constituents. In addition to the over 300 toxic chemicals originally reportable under TRI, a final rule (59 FR 61432; November 30, 1994) added 286 additional chemicals and chemical categories subject to the TRI reporting requirements. These chemicals were added based on human health effects, toxicity, and significant adverse effect on the environment. Also, approximately 361 chemicals are identified as extremely hazardous substances (EHS) for purposes of emergency planning (see following subsection. For each EHS, there is a threshold planning quantity. If this amount or more of the chemical is present at a facility, the owner or operator must notify in writing both the State Emergency Response Commission (SERC) and the local emergency planning committee (LEPC). There is a 1 percent *de minimis* threshold for mixtures and solutions. If a mixture contains an extremely hazardous substance in excess of 1 percent of the total mixture, that EHS must be considered under section 302. The facility must designate an emergency coordinator, provide planning information to the LEPC or TERC, and coordinate emergency response planning with the community.

B. EPCRA Implementation Mechanisms

Emergency Planning (Section 301). The governor appoints a SERC, which divides the state into local emergency planning districts and appoints a broadly representative LEPC for each district. Frequently, LEPC's are organized based on county boundaries. The LEPC receives information submitted by local businesses and other facilities that store, produce or use chemicals. The LEPC also conducts a community hazard analysis, identifying types and location of chemical hazards, vulnerable areas and populations, the risk of accidents and their potential effects on the community. The LEPC develops a local emergency response plan based upon the information gathered. Mining operations should be included in these plans, to the extent they use extremely hazardous substances above the threshold planning quantities. A representative from any mines within the planning area or the federal land manager could participate in the LEPC. A tribal chairman can appoint a tribal emergency response commission (TERC), with duties similar to that of a SERC.

Extremely Hazardous Substances (Section 302): For each EHS, there is a threshold planning quantity. If this amount or more of the chemical is present at a facility, the owner or operator must notify in writing both the SERC and the LEPC. There is a 1 percent *de minimis* threshold for mixtures and solutions. If a mixture contains an extremely hazardous substance in excess of 1 percent of the total mixture, that EHS must be considered under section 302. The facility must designate an emergency coordinator, provide planning information to the LEPC or TERC, and coordinate emergency response planning with the community.

Emergency Release Notification (Section 304): This section applies if there is a release from a facility of a CERCLA section 102 hazardous substance or an EHS above the Reportable Quantity within a 24-hour period. For the purposes of section 304, facility includes motor vehicles, rolling stock, and aircraft. Release reporting is not affected by the Bevill exclusion.

If the chemical is a CERCLA 102 hazardous substance and the release exceeds the Reportable Quantity, the facility must immediately notify the National Response Center in addition to notifying the LEPC and the SERC or TERC. Releases of reportable quantities of CERCLA 102 chemicals must be reported when they occur, regardless of whether they are likely to leave the property boundaries. There are more than 700 hazardous substances subject to CERCLA spill notification requirements.

If the chemical is an EHS but not a CERCLA 102 chemical, the facility must immediately notify the LEPC and the SERC or TERC when the release leaves the property boundaries. Releases of mixtures and solutions are subject to notification requirements only where a component hazardous substance or EHS of the mixture or solution is released in a quantity equal to or greater than its Reportable Quantity.

Right-to-Know Reporting (Sections 311-312): Businesses and government agencies must report amounts, location and potential effects of EHS present in the community to the SERC or TERC and LEPC. More than 500,000 products in commerce are covered by these sections. Since mines are not covered by OSHA, they do not presently have to report under these sections.

Any business or facility that is required by OSHA regulations to keep material safety data sheets (MSDS) on file for hazardous chemicals in the workplace must determine, based upon inventories of these materials, how and if it may need to comply with the inventory provisions of this law. If the chemical is a CERCLA section 102 hazardous substance, the facility must report for chemicals for which it has 10,000 pounds or more on site at any time during the year. If the chemical is an Extremely Hazardous Substance, the amount that triggers section 311/312 reporting is 500 pounds or the TPQ, whichever is lower.

To report under section 311, the facility is required to provide the SERC or TERC, the LEPC and the local fire department with either a list of the hazardous chemicals at the facility for which MSDSs are required, or a copy of each MSDS. Approximately 4.5 million facilities are covered, including some related to mining such as smelters, refineries, fertilizer product operations, and milling operations associated with gypsum board plants not located on mine property. Under section 312, companies must submit annual inventories of EHS to the SERC, LEPC and local fire department in March every year.

Since the mines themselves, as well as preparation and milling operations, are covered by the Mine Safety and Health Administration (MSHA), not OSHA, these provisions would not apply to those operations. MSHA and OSHA have signed a national Memorandum of Agreement (MOA) to delineate their respective areas of authority. Per this MOA, MSHA jurisdiction includes mineral extraction and milling operations, salt processing facilities on mine property, electrolytic plants where the plants are an integral part of milling operations, and alumina and cement plants.

For operations near the end of the milling cycle and the beginning of the manufacturing cycle, the scope of the term milling may be extended or narrowed, as determined by agreements between the MSHA District Manager and the OSHA Regional Administrator developed in accordance with the national MOA.

Toxic Release Inventory Reporting (Section 313): This section requires manufacturing facilities having 10 or more employees and using at least a threshold amount (25,000 pounds or 10,000 pounds or 1 million pounds for small releasers) of a TRI chemical(s) to report annually on their releases of that chemical(s) to the environment (See Alternate Threshold Rule, 50 FR 61488; November 30, 1994). Pounds of chemical released to each environmental medium must be reported.

Smelters are currently covered under TRI and report for chemicals such as lead and lead compounds, copper and copper compounds, zinc fume or dust, zinc compounds, manganese and manganese compounds, sulfuric acid, and hydrochloric acid. In addition, EPA has proposed that facilities in the metal mining SIC code be subject to TRI reporting.

General Implementation. Implementation of EPCRA is split between EPA and state/local/tribal governments. EPA provides technical assistance to state, tribal, and local government agencies to help them implement most sections of EPCRA. The state, tribe, or EPA can take enforcement action for violations of sections 302, 304, and 311-312. EPA is solely responsible for both implementation and enforcement of section 313 (TRI).

C. EPCRA Compliance/Enforcement

Administrative and Injunctive Authorities. EPCRA grants specific state and local authority to request information from facilities and to take enforcement actions in those situations where voluntary compliance has not occurred. LEPCs, TERCs, or SERCs could file a civil action under section 326 against a facility owner or operator in the U.S. District Court for violations of EPCRA, or they could assist the EPA in an enforcement action. Citizen suits against the owner or operator of a facility, the EPA Administrator, or the Governor or SERC, are also provided for under section 326(a)(1).

Under section 325, the federal government can bring administrative and civil or criminal judicial actions against violators. Section 325(a) authorizes EPA to order owners or operators of facilities to comply with sections 302 and 303. The local U.S. District Court has jurisdiction to enforce the order and assess a civil penalty of up to $25,000 per violation per day. EPA cannot assess these penalties administratively.

Penalties. Violations of section 304 emergency notification provisions can be addressed through administrative or judicial enforcement. There are also criminal penalties for knowingly and willfully failing to provide notice, or for providing false or misleading information. Section 304 violations can carry a Class I civil penalty of not more than $25,000 per violation or a Class II civil penalty of not more than $25,000 per violation per day. In the case of subsequent violations, Class II penalties of up to $75,000 for each day a violation continues may be assessed.

For violations of sections 311, 312 and 313, EPA can assess civil penalties by issuing administrative orders or by filing actions in the U.S. District Court. Violation of section 311 subjects the violator to a civil penalty of up to $10,000 for each violation. Sections 312 and 313 violations carry civil penalties of not more than $25,000 for each violation. The statute establishes that every day a violation continues is considered a separate violation.

D. EPCRA Funding

Actions carried out under EPCRA do not have a specific appropriation. LEPC's and SERC's can charge fees to facilities who report information to them to cover the administrative costs of handling the information.

E. EPCRA Natural Resource Restoration Provisions - N/A

F. EPCRA Good Samaritan Provisions - N/A

G. EPCRA Tribal Roles/Responsibilities - N/A

Native American communities may benefit from improved information TRI provides on facilities in or near their communities. Tribes can also designate themselves as Tribal Emergency Response Commissions (tribal SERC's or TERC's) or they can form local Tribal Emergency Response Committees under the existing SERC.

H. EPCRA Advantages and Limitations

An advantage of EPCRA is that it could assist small communities in getting preventive emergency planning at active or inactive mines before there is a spill or accident. By including mining facility representatives on LEPC's and enforcing mine owner/operator responsibility to notify the planning committee/state commission about the presence of extremely hazardous substances on site, it may be possible to improve the owner/operator's environmental awareness and responsiveness.

There are also potentially large fines for facilities that do not report information under this statute. Threats of fines could be used to encourage pollution prevention or obtain mitigation measures.

A significant limitation is that EPCRA cannot stop releases. As long as the releases are reported properly, there is no requirement that they be eliminated (that is largely the province of other authorities). Section 103 of CERCLA does not require reporting for some federally permitted releases. And the reporting frequency for continuous releases stable in quantity and rate can be reduced under section 103 of CERCLA. It can be difficult for the Agency to quantify releases after they occur, since it must be proven that the release exceeded the Reportable Quantity to show that reporting was required under section 304.

Mines are not presently covered by the chemical inventory requirements of sections 311-312 because of MSHA jurisdiction, nor by the TRI reporting requirements of section 313. The flexibility of MSHA and OSHA to decide what portions of a mining facility are regulated under each authority could be explored to see if those agencies are willing or able to expand OSHA coverage at some problem sites within the limits of the MOA. Guidance for federal facility reporting under Executive Order 12856 also should be reviewed to determine how federal land managers may be covered by EPCRA.

Disadvantages of the TRI include:

- Rulemaking is necessary in order to require reporting to TRI of releases from mining activities.

- Listed toxic chemicals potentially represent only a subset of chemicals that may be manufactured, processed, or otherwise used in mining activities.

- The manufacturing, process, and otherwise use threshold definitions and levels may inhibit reporting of the entire universe of chemicals that may be used at a mining facility.

- The release volumes indicated in TRI for a given facility may be only estimates; facilities are not required to do any additional monitoring for purposes of TRI data collection, so many facilities provide estimates of releases based on EPA guidance.

I. EPCRA Integration with Other Statutes

There are many overlaps of chemicals/metals in EPCRA with those covered by other environmental statutes. For example, 97 of the 126 toxic chemicals known as the priority pollutants for Clean Water Act purposes are also TRI chemicals. EPA has published aquatic life and/or human health protective ambient water quality criteria for 81 of the TRI chemicals. A number of TRI chemicals are covered by state water quality standards.

Approximately 305 of the individually listed TRI chemicals are also CERCLA hazardous substances. Two thirds of the individually listed TRI chemicals are regulated under RCRA. Forty of the individually listed TRI chemicals are currently used to identify a waste as a characteristic hazardous waste. When such chemicals are found in the waste above specified levels, the waste is subject to RCRA regulation. In addition, 181 of the individually listed TRI chemicals are also listed as hazardous waste when they are unused or discarded commercial chemical products.

Approximately 180 TRI chemicals are also hazardous air pollutants under the CAA. Fifty-five TRI chemicals are regulated under the Safe Drinking Water Act.

TRI data are used to identify gaps in regulatory coverage under environmental statutes. To some degree, TRI data were used in EPA's review of states' lists of impaired waterbodies developed under section 304(l) of the CWA. TRI data is one factor which EPA is using to identify industrial categories for which effluent limitations and standards should be developed or revised under the NPDES program.

VII. SAFE DRINKING WATER ACT

In 1974, Congress amended the Public Health Service Act and retitled it the Safe Drinking Water Act (SDWA). Part C of the SDWA directed EPA to establish a federal program setting minimum requirements for effective state programs to prevent underground injection which endangers ground-water resources of public water supply systems. The resulting regulations established two methods for authorization to inject: authorization by rule (40 CFR 144, subpart C) or by permit (40 CFR 144, subpart D). Since its passage in 1974, the SDWA has been amended six times (1976, 1977, 1979, 1980, 1986, 1996). The net effect of these amendments is that federal and state regulatory agencies have modified existing programs and/or established new strategies to protect ground water by promulgating even more effective regulations to control the permitting, construction, operation, monitoring and closure of injection wells.

Over the past 50 to 60 years, the practice of underground injection has become diverse in its many applications and essential to many human activities, including petroleum production, chemical production, foods production, manufacturing, mining, and many specialty plants and related businesses. The practice has expanded from disposal of produced brine from oil production to liquid hazardous and nonhazardous industrial waste. It is also a key component in the recovery of some natural resources, such as uranium and salt, and in the remediation of uranium contamination.

A. SWDA Jurisdiction/Applicability/Media/Constituents

The goal of the underground injection control (UIC) program, as established by SDWA and UIC Regulations by 40 CFR Part 124, and 144 through 148, is to prevent contamination of underground sources of drinking water (USDW) resulting from the operation of injection wells (See 40 CFR 144.12). This program establishes minimum requirements for state, tribal, and federal programs for control of all injection activities and provides mechanisms for implementation and delegation of primary enforcement authority. Where states and tribal authorities don't seek primacy, EPA automatically assumes direct implementation authority.

B. SDWA Implementation Mechanisms

Under the EPA UIC program, injection wells are divided into five well classes for the purpose of regulations (See 40 CFR 146.5). Injection wells are divided into five classes. Class III wells are those used to inject fluids for the recovery of minerals (e.g., solution mining for salts and sulfur and in situ leaching for uranium, copper, or (experimentally so far) gold. Class V and, for a while, some Class I wells have mining applications for the disposal of hazardous or nonhazardous wastes, including using mine wastes to backfill underground mines. The following is a general description of those classes:

(1) Class I wells inject hazardous and nonhazardous industrial waste below all USDWs,

(2) Class II wells inject fluids associated with oil and gas production where primary uses are injection for enhanced oil recovery, brine disposal, and storage of liquid hydrocarbons,

(3) Class III wells are used to inject fluids for the recovery of minerals where some of the principal uses are solution mining for the extraction of salts and sulfur and in situ leaching used to recover uranium, gold, and copper,

(4) Class IV wells are used to dispose of hazardous or radioactive wastes into or above a USDW (EPA has banned the use of these wells), and

(5) Class V wells are wells not included in the other above-mentioned well classes that inject largely nonhazardous fluids into or above a USDW. Some Class V wells that inject below a USDW may be reclassified to one of the above well classes I - III.

A USDW is defined as an aquifer or its portion which supplies any public water system or contains a sufficient quantity of ground water to supply a public water system, or contains less than 10,000 milligrams per liter (mg/l) total dissolved solids (TDS) and is not an exempted aquifer.

The classification system allows for different regulatory schemes for each of the classes such that endangerment of USDWs can be prevented. The criteria for defining where a well fits are: (1) type of activity, (2) nature of the fluids injected and (3) location of the well to a USDW.

C. SDWA Compliance/Enforcement

Administrative/Compliance Orders: Section 1423(c) provides authority to issue administrative compliance orders.

Civil Penalties: Section 1423 provides for civil penalties of up to $25,000 per day for a violation.

Criminal Penalties: Section 1423 provides for criminal penalties of up to $25,000 per day and up to 3 years imprisonment for knowingly violating the SDWA.

D. SDWA Funding - N/A

E. SDWA Natural Resource Restoration Provisions - N/A

F. SDWA Good Samaritan Provisions - N/A

G. SDWA Tribal Roles/Responsibilities

EPA may treat an Indian tribe as a state for purposes of the UIC program if the tribe meets the criteria defined in 40 CFR 145.52. These criteria include: (1) the tribe is recognized by the Secretary of the Interior; (2) the tribe has a governing body carrying out substantial government duties and powers over a defined area; (3) the UIC program to be administered by the tribe is within the borders of the Indian reservation; and (4) the tribe is reasonably expected to be capable of administering an effective UIC program by the existence of management and the technical skills necessary to administer an effective program.

H. SDWA Advantages and Limitations

At this time it appears that state and federal UIC programs have adequate regulations in place to manage Class V injection wells. The Agency, in the proposed Class V rule (40 FR 44652), felt that these wells posed very little threat to the environment and determined that additional federal regulation is not warranted. The Agency will continue to emphasize the need for owners and operators of these wells under 40 CFR 144.12 and 144.25 to obtain a permit, and the submittal of information on a case-by-case basis as needed to protect USDWs under 40 CFR 144.27.

I. SDWA Integration with Other Statutes

A proposed RCRA Land Disposal Restriction rulemaking referred to as Phase IV (60 FR 43654) may ban disposal of certain mineral processing wastes currently being disposed in these wells. The significance of these injection well classes is that they provide regulation for production of wells and nonendangerment of wells for USDWs.

VIII. TOXIC SUBSTANCES CONTROL ACT (TSCA)

A. Jurisdiction/Applicability/Media/Constituents

TSCA provides EPA with authorities to regulate the manufacture (including import), processing, distribution, use, and disposal of chemical substances. Under TSCA, EPA may require health and environmental effects testing by manufacturers, importers and processors of chemical substances, which include organic and inorganic substances occurring in nature, as well as chemical elements. TSCA also authorizes EPA to: require record keeping and reporting of information that is useful for the evaluation of risk, regulate chemical substances that present an unreasonable risk of injury to health or the environment, take action to address imminent hazards, require notification to EPA by prospective manufacturers of new chemicals, and make inspections or issue subpoenas when needed to implement TSCA authorities. Under TSCA, EPA must exercise these authorities in such a manner as not to impede unduly or create unnecessary economic barriers to technological innovation.

In practice, the most useful tool under TSCA has been section 6, PCB Regulations, as codified at 40 CFR Part 761. The mining industry has traditionally used high levels of PCBs. PCBs are most commonly found as the dielectrics in transformers and capacitors. These items are commonly found wherever there is a high electrical power demand. Transformers and capacitors, either single units or in banks, can be expected in any phase of surface or underground mining operations and the ore beneficiation process. PCB equipment has been replaced in many mines and all mines built after the ban on production of PCB equipment should not have had PCBs in transformers and capacitors.

B. TSCA Implementation Mechanisms

The PCB regulations require marking, inspections, annual document logs, and proper disposal for PCB equipment. Violations of the PCB regulations in the mining industry have been common. Increasing the EPA regulatory presence should be considered, especially for underground mines.

CERCLA has been used in conjunction with TSCA requirements to effect removal of transformers from underground mines. Actions taken at the Bunker Hill Mine in Idaho are an example where the mining company removed underground transformers prior to flooding of the mine. This prevented the future release of PCBs into the ground water system.

C. TSCA Compliance/Enforcement

Reporting and Retention of Information. Under section 8, EPA can require processors to keep records and submit information to EPA including information on the amount of the chemical substance processed; on how the material is used and disposed of; the byproducts resulting from processing, use, or disposal; health and safety studies completed; and the duration and frequency of exposure and the number of persons exposed in their places of employment. Section 8 also requires EPA notification when information in the hands of manufacturers, processors, and distributors of a chemical substance supports the conclusion that a chemical substance presents a substantial risk of injury to health or the environment. Under these provisions, EPA could write a rule requiring processors to keep records and report information that would detail the risks posed by their operations.

Citizens' Petitions. Any person can petition EPA to initiate an action under sections 4, 6, or 8 of TSCA and EPA must respond within 90 days to the petition. If EPA grants the request, it must then promptly commence the necessary rulemaking.

D. TSCA Funding **-** N/A

E. TSCA Natural Resource Resoration Provisions - N/A

F. TSCA Good Samaritan Provisions **-** N/A

G. SDWA Tribal Roles/Responsibilities **-** N/A

H. SDWA Advantages/Limitations

In the past, underground PCBs have been overlooked because inspectors have been reluctant to enter underground mines. MSHA training for EPA inspectors is available at no cost and requires little time. EPA inspectors not familiar with underground mines should request that an MSHA inspector accompany them.

I. TSCA Integration with Other Statutes

Section 9 of TSCA states that EPA will coordinate TSCA actions with actions taken under other federal laws and that TSCA will only be used in cases where other laws are not sufficient to address the risk, or in cases where the Administrator finds that it is in the public interest to take action under TSCA.

3. OVERVIEW OF NON-REGULATORY TOOLS

I. OVERVIEW

Non-regulatory approaches available to EPA to address environmental challenges posed by mining are typically employed to complement existing regulatory programs in addressing mining impacts. While recognizing that each non-regulatory effort is unique, there are certain themes that are common to the most successful ones, both site specific and non-site specific:

- **Active participation by principal stakeholders**, including a recognition of the environmental problems and a willingness to take on the issues.

- **Creative use of limited funding resources**, promoting coordination and research on mining issues. These include the University of Montana's Mining Waste Institute, a variety of groups comprising the Mining Information Network, and the Western Governors' Association (WGA). Some programs, such as CWA section 319 funds, have been successfully used to fund portions of cleanup projects.

- **Site specific flexibility** in adapting non-regulatory tools to fit the specifics of the site and the interest of the stakeholders.

- **Pollution prevention efforts supported by** federal and tate agencies, tribes, and other stakeholders, limiting the generation and use of waste materials.

- **Prioritization of cleanup projects**, often on a watershed basis, as a way of allocating limited resources and focusing on worst cases first.

- **Regulatory discretion** as a tool to promote creative problem solving and early implementation of cleanup projects. For example, having a site listed as a Superfund site might reduce local involvement.

- **Key Characteristics of Non-regulatory Tools**. Most non-regulatory approaches contain one or more of the following characteristics:

- **Financial**. Financial support often comes from a variety of sources when non-regulatory approaches are used. Funds are often leveraged, and budgets are typically tight. Examples include: EPA staff resources, RCRA 7007 and 8001 grant funds, CWA section 319 funds, other federal agency funds, state/local partnerships, and private initiatives.

- **Institutional**. These include Interagency Agreements, regional and national initiatives, and outreach in a variety of forms, (e.g., participation in and support of Idaho's Mining Advisory Committee).

- **Technical Assistance and Outreach**. This includes technical assistance, standardization of analytic methodologies, technology demonstrations, and education and training.

II. OBJECTIVES

The purposes of this discussion of non-regulatory tools include the following:

- Illustrate the key traits of effective non-regulatory tools. Sometimes these will be based on tools that have a regulatory connection, although the emphasis will be on the non-enforcement aspects of those authorities.

- Using specific case examples, point out areas where these tools have filled gaps in the current regulatory framework.

- Highlight model policies and approaches that could be the basis for future regulations or legislation.

- Point out the main limitations of non-regulatory approaches.

III. BACKGROUND

Non-regulatory tools to manage environmental problems posed by mining are typically employed to complement existing regulatory programs in addressing mining impacts. While current regulatory programs can often be adapted to address the environmental problems posed by mining, they can be cumbersome, expensive to administer, and understaffed. Non-regulatory tools have been developed to take advantage of the incentives created by a backdrop of enforcement oriented regulatory programs, or to coordinate these programs to maximize their overall impact. For example, when cleanups precede active enforcement of regulatory programs they may be easier and less expensive to implement. While recognizing that each non-regulatory effort is unique, there are certain themes that are common to the most successful efforts.

- Active participation by principal stakeholders, including a recognition of the environmental problems and a willingness to take on the issues. This typically includes federal, state and local governments, tribes, industry, citizens, and affected landowners. Participation does not necessarily mean funding, but it does mean cooperation.

- Creative use of funding resources. While little public money is specifically earmarked for mine site cleanup other programs, such as CWA section 319 funds, have been successfully used to fund portions of cleanup projects. State programs, local contributions, and private funding by responsible parties have all been tapped for assessment and cleanup projects. Technology demonstrations have sometimes been used to get seed money to develop a new cleanup approach.

An important category of non-regulatory tools is based on the principles of geographic based environmental management. These geographic approaches often have the following features:

- Site specific flexibility. The adaptation of non-regulatory tools needs to fit the specifics of the site and the interest of the stakeholders.

- Pollution prevention efforts supported by federal and state agencies, tribes, and stakeholders, limiting the generation and use of was materials.

- Prioritization of cleanup projects, often on a watershed basis, as a way of allocating limited resources and focusing on worst cases first.

- Regulatory discretion as a tool to promote creative problem solving and early implementation of cleanup projects. Good Samaritan provisions are an example.

IV. KEY CHARACTERISTICS OF NON-REGULATORY TOOLS

Most non-regulatory approaches contain one or more of the following characteristics.

Financial

Financial support often comes from a variety of sources when non-regulatory approaches are used. Funds are often leveraged, and budgets are typically lean.

EPA Staff Resources. Non-regulatory approaches often take a large amount of staff time and energy to implement.

RCRA 7007, 8001 grant funds. Section 7007 funds are grants for a wide range of training programs, for either states or individuals. Section 8001 funds cover research, training, and other studies related to solid and hazardous waste. Funds in both these sections cover potentially a wide range of projects and have been used extensively to fund mining research and technical assistance throughout all agency media program offices as well as the Office of Enforcement. Funding in recent years has been as high as $2.5 million, in FY 95 it is expected to be $500,000. In FY 89 and FY 90 most of the money went to support WGA related activities, now funds used for a variety of media related projects. Categories of funding typically include research at the Colorado School of Mines on mine waste, funding to maintain an environmental mining network, and funding to regions on mining related projects.

<ins>CWA Section 319 Funds</ins>. Section 319(h) established a demonstration grant program to assist states in implementing specific projects to demonstrate effective NPS control projects. Approximately $1,000,000 per year is spent through this mechanism on inactive mine projects, with oversight in the Regional offices. Types of activities funded include: education, staff development, technical assistance, project demonstration, and ground water protection.

<ins>Other Federal Agency Funds</ins>**.** These are often used to either supplement EPA funds or to support specific pieces of a non-regulatory approach or initiative. In some instances land management agencies have large budgets devoted to mining related programs. These can be significantly greater than the EPA funds discussed above.

<ins>State/Local Partnerships</ins>**.** Although usually smaller in size than federal monies, support from state and local stakeholders can often fill financial holes in geographic based approaches.

<ins>Voluntary Efforts</ins>. Good Samaritan work by private parties can contribute a significant amount towards clean-up of inactive and abandoned mines (IAMs).

<ins>Institutional</ins>

<ins>Interagency Agreements</ins>. MOUs, MOAs, and IAGs are all tools that can be used to deal with the large number of agencies that regulate mining. When used effectively, they can help clarify roles and streamline the overall regulatory process. For example, as part of the Coeur D'Alene Restoration Project a MOA between EPA, the State of Idaho and the Coeur D'Alene tribe was instrumental in helping reduce differences among the parties and focusing efforts on restoration goals.

<ins>External/internal teamwork</ins>. At a less formal level, interagency groups are often an effective means of focusing attention on certain projects or issues. They provide a way for individuals with expertise to interact. These coalitions are also an important first step in breaking regulatory impasses. The WGA Mine Waste Task Force is such an example. Within a region, internal teams also help focus efforts on mining issues, such as in Regions 8, 9, and 10, where most of the staff participation on mining teams is voluntary.

<ins>Regional and National Initiatives</ins>. These are also a useful way of improving communications and focusing efforts on addressing mining problems. The site specific approaches described in more detail in this appendix are all examples of such initiatives at the regional level.

Outreach. This ranges from detailed outreach to a local community to simply providing on-site staffing at critical junctures during a remediation. One type of outreach, involving community based environmental indicators, can provide an important link with strategically significant technical tool, watershed planning.

Technical

Technical assistance. This would include the dedication of either EPA staff or contractor hours to providing direct help to a stakeholder. This is often an effective tool in working with other agencies and states.

Analytic methodologies. These can range from predictive tools to well developed monitoring and testing standards that help make data analyses consistent. Examples include: resource assessment and goal setting methods, alternatives development, and cost effectiveness methodologies. One specific example of this is the State of Montana, which has developed an HRS type system used for priority setting.

Technology demonstration. Technology demonstration efforts have had a couple of roles in non-regulatory efforts. One is a traditional means of identifying new and effective treatment technologies. Another is that non-regulatory approaches themselves have been able to attempt less proven methods than more regulatory, Superfund type approaches to remediation.

Education and Training. Because of the multimedia nature of mining issues, training is often necessary to bring key players up to speed on technical or regulatory issues. Education efforts on a more broader scale have been used to highlight and respond to community concerns regarding the impacts of mining and regulatory activities.

Standardized analysis and monitoring methods. Different agencies use different methods for measurements ranging from simple location data to kinetic testing methodologies. Efforts to standardize this information make priority setting and monitoring significantly easier.

Other Characteristics

Compromise/Enforcement Discretion. Where there is a significant enforcement history in connection with a non-regulatory initiative, enforcement discretion is often a factor in helping to build a working coalition amongst a variety of players.

Institutional Controls. These include a variety of approaches, such as deed restrictions and other local regulations, that can be useful as part of an overall strategy.

Limits

<u>Staff resources</u>. One of the main drawbacks of non-regulatory tools are the large amount of staff time needed to make them successful. To some extent, though, this may be a matter of perception only. Although these approaches can require significant staff resources, they can avoid a much higher resource cost in the future if properly focused.

<u>Enforcement related issues</u>. As a result of the regulatory backdrop for many of these examples, enforcement and liability issues can obstruct or delay non-regulatory, cooperative or Good Samaritan efforts.

V. <u>EXAMPLES OF NON-REGULATORY TOOLS</u>

This sections describes several examples where non-regulatory tools were used to address various aspects of mine sites. Three of the examples are site-specific and the remainder are not site-specific but are more programmatic in nature.

Site Specific Examples:

- **A.** Coeur D'Alene Basin Restoration Project
- **B.** Clear Creek Watershed Project
- **C.** Arizona Copper Mine Initiative

Non-Site Specific Examples:

- **D**. RCRA Subtitle D Strawman Guidelines
- **E**. Mine Waste Technology Demonstration Project
- **F**. Region 8 Nonpoint Source Mining Project
- **G**. Bubble Trading
- **H**. Remining
- **I**. Wellhead Protection Programs

A. *<u>Coeur D'Alene Basin Restoration Project</u>*

The Coeur d'Alene Basin in northern Idaho has been heavily impacted by the effects of over 100 years of hardrock. Water quality has been severely degraded, habitat destruction is widespread, and extensive depositional areas have been impacted by mine wastes, including the Coeur d'Alene River and Lake Coeur d'Alene.

The Coeur d'Alene Basin Restoration Project (CBRP) brings together many of the tools which are commonly utilized in non-regulatory approaches to addressing environmental problems caused by mining.

However, like many other projects that are used as examples of non-regulatory success stories this project has a strong regulatory basis.

Against that regulatory backdrop, however, many of the features of the CBRP serve as an example of ways in which non-regulatory tools can be used to address the environmental problems posed by mining.

Key features of the project:

- MOA between EPA, the State of Idaho and the Coeur d'Alene Tribe of Idaho to coordinate activities and work towards consensus decision making in addressing environmental problems in the Basin.

- Establishment of a technical working groups composed of the major stakeholders in the Basin (including such federal agencies as the BLM as well as state and local government, citizens, and industry) to set priorities and develop technical approaches to problem solving.

- Establishment of a Citizens Advisory Committee to serve as a point of contact with technical working groups and help focus outreach efforts.

- Using a mix of resources to get work done on the ground.

<u>Technical approach</u>

A basin wide analysis of environmental problems (not only problems caused by mining) is underway. This effort involves a variety of stakeholders and has helped focus public attention on the project. Efforts to characterize the impacts of mining, agriculture, forestry, urban runoff, and recreational use on the rivers and lakes of the watershed are being used as the basis for a Lake Management Plan for Lake Coeur d'Alene. Concurrently, the Natural Resource Trustees for the Basin are studying the environmental impacts caused by historic mining practices and beginning to evaluate restoration options.

As an interim approach to moving cleanup projects forward while environmental studies are under way technical work groups have developed Best Management Practices to use in implementing cleanup projects. The effectiveness of these projects is being monitored as a guide to planning future cleanup efforts. Meanwhile, basin wide priority setting by technical working groups helps focus cleanup projects in those areas where the benefits will be the greatest.

<u>Institutional Approach</u>

A MOA between EPA, the State of Idaho, and the Coeur d'Alene Tribe of Idaho established a Steering Committee for the project, a Management Advisory Committee (MAC), a Citizens Advisory

Committee (CAC), and recognized the Coeur d'Alene Basin Interagency Group (CBIG) as a technical support group. The three parties to the MOA have all dedicated a staff person to the project. Supporting these three staff are a Public Involvement Coordinator and an Executive Secretary (both positions will be filled this winter). Other stakeholders in the CBRP contribute staff time and expertise through the MAC or CBIG.

Financial Considerations

Money to finance the CBRP has come from a variety of sources. Internal resources of the agencies involved have been used to fund staff and undertake investigations, participate in technical workgroups, and work with other stakeholder to set priorities and develop cleanup strategies.

Funding for cleanup projects has included:

- CERCLA Removal Funds
- Section 319 of CWA Funds
- RCRA Special Project Funds
- Idaho Natural Resource Damage Settlement Funds
- State Water Pollution Control Funds
- Privately funded cleanup projects (industry)
- County/local funding and in-kind contributions
- Volunteer efforts
- Other federal agencies on federal lands (e.g., BLM)

Other Characteristics

Many of the successful aspects of this project fit into the regulatory backdrop of CERCLA, CWA, and state and local regulations. Enforcement discretion has played a major role in moving projects forward. For example, the voluntary cleanup projects undertaken by industry in the Basin have been undertaken, in part, because EPA has stated its intention to use CERCLA enforcement authority to compel private parties to undertake work at high priority sites if they do not initiate cleanup projects on their own. The five million dollars available in the State Natural Resource Damage Settlement Fund is the result of settlement of a CERCLA case. The reliance on the backdrop of regulatory programs does not in any way diminish the success of the CBRP. Development of cleanup priorities and implementation approaches by all the Stakeholders in the Basin has sped up projects, created incentives to participate by moving aside regulatory constraints, and has demonstrated a willingness by all involved to move the process of restoration of the Coeur d'Alene Basin forward in a cooperative fashion.

B. Clear Creek Watershed Project

From the headwaters on the continental divide to the plains near Denver, Clear Creek connects small mountain communities with Colorado's largest metropolitan area. Covering roughly 600 square miles, the Clear Creek watershed includes 5 counties and more than 13 communities and provides more than 165,000 people with their drinking water supply. The water and watershed through which it flows easily establishes a sense of place for the citizens and a focus for efforts to protect the environment. Over 85 percent of the water is used as a drinking water supply for the metro area, therefore the people of the lowlands have a special interest in remediation of the impacts of the past mining activities.

Key features of the project include:

- No one organization initiated the watershed project, per se. It resulted from a critical mass of representative groups from industry, agencies, local organizations and private citizens that joined together to protect the one thing they all have in common, the waters of Clear Creek.

- Many of these projects and programs were instigated or facilitated by the two Clear Creek Watershed Forums organized and attended by a diverse group of stakeholder interests, bottom up.

- In 1983 the Clear Creek/Central City site was included on the Superfund National Priorities List. It is one of the largest Superfund study areas in the nation encompassing all of two counties in the upper watershed. Prior to the Watershed effort, Superfund activities were not welcomed (This is an understatement).

- Mining is part of the history and culture of the area that must be respected. A comprehensive approach is the only way that the locals have been able to approach the facts of mining environmental impacts.

<u>Technical</u>

Technical aspects of the Clear Creek watershed effort are characterized by complex past mining sources, complex hydrology and complex treatment technology. Joint sampling efforts by the full range of stakeholders and training of local personnel has not only established a shared, workable water quality baseline but a basis for trust among the stakeholders. In addition, a willingness to risk new technologies and bring in the experts if needed is a key component of the project. Demonstrating new technologies, such as passive mine treatment, provide a non-threatening form of technical assistance. Furthermore, a focus on problem identification and site specific resolution of problems is a strength of this approach as is the realization that we all live downstream.

Institutional Approach

Unlike the Coeur D'Alene project, formal arrangements between stakeholders were rejected. Because the Superfund action and a major lawsuit between parties came first in the process, there was a great deal of distrust between the stakeholders. The institutional approach for Clear Creek has been very flexible. A local watershed coordinator was key in making the process work. Local stakeholders wanted reassurance that this effort would not create another layer of government. The focus first was on information sharing, then joint identification of the problem. In the interest of avoiding duplication of efforts and to avoid arguments about data collection in possible future lawsuits, multiple interests are now sampling together. Joint project cleanups have been established. Enforcement actions for 404 and Superfund administrative orders proceeded unincumbered but possibly facilitated by relationships developed as part of the watershed effort. More difficult, multiple funding projects were then started. The local governments have, in some cases, taken on more responsibilities of environmental protection by way of ordinances, enforcement and project sponsorship.

Financial

EPA initially identified the upper portion of the watershed as a fund lead Superfund site. Because of the complexity and adverse local reactions a limited number of operable units were targeted for remediation. Limited stakes gambling was voted for two small towns in the upper watershed in resulting in Superfund sites being sold for millions of dollars and giving EPA the opportunity to negotiate compliance orders with the new owners. Much of the mining waste material in the area was remined for reprocessing at a nearby heap leach processing facility. EPA funds from nonpoint source and the Mining Headwaters Initiative were used as seed money for locally identified projects. Making sure everyone gets credit for participation is an important financial consideration. There are over 50 different projects involved in this initiative. Money to finance the watershed efforts has come from a variety of sources including:

- EPA financial support came from: Superfund, section 319 of CWA funds, Rocky Mountain headwaters initiative, and Pollution Prevention funds.

- Other federal funds came from USFS, BLM, BOM, USFWS, COE, and the Federal Highways Administration.

- State funding came from Department of Health, Department of Minerals and Geology, Department of Transportation, and Division of Wildlife. Each of the affected counties also provided funds.

- Corporate funding came from Gaming Associations, Coors, AMAX, Western Mobil, and Cooley Sand & Gravel.

- Environmental groups that contributed include: Clear Creek Land Conservancy, Trout Unlimited, Jefferson County Open Space, Canyon Defense Coalition, and the Sierra Club Legal Defense Club.

About 1.0 full time employee (FTE) divided among five individuals is allocated to this project.

Limitations

- Good Samaritan clause for CWA is needed for voluntary efforts to proceed

- Establishing the trust to make this initiative successful took a long time and a lot of effort.

- The transition between regulatory efforts and non-regulatory efforts in this watershed approach was difficult. Some of the activities that were thought achievable via voluntary means ended up as enforcement actions. In addition, some of the other federal agencies have lost their interest in participation as a result of proposed weakened regulations.

Other Characteristics

- Pollutant trading within the watershed
- Regulation of nonpoint source impacts by locals (septic tanks and storm water)

C. Arizona Copper Mines Initiative

The Arizona Copper Mines Initiative was implemented to better characterize the impact of active, inactive and abandoned copper mines on surface water and ground water, to develop an inventory of Arizona copper mines, and to ensure the cleanup and remediation of contaminated sites. A federal/state Arizona Copper Mines Task Force was formed to implement the Initiative. Its non-enforcement objectives include:

- Develop an inventory of active, inactive, and abandoned copper mines in Central and Southeast Arizona.

- Assess and characterize the impacts on natural resources from mining operations on the major watersheds in central and southeast Arizona including the impacts on surface water, ground water, and riparian habitats.

- Define methods to minimize and mitigate impacts of copper mines on surface water, ground water and riparian habitats.

- Conduct outreach to and develop cooperative agreements with the mining industry to enlist financial and technical support for demonstration projects, and for cleanup of inactive and abandoned mines.

Technical Approach

Priorities for mine evaluation were established. Steps included developing an inventory of mines (over 7,000), this was put together by the former U.S. Bureau of Mines, USFS, Arizona State Mine Inspector's Office, Arizona Department of Environmental Quality, and EPA Region 9.. This list was sorted to include sites with reactive type minerals (sulfides, pyrites) because of their higher acid production potential, and known problem mines. The list of high potential problem mines was narrowed to about 700. These mines were then plotted in the GIS according to their longitude and latitude location and mapped. Inconsistencies in format on how mines are located were resolved. Region 9 also developed a standard format for data base structure. Each agency has its own environmental evaluation forms and data base. These data bases are being incorporated into one data base that can be accessed by all participating agencies. This data base will be maintained by the Arizona State Lands Department. The Arizona State Parks Department under contract to the National Park Service prepared an Arizona Rivers Assessment Report that received input from various federal and state resource agencies. This report lists the outstanding waterways within the State of Arizona. The locations of these priority waterways were overlaid on the problem mines map. As a next step, water quality data obtained from the State of Arizona 305(b) report and other sources were analyzed to detect water quality standards violations. Water quality standards violations for metals and turbidity that occurred during the last five years were overlaid on the priority waterways. Those mines located on impacted priority waterways will be selected for further investigations.

Institutional

Members of Arizona Copper Mines Initiative task force which consists of federal and state agencies, work cooperatively without any formal arrangements. The Arizona Mining Association has also been invited to provide technical and financial assistance in the cleanup of abandoned mines. At one general meeting of all resource agencies, it was determined their was an overlap of mine inventory activities and inconsistencies between database structures. A separate subgroup was formed to resolve inconsistency of database formats between agencies and to reduce the possibility of duplication of inventory activities. The State of Arizona is involved in cooperative water quality monitoring and bioassessment efforts. Frequent coordination between agencies has been helpful in concluding enforcement cases, improving program communication, and in improving cooperation between various agencies.

Financial

Little funding has been dedicated to date. One CWA section 319 project to demonstrate impacts of inactive and abandoned mines through the collection of water quality data has been funded. The next step will be to remediate an abandoned mine. Most of the money to implement the Arizona Copper Mines Initiative is coming out of Water Management Division operating funds. RCRA funds were provided by EPA headquarters to buy equipment for implementation of the initiative. Additional RCRA funds will be used to perform biological assessments on Boulder Creek that will bracket active and abandoned mines.

Limitations

This has been largely a voluntary effort on the part of Region 9 staff, and consequently is limited at times by staff availability and conflicts with other regional priorities. Total staff resources are estimated at 1 FTE per year.

Non-Site Specific Approaches

D. RCRA Subtitle D Strawman Guidelines

Although this strawman was designed as part of the RCRA subtitle D regulatory program, it is non-enforcement in nature, and has many of the characteristics of other non-regulatory tools. EPA developed a series of non-regulatory alternative mine waste management approaches, Strawman I and II, in 1988 and 1990. These approaches addressed extraction and beneficiation wastes. These Strawman documents were staff-level trial balloons and were heavily based on approaches developed by the WGA Mine Waste Task Force. These approaches embraced the idea that a RCRA mine waste program would have to be tailored to the unique aspects of each state's situation, considering the distinct climatic, geological, and ecological characteristics of each mine. Strawman II was developed in anticipation of additional statutory authorities provided by the re-authorization of RCRA. It was released to the public in May 1990 and was designed to solicit comment from interested parties. Its non-regulatory characteristics included:

Institutional

- State implementation and enforcement of regulatory programs upon approval of Mining Waste Management Plans by EPA. EPA would retain oversight and enforcement authorities.
- State plans would be required to provide for coordination with programs of all state and federal agencies, including those of the BLM and the USFS.

- Would not require state programs to be structured so as to mirror federal requirements. Instead, would provide broad flexibility to states to design programs and to use existing state and federal programs as components of state plans and programs.

Technical

- Plans would have to be adequate to ensure that site-specific permits would be protective of human health and the environment.

- Would not prohibit mining in any location, but would place more stringent procedural and technical requirements in sensitive areas.

- Program would address all media (ground water, air, surface water, soils) using site-specific risk based performance standards. Permits would have to include conditions needed to achieve compliance with performance standards.

- Would require states to establish or use existing multi-media performance standards: ground and surface water, soils, and air. Standards could be established on state-wide or site-specific basis.

- Would require monitoring and corrective action for all media, closure and post-closure care, and financial assurance.

- In 1991, states, industry, and the environmental community approached EPA and requested that a forum be created to further discuss mine waste issues. In 1991 EPA chartered the Policy Dialogue Committee (PDC) on Mining under the Federal Advisory Committee Act (FACA). Meeting were held through January, 1993.

- The PDC had representatives from the states, the mining industry, the environmental community as well as from the major federal agencies (i.e., Department of the Interior (DOI), the Department of Agriculture (DOA), and EPA).

- The purpose of the PDC was to inform the various parties of each others positions and further the debate on development of a national mine waste program.

- No consensus was reached, however, the basic elements of a mine waste program were identified including, reliance on existing state programs, protection of ground water, limited federal oversight, and public participation.

E. Mine Waste Technology Demonstration Programs

This research demonstration program, administered by EPA's National Risk Management Research Laboratory in Cincinnati, Ohio focuses on treatment aspects of mining problems in the Butte, Montana area. Its non-regulatory features include:

Financial

- A total of $5 million has been allocated to this program. These were earmarked appropriations.

Technical

- The focus is on the engineering treatment aspects of mine wastes.

- Demonstration projects include clay based grouting, biocyanide treatment, sulfate reducing bacteria, nitrate removal using a combination of ion exchange and nitrate selective resins.

Institutional

- The project involves interaction between EPA, DOE and Montana Technical College gets some of the money. The project includes such technology transfer features as training on abandoned mines.

Limits

- There are questions as to how applicable these demonstration projects will be on a larger scale.

F. Region 8 Nonpoint Source Mining Projects

Several states have identified inactive and abandoned mines as one of the major categories of nonpoint source pollution within their states. The CWA states in section 319(h)(5) that grant funds are to be made available to control particularly difficult or serious nonpoint source pollution problems, including but not limited to problems resulting from mining activities.

Key features

- The projects under the nonpoint source program have focused on inactive and abandoned mines with no viable potentially responsible party.

- This program has been able to implement technically innovative demonstration projects that are very difficult under other clean-up programs.

- Because this is a non-regulatory, voluntary, Good Samaritan dependant program, it is able to leverage other funding sources.

- The projects focus on smaller areas and on low maintenance options.

- The projects also tend to focus on environmental rather than human health impacts.

<u>Technical and Institutional Approach</u>

A state must identify its areas of priority and must develop a management plan including best management practices (BMPs). Individual project proponents in high priority areas then submit proposals for funding of BMP implementation. There is a requirement of 60% match on the projects. In most states, technical assistance is provided to the project proponents by state and federal experts. The projects then compete for funding at an EPA regional level.

<u>Financial considerations</u>

For under one million dollars, Colorado's nonpoint source program has funded thirteen projects, ranging in cost from 12k to 250k. Total clean-up costs for these projects have often been an order of magnitude higher. This is due in part that the 309 projects are smaller and less complex, and address control of sources are opposed to remediating past releases. Typical projects include:

<u>French Gulch</u>. The French Gulch project addresses metals loading from the Wellington D'Oro Mine near Breckenridge. Concentrations of zinc below the mine have ranged from 1,000 - 10,000 ug/l with several samples much higher. Stream standards are exceeded in the Blue River during both high and low flow periods. Mine drainage and ground water movement are being characterized and the shaft of the mine was sealed to isolate the mine pool for possible future treatment. A portion of the French Gulch stream channel was reconstructed in 1993 through the dredge tailings blockage south of the Wellington Mine. The new channel has reduced the flow of ground water through the tailings pile. Geophysical work done by the former Bureau of Mines indicated that there may be another mine opening under the waste rock piles that is draining.

<u>Peru Creek Pennsylvania Mine</u>. The Peru Creek Pennsylvania Mine project includes a limestone feed system to the mine drainage, a settling pond, and a zeolite polishing unit for metals reduction. After start up of the project it was discovered that the lime storage and feed mechanism was not sufficient to deal with the high acidity of the drainage and winter inaccessibility of the site dictated that the neutralization system be re-engineered. Laboratory bench testing of other neutralized agents, zeolite testing, and field

testing showed that a bioreactor was possibly the best solution. Two large bioreactors (manure, sand and gravel mix) have been constructed but have not been activated.

St. Mary's Glacier. This project is intended to reduce acid mine drainage from the Alice Mine adjacent to Silver Creek, which is tributary to Fall River, which is tributary to Clear Creek in Clear Creek County. Drainage water from the old glory hole will be treated by a four stage system, which includes anoxic limestone drain, settling pond, pond for addition of fireplace ashes from nearby residences, and a final settling pond.

Animas River Targeting. This project was designed to target potential nonpoint source project areas in one of Colorado's most severely impacted river basins, the Animas Basin. The project included sampling of selected locations on three major tributaries in the basin in the vicinity of the Silverton/Ouray mining district in southwest Colorado. Mine drainage from inactive sites is being sampled, and a biological assessment of aquatic and recreation use potential is also being conducted. Eleven field crews are assisting with the project, including teams from the Bureau of Reclamation, BLM, USGS, USFS, Sunnyside, Homestake, and Solution Gold mining companies, and the Colorado Division of Wildlife. Sampling has shown that many stations in the basin have metal concentrations in excess of state-recommended criteria. Therefore new standards have been proposed. Potential for remediation of some sites is being assessed by the local Animas Basin association with help from the USFS, BLM, USGS, and Bureau of Reclamation.

Limitations

With the use of a CERCLA memorandum of understanding, these projects have been conducted as removal actions with on-scene coordinators ensuring that requirements under CERCLA are fulfilled. There is no such provision under the CWA. Several projects are on hold because of the fear of third party lawsuits under CWA based upon a recent ruling by the Supreme court not to hear the California Penn Mine case. Good Samaritan language has been drafted for inclusion in the reauthorization of the CWA in order to continue with mining nonpoint source projects.

G. Bubble Trading

A market-based or trading approach seeks to achieve water quality improvements in the most economically efficient manner by affording individuals and institutions choices on how to meet environmental objectives.

Trading means establishing upstream controls to compensate for new or increased downstream sources, resulting in maintained or improved water quality at all points, at all times, and for all parameters. Trading may involve point sources, nonpoint sources, or a combination of point and nonpoint sources. Although it can take many different forms, effluent trading, in principle, allows dischargers to allocate discharge reductions (beyond those required by technology-based standards) according to relative economic efficiency.

The statutory and legal framework for water quality-based trading can be found in section 303(d) of the CWA regarding Total Maximum Daily Loads (TMDLs). TMDLs are comprehensive in that they address all sources: point sources, nonpoint sources, atmospheric and ground water to evaluate all uses aquatic, domestic water sources, agricultural, and industrial. While using a watershed in decision-making, TMDLs also identify where the most limiting use is within the watershed as well as identifying the most limiting season or critical condition. TMDLs make a clear identification of what assemblage of regulatory and non-regulatory controls will be used to attain water quality goals and standards. This linkage between controls and instream standards so often illusive. The development of a TMDL affords the stakeholders the opportunity to negotiate what combination of controls are needed to attain goals as well as explore opportunities between control options.

It is one thing to collect data to characterize a mining problem but to put the information into a logical framework identifying what level of controls are needed to attain and maintain goals is not always evident. Consideration of instream standards including numeric criteria, narrative provisions including antidegradation criteria and all physical (flow), chemical and biological standards needed to support designated uses is embodied within a TMDL.

The conditions necessary to run an effective point and non-point source trading program include:

a. Identifiable watershed.
b. Sufficient point and nonpoint sources.
c. Ambient water quality goal.
d. Accurate and sufficient data.
e. Technology-based discharge requirements met.
f. Overall costs less.
g. Point source allocations are limiting.
h. Institutional structure.
i. Compliance incentive and enforcement mechanisms.

For example, a proposed mine project may be willing to clean up historical sources even if the cost of implementing the end of pipe technology is less than the nonpoint source cleanup costs, especially if it means the project could proceed more expeditiously. In other words, looking at the full financial picture may render incentives that go beyond the treatment cost differential.

H. *Remining*

A new cost-effective way to reclaim an abandoned mine may be to re-mine it (i.e., re-open the mine or re-process old waste to recover any ore left behind when the mine was closed), then complete the reclamation process.

For example, the typical site was abandoned when the operator deemed the mine no longer profitable, often after encountering difficult geologic conditions or low-grade ore. But with today's mining technology, many previously mined areas can be re-opened and re-mined at a profit -- and have been, particularly during the boom in the early 1980s. Re-mining usually means re-opening or enlarging an old mine pit to recover the remaining ore. But it can also involve re-processing old tailings piles, or removing old mine waste piles that block access to ore.

Re-mining has appeal. It offers a way to reclaim land according to current environmental standards, with no need for outside funding. But there are at least three potential problem areas that must be considered: first, reopening of a mine by an someone not familiar with all ramifications due to exposing additional discharge areas; second, mining companies will sometimes ignore certain previously mined areas to avoid potential legal liability; and finally, an operator may avoid re-mining, even though it is in close proximity to a new mining venture because the mine is still not economical.

I. *Wellhead Protection Programs*

The purpose of the Wellhead Protection (WHP) Program is to protect ground water-based public drinking water supplies from contamination and prevent the need for costly treatment to meet the drinking water standards. The WHP program is based on the concept that the development and application of pollution prevention land-use controls and other preventive management measures can protect ground water.

The program provides protection from contaminants in the surface and subsurface area surrounding a well or wellfield supplying water to a public system. WHP area boundaries are determined by hydrogeologic characteristics having a direct effect on the likelihood and extent of contamination including factors such as well pumping rates, time-of-travel of ground water flow to the well, aquifer boundaries, and the degree of confinement.

EPA approves WHP programs state-by-state, which are administered by the states. As of December 31, 1995, 41 states and territories have EPA approved Wellhead Protection Programs (see Table 1). Presumably, hardrock mining activities would be allowed within a WHP area providing they would not generate sources of contamination which may have any adverse effect on the health of persons. The probable causes of contamination of ground water can be difficult to identify, but once ground water becomes contaminated, cleanup (if possible) becomes very expensive. Ground water is used by the majority of the people in the United States for drinking water because it is less costly to use than surface water as a drinking water source. The higher costs for using surface water are primarily due to land acquisition and treatment requirements.

Table 1. States and Territories with Approved Wellhead Protection Programs

Alabama	Indiana	Nevada	Rhode Island
Arizona	Kentucky	New Hampshire	South Carolina
Arkansas	Louisiana	New Jersey	South Dakota
Connecticut	Maryland	New Mexico	Tennessee
Colorado	Massachusetts	New York	Texas
Delaware	Michigan	North Carolina	Utah
Guam	Mississippi	North Dakota	Vermont
Georgia	Missouri	Ohio	Washington
Hawaii	Montana	Oklahoma	Wisconsin
Illinois	Nebraska	Puerto Rico	West Virginia

APPENDIX D

OTHER FEDERAL REGULATORY AUTHORITIES

TABLE OF CONTENTS

1. INTRODUCTION

Besides the EPA authorities described in Appendix C, mining operations are subject to a complex web of federal, state, and local requirements. Many of these require permits before the mining operations commence, while many simply require consultations, mandate the submission of various reports, and/or establish specific prohibitions or performance-based standards. Among the federal statutes that are potentially applicable are those shown in Table 1 at the end of this appendix. Also shown are the agencies with primary responsibility for implementing or administering the statute and the types of requirements imposed on those subject to various statutory provisions.

A great deal of effective coordination among federal agencies has taken place in the past, often based on informal working relationships. However, there are many instances of conflicting or overlapping authorities (e.g., Executive Order Number 12580 -- Organic Acts) which require resolution. Overall, federal agencies with responsibilities related to mining activities need to coordinate their efforts more consistently than has occurred to date. Where appropriate and useful, this framework recommends that such relationships be formalized, so that appropriate coordination occurs regularly. This increased coordination is important to streamline the regulatory process. This will likely require some Memoranda of Understanding between agencies that articulate specific actions and time frames for accomplishment.

A key element in the consideration of responsibilities of federal agencies is the dual role of many federal agencies as both land managers responsible for oversight of various activities on such lands and as parties that may be regulated by state agencies or EPA. In developing specific regulatory actions (e.g., developing a general permit for abandoned and inactive mines on federal land), EPA representatives will need to be aware of the potentially precedent-setting actions in the exercise of regulatory tools on federal lands that may have implications for actions taken with respect to private land owners.

A sizable challenge in working with federal agencies will be addressing the inactive and abandoned mines on federal lands. For example, where a comprehensive watershed risk-based approach is used, federal agencies need to commit to carry out specific pollution prevention or control measures identified for particular sites. The Office of Surface Mining Reclamation and Enforcement (OSM) could share technical expertise gained by administering the Abandoned Mine Land Program to states and tribes. Under this program, Wyoming has reclaimed more than 20,000 acres of non-coal abandoned mine land; and Colorado, Montana, the Navajo Tribe, New Mexico, Utah, and Wyoming have closed more than 2,400 portals and 4,000 shafts. (OSM 1994)

There are also many specific federal agency coordination issues. For instance, statutory mandates set different priorities that may limit consolidating priority setting. SMCRA Section 403 priority setting criteria rank danger and human health higher than environmental factors. Federal agencies other than EPA may not now issue abatement orders under Section 106 of CERCLA (per a 1996 amendment to Executive Order 12580). Also, federal agencies other than EPA do have delegated authority to recover funds for remedial actions on federal lands. Frequently, federal land managers would like to participate in devising remediation at specific sites. EPA may also wish to explore having federal land managers undertake some enforcement actions using other authorities.

Many other agencies are designated as Natural Resources Trustees under CERCLA. The National Contingency Plan includes some duties of the trustees: assessing damage to natural resources, negotiation with potentially responsible parties, and seeking compensation from the responsible parties. Land managing agencies such as the BLAM and tribal chairmen have natural resource trust authority under CERCLA.

Another specific component of the relationship with other federal agencies involves active mine plans. It is important that the portions of these plans that indicate how the mine plan will meet applicable environmental standards are included and contain all appropriate information. Therefore, a joint, improved process involving EPA and other appropriate federal agencies is needed. (A similar issue exits for states.)

There is also an important partnership dimension to relationships between federal-state agencies in which the various agencies provide assistance and training to enhance their capability of their partners to regulate mining activities effectively. Partnerships in the joint assessment of mine sites are also needed to most efficiently use limited resource dollars to determine the extent of health and environmental risk at abandoned sites at a national level.

2. GENERAL FRAMEWORK FOR MINING ON FEDERAL LAND

There are many statutes and associate regulatory programs that govern federal land management and the disposition of minerals on federal lands. The Bureau of Land Management (BLM) has issued regulations that require operations to be conducted so as to prevent unnecessary or undue degradation of the lands or their resources, including environmental resources and the mineral resources themselves. The regulations specify that operators are to comply with federal and state environmental laws, including the Clean Water Act (CWA). Regulations encourage coordination and cooperation between the BLM and state regulatory agencies.

An operator who intends to disturb more than five cumulative acres, or to operate in certain sensitive areas, must file a plan of operations before commencing operations (lower level disturbances are subject to different requirements). The plan of operations must identify the site, they type of operations proposed, and measures to be taken to prevent unnecessary or undue degradation and to meet reclamation standards. These standards include (but are not limited to) the following:

- Taking reasonable measures to prevent or control on- and off-site damage to federal lands

- Measures taken to control erosion, landslides, and water runoff

- Measures to isolate, remove, or control toxic materials

- Reshaping the disturbed area, replacement of topsoil, and revegetation, where reasonably practicable.

Reclamation standards specifically do not apply to previously disturbed areas on a mining claim; operators are responsible only for their own disturbances. A reclamation bond is required for plans of operations, with amounts based on the type of operation and the operator's compliance record. In general, BLM does not require duplicate bonds where thee is also a state bonding requirement.

The Forest Service operates under several statutes that mandate the planning and management of lands within the National Forest System. These include the Organic Act of 1897, the Multiple Use and Sustained Yield Act of 1960 (MUSYA) and the National Forest Management Act of 1976 (NFMA). The Organic Act delegated broad authority over most land use activities within the National Forest System. It also provides for continued state jurisdiction over National Forest lands. Finally, it declares that forests shall remain open prospecting, location, and development of minerals under applicable laws, and that waters within the boundaries of the National Forests may be used for domestic mining and milling, among other uses. Section 3 of the MUSYA authorizes the Forest Service to cooperate with state and local governments in managing the National Forests. The NFMA amended the Rangelands and Renewable Resources Act of 1974 by establishing an extensive system of planning for the National Forests. Forest Service regulations require that mining rights are exercised in a way that will minimize adverse environmental impacts on surface resources.

Forest Service regulations (36 CFR 228) are broad and similar to BLM's in that they impose few specific technical standards. Regulations require that a proposed plan of operations be prepared unless there will be no significant disturbance of surface resources. All operators must comply with all applicable federal and state pollution control laws, including the CWA. Regulations allow for reclamation bonding conditioned on compliance with the reclamation standards. These standards (§122.8(g)) require that, where practicable, operators reclaim sites to prevent on- and off-site damage to the environment and forests surface resources, including (among others):

- Control of erosion and prevention of landslides
- Control of water runoff
- Isolation, removal, or control of toxic materials
- Reshaping and revegetation of disturbed areas, where reasonably practicable.

The National Environmental Policy Act of 1969 (NEPA) is also a significant influence on federal Land management and planning on Federal lands. NEPA requires federal agencies to consider the environmental impacts of their proposed actions, along with alternatives to the proposed actions. Under

NEPA and applicable regulations of the Council on Environmental Quality, federal agencies must prepare an environmental assessment (EA and/or and environmental impact statement (EIS) before undertaking any major federal actions significantly affecting the quality of the human environment. If the proposed action will not significantly affect the environment, the agency can issue a finding of no significant impact (FONSI). If a FONSI is not appropriate and an EIS is determined to be necessary, it must contain, among other things, a consideration of alternatives to the proposed decision, a full discussion of significant environmental impacts, an evaluation of cumulative effects, and a discussion of mitigation measures.

BLM and the Forest Service generally conduct a NEPA analysis before taking any formal planning action, issuing any permit or lease, or approving a mining plan of operations or other activity on federal lands. Those actions considered major and that will have significant environmental impact or public interest trigger the preparation on an EIS.

Mining Regulation on National Park Service and Fish and Wildlife Service Lands

The National Park Service has been charged by Congress to manage units of the National Park System so as to conserve the scenery and the natural and historic objects and wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations. The Fish and Wildlife Service has jurisdiction over a variety of areas designed primarily for species protection, such as National Fish and Wildlife Refuges. Although mineral operations are generally prohibited in these areas, both agencies have some statutory and regulatory authority for controlling allowed mineral development, including mineral development rights such as valid mining claims that had vested before designating the lands as protected areas.

The Mineral Leasing Act of 1920 specifically excludes National Parks and National Monuments from federal mineral leasing. Subsequent legislation and BLM regulations at 43 CFR 3100.0-2(2) make clear that, except for three national recreation areas, all units of the National Park Service are closed to federal mineral leasing. The Mining in the Parks Act of 1976 eliminated the language contained in six units of the Park System that allowed the location of mining claims within these units. As a result, all units of the National Park System are now closed to the location of mining claims under the 1872 Mining Law. The Act also directed the Secretary of the Interior to develop regulations to control all activities resulting from the exercise of valid existing mineral rights on patented and unpatented mining claims in any area of the National Park System to preserve the pristine beauty of these areas. In 1977, the National Park Service promulgated the requisite regulations in 36 CFR Part 9, Subpart A. Section 11 of the Act provides that a claimant subject to the Act who believes he has suffered a loss by operation of the Act or by orders or regulations issued pursuant to it may bring a takings claim in U.S. Court of Claims.

The National Park Service has extensive regulations governing exercise of valid existing mineral rights (36 CFR Part 9 Subpart A). The regulations restrict water use, limit access, and require complete reclamation. They also require that operators obtain an access permit and approval of a plan of operations before beginning any activity. A plan of operations requires specific site and operations information, and may require the operator to submit a detailed environmental report. Operators must comply with any applicable federal, state, and local laws or regulations.

The Fish and Wildlife Service (F&WS) manages a disparate group of wildlife refuges, fish hatcheries, research centers, etc., established either by statute, executive order, or public land order. Most F&WS units were either withdrawn from mineral entry when they were established, those few that were open to such entry have since been withdrawn. The F&WS has brief regulations (50 CFR 29.32) governing the preexisting mineral rights on lands under its jurisdiction. These regulations state that such rights shall, to the greatest extent practicable...prevent damage, erosion, pollution, or contamination of the lands, waters, facilities, and vegetation of the area. Operators must comply with all applicable federal and state laws and regulations for the protection of wildlife and the administration of the area. Waste and contaminating substances must be confined so as to prevent damage to the area, and shall be restored as nearly as possible to its condition before commencement of mining operations. However, nothing in the regulations may be applied in a manner contravening or nullifying vested mineral rights. As of the early 1990s, there were no known active mining operations in the F&WS preserve system although there may have been valid existing rights under the Mining Law in some cases.

Other Related Regulations, Policies, and Issues

U.S. Bureau of Indian Affairs. The *Indian Mineral Development Act of 1982* is the Bureau of Indian Affairs' overall planning and management statute for mineral development on tribal lands. Regulations governing the mining development have been promulgated at 25 CFR 211, Leasing of Tribal Lands, 25 CFR 212, Leasing of Allotted Lands; 25 CFR 213 Leasing of Restricted Lands for Members of the Five Civilized Tribes, Oklahoma, for Mining; and 25 CFR 225, Oil and Gas, Geothermal, and Solid Mineral Agreements. In addition, tribes have many internal policies regarding the protection of Tribal Trust Resources.

State/Federal Memoranda of Understanding. BLM and the Forest Service often reach agreements (Memoranda of Understanding (MOU)) with the states in which their lands are located. California's MOUs with the Forest Service (1979) and with BLM (1990) are illustrative. The 1979 MOU for reclamation insures that lead agencies accept reclamation plans that meet state and federal requirements. The 1990 MOU also gives the state the opportunity to comment on environmental assessments, the reclamation plans, and cooperative enforcement of bond adjustments and releases.

Regulation on Split-Estate Lands. Split-Estate lands are those where one party owns the surface estate, and another owns some or all of the underlying mineral estate. In the split-estate situation, the mineral estate is usually considered dominant, unless otherwise provided for by contract. The dominant mineral estate has the implied right to enter, occupy, and make such use of the surface as is reasonably necessary to explore, mine, remove, and market the minerals.

Where the United States owns the mineral estate, but not the surface estate, a lessee of the minerals must comply with the terms of the BLM leasing regulations (43 CFR Group 3500). Certain categories of public domain minerals may be located under the Mining Law, even if the surface has been patented. When allowed, location and development are subject to the Mining Law and BLM, Forest Service, National Park Service, and F&WS regulations to the same extent as other mining claims. The control the United States has over the surface estate, which could be owned by a party other than the United States if it is a split-estate situation, may vary depending upon the applicable law.

Because the United States can regulate the activity of mineral lessees, operators, permittees, and mining claimants ono split-estate lands where the United States owns the minerals but not the surface, it has some level of control over whether those operations comply with federal and other laws, including environmental laws. Agencies are more limited in their control of split-estate lands where the United States owns the surface, but another party owns the mineral estate. This situation often arises when a federal agency, such as the Forest Service, has acquired the surface estate for a specific purpose, and the conveyance is subject to a reservation of minerals. Where this is the case, the surface rights of the United States may be subject to the rights of the owner of the dominant mineral estate to enter the property and use the surface for all purposes reasonably necessary for development of the mineral estate. While the United States as surface owner may have some authority to regulate the surface use, it generally would not have the right to prohibit completely, use of the surface for development of the underlying minerals, since the mineral estate is dominant.

Inactive and Abandoned Mines on Federal Lands. None of the authorizing statutes described above provide for the reclamation of previously abandoned mines on federal land. Until the relatively recent past, statutory authority for BLM and most other federal agencies did not explicitly provide even for regulation, including reclamation, of mineral development on most federal lands. As a result, the residue of over a century of intense mineral development on federal lands, as well as patented and other private lands, remains. In recent years, Congress has considered some legislation relevant to mine reclamation. To date, none of these proposals has become law.

3. ADDITIONAL FEDERAL LAWS APPLICABLE TO MINING ACTIVITIES

Other federal statutes may also play a general role in mining regulation. The following sections describe the purposes and broad goals of several federal statutes, some of which have been mentioned above. The discussion for each statute also provides an overview of the requirements and programs implemented by the respective implementing agencies.

Endangered Species Act. The Endangered Species Act (ESA) (16 U.S.C. §§1531–1544) provides a means whereby ecosystems supporting threatened or endangered species may be conserved and provides a program for the conservation of such species. Under the ESA, the Secretary of the Interior or the Secretary of Commerce, depending on their responsibilities pursuant to the provisions of Reorganization Plan No. 4

of 1970, must determine whether any species is endangered or threatened due to habitat destruction, overuse, disease, or predation, the inadequacy of existing regulatory mechanisms, or other natural or artificial factors. When the Secretary determines that a species is endangered or threatened, the Secretary must issue regulations deemed necessary and advisable for the conservation of the species. In addition, to the extent prudent and determinable, she or he must designate the critical habitat of the species.

Section 7 of the ESA requires federal agencies to ensure that all federally associated activities within the United States are not likely to jeopardize the continued existence of threatened or endangered species or of critical habitat that are important in conserving those species. Agencies undertaking a federal action must consult with the F&WS which maintains current lists of species designated as threatened or endangered, to determine the potential impacts a project may have on protected species. The National Marine Fisheries Service undertakes the consultation function for marine and anadromous fish species while the F&WS is responsible for terrestrial (and avian), wetland and fresh water species.

The F&WS has established a system of informal and formal consultation procedures, and these must be undertaken as appropriate in preparing an EA or EIS. Many states also have programs to identify and protect threatened or endangered species other than federally listed species. If a federally listed threatened or endangered species may be located within the project area and/or may be affected by the project, a detailed endangered species assessment (biological assessment) may be prepared independently or concurrently with the EIS and included as an appendix. States may have similar requirements for detailed biological assessments as well.

National Historic Preservation Act. The National Historic Preservation Act (NHPA) (16 U.S.C. §§470 et. seq.) establishes federal programs to further the efforts of private agencies and individuals in preserving the historical and cultural foundations of the nation. The NHPA authorizes the establishment of the National Register of Historic Places. It establishes an Advisory Council on Historic Preservation authorized to review and comment upon activities licensed by the federal government that have an effect upon sites listed on the National Register of Historic Places or that are eligible to be listed. The NHPA establishes a National Trust Fund to administer grants for historic preservation. It authorizes the development of regulations to require federal agencies to consider the effects of federally-assisted activities on properties included in, or eligible for, the National Register of Historic Places. It also authorizes regulations addressing state historical preservation programs. State preservations programs can be approved where they meet minimum specified criteria. Additionally, Native American tribes may assume the functions of state Historical Preservation officers over tribal lands where the tribes meet minimum requirements. Under the Act, federal agencies assume the responsibility for preserving historical properties owned or controlled by the agencies.

A series of amendments to the NHPA in 1980 codify portions of Executive Order 11593 (Protection and Enhancement of the Cultural Environment--16 U.S.C. §470). These amendments require an inventory of federal resources and federal agency programs that protect historic resources, and authorize federal agencies to charge federal permittees and licensees reasonable costs for protection activities.

Where mining activities involve a proposed federal action or federally assisted undertaking, or require a license from a Federal or independent agency, and such activities affect any district, site, building, structure, or object include in or eligible for inclusion in the National Register, the agency or licensee must offer the Advisory Council on Historic Preservation a reasonable opportunity to comment with regard to the undertaking. Such agencies or licensees are also obligated to consult with state and Native American Historic Preservation Officers responsible for implementing approved state programs.

A special concern in some cases is related to the fact that many proposed mining operations are located in areas where mining has occurred in the past. Particularly in the west and Alaska, states and localities are viewing the artifacts of past mining (e.g., headframes, mill buildings, or even waste rock piles) as valuable evidence of their heritage. Since modern mining operations can obliterate any remnants of historic operations, care must be taken to identify any valuable cultural resources and mitigate any unavoidable impacts. Innovative approaches are often called for and implemented. In Cripple Creek, Colorado, for example, a mining operation wished to recover gold from turn-of-the-century waste rock piles. As mitigation for removing this evidence of the area's past mining, the operator replaced the piles with waste rock from their modern pit. In addition, the company provided interpretive signs in the area for the public.

Coastal Zone Management Act. The Coastal Zone Management Act (CZMA) (16 U.S.C. §§1451–1464) seeks to preserve protect, develop, and where possible, restore or enhance the resources of the Nation's coastal zone for this and future generations. To achieve these goals, the Act provides for financial and technical assistance and federal guidance to states and territories for the conservation and management of coastal resources.

Under the CZMA, federal grants are used to encourage coastal states to develop a coastal zone management program (CMP). The CMPs specify permissible land and water uses and require participating states to specify how they will implement their management programs. In developing CMPs, states must consider such criteria as ecological, cultural, historic, and aesthetic values as well as economic development needs. Applicants for federal licenses or permits must submit consistency certifications indicating that their activities comply with CMP requirements. In addition, activities of federal agencies that directly affect the coastal zone must be consistent with approved state CMPs to the maximum extent practicable. The CZMA also establishes the National Estuarine Reserve System, which fosters the proper management and continued research of areas designated as national estuarine reserves.

To the extent that mining activities are federally licensed or permitted, applicants must certify that all activities are consistent with applicable CMPs.

Farmland Protection Policy Act. The Farmland Protection Policy Act (FPPA) (P.L. 97–98) seeks to minimize the conversion of farmland to non-agricultural uses. It requires that, to the extent practicable, federal programs be compatible with agricultural land uses. The Act requires that in conducting agency actions federal agencies follow established criteria for considering and taking into account any adverse effects such actions may have on farmland. Where adverse effects are anticipated, federal agencies must consider alternatives that will mitigate any harmful impacts. Under the Act, the U.S. Natural Resource Conservation Service (NCRS) is required to be contacted and asked to identify whether a proposed facility will affect any lands classified as prime or unique farmlands. However, beyond considering potential adverse effects and alternatives to agency action, the Act does not provide the basis for actions challenging federal programs affecting farmlands.

Rivers and Harbors Act of 1899. The Rivers and Harbors Act (RHA) (33 U.S.C. §§401–413) was originally enacted to regulate obstructions to navigation and to prohibit the unpermitted dumping or discharging of any refuse into a navigable water of the United States. The Act also provides authority to regulate the disposal of dredged material in navigable waters. The provisions of section 407 forbid any discharge of refuse matter other than that flowing from streets and sewers in a liquid state. Under section 403, a permit is required from the U.S. Army Corps of Engineers for the construction of any structure in or over navigable waters of the United States.

Surface Mining Control and Reclamation Act (SMCRA). The Surface Mining Control and Reclamation Act (SMCRA) Title IV primarily addresses the Abandoned Mined Lands (AML) Program, under which coal mine sites abandoned before 1977 are reclaimed and, under certain circumstances, abandoned noncoal mines may be reclaimed. SMCRA provides for delegation of program implementation authority to states, with state programs overseen by the Office of Surface Mining Reclamation and Enforcement (OSM) and direct OSM implementation in nondelegated states. To date, OSM has delegated primacy to 23 states. In addition, three Native American tribes administer their own AML program. OSM administers SMCRA requirements in 13 states (most of which have no current coal production) and on all other Native American lands.

Under SMCRA, OSM has established criteria for setting priorities to reclaim AMLs, and these criteria rank danger and human health issues higher than environmental problems. Wyoming, the Navajo Tribe, and Montana are among those states that have successfully applied AML funds to noncoal sites after reclaiming all priority coal sites [30 U.S.C. 1239].

Wild and Scenic Rivers Act. The Wild and Scenic Rivers Act of 1968 (16 U.S.C. 1273 et. seq.) provides that certain selected rivers ...shall be preserved in a free flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations. Section 7 of the Act prohibits the issuance of a license for construction of any water resources project that would have a direct effect on rivers (or reaches of rivers) selected because of their remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values for the National Wild and Scenic Rivers System.

The system includes rivers and streams placed in the System by acts of Congress and rivers that have been studies and deemed suitable for inclusion. Any potential impacts on rivers and streams in the System must be considered and direct adverse effects on the values for which the river was selected for the System must be prevented.

States also have their own systems for protecting rivers and streams or portions thereof. While agencies may have no legal requirement to consider state-protected wild and scenic rivers and streams, any potential impacts to such streams should nevertheless be considered and addressed.

Fish and Wildlife Coordination Act. The Fish and Wildlife Coordination Act of 1934 (16 U.S.C. 661 et. seq., P.L. 85–624) authorizes the Secretary of the Interior to provide assistance to, and cooperate with, federal, state, and public or private agencies or organizations in the development, protection, rearing, and stocking of all species of wildlife, resources thereof, and their habitat. Most of the Act is associated with the coordination of wildlife conservation and other features of water-resource development programs.

Fish and Wildlife Conservation Act. The Fish and Wildlife Conservation Act of 1980 (16 U.S.C. 2901 et. seq.) encourages federal agencies to conserve and promote conservation of nongame fish and wildlife and their habitats to the maximum extent possible within each Agency's statutory responsibilities. The Act places no affirmative requirements on federal agencies.

Migratory Bird Protection Treaty Act. The Migratory Bird Protection Treaty Act (16 U.S.C. 703–711) prohibits the killing, capturing, or transporting of protected migratory birds, their nests, and eggs. Consultations with the F&WS are encouraged if project activities could directly or indirectly harm migratory birds.

Table 1. Other Federal Statutes Generally Applicable to Mining Operations

Statute/Section	Implementing/Responsible Agency	Procedural Requirements*	Overview
Endangered Species Act (16 U.S.C. §§1531–1544)	Fish and Wildlife Service	Prohibitions; Consultations	Requires federal agencies to ensure that all federally associated activities within the U.S. do not jeopardize the continued existence of threatened or endangered species r of critical habitat. Agencies undertaking a federal action must consult with the U.S. fish and Wildlife Service FWS) or the National Marine Fisheries Service (NMFS) to determine the potential impacts a project may have on protected species.
National Historic Preservation Act (16 U.S.C. §§470 et seq.)	Advisory Council on Historic Preservation	Consultation	Federally licensed mining activities that affect any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register, must afford the Advisory Council on Historic Preservation a reasonable opportunity to comment.
Coastal Zone Management Act (16 U.S.C. §§1451–1464)	EPA, States	Notification	Applicants for federal licenses or permits must submit consistency certifications indicating that their activities comply with CMP requirements. In addition, activities of federal agencies that directly affect the coastal zone must be consistent with approved state CMPs to the maximum extent practicable.
Farmland Protection Policy Act (FPPA) P.L. 97–98)	U.S. Soil Conservation Service	Consultation	U.S. Natural Resource Conservation Service (NRCs) must be asked to identify whether a proposed facility will affect any lands classified as prime and unique farmlands.
Rivers and Harbors Act (33 U.S.C. §§401–413)	U.S. Corps of Engineers	Permits	The RHA regulates obstructions to navigation and prohibits the unpermitted dumping or discharging of refuse into a navigable water of the U.S. The Act also provides authority to regulate the disposal of dredged materials in navigable waters. Also see §402 and §404 of the CWA.
Surface Mining Control and Reclamation Act (30 U.S.C. §§1201–1328)	Office of Surface Mining, Authorized States	Permits; Standards; Reporting; Royalties	Regulates surface effects of surface and underground coal mining that occurred afer 1977. Under certain circumstances, provides funding for reclamation of abandoned hardrock mines.
Mining Law of 1972 (30 U.S.C. §§22–54)	Bureau of Land Management, Federal land managers	Notification	Provides rights of free access to unrestricted public lands for purposes of claiming and recovering most metallic minerals Provides mechanism for claimants to obtain full title to claimed public lands.
Federal Land Policy Management Act (43 U.S.C. §§1701–1782)	Bureau of Land Management	Notification; Studies; Approvals	Requires BLM to prevent unnecessary and undue degradation of public lands. Implementing regulations specify noncompliance with Clean Water Act and other statutes as “unnecessary and undue” degradation. Establishes land planning process, including compliance with NEPA. Regulations impose procedural requirements on mining operations on BLM lands (e.g., approval of plans of operations), with most technical requirements determined by managers of BLM units or BLM State offices.

Table 1. Other Federal Statutes Generally Applicable to Mining Operations (Continued)

Statute/Section	Implementing/Responsible Agency	Procedural Requirements*	Overview
National Park System Mining Regulation Act (Mining in the Parks Act, or MPA) (16 U.S.C. §§1901–1912)	National Park Service	Standards; Notification; Approvals	Regulated mining activities within the National Park System. All mining claims in NPS system made prior to September 1977 had to be recorded by that time. No claims allowed after that time. Protects natural or historic landmarks within the park system by requiring that person conducting mining operations that threaten such landmarks notify NPS and the Council on Historic Preservation.
Multiple Use and Sustained Yield Act (16 U.S.C. §§528–531), National Forest Management Act	Forest Service	Notification; Studies; Approvals	Establishes that the National Forest System is to be managed for outdoor recreation, range, timber, watershed, and fish and wildlife purposes. Provides that the renewable surface resources of the national forest are to b administered for multiple use and sustained yield of products and services. Establishes land planning process, including compliance with NEPA. Regulations impose procedural requirements on mining operations on FS lands (e.g., approval of plans of operations), with most technical requirements determined by managers of FS units or FS state offices.
Mineral Leasing Act (30 U.S.C. §§181–287)	Bureau of Land Management	Lease (permit); Reporting; Studies	Requires leases and royalty payments for mining fuel minerals (including coal and uranium) on federal lands, and for mining hardrock minerals on acquired lands.

**NOTE:*

Permits: "License" to undertake an action subject to enforceable standards, reporting requirements, prohibitions, etc.

Approvals: Formal approvals by responsible official/agency of specified actions.

Standards: Numeric performance- or technology-based standards to limit emissions/releases, or numeric standards for protection of environmental medium.

Prohibitions: General restrictions or prohibitions on specified actions or on causing a particular effect by any action.

Studies: Requires studies of site-specific environmental conditions, proposed or existing operations, and/or potential environmental effects of operation.

Consultation: Requires consultations with specified officials/agencies prior to undertaking an action.

Reporting: Periodic reporting to regulatory agency on compliance.

APPENDIX E

OVERVIEW OF STATE REGULATORY APPROACHES

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1. Overview of Programs

Many state/tribal agencies have, over the past decade, emerged as leaders in the area of mining regulation. An effective EPA approach should build on the exemplary accomplishments of states and tribes in various media program areas and encourage and facilitate sharing of information and training procedures between federal, state, and tribal co-regulators. This requires an understanding of relevant State programs.

While EPA staff must be, and are, knowledgeable of state programs, this framework will not develop up-to-date descriptions of each state's mining programs. This appendix provides an overview of state programs and approaches. Other sources have compiled this information in greater detail [e.g., *State Regulation of Mining Waste: Current State of the Art*, Environmental Law Institute (ELI), November 1992 for Arizona, California, Colorado, Florida, Idaho, Missouri, Montana, Nevada, South Carolina, and South Dakota; March 1995 survey of Alaska, Arizona, California, Colorado, Idaho, Montana, New Mexico, Oregon, South Dakota, Utah, Washington, and Wyoming; or *An Overview of Metallic Mineral Regulation in Wisconsin*, Special Report 13, 1991, Wisconsin Geological and Natural History Survey, with a 1993 update from 1991 and 1992 legislative sessions]. On July 8, 1992, Greg Conrad, Interstate Mining Compact, stated that the ELI study presented a "fair and comprehensive overview of the ten state regulatory programs reviewed." Examples of state program components in the subsection that follows come from the 1992 ELI study, and may not be representative of current programs.

In developing an EPA mining framework, it is important that EPA identify those areas of federal environmental law for which the states have lead implementation authority, as well as those areas in which states have developed programs which do not have a federal analogue. Most states have active programs that deal with existing and proposed mines, and several states have developed programs to deal specifically with inactive and abandoned mines (IAMs)..

Active and Proposed Sites. States are often authorized to administer several federally mandated environmental programs (e.g., NPDES). A common requirement of such authorizations is that the state regulations and procedures must be at least as stringent as their federal counterparts. In addition, states often have additional features in their regulatory programs that arise from state specific statutes, regulations, or policies. In assessing a particular state's programs for regulating mining activities, it is therefore important to understand the authorization status of the program and any state-specific requirements or practices. There are a great variety and complexity of state mine waste programs. In terms of this mining framework, several features of these programs bear mention. The Environmental Law Institute's (ELI, 1992), in its evaluation of state programs, noted the following:

- Many state regulatory programs are "relatively" new and still evolving. In most cases major regulatory provisions, and sometimes the primary programs, are fewer than ten years old. Examples of major changes include Nevada's zero discharge program and its 1990 reclamation program, Idaho's cyanidation regulations, Montana's 1990 custom milling and reprocessing regulations, and Arizona's and New Mexico's reclamation programs.

- Mining waste is regulated primarily by either a reclamation-based program or a water pollution-based program. Colorado, Idaho (except for cyanidation facilities), Missouri, Montana, and South Dakota rely chiefly on their reclamation programs for most mining waste regulation. Arizona, California, Florida, Idaho, Michigan, Nevada, and South Carolina rely primarily on water quality programs. Wisconsin, however, has a multi-media regulatory approach that relies heavily on both reclamation and water pollution based programs.

- Varying levels of overlap and coordination occur among the agencies with jurisdiction. In most states, there is a division of labor which is primarily based on the state's governmental organization and on when programs were enacted or regulations adopted. Recently, there has been increasing movement toward unification of these regulatory programs. In Nevada, for instance, both reclamation and water quality are located within the same unit of the Division of Environmental Protection.

- Under RCRA, the states (except for Missouri) regulate both process units and waste units under unified schemes despite the federal regulatory distinction between a "waste management unit" and a "process unit."

- Regulation of existing mines is, in many states, proceeding more slowly than regulation of new mines and new units. This is partly a result of the newness of many of the programs or changes to the regulations under these programs (e.g., Arizona's aquifer protection permit program) and the difficulty of overlaying new requirements on units that have been operated for years and that have a continuing useful operating life. It is also due, to some extent, from the result of exemptions for existing operations (which in turn can be due to the difficulty noted here).

State regulations of active and proposed mining also have some common technical features that are also relevant to EPA's mining framework. These include:

- ***Standard setting***. All states are required by the Clean Water Act to adopt water quality standards, which set forth designated uses of the waters within their states and numericc and narrative criteria to protect those uses. [states are increasingly utilizing water quality-based effluent limits (WQBEL) for permitting]. States having specific design or performance standards tend to be in such areas as drainage control structures and other construction standards, such as those for liners.

- ***Financial assurance***. These vary significantly from state to state. The kinds of costs that can be covered include reclamation, and discharge contingencies. Costs also range from actual reclamation costs (e.g., Colorado[1] and Nevada), to reclamation plus contingency and closure costs (e.g., California). Other states have specified per-acre amounts.

- ***Closure***. Detoxification is subject to differing standards in those states that specify standards. Water availability also plays a major role in the various detoxification approaches. Some states defer decisions in this area until closure is imminent. Closure plans are usually required as part of the original application, but are often at a conceptual level until the end of the mine's life. Post-closure care of some sort is required in some (e.g., AZ, CA, MO, NV) but not all states.

The following paragraphs provide some indication of the variability of state programs and approaches.

In some cases, modifying state mining programs can lead to improvements for new mining operations, while maintaining less protective practices at older units. For instance, in Arizona, discrete heap or dump leach units closed before January 1, 1986, at mines with other active operations were not required to have a permit. A 1992 draft state guidance identified optimal design systems for some precious metal leach pads as a double lining with a leak detection/collection system and run-on controls to manage a 100-year, 24-hour storm event. However, the state will not require retrofitting all existing impoundments and facilities. On the other hand, Nevada required mines in existence September 1, 1989, to receive a water pollution control permit within three years.

In addition, prescriptiveness of regulations may vary, and some states establish permit-specific standards based on customary practices. Montana issued regulations for mills, small placer and dredge miners, and small miner cyanide operations in 1990 and 1991 which are more detailed in siting, location, waste characterization, design, and performance than regulations for large operating mines, which were developed primarily in 1980. Older permits operating within permitted standards could be subject to modification when field inspections reveal "significant environmental problem situations." Idaho surface mining regulations specify soil erosion performance (drainage of a 20-year, 24-hour storm) and reclamation (cross-ditching and revegetation) standards for roads.

[1] The initial $1.3 million reclamation assurances required in 1984 for the Summitville mine considered costs of surface grading, clay caps, and revegetation. After acquiring the authority to require bonding for water treatment, the state's Mined Land Reclamation Board increased the surety to $7.2 million in 1992. Reclamation costs were estimated to exceed $40 million when the owner filed for bankruptcy at the end of 1992. Note that water balances derived from using non-site meteorologic data underestimated the actual site water balance. (Knight Piesold)

Wildlife protection practices also differ from state to state. Citizen groups initially opposed siting a South Carolina gold mine in a populated area. The mine agreed to voluntarily supply $10 million of financial assurance for environmental protection and enhanced technical performance. Despite the efforts of a full-time crew intensively hazing with cannons, pyrotechnics, and other techniques to prevent bird kills, the mine reported 193 dead birds from 1987 to mid-1990. On the other hand, Arizona guidelines for cyanide management for wildlife protection included treatment of process solutions to less than 30 mg/l weak acid dissociable cyanide (or to non-lethality) and netting of impoundments, noting that harassment techniques like cannons and rock music have not been effective. Nevada law required wildlife permits issued to all existing mines with industrial ponds by April 1, 1990. Nevada requires floating covers or nets, neutralization or dilution, but recognizes that hazing has not prevented bird deaths. Nevada requires wildlife mortality reporting and has imposed penalties for bird kills.

Differential treatment and availability of data at new and older operations highlights differences in identifying and resolving concerns. For instance, the California Surface Mining and Reclamation Act reclamation requirements do not apply to lands disturbed before January 1, 1976. Monitoring the unsaturated zone became required in California due to 1991 changes in regulations. Financial assurances posted by new and existing operations in California since 1992 include funds needed to cover closure, postclosure, and release activities. Likewise, older Idaho cyanidation processing units may not be subject to permitting (and $25,000 to $100,000 financial assurance) until expanded or modified. On the other hand, in 1990, South Dakota law required operators using cyanide leaching and other chemical and biological processes to have an additional surety of $25,000 to $500,000 to respond to accidental releases to the environment, and the amounts were reassessed in 1992. South Dakota’s water pollution control program calls for monitoring and action after pollutants are detected in groundwater.

The amount of site data required by states can vary widely. Nevada permit applications have to contain hydrogeological information to depths at least 100 feet beneath point sources and historic monthly average rainfalls, and size of 24-hour storms for 10-, 25-, and 100-year events. Nevada water pollution control permit applications also require reports of ore, overburden, and waste rock samples and evaluations for potential pollutant releases. Further, compliance with minimum design criteria does not shelter the permittee from liability from any ensuing degradation of water. However, there are no financial assurance requirements in Nevada’s water pollution control law or regulations.

Colorado demonstrates administrative flexibility in permit issuance. Passive treatment of mine drainage systems through voluntary cleanups of abandoned mines are not subject to the five-year Colorado Discharge Permit System requirements. Colorado reclamation permits are for the life of the mine and contain site-specific design, monitoring, and reclamation requirements to fulfill the narrative performance standards in the Colorado Mined Land Reclamation Act and regulations. Detailed guidance recommends double liners for systems in contact with cyanide solutions.

Florida Department of Environmental Regulation (DER) issues a single permit covering ground water and surface water when possible. Local government can administer permit programs if approved by DER as being no less stringent than the state program and having the necessary enforcement capabilities and resources. Nevada is required to send counties notices of permit application. South Carolina requires operators to submit their reclamation plans to the local soil and water conservation district.

Missouri's Metallic Minerals Waste Management Act (MMWMA) permits are for the life of the facility, but the state reviews closure and inspection-maintenance plans every 5 years. Permits are issued without public participation. The state has few standards for siting and location, so permits specify the requirements. The Financial assurances of $1,000 per acre (but not less than $20,000 per permit) may not cover all costs of reclamation.

Post-closure protection and financial assurance requirements vary widely. Idaho mining programs do not specify post-closure activities. Nevada specifies up to 30 years of post-closure ground water monitoring, and submission of final closure plans two years before closure. Financial assurance in Nevada only covers reclamation costs, not the costs of neutralization and closure required under the state water pollution control permits--unless required by a federal land manager. South Carolina gold mines are bonded for $190,000 to $2.5 million, based on the amount necessary for reclamation. In South Carolina, reclamation plans include closure, but not postclosure. Post-closure care extends for 30 years in South Dakota.

APPENDIX F

SELECTED METHODS OF RANKING SITES

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This appendix addresses prioritizing or ranking mining sites for attention. The first section presents some principles about ranking inactive and abandoned mine sites (IAMs) in priority order for EPA consideration. Although regulatory authority may be sufficient for EPA to consider action at many mine sites, EPA is not likely to have the resources available to take action at all sites. Thus, some method of ranking the sites in priority order is advisable. The second section of this appendix provides some examples of priority ranking systems.

1. METHODS OF SETTING PRIORITIES

1.1 Overview

Establishing priorities that will guide remediation efforts leading to environmental improvement is one of the most important challenges facing regulatory authorities as well as interested stakeholders. Identifying key considerations in this regard is one of the main objectives of this mining framework. Given the number of mine sites and potential environmental problems, the lack of a comprehensive data set to evaluate impacts of all past mining activities, and limited resources, EPA and other federal, state, and tribal regulatory partners need to "rank" geographic areas and sites for inventory, evaluation, and remediation.

There have been a number of inventory and priority setting mechanisms established to address the large population of abandoned mine sites. Most of these are well suited to the specific geographic area(s) they are intended for. Some of these systems include:

- The State of Montana's ranking system.
- The National Park Service's ranking system.
- Ranking systems developed by other federal agencies.

Given the large number of sites and the expense of mitigation using existing technologies, the public and private sectors will realistically probably never have sufficient resources to perform field inventories or clean up all mining sites. Therefore, we must develop a process that ensures that our efforts go to areas and sites that will yield the greatest benefits in the most cost-effective manner. Cooperation among a wide range of stakeholders (federal agencies, states, tribes, nongovernmental organizations, and private industry) with different authorities, outlooks, priority-setting processes, and goals will require sharing of information and resources, and may require some compromise among different program objectives. EPA's numerous authorities and responsibilities for addressing health and environmental impacts at IAMs require the Agency to work at several different stages of the priority setting process.

The principles described here are applicable primarily to inactive and abandoned mines, rather than to proposed or active mines. The reason for this distinction is an assumption that proposed or active mines will typically be the subject of operating permits or requirements that will be the vehicle and trigger for gathering necessary information about proposed or active mining operations and any associated environmental and human health impacts. However, many of the principles articulated below are clearly applicable to proposed and active mines as well. For example, characterization of priority areas within a watershed will require inventories and information on both active and inactive mining activities in order to determine the highest priority sites for future actions.

EPA believes priority setting mechanisms must be established at multiple levels to most effectively address the range of issues posed by the large universe of mine sites. The next few pages describe an approach for setting priorities for action at four different geographic scales: National, regional/state/tribal, Mining Area (watershed, mineshed), and Site. Objectives at each level can include:

- At the **national level,** to portray accurately the scope of the IAM problem and the magnitude of resources needed to address it.

- At the **state level**, to identify impacted watersheds that deserve priority attention.

- At the **tribal level**, to be cognizant of Tribal trust responsibilities.

- Within **priority** areas, to develop effective interagency approaches for prioritizing individual mine sites for action.

- At the level of the **mine site**, to determine which regulatory or non-regulatory mechanisms are most effective in addressing the problems of a given site.

Table F-1 presents a summary of key components for setting priorities for action on inactive and abandoned mines for each of the four scales. The following set of considerations are reviewed at each level:

- The **major goals** to be reached and the specific type of activity associated with meeting the overall goal. This would include consideration of the key public and private parties (agencies, states, other stakeholders) who are responsible for the decisions/actions.

- The key **criteria and specific analyses** required to set the priorities and ensure success in meeting the different goals.

- The principal **outputs/action** that are appropriate for each level, in accordance with goals and the criteria/analyses reviewed.

Table F-1 Setting Priorities for Action on Inactive and Abandoned Mines (IAMs)

SCALE	GOALS	TYPE OF ACTIVITY	WHO	KEY CRITERIA*	ANALYSIS
National	Determine nationwide environmental degradation from IAMs Identify high-priority states, tribes, agencies and regions for budget and program action	Congressional decisions on budget and legislative agenda Federal Agency decisions on budget, program, research and regulatory agenda	Congress, EPA, DOI, DOA, Governors, Tribes, National Stakeholders-MPC, companies	National human health and ecological impacts Total Administrative and Mitigation Costs Federal Trust Responsibilities	Estimate size and scope of nationwide mining problem based on state, agency and tribal input.
State, region or tribe	Identify priority areas by ranking areas for action and/or near-term evaluation	State/Regional Assessment or Program Activity such as: • 305b reports • Nonpoint source assessments • NPDES General permit priorities • CERCLIS site entry • State/Tribal Groundwater Protection Programs • State/Tribal Water Quality Standards Review • State//Tribal/Regional Enforcement priorities	States EPA Federal land managers Tribes Regional Stakeholders	Impaired watersheds, habitat, groundwater, airsheds, etc. Location of historic mining districts Population centers and most sensitive individuals Most sensitive species, communities, ecosystems Institutional capabilities	Critical area identification Mineral district pollution projections Geographic overlays of risk assessment data at the mineshed, watershed level
Historic Mining Area (Mineshed, Watershed, Land Management Area, etc)	Ranking of sites for immediate action and/or near-term evaluation	Conduct area investigations such as: • Area-wide PA/SI • Mass loading evaluations (TMDLs; air) • NPDES General Permit • Fed. Land Mgmt. Planning	States EPA Federal Land Managers Tribes Regional Stakeholders Local Stakeholders	Extent of environmental and human health risk - all media Achievable cleanup goals (tech. feas., cost-effect., total cost) Enforcement potential Partnership potential Ownership Funding sources	Estimate discharge, transport and risk to receptors Site identification, including appropriate size Regulatory options assessment and tool box analysis
Site	Mine site mitigation Environmental improvement via reduced ecological and human health risk Evaluate post-mitigation success	Design and funding actions such as: • RI/FS type studies (CERCLA) • A106 request (Progr. fund. req) • NPDES Permit enforcement	All of Above, plus Specific parties (e.g. private landowners, payees)	Tech. Feas. (Design criteria such as chemical loading; site-specific data) Cost/Effectiveness Funding source Enforcement potential	Evaluation of site • specific data and selection of remedy, or • action

1.2 Goals of Priority Setting

The purpose of the priority setting process in this framework is to help decision-makers organize information and make consistent and rational judgments about which strategy of evaluation and action to pursue in order to meet both short- and long-term goals of environmental improvement. Cross-programmatic cooperation, team building and integration are key elements of this process. Because the type and scope of decisions are fundamentally different at various scales of resolution, the process provides a flexible approach that works at all of these different levels. For example, Congress is responsible for appropriating federal resources to the entire nation based on the general needs of large, multi-state geographic areas, states, tribes and federal agencies and consideration of other competing national issues and programs. As we narrow the geographic scope, the decision-makers change from federal to state/tribal, and to local. The goals, activities, criteria, analyses, strategies and priorities become successively more site-specific and complex as we move to the site level. In addition, as priority setting moves closer to the site level, there will likely be a demand for more precise data, and for greater coordination and communication among all involved parties.

1.3 Criteria in Priority Setting

In setting priorities for action which will result in mitigation of inactive and abandoned mines and environmental improvements, regulatory authorities need to consider a range of specific technical, scientific, institutional, and other criteria upon which to base national, state, area, and site-specific decisions. Further, the precision and type of information used at each different scale of the decision-making process will vary. High precision data can be used at a very small scale while qualitative data may be useful only at larger scales.

The following criteria need to be considered and evaluated in each level of the priority-setting process to determine the priority for action.

- Extent and type of environmental and human health risk.
- Total administrative and mitigation costs.
- Technical feasibility.
- Cost-effectiveness of activity.
- Partnership potential.
- Availability and type of data/information.
- Enforcement potential.
- Source of funds.
- Ownership.
- Institutional capabilities.
- Tribal Trust Resources.

1.4 Outputs of Priority Setting

One of the goals of the framework is to develop, at each geographic scale, a coordinated, systematic approach to assess and prioritize risks associated with IAMs, and to establish priorities for mitigation based on environmental and human health risk, as well as other key criteria such as resource availability and cost-effective technologies. This will ultimately result in clean-up of abandoned mine sites in the most efficient and effective manner possible in coordination with all affected and interested parties.

Cooperative programs such as the Clear Creek Initiative (Colorado) and Montana Ranking System can provide models for using both national and area-wide approaches, involving parties with different outlooks and goals and operating under numerous statutory authorities. Possible specific outputs of the priority ranking system could include:

- Establishing priorities for implementing the NPDES storm water comprehensive watershed risk-based approach for federal lands pursuant to Clean Water Act Section 402(p) and for reviewing multi-sector storm water watershed approaches for the private sector.
- Ranking CWA Nonpoint Source Projects (Section 319) for funding priorities.
- Prioritizing mine waste control demonstration projects pursuant to CWA Section 107.
- Entering sites on private and public lands into CERCLIS and initiating the PA/SI process pursuant to CERCLA Section 116.
- Prioritizing NEPA reviews for mining that will impact waters of the U.S.
- Prioritizing facilities for performing A-106 audits pursuant to Executive Order 12088.
- Establishing priorities for action under state Groundwater Protection Programs.
- Establishing priorities for mining-related technology and research development initiatives.
- Establishing priorities for remediation initiatives.

This geographic, hierarchical system for prioritization may be entered at any level; and one can move both up or down in scale within the hierarchy, for example, from the national scale down to the site level, based on the resolution of the data. Once geographic areas of concern are identified, a number of criteria can be used to further prioritize or categorize sites at this new scale. Alternatively, if one had sufficient data to take a response action at a site, evaluating the response action within a watershed to determine if goals within the larger area will be advanced by this activity may be appropriate.

The area-wide approach directs site investigation and cleanup activities towards the broad scope of problems affecting an area. Better decisions are made when the cumulative impacts of all mine sites in the area are considered and addressed. The basic premise of the framework for addressing mine sites is to identify and prioritize sites at the same time as known problems are being addressed. In the short term, actions can be initiated at many of the most damaged areas and sites while data gaps are filled for other less-characterized areas. In the long term, better information used in conjunction with site specific refinement of methods and approaches will result in the most effective cleanups and use of limited resources.

1.5 Multi-Level Priority Setting

National Level

Goal - At the national level, Congress, federal agencies, states, and tribes should determine the magnitude and scope of national environmental degradation resulting from IAMs. Further, they can cooperatively identify the high priority states and agencies for targeting resource appropriations as well as program, research, legislative and other future agendas. One key challenge in priority setting at this level is to balance resources devoted to environmental versus safety threats (e.g., open airshafts and adits, crumbling mill works, dams, and unstable tailings piles). Each can be significant but they are generally addressed under different legal authorities.

Criteria/Analysis - The key criteria to be used at this national level would include the relative extent and type of environmental and human health (including safety) impact in each state/tribal or Federal Land Management (FLM) area, and general estimates of the total public and private costs of mitigating IAMs. Specific information and analyses performed might include identifying non-coal mining activities within the state or tribal area, estimating the total number of mine sites, identifying major types of suspected or measured statewide impacts (e.g., number of miles of streams not meeting designated uses) as well as other indicators that the state or tribe has identified which qualify or quantify abandoned mines as an environmental problem.

Outputs - The output would be a large scale, nation-wide map or summary which identifies states, tribes, regions and/or federal land areas of highest priority where program, evaluation, budget, and other activities should be *initially* focused. A national approach that ranks *individual* sites for mitigation would require an extraordinary commitment, and would likely not be an efficient use of our current limited resources.

State, Tribal and/or Federal Land Management Unit Level

Goal - At this scale, priority setting should occur at the state, regional or federal land management level. The goal here is to identify priority geographic areas (e.g., watersheds, minesheds, Federal Land

Management unit) that are most impaired or threatened by mining activities and target them for action or near-term evaluation. It is crucial that this identification and ranking be performed jointly and cooperatively using a team-building and information-sharing approach. Key parties here include states, affected federal agencies, tribes, mining interests, environmental groups, local organizations, and other regional stakeholders.

Criteria/Analysis - The large number of individual sites makes a geographic, regional evaluation of mined areas more effective and efficient than a systematic effort of assessing individual sites. Although mine sites can be isolated, they are more frequently clustered in historic mining districts. Consequently, there are often cumulative impacts from multiple sites. In general, most information resources, inventories and data collections should be directed to known or easily identified problem areas. Therefore, it is suggested that this area evaluation be based upon mineshed-level data (e.g., geographic watershed areas delineated by the USGS as cataloging units within the Hydrologic Unit Code system).

At this level, the approach could develop a list of priority areas by compiling and overlaying data based on the following key criteria:

- Regional/state measures of the extent of actual human health and environmental impacts based on regional and/or local assessment reports (e.g., CWA Section 305(b) reports, nonpoint source assessments). Specific components might include impaired surface waters, watersheds and groundwaters, degraded habitat, degraded airsheds, disturbed terrestrial areas, and open mineshafts.

- Specific population centers and locations of most exposed individuals and critical ecological areas containing most sensitive species, communities, and ecosystems.

- Location of historic mining districts and estimates of mineral district pollution projections.

Outputs/Action - This information will be used to generate a list of priority minesheds which can be targeted for more site-specific evaluation. The major advantage of using an area-wide approach is that site investigation and remediation activities can be directed toward the broad problems affecting an area, including considering and addressing the cumulative impacts to all resources from all mine sites in the area. The ranking derived at this level could lead to different types of program and evaluative activities, including setting NPDES permit priorities, or working with state, tribal, or other federal agencies to develop comprehensive approaches to addressing mine site impacts.

Watershed Level

Goal - The purpose of assessment and prioritization at the watershed level is to evaluate and rank specific sites causing threats to human health and ecological resources and then rank them for action and/or near term evaluation. Also key to this site prioritization is the development of an area-wide plan to assess and prioritize additional sites within the area that are not adequately characterized. This process directs most resources toward investigating and assessing areas where actual environmental impacts are documented while continuing to identify and characterize additional high-risk areas.

Criteria/Analysis - Within the higher ranked geographic areas of concern (watershed, mining district, or section of a land management area) one of the major criteria to consider in developing the ranking system is the extent and magnitude of specific risk to human health and safety and to ecological resources from all media. Key indicators include areas where individuals/wildlife are exposed to contaminated soil; where drinking water supplies exceed Maximum Contaminant Levels; where acute or chronic water quality standards are exceeded; or where terrestrial/riparian habitats are severely degraded. In many instances, water quality problems represent a primary indicator of overall environmental degradation.

Where more detailed data are available, a more precise determination of risk can be determined by estimating discharge transport and exposure pathways in all media or by identifying specific locations of physical hazards. At this level, evaluating existing or potential human health and environmental risks should take into consideration the actual or potential presence of threatened or endangered species, presence of critical environmental resources such as wetlands or breeding habitat, and the specific exposure potential to the receptors of concern. Other variables to consider, if information is available, include the magnitude of existing or potential damage including concentration, toxicity, severity of impact, geographic extent, reversibility of damage, and persistence of pollutants of concern.

Other important criteria to evaluate and address in the ranking system at this level include achievability of cleanup goals (e.g., availability, cost and cost-effectiveness of monitoring and remedial techniques), ownership patterns, source of funding for different actions, and the potential for partnerships to share resources and information.

Outputs/Action - The analyses performed at this level should determine which priority watersheds, minesheds or planning areas should have more detailed, site-specific assessments and should also identify watersheds and other areas which are of a lower priority and may therefore require limited or no action. Information collected and evaluated at this level could be used, for example, to develop a CERCLA preliminary assessment and site investigation, identify priority cleanup actions, or collect data for various compliance and permit evaluations.

Site Level

Goal - At this scale, the purpose is to develop a more comprehensive assessment and characterization of individual mine sites within targeted minesheds and watersheds, in order to remediate the sources that are the most damaging to human health, safety and ecological resources. At this level, the goal is to use a more refined approach for designing specific mitigation activities. In addition, regulatory authorities may need to implement a program to evaluate the success of short- and long-term remediation efforts.

Criteria/Analysis - The major factors used to rank individual mine sites/sources within an area should be based on the impacts observed in and risks associated with the specific area. The ranking of sites at this level as well as the evaluation and data collection performed will likely be driven by area-specific concerns and conditions. For example, if the major environmental impacts in an individual watershed are found to be directly related to lead levels in stream waters and sediments, the high priority sites targeted for mitigation within that watershed should include those that are discharging lead to streams.

Other key criteria for ranking sites for mitigation include the technical feasibility and specific cost/effectiveness of remediation methods. Evaluation of “hot spots” will require detailed site investigation and resource evaluation and should be performed by personnel who have expertise in mining site remediation and resource assessment. ”Best professional judgement” of qualified personnel will need to be employed at the various levels of site and resource assessment. Practical, feasible technical and scientific approaches should be considered to determine the overall priorities for site action.

Outputs - The approach at the site level focuses characterization and remediation activities on areas of greatest human health and ecological concern by determining which specific sites would be the most cost-effective to mitigate and provide the greatest environmental improvements. For instance, this approach can prevent situations where an upstream site is remediated while at the same time downstream problems continue to cause impacts. Typical outputs at this level might include RI/FS type of studies, NPDES permitting and enforcement actions, or specific program funding requests.

1.6 Implementation Issues/Challenges

One of the major challenges associated in implementing a multi-level priority setting system such as the one described here lies in the fact that there are currently a number of systems in use that are effective at addressing certain parts of the problem. In addition to needing to mesh with these existing systems, a related issue is defining and agreeing upon the successively smaller boundaries of areas and then coordinating the activities and resources of all interested parties. In addition, all appropriate sources of existing information will need to be collected and reviewed in order to characterize geographic areas and mine sites causing ecological and/or human health problems within those locations. It will be critical to develop the most resource-effective approach to integrate data across programs and across media. Team-building, sharing data and information, and leveraging of staff, equipment and funding are critical to the success of this area-wide approach.

A second major challenge is that the requirements of specific statutes and regulations often drive action on a site-specific or media-specific basis, independent of larger area-wide evaluations, considerations and conditions. This may cause some difficulty in applying discretion to the development of specific remediation priorities. A third problem is how to ensure that progress on known sites is not delayed because of the time and effort required to establish priorities for action at the different levels. Many of these areas, particularly the larger and/or more complicated sites and geographic areas, have already been identified and characterized. It is critical that all parties reach agreement at an early stage about these high priority sites so that the next appropriate steps that will lead to speedy site mitigation and environmental improvements can be identified.

A fourth challenge lies in the need to develop a comprehensive, cost-effective and successful area and site-level ranking system that includes all media and receptors. Currently, many of the applied mine site ranking/assessment systems, such as Superfund's Hazard Ranking System (HRS) or the federal land managers' systems, are tailored for assessing and categorizing individual sites. They generally do not identify problem areas or characterize the overall condition of an area (e.g., watershed, airshed, or ecosystem). Similarly, the cross media NCAPS is used to rank/prioritize sites for RCRA remedial action. In contrast, the water body assessments required by the Clean Water Act (e.g., Section 305(b) reports) cover large areas, yet do not always identify specific sites of concern. Further, no current priority system adequately identifies risks to human health and evaluates them along with threats to special areas of concern, human safety risks from open shafts or effects to ecological resources at the species, community, and ecosystem level. There is a need to improve the ways in which priority ranking systems factor the components of the larger ecosystem level in with the needs and efforts at the site-specific level.

2. SELECTED EXAMPLES OF RANKING SITES

At present there are numerous programs being developed or already underway within states and within other federal agencies to identify, inventory, prioritize, and/or otherwise address mining related issues. Of particular interest are those programs which include explicit methods for prioritizing activities from a large population of options, such as ranking methods for sites targeted for possible remedial action. Accordingly, this appendix is intended to provide background information on a selection of existing programs for ranking sites, starting with several programs designed specifically for mine sites and then several applicable to other types of sites..

2.1 Montana Abandoned and Inactive Mines Scoring Systems (AIMSS)

Montana's AIMSS is a fully developed and implemented prioritization methodology which has allowed the state to establish a ranked list of "90 – 95 percent of the worst mines in the State" based on a previously developed inventory of roughly 6,000 abandoned mine sites and extensive site characterization data. The AIMSS is based on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Hazard Ranking System (HRS) (see section 7 below) with significant modifications employed to fit mining scenarios. The model's output provides a numeric score for each site analyzed, enabling relative ranking of the sites, with no absolute measure of risk implied. According to state officials, implementation of AIMSS cost $0.9 million for 273 sites in less than one year, roughly $3,100 per site[1].

The development and implementation of AIMSS has relied on several important phases, including development of a state-wide inventory of abandoned mines, systematic investigation of all of the mines to yield comparable data for each, professional land manager surveys to aid in identification of problem sites, and development of the AIMSS itself. Further, having developed the priority list of mines, the state is moving forward with the next phases of its abandoned mine land program. These are briefly discussed below.

Inventory Development. Having certified that all coal mine reclamation activities have been completed, Montana is authorized to expend Surface Mining Control and Reclamation Act (SMCRA) Abandoned Mine Lands fund resources on non-coal abandoned and inactive mine reclamation. During the late 1980s, Montana developed a state-wide inventory of non-coal mine lands. The process included use of a five-page site investigation form which required investigators to record observations beyond those principally related to safety hazards, such as the presence of discharging adits, low pH or high conductivity discharges, the presence of a mill at or near the property, acid generation indicator minerals, the presence of tailings, and so forth.

Pre-ranking of Inventoried Sites. The Abandoned Mine Reclamation Bureau conducted a rough sorting of the mine inventory based on professional land manager surveys as well as analysis of the investigation results for the total mine pool. The population of mines was searched for a number of hazard indicators such as tailings, low pH discharges, etc., with those sites not presenting any of the indicators eliminated from the priority pool. Land managers from the Forest Service, Bureau of Land Management (BLM), Department of State Lands, mining districts, and health departments were then asked to identify any properties within their jurisdiction known or believed to present environmental hazards. The canvass results and the rough screening results were then compiled to yield a list of 273 mines believed to represent the majority of the worst mines in the state[2].

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[1] Note that in 1993, 273 sites were ranked. An additional 58 sites were processed in 1994, with approximately 50 sites from the total pool eliminated based on findings of comparatively low risk, resulting in a total of around 280 mines on the final inventory of problem sites. Also note that the estimated cost of implementation does not include the costs associated with developing the initial AML inventory nor with the modification of the HRS to yield the actual AIMS system.

[2] Note that the state reports a good match between the list of mines identified on the basis of profession judgment and those selected according to rough screening of empirical data. However, there were also some "surprises," in which sites not known or identified by land managers came to attention through historic file searches or other means and subsequently were ranked very high in priority. Similarly, several sites suspected of presenting high potential hazard were found on closer examination to be relatively benign.

Site Characterization Investigations. In the next phase of the program, state officials conducted systematic site characterization investigations at each of the 273 mines previously identified. These investigations involved visual site inspection as well as sampling and analysis. Portable sampling and analysis equipment (i.e., X-ray fluorescence (XRF) units) was employed to guide the number of samples to be collected as well as to provide additional sampling data points for each site at lower cost and in less time. The total cost for site characterization was estimated at $0.9 million, or $3100 per site.

Development of AIMSS. AIMSS was developed based on the HRS, with significant modification designed to yield a more realistic comparison between mine sites than would be possible using the actual HRS. For instance, given the frequency of occurrence of high manganese oxide concentrations at mine sites, AIMSS does not use manganese concentrations in determining risk. Moreover, AIMSS was developed to consider multiple constituents of concern at the concentrations observed in site samples, in contrast to HRS (see section 7), which is based on the contaminant of concern observed to be present in the highest concentration. Data collected for the priority mine were then input into the model to yield ordinal ranking according to potential hazard.

Current and Future Directions. Once the list of mines presenting environmental hazards was compiled, the state was faced with the task of determining how best to act upon these data. One of the ongoing activities is to identify past and present owners/operators of the identified sites in an effort to determine whether a viable potentially responsible party (PRP) exists. Another ongoing effort is to overlay the 273 sites with geographic information such as watershed boundaries and wetlands to put the sites in "environmental context." It is hoped that this process will further refine the ranking to identify sites or areas most worthy of immediate attention.

2.2 Bureau of Mines Abandoned Mine Lands Inventory and Hazard Evaluation Handbook

In response to the need for BLM, the Forest Service, and other land managers to develop inventories of abandoned mines within their jurisdictions, the former Bureau of Mines developed the Abandoned Mine Lands Inventory and Hazard Evaluation Handbook. The Handbook was designed to guide consistent data collection for all mine lands within a geographic area up to the size of a National Forest and to allow systematic comparison of inventoried mine lands with respect to hazard potential. The 4-phase inventory and evaluation process progresses from identification and characterization of all mine lands within a geographic area based on file and map reviews to detailed site investigation of sites selected from the resulting inventory on the basis of a rough pre-screening analysis. The final screening level phase yields a numerical indication of the relative hazard of all sites investigated, with no estimation of absolute risk implied.

To date, no agency has adopted the Handbook to be applied to all of the public lands within its jurisdiction. However, both the Forest Service and the BLM have contracted with the Bureau of Mines to perform inventory and investigation within individual forests and resource districts.

Forest Service Lands in Washington State. The Bureau of Mines has conducted an inventory and pre-field screening of abandoned mine lands on all Forest Service lands within the State of Washington. The inventory effort was initiated as part of the Forest Service's Federal Facility Compliance Program. The methodology closely followed the process for inventory and initial characterization of mine lands presented in the Handbook. The pre-field screen was based on qualitative indicators of hazard and resulted in identification of 49 "A Category" sites from a pool of 2,208 sites on Forest Service lands in Washington. The intent was then to incorporate the inventory into a Geographical Information System (GIS) format to facilitate prioritization of investigations based on spatial characteristics of the sites.

BLM Use of Handbook. BLM is in the process of developing a National Abandoned Mine Lands (AML) strategy. As part of the design effort, BLM is evaluating the suitability of the Handbook and other inventory and prioritization tools for identifying priority sites on BLM lands throughout the country. The Handbook methodology was applied to the Winnemucca District in Nevada. As with the Forest Service study, the Winnemucca study included only the initial inventory and pre-field screening phases of the Handbook approach. Additionally, a number of sites from the mine inventory were selected at random and visited to allow verification of pre-field screening results.

2.3 Colorado Demonstration Project Program

Under the Colorado Demonstration Project (CDP) program, the State of Colorado selects and allocates Clean Water Act Section 319 (nonpoint source) grant funds to address inactive and abandoned mine sites in the state. Through early 1995, 27 individual grants have been awarded for 16 mining projects. The total funding has been over $2 million (approximately $500,000 per year). Site selection and grant allocations are approved by EPA Region VIII. Information on the CDP program was obtained from Greg Parsons of the Colorado Department of Public Health and the Environment, who is the program coordinator.

The broad basis for the program is the state's Section 319 water management plan (i.e., the plan for addressing statewide nonpoint source pollution). From the management plan and an associated database, the state identifies watersheds with water quality problems. This identification serves as the basis for determining/prioritizing sites for CDP/319 program funds. In making these selections, the state considers a number of technical, political, and resource factors in determining/prioritizing sites for CDP/319 program funding. These factors include:

- Which sites will be addressed under other programs (without CDP/319 program resources)
- Severity of environmental impacts and risks

- Site accessibility, feasibility, and ease of remediation
- Which sites will serve as good "demonstration" projects for remedial measures.

Beyond the above factors, the state also recognizes that CDP/319 program funding and other state resources available for abandoned mine site remediation (the Colorado Division of Minerals and Geology also participates in the CDP program) are almost always insufficient to complete the projects. Therefore, an additional factor in the selection process is the ability to form partnerships (i.e., the potential for obtaining further resources and participation from federal agencies, local governments, academia, environmental groups, and private industry). Many of the current projects (e.g., French Gulch and Chalk Creek) represent cooperative efforts among a wide range of diverse interested parties.

Of specific note, the program has undertaken several watershed-related projects (as opposed to individual site-related). Along with the Rocky Mountain Headwaters Initiative (see section 5 below), the CDP program is providing funding/services to the Animas watershed project (aimed at defining impacts and performing remediation throughout this watershed). The CDP program also includes funding for prioritizing and remediating abandoned mine sites for remediation in the Mosquito Creek watershed.

According to the state, the most significant difficulty associated with the CDP program is the potential for assumption of liability (CERCLA and Clean Water Act) by non-state/federal project participants. The state avoids CERCLA liability through an agreement with EPA Region VIII that provides that projects are clean-up actions. However, other project participants risk assuming such liability and this tends to limit "good Samaritan" actions. In addition, project involvement can lead to the need for the state to obtain NPDES permits and ensure compliance with water quality standards (which is often not possible). An additional "difficulty" is that the requirements of the 319 process focus on remedial actions/best management practices rather than site characterization activities. As a result, site investigation activities cannot be funded unless there is a clear need for remediation. Further, the program can lead to remedial measures being undertaken before problems are fully understood.

Overall, like other similar projects, implementation of the CDP program has been a learning process. The state recognizes the site-specific challenges associated with mine site remediation and virtually every project provides lessons learned. One major finding has been the advantages of developing and implementing source controls (i.e., measures that minimize pollution generation), rather than conventional treatment techniques that require perpetual care.

2.4 Rocky Mountain Headwaters Initiative

The Rocky Mountain Headwaters Initiative is similar to other major EPA initiatives designed to address water quality concerns in a specific geographic area (e.g., the Chesapeake Bay and the Great Lakes programs). The Initiative was initially developed to addressed mining-related watershed impacts in the mineralized Rocky Mountain areas of Region VIII. However, it was expanded to fund projects in other

Regions. For FY 1994, 20 projects received approximately $1 million of funding. Information was obtained from Jim Dunn, the EPA Region VIII coordinator for the Initiative.

The goal of the Rocky Mountains Headwaters Initiative is to fund mining-related demonstration projects aimed at addressing water quality impacts from inactive and abandoned mining operations that are not being addressed through other programs. The Initiative is a nonregulatory tool and funding is limited to nonprofit entities (other federal agencies, states, universities, local non-profit groups, etc.). Categories of water management projects include:

- Innovative Technology Applications
- Scientific Foundations (i.e., applied research projects)
- Methods and Protocols
- Environmental Restoration
- Data Acquisition and Management
- Public Involvement/Agency Coordination/Outreach.

According to the Region, the project selection/prioritization process remains somewhat subjective (although developing more standardized protocols is a goal for this year). Site selection and program oversight are performed by a multi-disciplinary, cross-programmatic team of EPA Region VIII staff. One key factor in project selection is an emphasis on partnership building. Funded activities tend to be components of cooperative efforts among federal, state, local, public interest, and private sector groups. In addition, the region recognizes the many site-specific challenges posed by mine site remediation. Therefore, projects selected for the Headwaters Initiative are often tailored towards providing tools to assist in site characterization and remediation. For example, several projects focus on development and assessment of methods and protocols for mine site/watershed assessment. Other funded projects involve evaluation of innovative technologies. Finally, many of the selected projects focus on watershed characterization and remediation, including extensive work in the Upper Arkansas River, Upper Animas River, and Clear Creek watersheds. Upper Animas Creek work is also being funded under grants from the Colorado Demonstration Project program.

The Region is currently developing a report on the results to date and lessons learned from the Initiative. This report will include a description of techniques/protocols that have proven to be particularly successful in characterizing, prioritizing, and remediating inactive and abandoned mine sites.

2.5 South Dakota Abandoned Mined Lands Inventory Act

In 1993 the South Dakota legislature passed the Abandoned Mined Lands Inventory Act authorizing the Department of the Environment and Natural Resources (DENR) to inventory abandoned mine lands in the Black Hills region of the state. The Act establishes a fund for the inventory effort (derived largely from monies raised through a now-discontinued tax on cyanide usage). In addition, the state has received a grant from the Western Governors Association (WGA) to fund a "screening" program in conjunction with the inventory development effort.

The Act specifies that the inventory effort can not proceed until the DENR executes a Memorandum of Understanding (MOU) with EPA granting an exemption from CERCLA liability to the state and its contractors covering any reclamation activities on abandoned mines. According to DENR, the MOU is nearing completion. The South Dakota Mining Association and other interested parties have been included in development of the language of the MOU.

The screening methodology has not yet been determined. However, DENR indicates that the tool will consider both safety and environmental factors, and, given the MOU with EPA, will likely resemble HRS-type screening tools.

2.6 CERCLA Hazard Ranking System

Section 105(8)(A) of CERCLA requires that the National Contingency Plan (NCP) include criteria for determining priorities among releases or threatened releases of hazardous substances, pollutants and contaminants, throughout the United States for the purpose of taking remedial action. Appendix A of the NCP (40 CFR, Part 300 Appendix A) contains these in the form of the Hazard Ranking System (HRS).

Section 105(8)(B) of CERCLA requires that the NCP, based on Section 105(8)(A) criteria, include a list of national priorities among the known or threatened releases throughout the United States. EPA describes the purpose of this National Priorities List (NPL) to be a source of information, to be used by EPA, the states and the public for identifying sites that appear to warrant remedial action. Listing (of a site) does not require any action of any private party, nor does it determine the liability of any party for the cost of cleanup at the site. EPA generally uses the NPL as the action list for evaluating remedial response and enforcement action under CERCLA. The NPL now includes over 60 mining-related sites.

The revised HRS assesses the relative risk among sites through evaluation of four migration pathways: (1) ground water migration; (2) surface water migration (through drinking water and human and aquatic food chain); (3) soil exposure (through resident population and nearby population); and (4) air migration. Within each pathway, sites are evaluated based on three factor categories: (1) likelihood of release (likelihood of exposure for soil exposure pathway); (2) waste characteristics; and (3) targets. Pathway scores are determined based upon the multiplication of factor category values and normalization to 100 points. The total site score (including all relevant pathway scores) is obtained by combining the pathway scores using the mathematical technique of root-mean-square. This mathematical technique results in higher scoring pathways contributing more significantly to the total site score than lower scoring pathways.

2.7 Priority Ranking Under Clean Water §303(d), TMDLs

The Clean Water Act includes numerous provisions requiring prioritization and ranking of potential actions, either in the statute or in its implementing regulations. One example is §303(d), which directs states to establish Total Daily Maximum Loads (TMDLs) for certain quality-limited waters. The TMDL approach attempts to provide a water quality-based mechanism for establishing point and nonpoint source controls for waters which have not achieved applicable water quality standards even after implementation of technology-based and other water quality-based controls.

When establishing its priority ranking for TMDL development, states must take into account the severity of pollution affecting the waters as well as the relative value and benefit of the waters to the state. Among the criteria listed in TMDL guidance to assist states in establishing priority ranking are:

- Risk to human health and aquatic life
- Degree of public interest and support
- Recreational, economic, and aesthetic importance of a particular water body
- Vulnerability or fragility of a particular water body as an aquatic habitat
- Immediate programmatic needs such as wasteload allocations needed for permits that are coming up for revision or for new or expanding discharges, or load allocations needed for BMPs
- Court orders and decisions relating to water quality
- National policies and priorities such as those identified in EPA's Annual Operating Guidance.

Section 303(d) does not identify an explicit method for ranking waters for TMDL development. Rather, the priority setting process is left to the states responsible for the program. States are encouraged to use a long-range planning approach to developing TMDLs for quality-limited waters and to consider broad geographic approaches to setting TMDLs. Note also that the 1991 "Guidance for Water Quality-Based Decisions: The TMDL Approach" identifies several approaches that may be considered by states in establishing their ranking and targeting systems. These include the priority setting systems applied under nonpoint source and Clean Lakes provisions of the Clean Water Act.

2.8 Priority Ranking Under the CSO Control Policy

In April 1994, EPA issued a national Combined Sewer Overflow (CSO) Control Policy intended to expedite Combined Sewer System (CSS) compliance with requirements of the Clean Water Act. In effect the policy outlines a process through which NPDES permit requirements and management controls may be applied to CSOs on a worst-first basis while continuing to capture the remainder of the affected community through a long-term control planning function.

EPA released *Combined Sewer Overflows--Guidance for Screening and Ranking* (August, 1995 available from EPA's Water Resources Center) to help permitting authorities to identify those CSOs most warranting immediate attention. The recommended screening process relies on the use of existing data provided in Clean Water Act sections 303(d), 304(l), and 305(b) documentation and other sources to identify CSSs with the greatest likelihood of causing significant adverse impacts. CSSs identified through the screening process are then to be ranked according to seven criteria, with the final total scores for the CSSs enabling an ordinal ranking of all CSSs within a population of regulated entities.

In general, the criteria used to rank CSSs under this process depend on the existence of ongoing impacts, the potential for impacts to sensitive or protected resources, the size and nature of the receiving water affected by a CSO, proximity to drinking water sources, and the suspected presence of toxics. Additionally, the Guidance documentation includes certain default assumptions intended to lead to "worst-case" estimation of risks posed by a CSS. For instance, a CSS score is to reflect the maximum score attributable to any CSO within the CSS for each of the criteria.