SOCIETY FOR MINING, METALLURGY, AND EXPLORATION, INC.

P.O. BOX 625002 • LITTLETON, COLORADO • 80162-5002

PREPRINT

97-304

ENVIRONMENTALLY RESPONSIBLE MINING: RESULTS AND THOUGHTS REGARDING A SURVEY OF NORTH AMERICAN METALLIC MINERAL MINES

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Sponsored by
Wisconsin Mining Association
National Mining Association
Society for Mining, Metallurgy and Exploration, Inc.
Women's Mining Coalition
Wisconsin Manufacturers & Commerce

For presentation at:
Environmentally Responsible Mining:
the Technology, the People, the Commitment
Milwaukee, Wisconsin — February 17-18, 1997

INTRODUCTION

A Precambrian volcanogenic massive sulfide mineral belt in northern Wisconsin has attracted the attention of mining and mineral exploration companies for over 25 years. To date, two commercially viable deposits have been discovered: the Flambeau deposit in Ladysmith, and the Crandon deposit in Crandon. Flambeau Mining Company, a subsidiary of Kennecott Corporation is in the final stages of mining the Flambeau copper and gold deposit. Crandon Mining Company (CMC), a partnership between Exxon Coal and Minerals Company and Rio Algom Mining Corp. is currently in the permitting process for the Crandon zinc and copper deposit.

For most of this 25 years, hard rock metallic mineral exploration and mining in Wisconsin have been the subject of intense debate. Public policy discussions about mining in Wisconsin have recently centered around proposed legislation that challenges the mining industry to prove sulfide mining can be done in an environmentally safe and responsible manner. The opponents to mining in Wisconsin allege that there are no environmentally safe sulfide mines in the U.S. or Canada, and point to environmental problems, especially acid rock drainage (ARD), at old hard rock mines in the western U.S. with the implication that mining today will create the same types of environmental problems. The sulfidic nature of these Wisconsin massive sulfide orebodies is one of the focal points of the current controversy over mining in Wisconsin. Mining opponents contend that mining and concentrating sulfidic rock and ultimate closure and reclamation of these operations cannot be done to control and contain acidification of sulfide-bearing materials and the resultant ARD.

This debate is not unique to Wisconsin. Across North America, mining industry detractors rely on outmoded images of mining of the past to foment public concern about mining and to justify their opposition to proposed mining projects and their support of anti-mining legislation. These public policy discussions about mining and the environment are taking place on the local, state, and federal levels.

MINING INDUSTRY ENVIRONMENTAL SURVEY

In support of its planning and permitting process, and its position that the hard rock mining industry is attuned to environmentally aware operations and has the appropriate science and technology to predict, prevent, and control ARD and other environmental problems, CMC commissioned a comprehensive study to survey the industry. The objectives of this study were to determine the extent and degree of environmental awareness and sensitivity in mining and processing operations and to locate examples of environmentally responsible operations in a sulfide ore environment.

CMC retained the services of the authors to conduct this survey based on their experience, background, and qualifications. Mr. Todd has degrees in wildlife ecology and more than 23 years experience in environmental and regulatory affairs in the metallic mining industry. Ms. Struhsacker is a geologist with over 20 years of experience in the mining industry, 11 of which have dealt with environmental and regulatory issues. Both authors are well known within the industry and have travelled extensively to both active and closed mine sites throughout North America.

Methodology

The survey was initiated in the Fall of 1995. Because of the large number of active, inactive, and closed operations, a phased approach was implemented. Hundreds of potential sites were screened initially to determine specifically which were operating within or had historically operated within a sulfide ore zone. Following this initial screening, contacts were established by telephone and fax with corporate and mine site environmental directors and managers, and with various state and federal regulatory agencies to discuss the scope of the study and determine which sites met the general criteria of operating within a sulfide zone. Over the course of several months, more than 150 telephone discussions with the companies, regulatory agencies, and organizations shown in Table 1 led to a narrowing of the field. As is

typical of these types of surveys, many individuals identified additional leads during their interviews. Some of these leads provided additional sites for review or people to contact. Although the survey was designed to be fairly comprehensive, it is not considered "all-inclusive". Indeed, it is likely that some operations meeting the criteria of operating in an environmentally responsible manner were overlooked. Additionally, the authors are fully aware that there are numerous examples of environmentally responsible operations that were not included in this survey for reasons of simple logistics and time constraints.

During the course of the telephone interviews, the initially proposed Wisconsin legislation (1995 Assembly Bill 758) pertaining to sulfide mining was discussed in order to determine whether there were any operations that categorically meet the criteria set forth in that proposal. Quickly, it became evident several *active* operations appeared to satisfy the operating criteria of 144.851 (2) (a), *to wit*, **"...that a mining operation has operated in a sulfide ore body in the United States and Canada for at least 10 years without polluting groundwater or surface water from acid drainage at the tailings site or at the mine site of from release of heavy metals."**

It also became readily apparent that examples of *formally reclaimed and closed* sulfide mining operations meeting the closure and reclamation criteria of 144.851 (2) (b) **"...that a mining operation that operated in a sulfide ore body in the United States or Canada has been closed for at least 10 years without polluting groundwater or surface water from acid drainage at the tailings site or at the mine site or from the release of heavy metals."** were difficult to find because of the arbitrary and inappropriate time frame criteria proposed in the bill. In restricting the analysis to mines that have been closed for at least 10 years, the bill eliminates from consideration many exemplary mines that used state-of-the-art technology and environmental controls but that have been closed and reclaimed for less than ten years.

It was also recognized at an initial point in the survey that there are abandoned mines in selected old mining districts throughout the country that meet both the operational and the closure criteria proposed in the legislation. One such district in southwestern Wisconsin is described in this paper. However, it was decided that the survey should evaluate environmental practices at modern mines and identify active, reclaimed, closed, and partially closed mines that employ sound, proactive, and contemporary environmental management practices, rather than conducting an intensive survey of old, abandoned mines. In this manner, the survey focused on identifying environmentally responsible mines that have been developed under the current environmental regulatory framework and that have used modern pollution prevention and environmental protection technology.

The ensuing investigation process identified more than two dozen active and closed operations throughout North America that merited site visits. Subsequently, based on additional telephone investigations, logistics, and weather-related constraints, 14 mines were visited during the Fall of 1996. Because of logistics and weather considerations, visits were limited to the contiguous 48 states, although several sites in Canada were identified which are worthy of a visit.

Mine site visits included inspections of operations presently active, in temporary closure, and permanently closed. Generally, visits consisted of three parts: 1) introductory discussions with site personnel explaining the purpose and objectives of the visit; 2) tour and inspection of the site and facilities of interest; 3) follow-up discussions and, sometimes, file and document reviews in the site office; and 4) discussions with regulators and community leaders at selected sites. These tours were documented by photos and videos taken at will.

Although not unexpected, the responses from both telephone interviewees and personnel at the sites visited consistently impressed the authors. The metallic mining industry in both the United States and Canada has been extraordinarily open, positive, and responsive concerning this survey.

The situation regarding mining industry-specific restrictive legislation in the State of Wisconsin has captured the attention of the entire industry.

Results and Discussion

The survey resulted in several definitive findings of fact:

1) Today's mines are highly regulated and make extensive use of pollution prevention and environmental protection technology. In contrast, old mines were largely unregulated, and operated with few if any measures to protect the environment. Therefore, it is inappropriate to use environmental problems at antiquated mine sites to predict what will occur in the future at modern mines;

2) Environmentally responsible operations are evident at every active mining operation explored by this survey;

3) There are examples of currently active sulfide mines that have been in operation for more than 10 years and have not caused surface or groundwater pollution;

4) There are at least several successfully closed and reclaimed mines that meet the operating criterion but do not yet meet the closure criterion. Thorough environmental monitoring at these sites indicates they are complying with all environmental protection standards and there is every expectation that they will continue to be in compliance at year ten and beyond following closure;

5) There are a number of old lead-zinc sulfide mines in southwestern Wisconsin that operated for more than 10 years, were either closed or abandoned more than 10 years ago, and have caused no known surface water or groundwater pollution problems. These sites meet both the operating and the closure criteria in the proposed legislation; and

6) Operations that mined sulfide ore for more than 10 years, were formally reclaimed, have been closed for more than 10 years, and have not caused surface or groundwater pollution are difficult to locate due to the arbitrary time criteria established in the proposed legislation. A more meaningful measure of compliance with all applicable environmental protection standards would evaluate operating and closed sites that are subject to rigorous and regular monitoring, reporting, and inspection requirements.

The remainder of this paper discusses the survey findings in more detail.

The Abandoned Mine Problem

Mining opponents often contend that the ARD problems at some old and abandoned mines are representative of what will occur at modern operations and newly proposed mines. Their premise is that mining today will create problems similar to mining of the past. This contention is without merit because modern mining operations are highly regulated at the federal, state, and local levels. Today, even operations proposing to mine oxide materials are required to conduct extensive waste characterization tests to determine the potential for generation of ARD. If the potential for ARD exists, waste management plans must be developed to prevent, minimize and control acid generation before construction can proceed. *Modern mines are designed for closure* to avoid, minimize, and mitigate potential long-term environmental concerns.

In contrast, unregulated mines of the past typically disposed of mine wastes without any environmental controls or constraints. Prior to the advent of current environmental laws and regulations, mine waste disposal sites were located for operational convenience rather than environmental concern. Mine wastes were deposited adjacent to the mines or directly down-gradient in the nearest valley much as domestic wastes of the time were sent to the nearest moving water body. Gravity was considered the great equalizer – the miners' and other industrial waste generators' best friend. Once the commercial ore was deleted, operators commonly abandoned sites with little, if any,

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thought to reclamation. In many settings, these old mine wastes remain vulnerable to wind and water erosion and, with the right geochemistry, the generation of ARD. The effective manner in which anti-mining activists use environmental issues at historic mines to create public concern about mining points to the importance of developing an industry program to help solve the abandoned mine problem.

Changes in the Regulatory Framework for Mines

In evaluating the environmental track record of the modern mining industry, it is essential to consider the enormous difference in the environmental regulatory climate that has developed in the last 20 years compared to the regulatory requirements for mines that operated prior to the late 1970s. Starting in about 1970, environmental laws and regulations to protect environmental resources such as groundwater, surface water, air quality, wildlife, and cultural and historic features were developed on both the federal and state levels. Just like any other industry, mines must comply with these regulations.

Table 2 shows the dates of enactment of some of the federal and state environmental laws and regulations affecting mining, and the approximate dates at which significant mining activities began at some major U.S. mining districts. It is evident from Table 2 that mining at many metallic mining districts throughout the country began well before the advent of environmental laws and regulations. Nearly all of the environmental laws and regulations affecting metallic mining were enacted since about 1970, with many significant state and federal environmental regulations being developed within the last decade. In contrast, mining at a number of important U.S. mining districts commenced more than a century before the enactment of the environmental laws listed in Table 2. It should be noted that the examples of environmentally responsible mines discussed below were developed concurrent with or after the establishment of the environmental laws and regulations shown in Table 2.

Metallic mining under the modern, stringent, environmentally sensitive regulatory climate prevalent at the state and federal levels is a completely different enterprise than 100 years ago...or even 20 years ago. State and federal regulators take their jobs very seriously and perform them in a very responsible manner. In the authors' combined years of experience, they have never encountered a regulator who desired to have an environmentally problematic mine on his or her watch. Likewise, although unintended incidents and accidents do occur, as in any facet of life, there are no mine or mill managers or mining companies who wish to be tagged as environmentally irresponsible. Mine operators at sites at which environmental problems develop have undertaken aggressive and responsive environmental remediation measures. The results of this survey support these conclusions. By definition, modern mining is, and will remain, environmentally responsible.

Can't argue with that

Environmentally Responsible Mining Operations: The Norm

It is important to emphasize that the sulfide mining operations singled out for discussion in this paper in no way detract from the environmentally responsible operations of the dozens of other metallic mining operations reviewed and, in some cases, visited during this survey. In many instances, the mines not specifically described in this paper display even higher levels of environmental awareness and proaction than those discussed. The vast majority of these mines have been in operation between five and ten years. During their operating periods, many have not exceeded any environmental standards and have maintained sparkling compliance records. Some, while excellent examples of environmentally sensitive operations, have had unexpected, and mostly minor, system upsets causing short-term exceedences of standards for which they were issued regulatory notices. This situation is not atypical for all industries, municipalities, and indeed, even U.S. natural resource regulatory agencies. Without exception, the operators at these sites responded aggressively and effectively to correct the noted problems. In most of these cases,

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the identified issues created regulatory compliance problems (i.e., an arbitrary standard may have been exceeded) but did not result in significant impairment of environmental resources (e.g. wildlife, air, soil, water, etc.) or jeopardy to public health and safety.

Every active operation, modern and historic, has some positive environmental story to tell; some large and showy, others more understated. This statement is not to be misconstrued as a rosy-hued Pollyanna-type declaration. Environmental problems and issues do, indeed, exist at some mines, particularly older operations, where initial planning and facility designs (generally pre-1975) were significantly less sensitive (or "insensitive" in some cases) to environmental concerns than in later years. However, even those operations with significant problems are presently working toward either permanent resolution or control and maintenance of those problems in a manner consistent with today's standards. Modern mining statutes and regulations at the state and federal levels, modern business practices, and criteria established by the international financial community require no less.

The most prominent general examples of positive environmental stories observed or documented during this survey and during the careers of the authors include the following areas in which many mining operations have gone the extra step beyond regulatory requirements. Again, the authors do not imply that the following examples are by any means all inclusive.

- *Improvement of water quality*. In some cases, new mines have been permitted within old mining districts that are the loci of poor quality water discharging from historic workings, waste rock piles, or tailing impoundments. Similarly, there are some older mines still in operation. Where this scenario occurs, it is typical for the active operation to either remediate the contaminated drainages outright, or, at some sites, to divert contaminated drainages into the active process water return and treatment system. The end result in several instances is a radical improvement in downstream water quality over historic levels, including rehabilitation of public sport fisheries and increased viability of threatened or endangered species habitats.

- *Wildlife Protection and Habitat Enhancement*. Probably the most ubiquitous example of environmental responsibility by mining operations is in the area of terrestrial and aquatic wildlife resources. Granted, some form of wildlife protection or mitigation plan is required for today's mines. Many operations go well beyond the scope of these requirements to implement resource protection and habitat improvement programs. Even many of those older and, in some cases historic, operations maintain or sponsor ongoing wildlife projects. As is typical of any human population group employed in the natural resource fields, most employees in the metallic mining industry are oriented toward outdoor activities, not the least of which are hunting, fishing, camping, and wildlife observation and photography. Thus, many operations can exhibit examples of wildlife protection and habitat enhancement programs including projects to save threatened amphibians, to reintroduce peregrine falcons (an endangered species), to improve in-stream fisheries habitat, and large mammal telemetry projects. Indeed, the results of this survey revealed that most mine site reclamation plans are geared toward wildlife habitat restoration, creation, or enhancement as the primary beneficial post-mining land use.

- *Wetlands*. Development, enhancement, or restoration of wetlands is a commonly required mitigation for modern mining in settings where operations will disturb or otherwise impact existing wetland areas. Wetlands mitigation is common in today's mine permitting world. However, there are a number of examples of both historic and newer active operations where the extra step has been taken to create or enhance wetlands. Mine operators are learning the multiple benefits that natural and created wetlands have for active and inactive operations. These

benefits include passive aerobic and anaerobic water treatment, sediment control and water clarification, control of stormwater run-off and run-on, aesthetic appeal, and valuable wildlife habitat.

- *Reclamation.* Post-mining reclamation of disturbances on federal, state, and private lands is a requirement in all states and in most foreign countries. Those states with active metallic mining operations, without exception, have promulgated stringent, specific, and detailed rules and regulations concerning mined land reclamation over the past 20 years. Therefore, the issue of environmentally responsible mining is not whether a mine site will be reclaimed, but rather, the manner in which reclamation is accomplished. In its most basic form, mined land reclamation is a "green is good" proposition; stabilize it and grow grass. While some operations continue to subscribe to this "one size fits all" format, a number of others have expanded upon their reclamation requirements and have made virtual showcases of their sites even while still operating by taking extra measures to blend the site into the surrounding landscape and to create aesthetically pleasing and productive post-mining land uses. As with other environmental components at mine sites, high quality, responsible reclamation simply makes good business sense. A number of operators believe that if they go beyond the letter of the law in their reclamation practices, these efforts will enhance their working relationship with the regulatory community and the public at large. Many times this is an accurate presumption as "reputation" literally can mean the difference in millions of dollars and years of time in today's metallic mineral permitting environment.

- *Cultural Resources.* The National Historic Preservation Act and various state laws require assessment and protection of significant archaeological and historic resources located on federal and state lands. In assessing, protecting, and mitigating necessary disturbances to these resources, a number of active operations have taken the extra step to preserve interesting and significant sites located on private and patented lands under their control. In a number of instances, mining interests have worked with state and federal regulatory agencies to join in protective covenants and to erect interpretive signs and centers for public use. This sensitivity to historic interests is particularly evident where newer operations have been developed within historic mining districts. Historic mining artifacts and their history are as much an interest to operators of modern mines as they are to the general public.

- *Community Relations.* Every active operation has some form of community relations programs that go well beyond any regulatory or legal requirements. Mining managers and employees live in the communities most affected by their operations; they are active members of those communities. As such, it is in the best interests of their companies, their families, and their employees' families to establish, promote, and maintain the mutual respect that is the foundation of good relations. Without exception, all active operations investigated during this survey worked closely with and contributed to the local communities and counties in which they reside. Programs included financial assistance with community infrastructure such as roads, schools, police and fire departments, as well a contributions to hospitals, health clinics, and local and national conservation organizations. In at least one instance, heavy equipment and operators from an active, older mine were virtually on call by the nearby communities when assistance was needed for even minor emergencies. The survey also found that most active operations conduct business in the spirit of open planning, and consult with community leaders and citizens when expansions or changes to operating scenarios occurred. The majority of active operations give public and educational tours of their operations - some on virtually no notice. In addition to conducting formal tours, several operations offer self-guided "tours" from nearby vantage points.

Operations Active for More than 10 Years

The survey located six active metallic mining and milling operations that: 1) mine and mill sulfide ores; 2) have been in continuous operation for periods ranging from 10 to 83 years; and 3) have received no regulatory notices or orders for releasing ARD or metals to surface or groundwaters. Several of these mines are described at the end of this paper.

These active operations are located in either sensitive, high quality resource areas (scenic, fish and wildlife, etc.) or within heavily used recreational areas or both. These mine sites, located in California, Colorado, Montana, Missouri, and New York, have the following elements in common:

- Each has an active and dedicated professional environmental staff at the site. These personnel maintain integrated working communications with and support from both the mine managers and the corporate environmental directors and managers;

- All have excellent relations with surrounding communities; each maintaining an open planning policy with the public;

- All display examples of superior reclamation practices, fish and wildlife habitat preservation and enhancement programs, wetlands protection and enhancement, or other environmentally oriented programs. Typically, these programs go beyond the letter of regulatory requirements;

- Each displays a solid qualitative and quantitative understanding of the environment in which it operates, the ecological relationships within that environment, and the potential impacts of operations on the components of that environment; and

- As with all active mining operations, each is strictly regulated by local government, state agencies and, depending upon location and land ownership, the federal government.

Of these six active sites, three have been operating continuously for more than 20 years, and two of those truly can be considered "historic." In the latter two cases, the present operations have upgraded their facilities and operations as modern times have dictated to maintain compliance with increasingly more stringent environmental rules and regulations. Where past practices, acceptable at those times, caused environmental impacts, these operations have expended considerable effort and resources to remediate those impacts.

Answer: None

Operations Inactive for More than 10 Years

The arbitrary time criteria in the proposed legislation are not a meaningful yardstick with which to measure the environmental performance of today's mining industry. In assessing the environmental track record of the modern mining industry, considerable weight should be placed upon the large number of currently operating environmentally responsible mines, some of which are more than 10 years old, and the number of successfully reclaimed sites even though they do not meet the 10 year closure criterion.

There should be no doubt that active mine sites prove that environmentally responsible mining is occurring throughout the country. The regular basis with which mining environmental professionals, regulators, and in some cases, citizens monitor and inspect active mine sites provides real time, concrete evidence of their environmental performance. The fact that these sites have not yet been reclaimed for 10 years is irrelevant.

Similarly, mines that have been successfully reclaimed for fewer than 10 years cannot be dismissed as compelling evidence of the mining industry's ability to operate in an environmentally responsible manner. Many of these reclaimed sites are still in a post-closure monitoring and maintenance status that requires mine operators to monitor the sites and provide regular monitoring and compliance reports to state and/or federal regulatory agencies. Additionally, regulatory authorities are required to inspect these sites on a

regular basis. Sites reclaimed within the last 10 years are thus the subject of considerable environmental monitoring and regulatory scrutiny to detect any potential environmental problems. Therefore, the 10 year closure criterion proposed in the bill is an arbitrary and meaningless measurement that does not provide regulators or citizens with useful information. The ongoing monitoring and scrutiny at recently closed sites provides substantive documentation of the environmental performance at these sites.

EXAMPLES OF ENVIRONMENTALLY RESPONSIBLE MINES

This survey documents that environmentally responsible mining is taking place at numerous mines throughout the country. Every site evaluated by this survey is an example of an environmentally responsible operation. A few such sites are described below. The mines discussed in the following paragraphs by no means form an all inclusive list. These sites were selected for discussion to represent a range of commodities produced, mining and mineral processing techniques used, and geographic settings. Several of the mines described below, like many of the sites researched in this survey are located in scenic areas - some in high altitude, steep, mountainous terrain with severe climate conditions. The many environmentally responsible mines operating successfully in these scenic and environmentally sensitive settings prove that sulfide mining can be done in an environmentally responsible manner - especially in light of today's stringent mining regulations. These regulations require state-of-the -art engineering design, pollution prevention technology, monitoring, and financial guarantees to ensure that mines are built, operated, and reclaimed to the highest environmental standards.

A few examples of environmentally responsible sulfide mines include the following:

The Henderson Mine and Mill - this molybdenum sulfide mine and mill have maintained a spotless environmental compliance record since 1976 when mining and milling operations commenced. Located less than a 2-hour drive west of Denver, Colorado at an elevation of 10,346 ft in the spectacular mountain scenery of the Colorado Front Range; the areas immediately around the mine and mill serve as Denver's backyard and receive intensive year-round recreational use. Denver residents regularly use areas adjacent to the mine and mill sites for fishing, camping, picnicking, hunting, hiking, skiing, and snowmobiling. Treated wastewater from the operation supports a thriving population of Boreal toads, a species that the U.S. Fish and Wildlife Service is considering listing as threatened and endangered. Streams downstream from both the mine and mill facilities are excellent brown and brook trout fisheries. Both the mine and the mill are located in Denver's watershed, and two reservoirs associated with the nearby reclaimed Urad Mine are used as municipal reservoirs for the city of Golden, Colorado.

The Viburnum Mine No. 27 - developed in geology similar to that found in southwestern Wisconsin's lead-zinc mining district, the water from this lead-zinc sulfide mine, which operated from 1960 to 1978, is so clean it has served as the primary domestic water source for the town of Viburnum, Missouri since 1981.

The McLaughlin Mine - straddling three counties about 70 miles north of San Francisco in the rugged mountainous terrain of California's Coast Range, this gold mine is acknowledged by regulators, environmentalists, and the mining industry to be a model of effective environmental practice. Proactive mine planning and permitting processes, pollution prevention features, and reclamation and habitat management programs are just some of the mine's successful environmental efforts that have been adapted for use at other mine sites. Comprehensive environmental monitoring of the McLaughlin Mine confirms the ecological effectiveness of these practices. This monitoring demonstrates that since its development in 1985, the mine has operated without environmental harm, and has not only protected but actually enhanced the quality of both on-site and downstream habitats and improved downstream water quality. Using ecology-based habitat management planning, resource values of the

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surrounding landscape that were disturbed by historic mining are in the process of being restored and enhanced. Ultimately the entire mine site and attached buffer lands of thousands of acres will become a wildlife preserve and an environmental studies field research station for the University of California.

The Stillwater Mine - located in southern Montana in the magnificent Beartooth Mountains on the northern edge of the Absaroka-Beartooth Wilderness, about 30 miles north of Yellowstone National Park, this platinum-palladium sulfide mine is an excellent example of environmentally responsible mining in an extremely beautiful and sensitive environment. Operating since 1987, the Stillwater Mine has maintained a clean environmental record. The only domestic source of these strategic minerals, the Stillwater operation includes an off-site smelter in Columbus, Montana with state-of-the-art pollution control equipment. This underground mine is recognized by regulators, environmental groups, and industry experts for its excellent concurrent reclamation activities, wildlife enhancement projects, community support programs, and responsive environmental management. In addition to its scenic attributes, the area around the mine is also recognized for its recreational opportunities - the mine is adjacent to the Stillwater River, a Montana Blue Ribbon Trout Fishery.

The Cannon Mine - located at the intersection of South Miller and Circle Streets, this gold mine was developed in 1985, one block south of the Wenatchee, Washington, city limits. This agricultural community of approximately 40,000, known as "the apple capital of the world", is about 150 miles east of Seattle. With residents, parks, churches, schools, hospitals, and an equestrian center as its neighbors, the Cannon Mine is a model of environmentally responsible mining in an established urban environment. The mine, which operated for nine years, is now in the final stages of reclamation, and nearly all traces of this once bustling underground mining and milling project are gone. All of the millsite buildings have been removed, the area regraded, and replanted; the mine portal has been plugged; and the tailings management area has been reclaimed and planted with natural grasses. The local school district has converted the mine buildings into offices and an equipment maintenance facility. As quoted in a July 2, 1996 article entitled "A Promise Kept - Mine Tailings Cleaned Up" in the Wenatchee World, a local official states that the mine has done a good job living up to its promises - "The scale of the (reclamation) work is just amazing. It's been a good project."

The Flambeau Mine - Located in northern Wisconsin's Rusk County, partially within city limits of Ladysmith and immediately adjacent to the Flambeau River, this copper mine has complied with all applicable environmental regulations since opening in 1993. Stormwater runoff from sulfide waste material and the operating open pit, along with groundwater infiltration into the pit, are treated in a state-of-the-art water treatment facility that produces mine discharge water which has proven safe at 100 percent concentration (i.e., without dilution) for the most sensitive aquatic life, and meets state drinking water safety standards. Examinations of fish, crayfish, macroinvertebrates, and dragonfly; sediment sampling; and habitat characterization both above and below the mine discharge point prove the mine water has not adversely affected river life. Upon completion of mining in 1997, the open pit will be backfilled and the site will be recontoured and revegetated to pre-mining conditions. City officials credit the mine with creating an economic miracle for the local community of 4,000 people. Tax revenue from the mine has stimulated an economic development boom in Rusk County where the unemployment rate has fallen from 15.3% just prior to the mine opening to 4.0% in October 1996. The Flambeau Mine is one of Rusk County's top tourist attractions, with over 30,000 people per year visiting the mine's information center.

Southwestern Wisconsin Historic Lead-Zinc District - At least a dozen historic (i.e., closed) mines in the lead-zinc district southwestern Wisconsin and adjacent parts of Iowa and Illinois meet the arbitrary operating and closure criteria in the proposed legislation. As shown in Table 2,

mining in this district began as early as 1825, long before the enactment of federal and Wisconsin environmental laws and regulations. Mining in the district continued into the twentieth century, with the last zinc mine closing in the late 1970s. Most of the mines in southwestern Wisconsin were abandoned without formal reclamation; many were simply plowed under and today remain as nearly indiscernible features in the rolling farmlands characteristic of this part of Wisconsin. Although a few isolated and localized water quality problems are known at several mines in the district, there are literally hundreds of historic mines that do not create surface water or groundwater pollution problems. The ore bodies in this district contain abundant acid-generating iron sulfide minerals (pyrite and marcasite). However, ARD is not a problem in this district due to the high acid neutralization capacity of the carbonate host rocks. A number of communities in the area including Platteville and Dodgeville, Wisconsin; Dubuque, Iowa; and Galena, Illinois and are built on top of and adjacent to these historic mines.

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ACKNOWLEDGEMENTS

The authors wish to gratefully acknowledge the extraordinary help and cooperation of their mining industry colleagues who graciously provided information, suggestions, and site tours during the course of collecting the information presented in this survey. The survey could not have been performed and this paper could not have been written without their assistance.

Table 1
Industry and Regulatory Agency Contacts Made During the Survey

Amax Gold Inc. - Corporate
Amax Gold Inc. - Fort Knox Mine
Amax Gold Inc. - Sleeper Mine
Amax Gold Inc. - Wind Mtn. Mine
Arizona Department of Environmental Quality
ASARCO - Corporate
ASARCO - Exploration
ASARCO - Mission Unit
ASARCO - Globeville Unit
Atlas Corporation
Barrick Gold Corp.
Barrick - Goldstrike Mine
Battle Mountain Gold Co. - Corporate
Battle Mountain Gold Co. - Crown Jewel Project
Battle Mountain Gold Co. - San Luis Mine
Behre Dolbear & Co., Inc.
BHP Copper
BHP - Corporate
British Columbia Ministry of Energy, Mines and Petroleum
British Columbia Ministry of Environment, Lands, and Parks
Brohm - Gilt Edge Mine
Brown and Associates
California Regional Water Quality Control Board
Canyon Resources Corporation
Chelan County Planning Dept.
Coeur d'Alene Mines Corp.
Coeur - Rochester Mine
Colorado Mining Association
Colorado Department of Public Health and Environment
Colorado Division of Minerals and Geology
Consultants (3)
Crandon Mining Company
Cyprus Amax Minerals Company
Cyprus Climax Metals Company - Corporate
Cyprus Climax Metals Company Climax Mine
CR Kendall
Cyprus Climax Metals Company - Henderson Mine
Cyprus Climax Metals Company - Henderson Mill
Echo Bay Mines - Corporate
Echo Bay Mines - Kettle River JV
Echo Bay Mines - McCoy/Cove Mine
Echo Bay Mines - Round Mtn. Mine
Echo Bay Mines - Sunnyside Mine
Ellis Environmental Engineering
EnviroNet Inc.
Environmental Support Services
ESCO Associates, Inc.
FMC Gold - Beartrack Mine
Geochimica, Inc.
Golder Associates Inc.
Greenwald & Associates
Homestake Mining Company - Corporate
Homestake Mining Company - Homestake Mine
Homestake Mining Company - McLaughlin Mine
Hydrologic Laboratories, Inc.
Idaho Dept. of Health and Welfare
Idaho Dept. Environmental Quality
Independence Mining Company - Cresson Mine
Independence Mining Company - Jerritt Canyon Mine
Inmet Mining - Samatofum Mine
Jefferson Group
Kennecott Corporation - Corporate
Kennecott Minerals Company

Table 1 (continued)
Industry and Regulatory Agency Contacts Made During the Survey

Kennecott - Flambeau Mine
Kennecott - Ridgeway Mine
Kennecott Utah Copper
Kenneth R. Paulsen Consulting, Inc.
Kinross Gold USA, Inc. - Corporate
Kinross Gold USA, Inc. - Exploration
Kinross - Candelaria Mine
Knight Piesold Inc.
LSX, Inc.
Mattabi Mines Ltd.
Missouri Department of Environmental Quality
Montana Department of Environmental Protection, Reclamation Division
Montana Water Quality Bureau
Nevada Division of Environmental Protection
Nevada Department of Minerals
Nevada Mining Association
New Crest Resources, Inc.
Noranda Mining & Exploration, Inc.
Northwest Mining Association
Pegasus Gold Corporation - Corporate
Pegasus - Beal Mountain Mine
Pegasus - Montana Tunnels Mine
Pegasus - Zortman/Landusky Mine
Placer Dome Canada - Equity Silver Mine
Placer Dome U.S., Inc. - McDermitt Mine
Placer Dome U.S., Inc. - Corporate
Rio Algom Mining Corp. - Corporate
Royal Gold, Inc.
Royal Mountain King Mine
RTR Resource Management, Inc.
Selland Construction - Cannon Mine
Sonora Mining Corp. - Jamestown Mine
Stibnite Mine Inc.
Stillwater Mining Company
The Doe Run Company - Corporate
The Doe Run Company - Viburnum Mine
Thompson Creek Mine
USDA Forest Service
USDI Bureau of Land Management
U.S. EPA Region 10; Water Management Division
U.S. Silica
University of Saskatchewan - Civil Engineering Department
Wharf Resources - Golden Reward Mine
Wharf Resources - Wharf Mine
Wright Water Engineers, Inc.
ZCA Mining Division - Balmat Operations

Table 2

Comparative Dates of Historic Mining Activities in Selected U.S. Mining Districts and Enactment of State and Federal Environmental Laws and Regulations

Date	Commencement of Mining Activities	Enactment of Environmental Laws or Regulations Affecting Mining
1825	Upper Mississippi Valley lead mining (Southwestern Wisconsin and adjacent Iowa and Illinois)	
1849	California - gold mining	
1858	Colorado - precious metals mining	
1859	Nevada - Comstock Lode silver and gold mining	
1862	Montana - gold mining	
1863	Utah - copper mining	
late 1860s	Upper Mississippi Valley zinc mining (Southwestern Wisconsin and adjacent Iowa and Illinois)	
1875	South Dakota - Black Hills gold mining	
1877	Colorado - base metal mining	
1877	Arizona - copper mining	
1882	Montana - copper mining	
1917	Colorado - molybdenum mining	
1965	Nevada - Carlin-type gold mining started	
1966		National Historic Preservation Act
1967		Air Quality Act
1969		National Environmental Policy Act (NEPA)
1970		Occupational Safety and Health Act (OSHA)
1970		Clean Air Act
1970		CA Environmental Quality Act (CEQA)
1971		MT Metal Mine Reclamation Act

Table 2 (continued)
Comparative Dates of Historic Mining Activities in Selected U.S. Mining Districts and Enactment of State and Federal Environmental Laws and Regulations

Date	Commencement of Mining Activities	Enactment of Environmental Laws or Regulations Affecting Mining
1971		MT Environmental Protection Act (MEPA)
1972		Federal Water Pollution Control Act/Clean Water Act
1973		Endangered Species Act
1974		Safe Drinking Water Act (SDWA)
1974	Mining begins at Henderson Mine, CO	U.S. Forest Service Mining Regulations
1975		CA Surface Mined Land Reclamation Act (SMARA)
1976		Federal Land Policy and Management Act (FLPMA)
1976		Resource Conservation and Recovery Act (RCRA)
1976		Clean Water Act Amendments
1976		CO Mined Land Reclamation Act
1977		Mine Safety and Health Act (MSHA)
1977		Surface Mining Control and Reclamation Act (SMCRA)
1977		WI Metallic Mining Reclamation Act
1977		ID Surface Mining Act
1979		Archeological Resources Protection Act
1980	Mining begins at Jerritt Canyon, NV	Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as Superfund
1981	Viburnum Mine No. 27 becomes drinking water source for Viburnum, MO	U.S. Bureau of Land Management Mining Regulations
1982		SD Mined Land Reclamation Act

Table 2 (continued)
Comparative Dates of Historic Mining Activities in Selected U.S. Mining Districts and Enactment of State and Federal Environmental Laws and Regulations

Date	Commencement of Mining Activities	Enactment of Environmental Laws or Regulations Affecting Mining
1982		WI Metallic Mineral Mining (Ch. .NR 132) and Regulation of Metallic Mining Waste (Ch. NR 182)
1984		Hazardous and Solid Waste Amendments
1984		CA Chapter 15 Discharges of Waste to Land, Article 7, Mine Waste Management
1985	Mining begins at Cannon Mine, WA	
	Mining begins at McLaughlin Mine, CA	
	Mining begins at Sleeper Mine, NV	
1986	Mining begins at Goldstrike Mine, NV	Superfund Amendments and Reauthorization Act
1986	Mining begins at Montana Tunnels, MT	Emergency Planning and Community Right-to-Know Act
1987	Mining begins at Stillwater Mine, MT	UT Mined Land Reclamation Act (amended)
1988		ID Code §39-118A (statutory provision requiring permits for processing ore by cyanidation)
1989		NV Water Pollution Control Law
1989		NV Mined Land Reclamation Act
1990		MT Admin. R. §§26.4.160 to .168
1990		Clean Air Act Amendments
1993	Mining begins at Flambeau Mine, WI	CO Mined Land Reclamation Act Amendments