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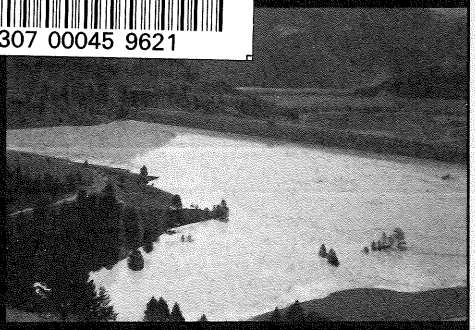

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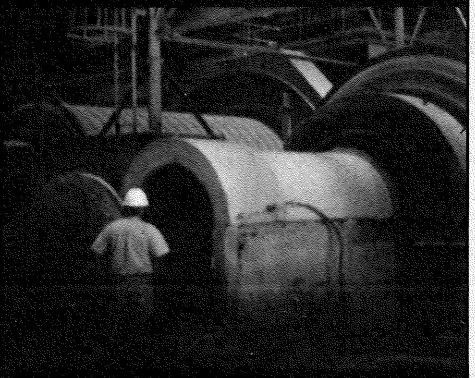

The Report on the Mining Simulation Project

January 1990

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This report is one of three documents prepared by the Nonferrous Mineral Project. For more information, see the companion volumes:

Appendices to the Final Report: Nonferrous Mineral Project (June 1989)

and

The Nonferrous Mining and Processing Industry: A Review of Literature and Other Information (June 1989)

The Report on the Mining Simulation Project

Nonferrous Mineral Project

Printed on Recycled Paper

Report on
The Mining Simulation Project

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REPORT ON
THE MINING SIMULATION PROJECT

ABSTRACT

This cooperative study has been undertaken by representatives of the environmental community, the mining industry, the Minnesota Department of Natural Resources (DNR) and the Minnesota Pollution Control Agency (MPCA) in order to identify and resolve environmental issues associated with base and precious metal mining in a neutral atmosphere before a commercial mining development is announced. The study is an outgrowth of the 1987-88 Minnesota Forum sponsored by the Blandin Foundation. The participants reviewed the existing permitting and environmental review processes and visited mining operations in other areas of the country and of Canada which had attributes similar to those that might be encountered in an operation in Minnesota. In addition, the MPCA prepared a literature study on the environmental effects of nonferrous mining. Central to the study has been testing Minnesota's as-yet-untried nonferrous mining regulatory program using three hypothetical mining developments sited in environmentally sensitive areas where future mining could occur. Results include identification of critical paths for regulatory decision making, identification of particularly sensitive environmental issues that will need continued deliberation before resolution, and characterization of data necessary for environmental review and permitting decisions. Consensus based conclusions have been reached on aspects of seven major issue areas: exploratory drilling; environmental review and permitting processes and procedures; land-use conflicts; water quality and quantity; air quality; design operation, closure and postclosure care; and financial assurance.

REPORT ON
THE MINING SIMULATION PROJECT

EXECUTIVE SUMMARY

Increasing sensitivity to environmental concerns on the part of the public, special-interest groups, government and industry, coupled with an increasingly litigious and adversarial climate often characterized by opposition to new industrial development, mandates the search for ways to anticipate, mitigate and resolve environmental conflicts in order to facilitate appropriate and environmentally-sound economic development. This is particularly true in the area of new mineral developments.

Mineral production has long been a significant part of the economic and social fabric of Minnesota. Since the late 19th century the state has been the leading U.S. producer of iron ore as well as producing important amounts of aggregate, dimension stone, silica sands and heavy clays.

Minnesota has significant unexplored and undeveloped potential for additional mineral production. Nonferrous mineral exploration began in the 1860s with the search for gold in Minnesota. In the 1950s and 1960s exploration for copper-nickel resulted in the identification of two large low-grade deposits whose development was then deferred to allow for a generic environmental study. At the conclusion of this study, the economics of the base metal industry had changed. The development of these deposits has been indefinitely postponed.

Since 1980, interest in nonferrous mineral exploration, principally for gold, base-metal sulfides and platinum-group metals, has been heightened by discoveries and developments in Ontario, Manitoba and Wisconsin, as well as by evolving geological concepts regarding deposits of such metals. However, mineral exploration in Minnesota has been perceived by industry to be hampered by an adverse tax structure, problems of land availability and a potentially unfriendly regulatory climate.

In September 1987, in order to examine factors affecting development of the state's mineral resources, the Blandin Foundation, a Grand Rapids-based philanthropic organization, convened the Minnesota Minerals Forum. Participants in the Forum included senior state agency officials and representatives of the mining industry, academic community and environmental groups.

The Forum participants believed that for the nonferrous and precious metals industry, tax issues had been addressed by bills passed during the 1987 legislative session. A major item of concern, particularly to industry, was a regulatory climate which could potentially inhibit mineral development. Though there is in place in Minnesota an operating body of rules and

precedents governing iron mining, no such precedents exist for the nonferrous and precious metals industry. Accordingly, a unique project was developed to examine the as-yet-untested regulatory framework through a series of hypothetical "case studies," thereby evaluating the environmental review and permitting process for several geologically and economically realistic though nonexistent mine developments.

A working group for this project was formed by the Minnesota Department of Natural Resources (DNR), the Minnesota Pollution Control Agency (MPCA), the environmental community as represented by Project Environment Foundation (PEF), and mineral industry interests represented by Ernest K. Lehmann & Associates, Inc. (ELA), a Minneapolis-based geological consulting firm.

The working group formulated the following objectives for the proposed Nonferrous Mining Project:

1. Identify the environmental issues associated with precious- and base-metal mining.

2. Anticipate the data needed by industry and government to address those issues.

3. Determine shortcomings and duplication in the regulatory process to reduce costs and time requirements for industry and government while ensuring effective environmental safeguards.

4. Educate government, the environmental community and industry about the economic impact of development on the state's economy and on the mining industry.

5. Help all participants better prepare for participating in the permitting process.

6. Develop state policies to better address environmental and economic issues that may be identified during the study.

In order to fund the project, the two state agencies, DNR and MPCA, received an appropriation of $185,000 from the Minnesota Legislature. Project Environment Foundation and ELA jointly requested and received funding by a major grant from the Blandin Foundation, smaller grants from several other foundations and donations from a number of mining companies, service companies and individuals; approximately $130,000 in private funding was raised. A number of other parties assisted the industry group in the technical aspects of the project, and several major state and national environmental groups assisted PEF in its work.

The project activities carried out included the following:

1. An initial conference sponsored by the regulatory agencies to review the existing regulatory process.

2. Visits by participants to active mining operations in the U.S. and Canada that have particular attributes similar to what would be expected in new mining developments in Minnesota.

3. The development, review, discussion and analysis of three hypothetical mining case studies.

4. A review of the literature on environmental impacts of base- and precious-metal mining.

5. An analysis of the environmental review and permitting process and construction of a chart depicting the existing process.

6. Identification and examination of major issue areas.

7. Preparation of a report that includes conclusions and recommendations of the participants.

The first volume of this report discusses the work done and the conclusions and recommendations of the project team. Volume II contains appendices including notes on field trips, the actual case studies and formal responses, lists of participants and the interagency memorandum of understanding. Volume III is the literature study of environmental impacts prepared by the MPCA.

Field trips to operating mines were undertaken because they permitted participants to view problems of existing operations, assess solutions applied and learn from the experience of others.

In order to focus analysis and discussion, three realistic, site-specific, but hypothetical mine models were developed by the industry representative:

1. An underground platinum-palladium mine located in the Duluth gabbro complex. The proposed site is within an area that drains into the Boundary Waters Canoe Wilderness Area. Both existing iron mining areas and areas of high recreational values (mainly sport fishing) border the site. In addition, it is a wolf habitat area. Mining at 600 tons per day (tpd) would be by room-and-pillar methods. A bulk flotation concentrate would be produced which would be shipped out of state or out of the country for smelting.

2. A 4000-tpd copper-zinc-gold-silver massive-sulfide deposit in Archean greenstones located in a terminal moraine area. The area where the hypothetical deposit is located has summer cabin sites,

wetlands and streams, recreational value and timber value. The deposit was postulated as a open pit mine initially with conversion to underground mining after seven years. A three-product flotation mill was assumed, with all products shipped out of state for smelting.

3. An arsenical gold deposit associated with an Archean iron formation, located in and adjacent to one of Minnesota's environmentally significant "patterned" peatlands. This deposit was postulated to be mined by underground methods at a rate of 2000 tpd with a projected mine life of 11 years. The ores were to be treated by a cyanide agitation leach with gold recovery by the Merrill-Crowe process.

Each case study was prepared in written form (Volume II) and included a description of the site characteristics and mining and treatment plans. Other physical and operating characteristics were specified as well. Maps and sections were provided, as were data on geology, soils, hydrology, the composition of potential waste, tailings, processing, reagents used, socio-economic impacts and other factors.

Each case was then discussed by the participants in a one-day session. These sessions were in part a simulation of an initial "scoping session" that might occur at the outset of agency review of a project. As many as 30 to 40 persons from the agencies and environmental and industry groups attended each session. In addition to discussions, the agencies and the environmental community presented prepared written comments. (Volume II)

Out of the discussions of the cases grew a graphic representation of the environmental review and permitting process, in the form of a chart (Figure 1). The development of this timetable has been essential to an understanding by all parties of the existing process and regulations. It is a key to working through that process most efficiently.

The chart is based on the environmental review and permitting requirements as required by law and regulation. It outlines agency timetables and identifies actions and major data required of the project sponsor, as well as of the regulatory agencies. The time frame is "optimistic" in that it postulates that data needs will be met adequately and in a timely manner by the sponsor. It also assumes that there are no legal challenges resulting in additional public hearings or court procedures.

The chart suggests areas for possible substantive simplification and improvement of the review process. These include the possibility of combined hearings for major permits and the environmental review process, single reports and interrelated data sets.

Discussion and analysis brought about by the case-study review and the construction of the flow chart suggested seven major issue areas. These were discussed at length among the participants and their individual views are presented in Section 5 of the report. These issue areas are:

Exploratory Drilling
Environmental Review and Permitting Processes and Procedures
Land-use Conflicts
Water Quality and Quantity
Air Quality
Design/Operation/Closure/Postclosure Care
Financial Assurance

Some consensus conclusions and recommendations have been reached in each major issue area.

Major conclusions and agreements are:

1. Exploratory Drilling. Though no instances of ground water contamination from exploratory drilling are known in the state, a further review of drilling additives by the Minnesota Department of Health is recommended.

2. Environmental Review and Permitting Processes and Procedures. In Minnesota, two agencies have primary permitting authority for mining. A number of other state, federal and local authorities are involved in permits as well. Therefore, when a mining proposal is submitted for initial review, we recommend that an existing inter-agency (DNR and MPCA) coordinating committee establish a review and permitting team; standardize map, data and monitoring needs; develop a project-specific timetable; and evaluate the practicality of joint permit applications (including permit plans) and hearings for various permits.

   Early and frequent involvement of local units of government, the public and special-interest groups is highly desirable and needs to be fostered. We suggest the formation by the project sponsor of local or regional advisory boards.

   Everyone should play by the same rules; that is, the regulations as they exist at the time of the application. In other words, "end runs" by any of the parties do more harm than good in terms of credibility of the participants and the process. Such "end runs" will probably slow down, rather than expedite, the process.

3. Land-use Conflicts. Land-use conflicts triggered by a mining proposal probably represent the most difficult conflicts to resolve. This is largely because the judgments involved in such conflicts are subjective and value-based. To facilitate evaluation of the merits of various viewpoints in these difficult matters, we recommend that Minnesota's environmental review rules should be amended to require a cost/benefit analysis based on an inventory of all costs and benefits, including those that are not quantifiable in dollar terms.

4. Water Quality and Quantity. In technical terms these encompass the most significant probable impacts of new mining development. We conclude that minimization of these impacts will require adequate base-line monitoring, characterization of expected mine wastes, determination of receiving water criteria, determination of operating procedures and mitigative measures, and collection of operational and postclosure monitoring data. The existing and proposed rules address these issues.

5. Air Quality. Current regulations appear to be sufficient to handle expected impacts of mining and milling operations.

6. Design/Operation/Closure/Postclosure Care. Applicants for permits are required to submit mine design data, operational plans, closure (reclamation) plans, and postclosure care plans. In order to produce these effectively, data and information needs of the agencies must be identified and coordinated early in the process. Plans must be updated periodically during the life of the operation. At the time of closure, the closure plan will be reviewed and implemented. The agencies will evaluate the possibility of using a joint closure plan.

   If initial waste characterization studies are not conclusive as to acid production potential, metal release or other hazards, regulatory decisions regarding waste disposal and treatment should be made in a conservative manner.

7. Financial Assurance. Assurance of the sponsor's financial ability to meet regulatory obligations will be required. However, we believe that this can be provided in a variety of forms, that is, "bonds" are not the only way such assurance can be provided. However, such assurance must reflect projected closure and postclosure costs as well as credible accident clean-up costs.

We further conclude that the Mining Simulation Project has constituted a unique cooperative effort by industry, government and the environmental community to examine the environmental and regulatory concerns related to

the potential for a new base- and precious-metal mining industry in Minnesota.

We also conclude that the use of a hypothetical "case study" approach has allowed participants to focus on real issues without encountering the make-or-break environment of an actual development project. It gave the participants a deeper understanding of the potential benefits and costs of new mining developments.

The construction of a chart depicting the existing permitting and environmental review process has helped develop consensus on possible ways to improve the regulatory process to the benefit of the responsible agencies, industry, the public and the environment.

REPORT ON
THE MINING SIMULATION PROJECT

1.0 INTRODUCTION

1.1 Purpose of the Project

The simulation project attempts to test the existing and proposed, but as yet untried, nonferrous and precious metal mining environmental review and permitting process. It represents a unique and cooperative effort by the environmental community, industry and government to anticipate and set the stage for resolution of identifiable environmental issues before there are discoveries of commercially exploitable gold or base-metal deposits in Minnesota.

Specific project objectives include:

1. Identify environmental concerns associated with precious- and base-metal mining;

2. Anticipate data needed by industry and government to address those concerns;

3. Determine shortcomings and duplicate requirements in the regulatory process to reduce cost and time requirements for industry and government while ensuring effective environmental safeguards;

4. Educate government, environmentalists and industry as to the impact of development on the state's economy and on the mining industry;

5. Help the mining industry better prepare for participating in the permitting process;

6. Develop state policies to better address environmental or economic issues that may be identified during the study.

1.2 History of Nonferrous and Precious Metals Exploration in Minnesota

Mineral resources have long been a significant part of the economic and social fabric of Minnesota. Since the 1870s, iron mining has contributed significantly to Minnesota's welfare. Minnesota traditionally ranks in the top four or five states in the value of production of non-fuel minerals. Its iron-ore industry is a world-class mining industry, providing the great bulk of America's iron-ore requirements and employing thousands of Minnesotans.

In addition to iron mining, the state is a significant producer of sand, gravel, crushed stone and dimension stone, as well as a producer of clay, peat, silica sand and other non-metallics.

Though there was early interest in gold exploration in the northern part of the state in the late 19th century, this interest faded at about the turn of the century.

The interest in base metals revived with the discovery of copper-nickel mineralization in the Duluth Complex in 1948. This triggered a significant exploration effort in this area by a number of major and junior companies. By the late 1960s, two projects had reached the stage where mineral deposit evaluation was occurring with the sinking of shafts and taking of bulk samples. These two projects, the Minnamax project of AMAX and the Spruce Road-Maturi project of INCO, resulted in considerable concern about the impacts of mining on the environment. As a consequence, the Minnesota Legislature authorized a study of the impacts associated with mining of copper-nickel minerals. The Legislative Commission on Minnesota's Resources provided funds to the Minnesota Environmental Quality Board (EQB) to undertake the "Regional Copper-Nickel Study" in 1973. In 1974 the EQB imposed a moratorium on the acceptance of any site-specific Environmental Impact Statement (EIS) on copper-nickel mining development prior to the completion of the study. As a result of this action, the DNR made an administrative decision to suspend state lease sales for copper-nickel minerals for the duration of the study. The study was completed in 1978, with final reports submitted in 1979.

During the late 1960s and early 1970s, a combination of factors had given rise to exploration for deposits of base metals in the greenstone environments of northern Minnesota. Some of these factors included the presence of exploration companies already engaged in copper-nickel exploration in the Duluth complex; improved geophysical and geochemical tools which permitted more effective search in areas of extensive glacial cover such as those that characterize much of the state; a buoyant metal market; new geologic concepts regarding the formation and location of base-metal ore deposits in volcanic terranes; and exploration activity north of the border.

With the imposition of the moratorium on leasing, practically all exploration ceased and the industry perceived Minnesota as a state which was not interested in fostering mineral development. In the meantime, copper and nickel markets began to weaken so that by the time the copper-nickel study was completed, a window of economic opportunity had passed. Both INCO and AMAX postponed their projects indefinitely and AMAX later abandoned its project. INCO continues to maintain its lease.

In 1979, with the completion of the EQB study, some interest in base-metal exploration in the volcanic greenstone terranes revived. These types of deposits, though probably smaller in size than the great low-grade copper-

nickel deposits, could potentially be economic because of the expected higher grades and the multi-element composition of such deposits. Since these deposits contained recoverable amounts of a number of metals, typically copper, zinc, lead, silver and gold, they were perceived as giving the explorer/developer a hedge against fluctuation of market prices of individual metals.

Though exploration interest increased, it was hampered by a number of factors, including the availability of land on which to explore, the state's tax regime, the industry's perception of the business climate and questions in the minds of industry members about the regulatory framework.

The reawakened interest in precious metals was triggered by both economic and technical factors. On the economic side, the creation of a free market in gold in the 1970s coupled with inflationary pressures had resulted in significant price rises of gold in the early 1980s. On the technical side, the discovery of the Hemlo gold deposits on the north shore of Lake Superior and the recognition that these geologic terranes could extend into or be repeated in Minnesota, encouraged exploration. Additionally, geologists recognized that other possible gold-bearing environments could be present in the state.

1.3 History of the Project

In the context of this historical setting, in the fall of 1987, the Blandin Foundation organized and hosted a Mineral Forum. The participants in this forum were a group of about 25 individuals including senior management of state agencies, representatives of the academic community, industry (including the iron-ore industry, the nonferrous minerals industry, and the aggregate industry) and the environmental community.

In the discussions during the Forum, industry representatives identified major industry concerns which blocked nonferrous and precious-metal exploration, and thereby eventual discovery and development. Industry concerns include:

1. Availability of land on reasonable terms on which to explore and mine;

2. Issues related to the tax and business climate; and

3. Questions relating to the regulatory climate.

Expressed in its most basic terms, the industry questioned whether or not a company which had discovered a commercial orebody would be able to obtain the permits to economically mine such deposits.

It was noted by industry members that progress was being made on the land-availability issue through revision of the state rules for leasing of nonferrous metallic minerals. Also, the 1987 legislature enacted a major restructuring of the taxes on non-iron-ore mineral production which clarified and reduced such taxes.

With these actions by the state, industry proposed that it would be timely to address the regulatory process. During the Mineral Forum, in an informal discussion among industry, Minnesota Department of Natural Resources (DNR), Minnesota Pollution Control Agency (MPCA), and environmental representatives, the suggestion was made that it would be worthwhile to examine the regulatory framework. Such an examination would test whether the state's environmental review and permitting process for base and precious metals is workable, predictable, realistic and adequate.

A mechanism by which to test this regulatory framework would be through the use of hypothetical mining case studies of deposits such as those which might realistically be found and proposed for development. The analysis of these case studies would test the state's environmental review and permitting process for base- and precious-metal development. It would provide a training exercise for industry, state and environmental personnel. Furthermore, this process would identify each participant's concerns and set the stage for resolving some of these concerns. Utilization of the case study approach, with cases prepared by industry to represent a realistic and probable set of circumstances, would serve to focus the other participants on real-world circumstances and likely problems. Case study discussion would serve as a forum in which real problems could be addressed without the depth of emotional commitment that participants might have in an actual environmental review and permitting process. It might open ways to resolve future environmental conflicts.

At the conclusion of the first meeting of the Blandin Minerals Forum, it was agreed that William Brice, Director of DNR Minerals Division, Mike Robertson, Deputy Commissioner of the MPCA, Nelson French, then with Project Environment Foundation (PEF), and Ernest Lehmann of Ernest K. Lehmann & Associates (ELA) would develop the framework of a "Mining Simulation Project" which would seek to test and improve the regulatory framework.

A series of meetings were held in the fall of 1987 between these parties. The new Executive Director of Project Environment Foundation, Gayle Peterson, represented the environmental community. Prior to this process, the DNR Minerals Division and MPCA undertook a Memorandum of Agreement (MOA) regarding mining activities (Appendix A-1). Early on, the four parties agreed that significant funding would be required. It was also recognized that the two state agencies would look for funding from public sources, i.e. the Minnesota Legislature, while both industry and the environmental community would look for private sector funding.

For their part, the MPCA and the DNR drafted the scope of work contained in Appendix A-2. The objectives of this scope of work were set out as:

1. Develop an understanding of new mining industry and existing regulatory structure;

2. Develop simulated mining proposals;

3. Identify issues associated with mining proposals; and

4. Evaluate environmental review and permitting procedures.

Concurrently, Project Environment Foundation, representing the environmental community, and Ernest K. Lehmann & Associates, Inc., representing the industry viewpoints, drafted a joint project proposal in an effort to coordinate objectives and to obtain funding. This proposal (Appendix A-3) set out the objectives of the project as follows:

> "The simulation project attempts to test the existing, but as yet untried, permitting process. It represents a unique and cooperative effort by environmentalists, industry and government to anticipate, resolve and eliminate environmental conflict before there are discoveries of commercially exploitable gold or base-metal deposits in Minnesota. Specific project objectives include:
>
> 1. Identify environmental concerns associated with mining;
>
> 2. Anticipate data needed by industry and government to address those concerns;
>
> 3. Determine shortcomings in the regulatory process to minimize time constraints placed on industry;
>
> 4. Educate government, environmentalists and industry as to the impact of development on the state's economy and on the mining industry;
>
> 5. Help the mining industry better prepare for participating in the permitting process;
>
> 6. Where needed, develop state policies to better address environmental or economic issues that may be identified during the study."

1.4 Financial Support of the Project

1.4.1 State Support

The work of the two agencies was funded by an appropriation from the Minnesota Legislature passed during the 1988 session.

1.4.2 Private Support

Significant private support was required both to prepare and present the case studies by the industry and provide the necessary resources to allow the environmental community to make a thorough and significant investigation of the issues raised and to respond to those issues.

The private sector portion of the project has been supported through the generosity of a major grant from the Blandin Foundation. In addition, support has been obtained from the Quetico Superior Foundation, Elmer Andersen Foundation, Chevron Resources Company, Noranda Exploration Inc., BHP-Utah International Inc., Homestake Mining Company, Minnesota Power, Longyear Company, American Shield Company, Tamarack Mining Company, Resource Exploration, Inc., Robert Gardner, William Gardner, June Gardner Hand, J.L. Shiely Company, Ernest K. Lehmann & Associates, and Newmont Mining Company.

American Mine Services of Denver, Colorado; James Muhm, Environmental Consultant, Denver; and Ernest K. Lehmann & Associates contributed substantial amounts of in-kind services. William Ulland, American Shield; Mike Faley, Chevron Resources; Roger Kuhns, BHP-Utah; David Baxter, Normin Mining; and John Gustaffson, Minnesota Power, attended one or more of the "case scoping" sessions as industry participants.

Companies and individuals who were contacted by the industry participants to review the cases and other aspects of the study are listed in Appendix F. Though these groups and persons contributed substantially, the major responsibility for interpreting and stating the industry viewpoint remains with Ernest K. Lehmann & Associates, Inc., and any errors or omissions are ELA's responsibility.

Herbert Wright, Eville Gorham, Miron Heinselman, John Roscoe, Janet Green, Darby Nelson, Gordon Davis, Ken Hiemenez, Nelson French, Kevin Proescholdt, Paul Glaser, Helen Langesley, Chuck Meyer, James Almendinger, Amy Wadsworth, Lynn Preis, Paul Toren and Judy Bellairs all contributed time and effort to the preparation of the environmental positions. Project Environment Foundation organized an advisory group composed of individuals and representatives of Minnesota environmental organizations. Throughout the process, PEF consulted with this group at monthly meetings. Participants are listed in Appendix D.

1.5 The Moderator

The case study discussions and the ensuing wrap-up sessions were moderated by Roger Williams of the Minnesota State Planning Agency. Williams merits special thanks for his role as a mediator and facilitator.

2.0 MANAGEMENT OF THE PROJECT

A senior management group, consisting of William Brice, Director of the Division of Minerals, DNR; Mike Robertson, Deputy Commissioner of the Minnesota Pollution Control Agency; Gayle Peterson, Executive Director of Project Environment Foundation; and Ernest K. Lehmann, President of Ernest K. Lehmann & Associates, Inc., directed the project.

A working group was also established and met more frequently to handle day-to-day planning and administrative activities. This group consisted of John Beck, Senior Geologist, ELA; Don Arnosti, Project Manager for PEF; William Lynott, Office of Planning and Review, MPCA; and Arlo Knoll, Manager of Mineland Reclamation, DNR.

3.0 PRESS AND PUBLIC RELATIONS

The initial news of the project received some attention in the local and trade press. PEF and ELA sent out a joint press release to local newspapers and trade journals. A short description of the project was broadcast on public radio. After these initial informational releases, aside from responding to media inquiries, it was agreed that no additional publicity would be sought until the project report had been completed.

4.0 THE PROCESS

4.1 Introduction

Following notification in May 1988 by the Blandin Foundation that they would fund a large part of the private sector effort, the project formally got underway on July 1, 1988. This was the beginning of the agencies' fiscal year and the effective date of the commencement of the legislative appropriation.

The project work developed several specific phases. These included:

1. Review of the existing regulatory process;

2. Visits to existing mining operations that might have attributes similar to what would be expected in new mining developments in Minnesota;

3. Development of the mining case studies;

4. Review and discussion of the mining case studies and identification of issues;

5. A review of pertinent literature;

6. Analysis of the EIS scoping and permitting process in terms of the specific mining case studies;

7. Preparation of a report and conclusions.

4.2 Review of the Existing Regulatory Process

In order to set the stage for the analysis of the case studies and to achieve a common level of understanding of the regulatory process, a one-day session was held in July 1988 for the purpose of presenting to all participants the regulatory programs and requirements of various government agencies.

After introductory remarks by PEF and industry representatives, formal presentations regarding the existing regulatory framework were made by:

Minnesota Environmental Quality Board:
- The Environmental Review Process

Minnesota Pollution Control Agency:
- General Overview and Coordination (Office of Planning and Review)
- Water Quality Permits (Division of Water Quality)
- Air Quality Permits (Division of Air Quality)
- Hazardous Waste Permits (Division of Hazardous Wastes)

Minnesota Department of Natural Resources:
Mineland Reclamation Draft Rules (Division of Minerals)
Waste Characterization Studies (Division of Minerals)
Water Appropriation (Division of Waters)
Protected Waters (Dam Safety) (Division of Waters)
U.S. Corps of Engineers:
Wetlands Regulation

The meeting was attended by representatives of the various participants and by several observers, including representatives of the U.S. Forest Service.

4.3 Visits to Existing Mines

As a part of the project, participants toured a number of mining and milling operations. The purpose was to observe mining and treatment methods, environmental controls and other aspects that could be similar to those that might be utilized in a base- or precious-metal mining operation in Minnesota.

Industry representatives stressed that these should not be taken as one-on-one comparisons and that observers should recognize that only parts of each operation might be similar to those which might later be encountered in a Minnesota operation.

MPCA participants pointed out that Minnesota requirements may be more stringent than those in effect in the states and provinces visited and that the pollution control measures in effect at the properties visited might not be sufficient, applicable or allowed in Minnesota.

DNR Minerals and ELA selected three operations in Montana for the first trip, carried out in August of 1988. These operations were:

Golden Sunlight Mine. (Placer Dome Inc.) Whitehall, Montana. This is a moderately large, 6700-ton-per-day (tpd) open-pit gold mine with the ores processed by cyanide agitation leach followed by carbon-in-pulp recovery of the gold.

Montana Tunnels. (Pegasus Gold Company) Jefferson County, Montana. This is a large, 16,000-tpd open-pit mine, mining a sulfide ore containing copper, lead, and zinc with moderate amounts of gold and silver. The ore is processed by flotation to produce two concentrates that are shipped to smelters in East Helena, Montana, and Trail, British Columbia, for recovery of salable metals.

Stillwater Mine. (Chevron Resources Company, Johns-Manville Corp.) Nye, Montana. This is a small, 800-tpd underground platinum-palladium mine which recovers a bulk sulfide concentrate containing platinum group

metals. At the time of the visit, this concentrate was being shipped to Belgium for smelting. The mine is located in an environmentally sensitive area near the Beartooth Wilderness.

In conjunction with this trip, discussions were held with representatives of the Montana State Mining Impact Board (which addresses socioeconomic issues associated with mining), several groups within the Montana State Lands Department (a state regulatory agency similar to the Minnesota Department of Natural Resources), and several local environmental organizations.

In October 1988, a second trip was arranged to two Ontario, Canada, operations. The mines visited on this trip were:

Golden Giant. (Noranda Ltd.) Hemlo, Ontario. This is a 2500-tpd underground gold-mining operation, part of a complex of three mines all mining part of the same large orebody. The ores are processed by cyanide agitation leaching with gold recovery by carbon-in-pulp.

Winston Lake Mine. (Minnova, Inc.) Near Schreiber, Ontario. This is a 1550-tpd underground operation mining a massive-sulfide zinc-copper orebody. The ore is processed by flotation techniques and concentrates are shipped to smelters in Quebec for processing.

In the course of this trip, meetings were also held with representatives of the Ontario Ministry of the Environment in Thunder Bay, Ontario.

In February 1989, a third and final trip was arranged by ELA and the MPCA to northern Michigan. This trip included:

Ropes Gold Mine. (Callahan Mining Company) Ishpeming, Michigan. This 2000-tpd low-grade underground mine utilizes cyanide agitation leaching and the Merril-Crowe process for recovery of gold. Tailings disposal is in a former taconite mining pit. The mill is housed in a former iron-ore mill. Only the surface facilities were visited.

White Pine Smelter. (Copper Range Company) White Pine, Michigan. Though smelting and refining operations were not to be contemplated under any of the case study scenarios, MPCA participants requested the opportunity to visit a smelter. The White Pine smelter, constructed in the 1950s, smelts relatively low-sulfur copper ore. The setting of White Pine is in a heavily forested area and near significant recreational amenities.

Detailed notes on these trips are attached as Appendix B.

4.4 Development of the Case Studies

The primary responsibility for the development of the case studies rested with the industry representatives since the objective was to provide realistic proposals as the basis for discussions.

In making the selection of cases, ELA consulted with mining company sponsors of the project and solicited their views. The viewpoints of the other participants in the project were also solicited and included.

The original choice of cases was to include:

1. A small to medium-size underground platinum-palladium mining operation. This choice was suggested because of industry interest, since 1985, in platinum-group metals exploration in the Duluth complex.

2. A copper-zinc massive-sulfide open-pit and underground mine of medium to large size. This type of deposit represents the current primary target type for base-metals exploration in the state.

3. A gold deposit to be mined by underground methods and treated by cyanide agitation leaching. A medium-size operation of this type represents the primary target for most explorers now operating in the state.

4. A very small open-pit gold operation to be treated by cyanide agitation leaching.

The fourth case was criticized by the industry advisors as being unrealisticly small and unlikely. Industry advisors expressed a preference for the case of a small to medium-size gold operation located on private or state lands open for leasing within the federally designated "mining protection" area. The environmental representatives objected to use of any case which was located within or adjacent to the mining protection area. It was subsequently agreed between PEF and ELA not to proceed with the fourth case. Both parties agreed that there probably would not be either the time or the funds available to deal adequately with four cases and that most of the conceptual issues would probably be addressed in one or more of the other cases.

The original location proposed for the third case was in the North Black River peatland. The environmental community objected to this location. In discussions by the participants, it was agreed to move the case to the Mulligan Lake peatland, which is identified as an "ecologically significant" peatland [from Recommendations for the Protection of Ecologically Significant Peatlands in MN, DNR 1984]. The industry representatives agreed to the selection of Mulligan Lake since it still provided the opportunity to explore

issues related to the decision-making process as it would be applied to substantial environmental land-use conflicts.

4.5 Design of the Case Studies

In designing the case studies, ELA attempted to put together for each case the relevant site data that might be at hand to the proposer of a project at the time of a "pre-scoping" environmental review conference and "pre-application" permitting conference with the regulatory agencies. The limitations of the cases and the process by which they were prepared are set out by ELA in Appendix C-1, "Introduction to the Mining Simulation Case Studies."

The guiding principles for preparation of the cases was to make them realistic, to use site-specific data to the extent possible, and to present the economically preferred case as viewed by a project sponsor. It was stressed that in all cases the deposits, though geologically reasonable at that particular location, were and are hypothetical and that no deposit is known to exist at any of the designated sites.

Each case summarizes the background and purpose of the case, gives a physical and geological description of the site and the deposit, describes the proposed facility, gives the major essential operating and waste-disposal parameters, including staffing and economic impacts, and summarizes the major anticipated environmental impacts. Each case includes relevant preliminary maps and a glossary.

4.5.1 Case I. The Roaring Platinum Mine

The deposit would be mined as a small, 600-ton-per-day, 180,000 ton-per-year underground platinum mine. The hypothetical site was selected in Lake County, in the Duluth complex south of the Kawishiwi River. The orebody was located at a depth of 2,500 feet below the surface and would be mined by conventional room-and-pillar methods. The ore would be hoisted to the surface through 14-foot-diameter vertical shafts and treated by flotation to produce a bulk sulfide concentrate that would be shipped to a smelter located elsewhere in the U.S. or overseas. The mine would employ about 60 people for a period of 16 years after commencement of operations. The case is detailed in Appendix C-2.

4.5.2 Case II. The Large Mouth Copper-Zinc-Gold-Silver Mine

This case describes a medium-to-large deposit to be mined at the rate of 4,000 tons per day (1.2 million tons per year) at a hypothetical site in the end moraine terrane in Itasca County. The mine was to be opened up originally as an open pit, converting to underground operation after seven years. The open-pit operation would permit earlier and more complete extraction of near-surface, higher-grade ores at a lower cost. It involved

stripping of large amounts of overburden and waste rock, some of which had acid generation capabilities. The siting also involved wetlands and potential trout stream conflicts. The mine would employ 235 to 305 people during its operational life of about 15 years. The case is detailed in Appendix C-3.

4.5.3 Case III. The Jeep Trail Gold Mine

This case describes a medium-sized gold deposit to be mined at a rate of 2,000 tons per day (0.6 million tons per year) at a hypothetical site in the Mulligan Lake peatland in western Lake of the Woods County. This peatland is identified as "ecologically significant." Most of the plant and facility as proposed would be located on mineral soils, but within the drainage area of the peatland, two of the facilities (shaft and access road) would be within the "peatlands watershed protection area" portion of the peatland. Part of the underground mine would lie beneath the "core area" of the peatland. The proposed mine would be developed by underground methods with the proposer anticipating no subsidence of the surface. The ore would be treated by cyanide agitation leach with gold recovery by the Merril-Crowe process. Added complications would be the high acid-generation characteristics of the tailings and some of the waste rock and the fact that the ores naturally contain arsenic. The case is described in Appendix C-4.

4.6 Field Trip to Case Study Sites

In October 1988, early in the process of preparation of the cases, the environmental groups requested and it was agreed that a field trip be organized to visit the proposed sites. The Roaring Platinum case site, the Large Mouth site, and the original site of the Jeep Trail case in the North Black River peatland were visited. In addition, the site of the Raspberry gold prospect near Ely, Minnesota, was visited. This site was the possible location of the proposed fourth case, the very small open-pit gold operation. The participants on this trip are listed in Appendix B.

4.7 Discussion of the Cases

After each case was prepared in draft form, it was circulated to the participants for initial comment. Some of these comments were incorporated in the final drafts of the cases, which are included with this report as Appendices C-2, C-3 and C-4.

A series of one-day sessions (moderated by Roger Williams) was then scheduled to discuss each case; these were held in February and March of 1989.

The format for these sessions called for the industry representatives to make a brief presentation of the case. Following this, each of the other three participants presented formal comments on the case, including the

issues raised and data required or desirable. These formal comments are appended to each case.

After the formal comments, senior project personnel and the moderator set an agenda for discussion of cases. Each discussion focused on the significant issues raised by the case study. An effort was made to discuss new issues raised in the second and third cases and not renew discussion on issues previously covered.

An attempt was made to record these sessions, using a tape recorder and, in two instances, a stenographer. The results were largely unsuccessful, due to poor recording apparatus and the technical nature of the discussions, which made it impossible for the stenographer to take meaningful notes.

4.8 Literature Study

One of the important tasks that the MPCA wished to undertake was to put together a comprehensive search of the literature on the environmental impacts of nonferrous and precious-metal mining that would assist staff and managers in dealing with environmental issues raised by nonferrous and precious metal mining. It was believed that such a review would also be of value to the other participants in the process and to future project sponsors or project reviewers in that it would provide an up-to-date primer on nonferrous mineral development.

The MPCA circulated a draft of the literature study to the participants in March 1989 with a request for comments. The literature study was revised in light of these comments and is part of this report as Appendix E.

4.9 Wrap-up Sessions

The management team believed that on the completion of the case study discussions, an effort should be made to draw some general observations from the case study experience. The intention was to develop conclusions and recommendations which would make the environmental review and permitting process more expeditious and effective while ensuring environmental protection.

The industry representatives suggested that the wrap-up session initially try to develop a critical path diagram for the environmental review and permitting processes. This chart would indicate the various components of the process, the data requirements and the participants.

The wrap-up session was held April 14, 1989, and focused essentially on environmental review and permit issues and on developing a chart with data requirements for the preconstruction, operation and closure phases. In addition, a plan for the development of the final report was outlined.

5.0 MAJOR ISSUES

Through the discussions of the case studies of the hypothetical mines many issues relating to mine operations were identified by project participants. (Issues not raised by the case studies could come up in the course of an actual permitting process.) In order to address the concerns raised and highlight areas of particular importance, the issues have been grouped into seven broad categories: exploratory drilling; environmental review and permitting processes and procedures; land use; water; air; design, operation, closure and postclosure care; and financial assurance. Joint agreements on these issues are included in section 7.0.

Comments prepared on these issues and contained in this chapter provide the perspective of participants. These categories contain overlapping issues. Where possible, each issue has been addressed in one category; when the issue is part of an additional category, the reader will be referred to the first category in which it was cited.

5.1 Exploratory Drilling

5.1.1 Explanation of the issue

Initial information regarding the characteristics of a mineralized body of rock is typically gained through exploratory drilling. Concerns have been expressed regarding exploratory drilling and its regulation pertaining to:

1. The effect of drilling on ground water,
2. Drill site location,
3. Assurance that the drilling and reclamation will be properly conducted.

5.1.2 Comments

5.1.2.1 Department of Natural Resources Response

Exploratory Drilling on All Mineral Leases

Minnesota statutes and rules relating to explorers and exploratory boring requires the registration of all explorers, submission of data on drill hole location, and the temporary or permanent abandonment of all exploratory borings immediately upon completion of drilling activities.

A temporary abandonment must be maintained in such a manner so as the drill hole is not a source or channel of contamination to any aquifer. Permanent abandonment requires the filling of the rock formation portion of the boring with cement or neat cement. Heavy drilling fluids are allowable in unconsolidated portions of the hole only if they provide a permeability no greater than the surrounding materials. The requirements for temporary and

permanent abandonment were designed to prevent aquifer contamination from surface materials as well as cross-aquifer contamination.

The DNR conducts two inspections (once during drilling, once after abandonment) on each drill hole placed on state leased lands. In addition, Department staff have made a final inspection on over 80 percent of the drill holes on private lands since 1981. This activity includes a scintillometer reading, inspection of drilling procedures, abandonment procedures, compliance with siting of the drill hole away from environmentally sensitive areas (e.g., eagles' nests) and final site reclamation and/or cleanup. Inspection reports are on file in the DNR Division of Minerals Hibbing office and available for public review.

It is the observation of DNR drill site inspectors that the rules are being closely followed by the exploratory drillers. Almost all holes are permanently abandoned within 24-72 hours of completion of drilling activity, with the remaining being temporarily abandoned. In addition sites are in compliance with siting restrictions and are cleaned-up upon removal of the drill rig.

The DNR has no knowledge of contamination of any ground water aquifers or wells due to the use of drilling as an exploration technique in Minnesota. The Department believes the regulations are effective and offer adequate protection of the state's ground water resources from impacts of exploratory drilling.

Exploratory Drilling on State Mineral Leases

The state metallic minerals lease required for the exploration and mining of state-owned minerals includes provisions governing surface use, drilling, conduct of operations, inspection and compliance with applicable laws. As manager of these minerals, the Department has developed a checklist it provides to all state mineral lessees that sets forth guidelines to assist the lessee in complying with the provisions of the state minerals lease requirements as well as the requirements of the Minnesota exploratory boring law. The checklist is included here as it provides additional perspective on how the DNR manages the state's mineral rights. Those checklist activities that are noted with an asterisk are requirements of the Minnesota exploratory boring law and are applicable to exploration on all mineral leases (i.e., private, federal and state).

Checklist Activity: GEOPHYSICAL, GEOLOGICAL AND GEOCHEMICAL SURVEYS

1. Prior to performing any ground exploration activity on any state metallic minerals lease, regardless of surface ownership, the Exploration Section of the Minerals Division at the Hibbing office of the Minnesota Department of Natural Resources must be notified.

Prior to grid cutting, a grid location map must be sent to the Exploration Section. Immediately prior to conducting and after completion of individual geophysical, geochemical or geological surveys, the Exploration Section is to be notified.

2. If the Minnesota Department of Natural Resources has administrative control of the surface, the appropriate Minnesota DNR Area Forest Supervisor or Area Silviculturist and Area Wildlife Manager must be consulted prior to the time when grid cutting (cutting of brush to facilitate sight lines) and geophysical, geological and geochemical surveys are performed. Area Forest Supervisors' or Area Silviculturists' and Area Wildlife Managers' names and addresses are provided to all exploratory drillers.

3. If the county controls the surface (i.e., tax-forfeited land), contact the appropriate county official with reference to their requirements for the use of the surface.

Checklist Activity: DRILLING, TRENCHES AND PITS

*1. In advance of drilling on any state metallic minerals lease, the exploratory boring law requires that an explorer must be registered by the Minnesota Department of Natural Resources - Minerals Division (DNR-MD) and licensed by the Minnesota Department of Health (MDH).

2. Prior to any surface sampling for exploratory or prospecting purposes which produces surface disturbance beyond what is typical of geochemical or outcrop sampling (e.g., trenches, pits), the Exploration Section, along with the appropriate surface managers, must be informed of the location and magnitude of sampling anticipated.

*3. The exploratory boring law requires written notification to be submitted to the Exploration Section of the DNR-MD and to the Ground Water Quality Unit of the MDH at least ten days prior to moving a drill rig onto a drill site, regardless of surface ownership. Notification must include a location map at a scale of one inch = two miles locating the drill site to the nearest 40-acre parcel. To eliminate duplication, a map at a larger scale showing the site location and the access drill road will be acceptable at this time. In any case, a drill site and drill road location map must be submitted to the Exploration Section prior to moving a drill rig onto a drill site where a state metallic minerals lease has been issued. As required by the state metallic minerals lease, the Exploration Section must be notified in advance of the exact date drilling will begin. The Exploration Section must be notified immediately following drill rig removal from the site. The Exploration Section must

be notified, as soon as practical, when drill core is available for examination. The mining company core log should be made available for use by the Minerals Division geologist when he examines the drill core or cuttings.

4. There are recreational trails which are maintained for riding, hiking, biking, snowmobiling or cross-country skiing in the area of some state leases. If drilling activity is likely to significantly interfere with trail use, contact the appropriate DNR Trails Coordinator. Trails and Waterways Coordinators' names and addresses are provided to all explorers.

5. If the Minnesota Department of Natural Resources has administrative control of the surface, the appropriate Minnesota DNR Area Forest Supervisor or Area Silviculturist and Area Wildlife Manager must be consulted with reference to drill road location and other related drilling activity.

6. If the county controls the surface (i.e., tax-forfeited land), contact the appropriate county official with reference to their requirements for the use of the surface.

*7. The Department's Division of Waters must be contacted prior to any drilling activity which would appropriate, use, divert or interfere with public waters. (In cases where drilling is within 50 feet of a waterway or body of water, special drilling procedures may be required by the Minerals Division.)

*8. Regardless of surface ownership, the Minerals Division will inspect the drill site while the rig is on the site and again after it has been removed. If any unusual conditions are observed during the initial inspection, the lessee will be informed as to the corrective steps necessary to be taken before the site is abandoned. After the rig is removed from the site, the Minerals Division will make the final inspection. The final inspection will determine whether or not the site was left in an acceptable condition. If not, the lessee will be informed as to what corrective steps to take to make the site acceptable.

*9. As required by the exploratory boring law, the MHD, DNR-MD, MPCA, and county health officials and their officers and employees shall have access at all times to drill sites for the purpose of inspecting the drill holes, drilling, abandonment of holes, sampling ambient air and drilling waters and measuring the radioactivity of the waste drill cuttings.

*10. The explorer shall promptly notify the MDH, MDNR-MD, MPCA and county health officials of any occurrence during drilling that has a

potential for significant adverse health or environmental effect and shall take immediate action to minimize any adverse effects.

*11. Explorers are required to permanently or temporarily abandon drill holes in the same manner as that prescribed for the abandonment of water wells. The Ground Water Quality Section of the MDH should be contacted for further information.

*12. Within 30 days of permanent or temporary abandonment of a drill hole, the explorer must submit an abandonment report, on forms provided by the Commissioner of Health, to the MDH. The abandonment report must include:

a. A map showing the location of each drill hole at as large a scale as possible, which is normally prepared as part of the explorer's record;
b. Type and thickness of overburden and rock encountered;
c. Identification of water-bearing formations encountered;
d. Identification of static water levels, if taken, and other hydrologic conditions encountered;
e. Method of abandonment;
f. Method of construction and drilling used; and
g. Average scintillometer reading of waste drill cuttings prior to backfilling of the recirculation pits.

*Checklist Activity: MINERAL DEPOSIT EVALUATION

The State's environmental rules require that an Environmental Assessment Worksheet (EAW) be prepared prior to a mineral deposit evaluation of metallic mineral deposits other than natural iron ore and taconite. Mineral deposit evaluation is defined in the exploratory borings law to mean an examination of an area "to determine the quality and quantity of minerals, excluding exploratory boring but including obtaining a bulk sample, by such means as excavating, trenching, constructing shafts, ramps, tunnels, pits and producing refuse and other associated activities." Such activities may also require state permits and licenses.

5.1.2.2 Minnesota Pollution Control Agency Response

To date, MPCA has taken no direct regulatory role in the exploration phase of mining. The statutes (Minn. Stat. Ch. 156A) and rules (Minn. Rules Ch 4727) give the MDH the lead role in the regulation of exploratory drilling. Since drill holes are conduits to the ground water (an MPCA regulatory concern), MPCA is concerned that these and other rules be properly applied so as to protect the ground water resource. These rules provide that MPCA may inspect exploration activities.

Because MPCA has the lead responsibility for enforcement of water quality standards in the waters of the state, the agency may require

permitting of exploration activities under certain circumstances. An example would be a case in which an exploration activity would incorporate a disposal system whose characteristics (size, manner of disposal, parameters) would create the potential for environmental problems. The agency would also take the lead in dealing with any contaminant spills.

MPCA must be notified immediately in the case of spills or other occurrences which may affect air or water quality and may require that a spill contingency plan be filed with the agency before drilling in certain cases.

5.1.2.3 Environmental Response

Recommendations:

1. Bonds or other forms of financial assurance must cover all exploration programs to ensure that adequate funds are available to close borings and to properly cleanup and reclaim roads and drill sites. (See environmental comments, Section 5.7.2.3)

2. Environmentally significant peatlands must be protected.

   a. No exploratory drilling or mining must be allowed in the core areas. (See environmental comments, Section 5.3.2.3)

   b. The watersheds surrounding ecologically significant peatland core areas are fragile environments and must be managed to protect the core areas from exploration and mining impacts.

3. An Environmental Assessment Worksheet (EAW) must be required for all exploratory drilling proposals in fragile environments. (See environmental comments, Section 5.3.2.3) The EAW will identify potential environmental impacts of drilling and aid in the development of special restrictions to minimize these impacts.

   Restrictions recommended for fragile peatland environments include:

   a. Drilling must only occur when the ground is frozen.

   b. Drill site access must be along existing routes of disturbance, when present.

   c. The number of surface locations and holes needed to explore the geology should be minimized, utilizing directional drilling and other techniques.

   d. Cutting of vegetation for access or surveying must be minimized.

e. Extensive trenching or earth moving for access, exploration or the construction of a drill site are prohibited. No pits or trenches should be constructed in the peat. Drill cuttings should be settled in tanks brought on to the site.

f. Drilling fluids must be circulated in a closed system of tanks and pipes brought onto the site and removed upon completion. All drilling fluids and other materials should be removed from the site for proper disposal elsewhere.

g. The bore hole should be properly closed upon completion of its design function.

h. Close supervision of exploratory drilling must be exercised by the appropriate regulatory bodies.

5. Written performance standards for exploratory drilling must be developed by the DNR and the MPCA to:

a. Safeguard fragile environments;
b. Ensure proper collection and disposal of drilling fluids, oils and other waste;
c. Prohibit entry of surface runoff into the bore hole or drilling mud pits;
d. Ensure adequate reclamation.

6. The Minnesota Department of Health rules should be amended to prohibit the use of toxic drilling fluids.

7. The MDH should conduct field inspections during closure activities when ground water resources are at risk.

Findings:

Exploratory drilling is usually conducted with a truck-mounted drill rig. An access road and level "drill pad" are often bulldozed, along with trenches and pits in which to circulate drilling fluids.

Exploratory drilling can damage fragile environments, raises concerns about ground water contamination and is not covered by any written reclamation requirements.

Fragile environments such as lake beds, wetlands, river bottoms, watersheds of Ecologically Significant Peatlands, wildlife refuges, cultural and archaeological sites, and habitats for rare and endangered species are especially susceptible to impacts from mineral exploration.

DNR personnel have observed changes in peatland vegetation surrounding mineral exploration drill sites in the Thief Lake Wildlife Refuge one year after drilling. The changes apparently resulted from the fertilizing effects of mineral soils and drilling muds introduced by drilling on the poorly buffered peat ecosystem.(1)

The issue of exploration in a fragile environment was raised during the "Jeep Trail" simulation. The site of the scenario was the Mulligan Lake Peatland, which has been identified as "ecologically significant" by the DNR.(2) It is home to numerous threatened and endangered species and contains unique vegetation and land forms. The key factors in the formation and maintenance of these peatland features are the water chemistry and flow patterns.(3) This hydrologic regime is complex, poorly understood and very delicately balanced. "The processes that perpetuate the peatland ecosystem, as well as plant communities and rare species, are extremely sensitive to changes in water levels and water chemistry."(4)

Exploratory boring for minerals raises important ground water concerns: a. the introduction of dangerous substances from the surface or from drilling fluids into groundwater, and b. the mixing of ground water from separate aquifers. Contamination might occur during drilling, or as a result of ineffective well closure.

Improper construction and operation of the drill site may permit surface drainage to carry oil, grease or other contaminants into the mud pits or bore hole. Exploratory drilling is usually conducted with bentonite (a form of clay) and water, which presents no known toxic hazard. In some instances, other drilling materials are also used, some of which present environmental hazards.

Quik-trol is an organic polymer sometimes used in exploratory drilling. The product safety sheet states, "Do not use, store or dispose of Quik-trol where it may leach, spill or run off into waterways. It is moderately toxic to aquatic species."(5) Rules and statutes governing water wells and exploratory boring do not explicitly prohibit the use of such toxic drilling fluids.(6)

Closure requirements for exploratory borings are designed to prevent mixing of waters from different aquifers. To date, however, the MDH has had insufficient staff to inspect or supervise actual well-closing operations to assure compliance. Prior to the 1989 legislative session, the MDH had a staff of four to keep track of records for the 7-14,000 holes drilled annually in Minnesota. MDH field inspections for closure of exploratory borings were rarely, if ever performed.(7) Without proper education and monitoring of drillers these rules cannot serve their function to protect ground water. DNR field personnel conduct field inspections, but well closure is not their responsibility.

Proper reclamation of both the drill site and access roads constructed to the site is necessary upon completion of the drilling. This may include leveling and seeding a site and removal of culverts or other road structures. The objective is to minimize the environmental disturbance from exploration.

There are currently no written reclamation standards for exploratory drilling. Both the public and the industry could obtain a better understanding of requirements with a written reclamation policy.

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(1) Norm Aaseng, DNR minerals division, conversation with Don Arnosti, March 10, 1989.
(2) Minnesota DNR, Recommendations for the Protection of Ecologically Significant Peatlands in Minnesota, Nov. 1984, p. 15, Table 1.
(3) D. I. Siegel, Hydrogeologic Setting of the Glacial Lake Agassiz Peatlands, Northern Minnesota, U.S. Geological Survey, Water Resources Division, St. Paul, MN, 1981, pp. 12-13, 20-21.
(4) DNR, Preliminary Report, Protection of Ecologically Significant Peatlands in Minnesota, June 1984, p. 45.
(5) Quik-trol, "Environmental, Safety and Transportation Data Sheet," NL Baroid Environmental Services, Oct. 1988.
(6) Minn. Stat. ch. 156A, Minn. Rules ch. 4727
(7) Jim Nye, MDH, telephone conversation with Don Arnosti, March 22, 1989.

5.1.2.4 Industry Response

Exploratory drilling has only a minor and temporary environmental impact. The current law (Minn. Stat. ch. 156A as amended in 1989 by Minn. Stat. ch. 326) and regulations governing exploratory drilling give those state agencies most directly involved with the activity the authority to address any potential conflicts that may arise. Specifically, this statute and the regulations require:

1. Anyone intending to conduct exploratory drilling to be licensed by the Minnesota Department of Health and the Minnesota Department of Natural Resources.

2. An explorer may be required by the DNR to provide financial assurance that they have the ability to comply with the requirements of the law.

3. Factual data generated by exploratory drilling on state lands and one-quarter of all remaining drill cores must be submitted to the state no later than six months after the termination of a lease.

4. Ten days prior to the start-up of drilling, notification of the proposed location must be sent to the MDH and the DNR.

5. Inspections of the site can be made at any time by the MDH, DNR, MPCA, and the local county health department.

6. Abandonment of exploratory holes must comply with the regulations governing the abandonment of water wells.

7. The Minerals Division of the DNR inspects the drill site while the rig is on site and will make a final inspection to determine if the site has been left in an acceptable condition.

8. Violation of the regulations pertaining to exploratory drilling shall be considered a gross misdemeanor.

Administration of these regulations has been ongoing since passage of the act. To our knowledge, no significant problems have arisen in Minnesota. The regulations in place are sufficient to assure no such problems are incurred in the course of exploratory drilling.

5.2 Environmental Review and Permitting Process/Procedure

5.2.1 Explanation of the issue

A new metallic mining operation in the state must undergo environmental review. This review takes the form of a mandatory Environmental Impact Statement (EIS). The DNR, as the Responsible Government Unit (RGU), is the lead agency for the preparation of this EIS. The operation must also receive permits from the DNR (permit to mine, water appropriation, protected waters, dam safety) and MPCA (water quality permits, air quality permits, storage tanks and hazardous waste permits, if needed) before construction can begin. Other federal, state and local approvals may also be necessary. It is important that critical environmental issues be identified and addressed through these processes and that the process proceeds in a timely fashion. (See also section 6.0)

5.2.2 Comments

5.2.2.1 Department of Natural Resources Response

As stated above, a new metallic mineral mining operation must undergo Environmental Review (ER) and obtain permits before construction and operation can begin. The ER process for a new mine will include the preparation of a scoping Environmental Assessment Worksheet (scoping EAW) and an Environmental Impact Statement (EIS). The preparation of these two documents, including public review and meetings, can take at least 1.5 years. The permitting processes of the various regulatory agencies can take approximately this length of time and possibly longer if contested case hearings are required. If these two activities (ER and Permitting) were run in series, it would take a minimum of 3 years to complete. This would be too long a time period for a developer to wait before it is determined if permits would be granted or, if granted, terms and conditions of the permits.

Although permits cannot and should not be granted before the Environmental Review process is completed, it is reasonable to start the permitting procedures in parallel with the Environmental Review process. These two

distinct programs directed at accomplishing different purposes will each be most effective if they have access to data and information developed by the other. For example, analysis of impacts by the EIS can best be done using information on mine waste characterization obtained through the permitting procedure. On the other hand, the permitting process will work most effectively if it has available information on land-use issues developed by the EIS document.

As the permitting process does draw on information contained in the EIS and since permits, if granted, cannot be granted until the EIS is complete, it is important that the EIS address all environmental issues thoroughly. If this is not done and legitimate issues arise late in the preparation of the EIS, lengthy delays to completing the ER and permitting processes are likely to occur.

In order to ensure that the EIS does address all relevant issues, a scoping Environmental Assessment Worksheet (scoping EAW) is first prepared. In this scoping process all land-use, environmental, and socioeconomic issues are to be identified for evaluation by the EIS document. A comprehensive and well-thought-out scoping EAW can help ensure that the EIS will address all relevant issues in a timely manner.

It should be understood that in Minnesota the Environmental Review process, with its companion documents (EIS and scoping EAW), is not a decision-making process. That is, the EIS document does not recommend whether a mining project go forward or be terminated. The EIS only describes impacts from the proposed project and of alternatives to the proposed project. It is the regulatory agencies, through their permitting authority, that determine if permits can be granted. If permits are granted, the developer must decide whether to proceed based on the terms and conditions of any permits granted.

With the ER and permitting processes running concurrently, it is important that there be a coordinated and close working relationship between them. Unclear lines of responsibility in the above procedures result in duplication of effort and attention to extraneous matters to the detriment of identification and resolution. This could in turn result in discouragement of industry, diminished cooperation and, ultimately, distrust by the public. On the other hand, an efficient Environmental Review (EIS/EAW) and permitting process will result in optimizing siting decisions, mine design, operation and closure and thus provide the best environmental protection for the state's resources while, at the same time, providing an opportunity for mineral development. An efficient process is most likely to result if it includes the following components:

1. Early and full disclosure of mining plans.

2. Rigorous and prompt identification and agreement on the EAW scoping document that identifies all issues to be addressed by the EIS.
3. Prompt development of a schedule for the environmental review and permitting processes.
4. Joint meetings between mine developer and regulatory agencies to identify:
   a. Leadership roles and responsibilities of all parties.
   b. Identification of monitoring requirements and schedules.
   c. Identification and standardization of data and map requirements.
   d. Agreement on financial assurance mechanisms.
5. Opportunity for timely and up-front participation in Environmental Review process by environmental lobby and public.
6. Periodic public meetings in area of proposed development to update public on status of project and to receive comments.
7. Opportunities for public review and comment on final permit conditions.
8. Identification of a small interagency task force that will be responsible for administering the project.
9. Conducting environmental review and permitting procedures concurrently.

5.2.2.2 Minnesota Pollution Control Agency Response

Environmental review: MPCA's role in environmental review of mining projects is usually that of reviewer and commentor. In this role MPCA participates in scoping, serves on work groups and reviews documents.

In addition to the above role, MPCA shares the public's interest in maintaining the vigor and integrity of the State's environmental review program. To this end, we make the following comments:

1. Environmental review and permitting are different processes that are intended to perform different functions. They cannot perform each other's functions and may not be substituted for one another. They do have elements in common, and, other things being equal, work best when they proceed simultaneously on parallel tracks so that information and expertise can be shared. Minnesota Rules pt. 4410.2900 contains the authorization for this procedure.

2. Environmental review is not required for exploratory drilling, but is required for bulk sampling. This is one reason why early consultations between the operator and state regulatory personnel would be a good idea.

3. It is a key purpose of environmental review to subject development projects to public scrutiny and to assure accountability in public

decision- making. It is incumbent upon agencies and project sponsors to see to it that sufficient information about impacts and plans for mitigation are presented for this purpose to be served.

4. MPCA applies a sulfate criterion to effluent discharges to waters where wild rice is present. This makes an inventory of wild rice stands quite important. This should be done in the course of data gathering for environmental review.

Federal program: The project should note that U.S.EPA is developing a federal program to regulate mining waste disposal. Program development is actively underway, although rulemaking cannot take place until RCRA is reauthorized. Rulemaking is thus unlikely before 1991.

Relationships: It is important to establish and maintain clear lines of responsibility among the various parties to a development proposal, so that operators can be clear on which agency they are responsible to for various activities. While the missions of the involved agencies are generally clear and distinct, this is often not apparent to those outside the agencies. Each agency should meet early with project sponsors in order to establish requirements and timetables, and acquaint the developer with the "rules of the game." To avoid confusion, these should be individual meetings when permitting issues are being worked out.

The perception that the agencies involved regulate the same things and therefore have the same information needs for permitting purposes is pervasive, and all involved parties must guard against the assumption that data submittals for one agency will serve the purposes of another. Since it is MPCA's responsibility to set air and water quality standards and enforce compliance with those standards, the agency's data requirements are aimed at providing agency staff with the tools they need to develop requirements which allow those standards to be met. This often requires that particular testing and characterization techniques as well as very low-level detection methods be employed in generating the required data. Thus, while some standardization of map scales and other general information may be possible, the potential for overall standardization of data submittals is not great, unless the level of detail and techniques required for MPCA permitting are acceptable to other agencies for their needs.

5.2.2.3 Environmental Response

Recommendations:

1. Our recommendations for comprehensive public involvement in environmental review and permitting have been adopted as joint recommendations. (Sections 7.1.2.2-4)

2. Environmental review and permitting must not be rushed in order to hold to theoretical timetables. The ultimate objective of the process is environmental protection. With such a complex process, each project proceeds at a different pace. Cutting corners will only lead to administrative and legal challenges.

3. A thorough analysis should be conducted to determine compliance with existing air and water quality permits, assess the effectiveness of the permitting system in protecting the environment, and recommend changes in enforcement activities or authorities.

4. Preparation of an environmental assessment worksheet (EAW) should be mandatory for exploratory drilling in fragile environments. (See Section 5.1.2)

Findings - Environmental Review:

Environmental review, familiar in its most comprehensive phase as an "environmental impact statement" or EIS, is designed in Minnesota to provide information about the environmental impacts of a proposed project and to examine alternatives. This information is used by regulatory agencies in permitting and by the public to ensure accountability in public decision-making.

For mining proposals in Minnesota, preparation of the mandatory EIS happens in two distinct phases. The scoping phase determines the issues to be examined in depth in the review phase. An EIS is determined to be complete and adequate if it answers all the environmental questions raised or, after attempting to develop the answer, can provide an honest "we don't know."

The EIS must examine alternatives to the proposed project, but it does not recommend action. (An EIS meeting federal requirements, which differ from state requirements, may be mandatory when federal lands or resources are involved in the proposed development. Federal EIS requirements are beyond the scope of this study.)

For a description of the ideal environmental review process, see section 6.4, and the chart accompanying this volume.

Findings - Permitting:

"Go/No Go" decisions are made in the permitting process, and are based partly on information developed in the EIS and partly on the ability of "stipulations" or conditions written into permits to mitigate or eliminate environmental impacts identified in the EIS. Permit decisions often rely on information gathered for the EIS. It is important not to rush to write permits before environmental review is complete.

Many permits are required before a mine may be opened in Minnesota.

From the DNR:

1. A mineland reclamation permit or "Mining Permit" covering project siting, planning, construction, operation and closure;
2. A water appropriations permit;
3. A protected waters (dam safety) permit.

From the MPCA:

1. Water quality permits;
2. An air emission permit; and possibly,
3. A hazardous waste permit;
4. A storage tank permit.

In addition, the MPCA needs to approve engineering plans and specifications related in any way to issues of their responsibility. Depending upon the specific proposal, other permits may be required from the Army Corps of Engineers, the U.S. Forest Service, other Federal government agencies or local units of government.

All required permits must be obtained before opening a mine, but such permits are rarely denied. Legislation generally requires that a permit be granted, if impacts can be contained within "permittable limits" through permit stipulations. Existing regulations do not necessarily require that environmentally preferred alternatives be favored in permitting. (See environmental recommendations in Section 7.1.4.3)

Details of each permit are developed by the staff of the appropriate agency. Stipulations covering monitoring requirements, water quality standards and construction designs, for example, are written into the permit to ensure that required standards are maintained. Permitting processes vary, but this is the stage where important decisions are made and solutions are devised to minimize or eliminate environmental impacts identified in the EIS. Public participation is critical at this stage to ensure strong environmental safeguards.

From approval of the final permit and project start-up, through operation, to closure and reclamation, constant review and monitoring must assure that permit requirements are being met. If permit conditions are not met, fines may be assessed or the permit may be revoked, thereby closing the facility. Periodically, (every one-to-five years or longer) permits are renewed or revised, based on current information and plans. Final release from a permit comes when the closed facility has been reclaimed for some other use and no longer needs maintenance or monitoring.

PEF has serious questions about compliance with MPCA water quality permits. Our examination of the NPDES/SDS files has revealed a large

number of permit violations, ranging from paperwork and reporting violations, to serious pollution problems.

The present level of staffing in the agency's enforcement units is inadequate. Staff is able to adequately monitor only a limited number of permits.

5.2.2.4 Industry Response

The process, procedures and data requirements must be flexible. Though there are common features associated with all mining and particularly with base- and precious-metal mining, each deposit is unique as to the ore, the setting and the mining and processing requirements. No single "cook book" approach to permitting will fit all circumstances.

Mineral raw materials, along with agricultural and forest products, are the basic building blocks of our civilization. Without mineral raw materials our basic needs for shelter, food products, energy, transportation and the means for production cannot be met. The U.S. has become increasingly dependent on foreign supplies for many basic mineral raw materials, creating both an undesirable strategic dependence and aggravating economic problems related to balance-of-payment issues. Thus the development of mineral deposits and the existence of a well-run, healthy mineral industry is of national as well as local importance.

The development of mineral deposits also has been shown to have important economic benefits, creating direct and indirect jobs, usually at a ratio of about two-to-four indirect jobs to one direct job. The mining project creates sources of direct tax revenues plus indirect tax revenues through taxes on personal income and real property of owners and workers. It creates a benefit by reducing unemployment and unemployment compensation costs. In the case of state or federal lands, royalty revenues will also flow to the federal government, the state and local communities.

Base and precious metals are readily traded in a worldwide market. The operator must maintain competitiveness in that market. Unless the operator is competitive, he or she will fail, resulting in a significant loss of jobs, both direct and indirect, and taxes and royalties to the state and communities. Therefore, conditions set forth in permits should be reasonable and practical in light of then- existing scientific and technical knowledge and of the economic conditions affecting the project. The total elimination of risk is not possible; nor should an operator be required to install unnecessary expensive mitigation measures to guard against marginal and unlikely risks.

Time is of the essence. When starting down the permitting road, the operator already has large amounts of money committed to the project. If the process does not move rapidly, the operator not only loses interest on these funds but, having committed future resources to the project, has limited the

ability to commit to other attractive projects because of limitations of his or her overall financial and technical resources. In order to spread regulatory as well as technical risk, the Operator will be reluctant to make more than the minimum commitment possible to any one project unless he or she can be assured of a rapid decision on permitting issues. A well-defined, speedy process will be a better process because it will encourage the operator to commit more resources to identifying, investigating, solving or mitigating possible environmental problems based on the expectation of getting early "go" or "no go" decisions.

Information and data requirements should be defined early in the process. Data required should be germane and relate to significant issues; that which is of marginal importance should not be requested or required because it is both expensive to obtain and of questionable value. Both the effort to provide such data and the evaluation and interpretation of it distracts all parties to the process from the important issues.

The amount of information required should also reflect the size of the project. For example, a small operation with a small labor force will have limited socioeconomic impacts and should not be required to provide the same level of such data as might be required from a very large operation that might employ many hundreds of people. It is of no benefit to any of the parties to gather data on or expend effort examining issues of no or little relevance to the specific project.

For this reason, a thorough and careful job of scoping the currently mandatory EIS and of planning data requirements for permits is essential. This requires early consultation with state and federal agencies and with local communities, the environmental community and the public.

Insofar as possible, the environmental review process and the major permit reviews by agencies at all levels (local, state and federal) should run in parallel to shorten the overall time required to complete the process. This will also allow for more effective and efficient collection of data, preparation of studies and design of various aspects of the project which will require several permits.

Lastly, once the potential operator has made a good faith and professionally appropriate proposal, the burden of proof on issues relating to adverse effects should not be on the project sponsor but should be on the party raising objection to a specific aspect of the proposal. It is axiomatic that it is not possible to prove a negative proposition. Therefore the sponsor should not be required to prove that there is no risk of failure or adverse consequences. Rather, it should be incumbent on any opponents to make a showing that there is significant risk of an adverse outcome.

5.3 Land Use

5.3.1 Explanation of the Issue

A mining operation will cause changes in the local environment which may be temporary or permanent. It is very important to design the mining operation in a manner that reduces and mitigates conflict with current as well as future, on-site and adjacent land uses. In certain areas mining is precluded by law.

Land-use concerns include recreational values, unique scientific and natural features, wildlife and endangered species, historic and archaeological values, social and economic costs and benefits and impacts on air and water resources. (Water and air issues are discussed specifically in Sections 5.4 and 5.5.).

5.3.2 Comments

5.3.2.1 Department of Natural Resources Response

The Department of Natural Resources as manager of the state's land, mineral, wildlife, timber, and water resources is responsible for major land-use decisions and policies that affect everyone in the state. The Department balances land-use development through the use of management plans for Trails, Parks and Recreation, Wildlife, Fisheries, Forestry, and Water Management. These management plans have and will continue to take into account rare and endangered species, habitat preservation (such as ecologically significant peatlands) and competing land uses such as mining. The Department has other procedures, policies, regulations and laws it follows or enforces in addressing land use issues. The following describe some of those associated with mining.

Waters

The Division of Waters (DOW) has identified all surface waters of the state that are designated "Protected Waters." Although the Division of Waters has direct regulatory control over activities in all protected waters of the state, including types 3, 4 and 5 wetlands, it does not normally control activities in wetland types 6, 7 and 8 (peatland types).

Mining activities are regulated under the DNR Division of Waters' Protected Waters and Appropriation Permit Programs, including the closure aspects of these programs. Permits issued under these authorities generally have not been considered "land-use" permits since major land-use issues are normally resolved prior to permit application. However, the DNR Division of Waters has several methods of indirectly regulating certain aspects of land use through the state's Shorelands, Floodplains and Wild and Scenic Rivers Management Acts. Several of these laws require local governments to adopt

zoning ordinances that meet state-wide minimum standards. The DNR has the authority to set these standards and to review local ordinances for compliance, and thus it has indirect control over the uses of water surfaces, shorelands, floodplains and lands adjacent to designated rivers. A brief description of these regulatory programs follows:

1. Shorelands - The Shoreland Management Act authorizes the DNR to classify the shorelands of the state according to allowable intensity of development and then to establish minimum state-wide zoning standards to aid municipalities in regulating use of the land.

   Land within 1,000 feet of the Ordinary High Water Level of a protected water basin, or within 300 feet of a protected watercourse, is subject to the minimum standards authorized in the Shoreland Management Act. These standards regulate land uses, lot sizes, structure placement, sanitary facilities and changes of bottom contours of adjacent protected waters. State standards also establish the conditions under which variances from the ordinances may be granted. Shoreland zoning ordinances may also apply to unprotected waters and wetlands, at the discretion of the particular county.

2. Floodplains - The Floodplain Management Act controls development and construction on floodplains. The primary purpose of the Floodplain Management Act is to "manage the floodplains for beneficial uses compatible with the preservation of the capacity of the floodplain to carry and discharge the regional flood."

   Like shorelands, floodplains are regulated by local zoning ordinances and must comply with minimum standards established by the DNR. The DNR standards include specifications for acceptable construction, flood warning requirements, sanitary protection measures, and procedures for granting variances.

3. Wild and Scenic Rivers - The Minnesota legislature has acted to preserve some rivers that provide unique natural settings of "outstanding scenic, recreational, natural, scientific and similar values." Any portion of a river that is wild, scenic or has important recreational value may be included in the program.

   The Wild and Scenic Rivers Act also requires local governments to develop zoning ordinances to preserve natural beauty, prevent pollution, minimize crowding, prohibit poorly planned or inappropriate development and promote the general welfare of the public. These ordinances may vary from place to place, but they all must meet DNR standards for the designated rivers and adjacent lands. The regulations affect lot size and the number, placement and design of structures. Utility transmission crossings, roads and clearing of vegetation are also regulated.

Peatlands

In 1984 the DNR published a report titled: Recommendations for the Protection of Ecologically Significant Peatlands in Minnesota. This report identified 18 peatlands that the Department's task force believed were of special significance and should be given special protection. The report contained a Bill for an Act that was introduced in the Minnesota Legislature. Although the bill was not acted upon by the legislature, the Department's management policy with respect to mining in these peatlands is contained in that draft bill. Specifically, the bill stated that metallic or industrial mineral mining would not be allowed within the core areas of those peatlands that have been proposed as Scientific and Natural Areas. However, mining could be allowed in the watershed protection areas and core areas of peatlands proposed as Peatland Scientific Protection Areas provided:

1. An adequate environmental impact statement has been prepared and approved by the commissioner which describes the measures, including restoration measures, which must be taken to protect the peatland scientific protection area and which describes the measures that must be taken to minimize disturbances to the areas outside the mining area to surface or ground water hydrology or chemistry so as to prevent significant change to vegetative and landscape features outside the permitted area;

2. Following approval of a mining project and prior to mining activities at the site, the operator acquires and donates to the state of Minnesota other peatland acreage of ecological significance which has been identified by the commissioner as ecologically significant and in an amount twice the acreage of the peatland used as a mining area; and

3. The maximum combined total of all mining areas within peatland scientific protection areas shall not exceed 1,500 acres.

Reclamation

The Department's existing rules for the reclamation of iron ore and taconite mines address land-use conflicts associated with mining in the Siting Section of the rules. This section contains general criteria for site selections for those portions of a mining operation for which there may be flexibility in siting. These include: stockpiles, tailings basins, water reservoirs, processing plants, offices and auxiliary facilities. The rules require that these facilities be sited so that impacts on the public and other natural resources are minimized to the extent practicable. The rules also define areas of the state that are excluded from mining unless a state or national emergency exists which would require the development of mineral resources within these areas. Examples of Exclusion Areas for Mining include: the Boundary Waters Canoe Area (BWCA); national wilderness areas; national

parks; national monuments; state wilderness areas; designated state scientific and natural areas; state parks (except where such areas are established as a result of their association with mining); within a national wild, scenic or recreational river district; within 300 feet of any state trout stream; and within 500 feet of any occupied dwelling.

Finally, the rules identify Avoidance Areas where mining will not be allowed if there is a prudent and feasible alternative site. Examples of Avoidance Areas for mining include: within any national wildlife refuge or waterfowl production area; state wildlife management area; or on lands designated as national natural landmarks or national trails or any state designated trails.

The Department is in the process of writing rules for the reclamation of base- and precious-metal mining. These rules will also have to address conflicting land-use issues identified above.

Leasing

The majority (69 percent) of mineral rights in the state are privately owned while the federal government owns approximately 7 percent and the state of Minnesota owns approximately 24 percent. As managing agent for almost all of the state-owned minerals, the DNR is responsible for the leasing, exploration and mining of minerals on state lands.

In this capacity, the Division of Minerals has established a comprehensive screening process before it leases its mineral rights for exploration and mining. The purpose of this screening process is threefold:

1. To identify lands that the state does not want to lease for exploration and possible mineral development because the lands have greater value to society if undisturbed by mining (such as state parks);
2. To identify lands that may be offered for lease with the exception of certain features (such as the beds of unmeandered lakes); and
3. To identify lands that can be leased subject to some conditions or restrictions on exploration and mining procedures.

Prior to offering lands and mineral rights for lease, the Department conducts a review of all lands it is proposing for lease. As a part of the review, the Department publishes a Notice of Intent to hold a lease sale. This notice is sent to state agencies, public interest groups, interested explorers and developers and the public. The Department actively solicits input on the sale areas from the State Historic Preservation Office, the Environmental Review Unit of the MPCA, Voyageurs National Park, Superior National Forest, Chippewa National Forest and individuals who have raised issues in past lease sales.

The review includes discussions with environmental groups (e.g., Sierra Club, Audubon Society, Nature Conservancy) to allow them to make comments before making final decisions on lease areas. As a result of these discussions as well as discussion with other state agencies and Divisions within the DNR, lands proposed for lease are either: included in the lease sale; excluded from the lease sale; or included in the lease sale subject to certain conditions or restrictions being placed on mining and exploration.

Excluded Lands

Examples of lands excluded from past lease sales are described below.

1. Beds of all meandered lakes.
2. Beds of non-meandered lakes 10 acres or larger in area.
3. Beds of major or significant rivers, such as:
   a. Minnesota canoe and boating rivers;
   b. Wild, scenic and recreational rivers;
   c. Any rivers in the mining exclusion section of the Reclamation Rules for mining taconite and natural ore.
4. Islands (not offered since 1971).
5. State parks.
6. All lands within the boundaries of Scientific and Natural Areas.
7. All lands within the BWCA.
8. All lands within Core Areas that are proposed as peatland Scientific and Natural Areas.
9. All lands within the Mississippi Headwaters Corridor.
10. Portions of Black Bay Management Area near Voyageurs National Park.
11. All lands within the North Shore Lake Orientation Zone.

"Subject to" Lands

Lands leased "subject to" special mining and exploration conditions in past lease sales included the following:

1. Core Areas of Environmentally Significant Peatlands.
2. Lands within one-quarter mile of State Canoe and Boating Rivers.
3. Lands adjoining designated Trout Streams.
4. Lands adjoining the Taconite, Arrowhead State and North Shore Trails.
5. Wildlife management areas and acquired lands for wildlife management sites.
6. National Heritage Sites.
7. Historical and Archaeological Sites.
8. Recreational Sites.
9. Portions of Black Bay Management Area.
10. Fish hatcheries, spawning areas or rearing ponds (unless exemptions made with approval of Fisheries).

Some lands may be offered "subject to special review of exploration plans." These lands are in areas where special care is needed to insure exploration does not conflict with other uses of the land or adjacent lands. These other uses are usually for conservation or recreation. In past leases this special "subject to" has been added to some lands that are located within the following areas:

1. The Mining Protection Area of the BWCA or close to the BWCA.
2. The shore of Lake Vermilion.
3. The Fernberg Corridor (near the BWCA).
4. On the shore of the Rainy River.
5. Close to the Voyageurs National Park.
6. The shore of Tilson Creek near the Black Bay Management Area.
7. Lakes that are part of the MPCA's acid rain study.
8. The Birch Lake area (St. Louis County).

After a lease sale, all lands receiving bids undergo a final review to ensure no problems have been overlooked and also to address any environmental issues raised after the sale.

5.2.3.2 Minnesota Pollution Control Agency Response

MPCA is not a land management agency and has no direct control over land-use and zoning matters. However, MPCA has used the land use designations of others in setting and enforcing standards for various classifications of environmental media, as follows:

1. As provided in MPCA rules (Minn. Rules pt. 7050.0180, subp. 3), all discharges to waters of the state in state-designated Scientific and Natural Areas are prohibited, as are discharges to waters of the BWCA, Voyageurs National Park and federal or state wild river segments.

2. As provided in MPCA rules (Minn. Rules pt. 7050.0420), trout streams and lakes listed in DNR Commissioner's Orders 2089 and 2230 are classified as trout waters for regulatory purposes. Lake trout lakes are also classified as trout waters. This designation has the effect of placing a higher use classification on such waters (1B,2A), which in turn places more restrictive limits on dischargers.

3. As provided in MPCA rules (Minn. Rules pt. 7050.0180, subp.6), discharges to (a) designated lake trout lakes, (b) waters bounded by the zoning corridor placed along the Mississippi River from Lake Itasca to the southern border of Morrison County by the Mississippi Headwaters Board Comprehensive Plan, (c) federal or state-designated scenic and recreational river segments and (d) listed calcareous fens must pass a prudent and feasible test. This means that if there is no prudent and feasible alternative to discharging

to the above waters, MPCA must decide whether to permit the discharge and what restrictions would apply.

4. As provided in federal Prevention of Significant Deterioration (PSD) rules (40 CFR 52.21), Voyageurs National Park and the BWCA are designated class I areas for air quality purposes. This has the effect of placing special restrictions on sources whose emissions would affect either of these two areas.

Also, while MPCA has no regulatory interest in the BWCA Mining Protection Area as such, as a practical matter there is a high probability that a mining operation located within it would be upstream from an Outstanding Resource Value Water (ORVW). The rules (Minn. Rules pt. 7050.0180 subp. 1 and 9) provide that discharges to ORVWs and tributaries of ORVWs must be controlled so as to assure no deterioration of the ORVW.

Noncompatible uses: Wetlands are waters of the state, and any discharges to them must not result in water quality violations. MPCA will not permit their use as treatment systems except in extraordinary circumstances.

Exclusion areas: MPCA cannot issue permits for an operation which would require waste disposal in an ORVW in which discharges are prohibited.

In addition to the above considerations, it is also true that MPCA's permitting decisions sometimes have implications for land-use issues. For example, an operation which may be permittable with relatively few restrictions in one area may not be permittable, or permittable only with stringent constraints, in another area.

5.3.2.3 Environmental Response

Issue background:

A balance must be struck between conservation and development of our natural resources. Short term, one-time benefits to this generation derived from mining must be weighed against sustainable, often noneconomic benefits to all generations.

Irreplaceable natural treasures such as the BWCA, Voyageurs National Park, patterned peatlands and scientific and natural areas must forever be protected from the direct and indirect impacts of mining; no short-term economic gain can justify their loss or damage.

Recommendations:

1. Before state lands are offered for lease, they should be reviewed by the DNR Office of Planning resources or for uses that strongly conflict with mining. Areas identified with such uses or resources should undergo

formal environmental review to determine if land-use conflicts would preclude mineral development. If so, those lands should not be offered for lease. Neither the industry nor the public is served by spending money to explore for minerals that are unmineable due to land-use conflicts.

2. Land-use review must be conducted before state leases for exploration containing the implicit right to mine are granted.(1) If mining is incompatible with other land uses, then it is deceptive to lease the land only for exploration. The objective of any exploration program is to find a mineable mineral deposit and mine it.

3. State lands within the boundaries of the Federal Boundary Waters Wilderness Mining Protection Area should be managed in accordance with federal policy. Existing leases on state lands within the area should be bought out.

4. The core areas of all peatlands identified as ecologically significant by the DNR should be protected as state scientific and natural areas.(2) Surrounding watershed areas must be managed to preclude any impact on core areas.

5. Draft DNR mineland reclamation rules should be amended to make all categories of wetlands "mining avoidance areas." Impacts on wetlands from mineral development should be avoided whenever possible, with facilities and access roads situated to minimize impact.

6. Waste dumps and tailings basins should never be permitted in wetlands. The elevated water table guarantees that contaminants from the waste will be transported off site. (See environmental comments in section 5.6.2.3)

7. Natural wetlands should not be used as replacements for water treatment systems. All discharges to wetlands must meet strict water quality standards at the point of discharge. (See environmental comments about wetlands treatment in section 5.4.2.3)

8. The state should adopt a "no net loss" policy toward wetlands that are drained or otherwise destroyed by mining. These lands must be replaced by restoration of wetlands of equal or greater ecological value in the same watershed.

9. A statewide DNR management plan should be developed for the protection of rare and endangered species, under the 1973 State Environmental Policy Act.

Issue background:

Mining is an intensive, extractive land use. Developing a mine in an area may preclude competing uses such as forestry, outdoor recreation, wilderness and species habitat. The mine can create impacts such as noise, traffic, dust and polluted water discharges that may affect a wide surrounding area. After reclamation, some land uses may be partially or wholly restored. However, other uses such as wilderness, old-growth forest, natural wetlands or habitat for rare species may be lost forever when a decision to mine is made.

At the heart of some of the bitterest mining controversies lies a question of values; "Is mining the best use of the area?" In many cases, the answer is "no."

Land-use was a major conflict in two proposed Mining Simulation scenarios:

1. A proposal located in, and later near, the Boundary Waters Canoe Area Wilderness Mining Protection Area which was finally dropped from the project;

2. Another proposal for mining in and near scientifically significant patterned peatlands, named "Jeep Trail," was ultimately "located" in the Mulligan Lake peatland.

All scenarios raised the questions about the impacts of mine development on habitats for rare and endangered species.

Land-use Conflicts in Minnesota - Findings:

The Mining Protection Area is a Federally-designated buffer zone along some of the most affected border areas of the BWCA Wilderness. With the designation of the buffer zone with Public Law 95-495 in 1978, Congress recognized the BWCA as a national treasure to be protected from impacts of nearby mining.

The legislation applies directly only to lands and minerals owned by the Federal government, which predominate in the designated zone. Traditionally, states adopt the federal management policy to manage state inholdings.

In this case, the DNR, over environmentalists' protests, chose to ignore the Federal precedent and in 1983 leased lands within the Mining Protection Area to two mineral exploration companies. A proposal to mine in this area will result in an intense political and legal battle. The state's environmental community is united in opposition to the development of any mine within the

Mining Protection Area and advocates that the state's management policy conform to the Federal government's.

Minnesota's Ecologically Significant Patterned Peatlands were identified by the DNR in an extensive study conducted in the late 1970s and early 1980s. Of the 6.2 million acres of peatlands in the state, approximately 175,000 acres (2.8 percent) were designated "Ecologically Significant" based on millions of dollars of scientific investigation. An additional 320,000 acres of "Watershed Protection Areas" surrounding these core areas were identified as critical to the protection of the core areas.(3)

The peatlands are unique for a number of reasons. They are home to numerous rare and endangered species, as well as other game and non-game species.(4) They are the only extensive ecosystem in the state to survive relatively intact, offering the opportunity to develop management plans to protect ecologically significant areas instead of whatever remains after development. In addition, they are an important laboratory for ecological research into peatland developmental processes and regional hydrology.(5)

The DNR has developed a management plan that prohibits mining in core areas of four of the 18 peatlands and puts restriction on mining in the remaining peatlands. However, it has failed to formalize the management plan; consequently, all of the ecologically significant peatlands remain at risk today. Many mineral leases have been awarded in these peatlands since their identification.(6)

Environmental and conservation groups have recommended the protection of the "core" areas of identified ecologically significant peatland as Scientific and Natural Areas. No mineral exploration or development should occur in those areas, and great care should be taken to protect the core lands from impacts of development on surrounding areas.(7)

Wetlands play a critical role in Minnesota's environment. They provide habitat for game and non-game species and regulate surface water flow by storing water in time of high precipitation and runoff, and releasing it in times of low flow. Wetlands also provide critical fisheries habitat, recharge the ground water, and serve as a natural water treatment system to remove contaminants. More than 75 percent of Minnesota's already-reduced area of types 3,4, and 5 wetlands were drained or filled between 1953 and 1984.(8)

Mining can impact wetlands directly with shafts, causeways, subsidence and drainage if the ore deposit lies beneath. Indirect impacts may come from siting facilities, roads or waste dumps in wetlands or their watersheds; lowering water tables with pumps; or by discharging waste water to wetlands. (See environmental comments section 5.4.2.3)

The DNR supports a "no net loss" policy toward wetlands in Minnesota and will be instrumental, through permit stipulations, in mitigating any wetlands lost to mining operations.(9)

Rare and endangered species and their habitats are protected to safeguard the diversity of Minnesota's natural heritage. Even the smallest of organisms contain large amounts of genetic information, lost forever with extinction. Each species lost eliminates the opportunity for future biological research and its potential for increased scientific knowledge and economic benefits.

The rarest of species serve as sensitive indicators of the health of the natural world. Rare species act like canaries in a coal mine. Decreases in populations and in species abundance warn of environmental decline that affects us all.(10) Stabilization and recovery of populations of rare species offer us hope that we are making progress in maintaining a healthy environment.

Minerals are alike, whether mined in Minnesota, Montana or Mozambique. These commodities are traded in a global market. Minnesota's rare species exist only in their unique habitats. Once their habitat is disrupted, they are lost. It is often impossible to re-establish the specific environmental conditions necessary for their reintroduction.

Mining impacts on habitats for rare and endangered species must be avoided whenever possible and mitigated to the extent that they are unavoidable. The State Environmental Policy Act states that "it is the continuing responsibility of state government... (to)... preserve important existing natural habitats of rare and endangered species of plants, wildlife and fish, and provide for the wise use of our remaining areas of natural habitation, including necessary protective measures where appropriate."(11)

In the 16 years since the passage of the Act, the DNR has not implemented a state-wide management plan to protect rare and endangered species. No formal process is in place to balance the requirement to protect these species with impacts caused by mining.

Recreational uses of forests and waters are often altered or precluded with mineral development. Shorelands, streams, lakes, forests and fields are important to fishermen, bird watchers, hunters, hikers, campers, canoeists and wildlife enthusiasts. Outdoor recreation annually contributes more than $700 million to Minnesota's economy.(12) Noise, dust, traffic and polluting discharges from mining degrade recreational opportunities nearby.

Recreation and residential use have conflicted for decades with mining proposals near the southern and western approaches to the BWCA in the Superior National Forest. Stretching from Lake Vermillion on the west, past Burntside, Shagawa and Fall Lakes, to the South Kawishiwi River on the

east, the area has seen iron and taconite mining, as well as periods of interest in gold, platinum, copper and nickel mining. It is an intensely utilized recreational area with thousands of homes, resorts and cabins and provides access for more than half the BWCA's annual visitors.(13)

Public attention is currently focused on a BHP-Utah exploratory drilling program between Shagawa and Fall Lakes, just outside the BWCA Mining Protections Area. The company was recently awarded a lease covering 289 acres of the bed of Shagawa Lake.(14) Much of the exploration is taking place on private lands. There are strong local concerns over the impacts of exploratory drilling and mining on water quality and the appropriateness of contemplating mining in watersheds that flow into the adjacent BWCA, just a few miles downstream.(15)

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(1) State "exploration leases" are titled, Lease To Prospect for, Mine and Remove Metallic Minerals.
(2) Minnesota DNR, Recommendations for the Protection of Ecologically Significant Peatlands in Minnesota, 1984, p. 15, Table 1.
(3) DNR, Recommendations for Protection, pp. 16-18.
(4) U.S. Fish and Wildlife Service, Biological Report #85, The Ecology of Patterned Boreal Peatlands of Northern Minnesota: A Community Profile, Paul H. Glaser, 1987.
(5) DNR, Recommendations for Protection, pp. 1-9.
(6) The boundaries of these peatland management zones have not been entered into the DNR's computerized lease records. The Department cannot quickly determine which and how many leases fall into these zones. PEF is currently reviewing more than 600 leases issued since Nov. 1984 to determine the actual number.
(7) Don Arnosti, et al., letter to William Brice, DNR Mineral Division Director, June 8, 1989.
(8) DNR, Division of Waters, Minnesota's Protected Waters and Wetlands Inventory, David B. Milles, August 1988, pp 1-2.
(9) Steven Thorne, DNR Deputy Commissioner, letter to Darby Nelson and Don Arnosti, May 25, 1989.
(10) Barbara Coffin and Lee Pfannmuller, ed., Minnesota's Endangered Flora and Fauna, MN DNR, 1988, Foreword.
(11) Minn. Stat. ch. 116D, subd. 2(j).
(12) T. Kelly and W. Becker, DNR unpublished report, 1985, figure C4.
(13) Ely Chamber of Commerce.
(14) DNR Lease to Prospect for, Mine and Remove Metallic Minerals, Number MM-9385-N, Oct. 4, 1989.
(15) DNR "Record of Decision" for Spaulding Bay Exploratory Drilling Project, Aug. 16, 1989. Twenty-three of the forty comments were from local residents.

5.3.2.4 Industry Response

In terms of the existing process, land-use issues will be identified and addressed in the environmental review process and will be resolved by the RGU (in this case the DNR) and by the DNR as part of the issuance of the mineland reclamation permit (the "permit to mine"). Where federal lands are involved, an environmental review by appropriate federal agencies will also be required. Local viewpoints may additionally be reflected by county or municipality zoning requirements.

Land-use issues will have an important bearing on the design of a mining operation; early identification of these issues may allow some compensation for potential conflicts in the design. In some instances conflicts regarding land use may be the most critical issues facing the project sponsor, the regulatory agencies and the public.

Orebodies are unique and rare natural features. Unlike most industrial developments, the location of a mine cannot be selected from one of many areas; ultimately, the mine and related facilities will be located at or near the site of the orebody that has been discovered.

Because orebodies are unique and rare and because society needs the raw materials and economic benefits that they produce, few, if any, areas should be closed to exploration. Exploration is not a land-use decision and, if properly done, in and of itself has little or no impact (see Section 5.1). However, successful exploration depends on the ability of explorers to test a large number of targets in favorable geologic terranes because the "odds" of any one target being an orebody are very small. Probably fewer than one in one hundred drilled targets ever are considered for economic development.

After successful exploration is complete, an evaluation can then be made, on a site-specific basis, of the impact of a possible mining operation. This evaluation and the design of a mining operation must balance the physical, economic and environmental constraints and costs of the proposed operation in the specific area where the orebody is located against the resultant benefits. The actual amount of land required for a base or precious metals operation is typically small, ranging from tens to hundreds of acres. Against this must be balanced the productivity of this land in terms of jobs and economic activity.

At any particular site, there typically are some alternatives available for the location and construction of at least part of a mine's facilities. Thus, "costs" can be reduced with perhaps only a marginal reduction of the economics of operation. Early communication with local area residents, local political jurisdictions, the appropriate state and federal governmental agencies and the environmental community regarding mine design and the layout of the facilities will help reduce conflicts and may improve design. The resulting dialogue will permit a full discussion of costs and benefits and practical design alternatives.

5.4 Water

5.4.1 Explanation of the Issue

Surface water and ground water resources are a valuable asset and a critical concern at the local and state level. New and expanded discharges from mining operations must meet water quality nondegradation requirements. An operation must also meet permit requirements for alteration of protected waters, and appropriation and discharge of waters. Prior to any mine construction, permits addressing these issues must be obtained from the PCA and DNR as well as other appropriate agencies (such as U.S. Army Corps of Engineers, U.S. Forest Service, Minnesota Department of Health, U.S. Mine Safety and Health Administration).

5.4.2 Comments

5.4.2.1 Department of Natural Resources Response

Chemical, mineralogical and physical characteristics of mine wastes are important factors in determining the water quality of drainage from the wastes. A major requirement of the Division of Minerals' draft reclamation rules is the characterization of waste materials prior to mine development so that projections on water quality impacts can be made. The projections will allow appropriate reclamation techniques to be implemented to mitigate these impacts.

To initially estimate the extent and compositional variability of the wastes, the range and average values must be provided for sulfur content, sulfide mineralogical characteristics, buffering mineral abundance and trace metal content. The characterization must account for compositional variation within the waste and must, therefore, consider the geology of the specific site (e.g., individual formations, rock types, etc.). The frequency of analysis can be determined only by reviewing detailed data from the site (i.e., geology and mine plan) and must allow for estimating the mass of waste within various compositional categories.

The major focus of the more detailed characterization studies is to determine the tendency of a waste to produce acid drainage. This is determined by comparing the acid-producing potential (APP) and acid neutralizing potential (NP) of the waste. Quantifying these parameters on pre-mining samples, such as drill core and bench test or pilot plant tailings, is the first step in mine waste characterization. It will identify wastes which will most likely produce acid (high APP, low NP) and extreme nonacid producers (low APP, high NP). Intermediate solids would be subject to further characterization.

Mineralogical characteristics, such as the sulfide mineral grain size, mode of occurrence and size of sulfide liberation also influence the acid-producing behavior of the mine waste. Description of these characteristics may be necessary for a more refined estimation of the acid-producing character of the waste.

Any trace elements present in the waste can be released with either neutral or acidic drainage. However, the extent of release will be much greater with acidic drainage. Since release of these constituents alone can adversely impact natural resources, their identification and quantification is also required.

Laboratory dissolution tests must be conducted on characterized wastes to determine the relationship between waste composition and drainage quality. For example, for wastes in which comparison of APP and NP does not clearly

indicate the acid-producing character of the waste, laboratory dissolution tests will be used to determine if they are acid producers.

Detailed characterization of operational wastes, particularly the variation of composition with particle size, is required to extrapolate the characterization and laboratory results to the field. Construction of test plots to examine the dissolution of field-scale wastes under natural conditions may be required to revise estimates based on the initial waste characterization and laboratory dissolution tests.

Estimates on the quantity of water that will drain from these wastes when placed in stockpiles or tailings basins can be obtained with hydrological modeling such as the EPA HELP model. Combining water quality and water quantity estimates, it is possible to predict total annual mass release of materials from the waste disposal facility.

Comparing mass release with environmental baseline monitoring information on the quantity and quality of existing water resources (baseline monitoring data required by MPCA and in the EIS) allows an evaluation of impacts on natural resources to be made and effective mitigation techniques identified. As part of the evaluation, numerical water quality standards and compliance points have to be made (MPCA-NPDES/SDS permit). Based on the projected impacts, reclamation procedures can be designed to minimize impacts, and these requirements can be incorporated into the DNR's Permit to Mine.

The DNR Division of Waters is responsible for regulating water quantity impacts through their Protected Waters and Appropriation Permit program. These permits typically focus on mitigation through either engineering design or relatively minor site relocation. Thus, resolution of large water-related land-use conflicts by waters permitting is difficult to achieve if not addressed by existing law (such as floodplain, shorelands, or wild and scenic rivers legislation previously discussed). Precious-metal mining operations typically do not use large quantities of water, nor do they affect large areas of land, which result in large-scale watershed alterations. For this reason, water use and watershed alteration issues (other than associated land-use issues) are not expected to be as great as they are with taconite mining.

Impacts such as the effects on peatland hydrology, ground water impacts from mine dewatering and post-operational runoff design should be anticipated to the extent possible, identified in the Environmental Review (ER) scoping process and properly evaluated through the EIS and permitting processes. Proposed watershed alterations or water appropriation will likely require the gathering of pre-operation baseline data/information. Assuming these issues are identified through the ER scoping process, the specific permit data/information needs may be met prior to completion of ER. However, in the past, the ER process has not always included this information in appropriate detail.

Pre-operational data/information needs normally focus on characterization of seasonal climatologic and hydrologic aspects of the proposed area to be mined or site-specific hydraulic conditions. Sufficient data/information is needed to properly assess operational impacts and guide post-operational closure plans. For example, pre-operational characterization of potentially affected ground water and surface water resources will be essential for proper facility siting and design, operational impact evaluation and post-operational closure design.

Operational data/information needs (permit requirements) normally include monitoring volumes and timing of water appropriated, efficiency, erosion control success associated with miscellaneous Protected Waters Permits, and parameters necessary for the evaluation of the safety of dams. The direct effects on nearby ground water and surface water resources may also have to be monitored, and contingency plans developed to deal with potential problems.

Operational downstream water quantity impacts may be mitigated through distribution or timing of release of water from dewatering. Post-operational downstream water shortages caused by mining may require temporary, supplemental pumping as mitigation until pit or mine water levels stabilize.

Operational and post-operational dam safety is a major concern, requiring extensive engineering design, monitoring and detailed reclamation planning. Perpetual post-operational maintenance and monitoring may be necessary as long as the dam is subject to dam safety rules. Conceptual plans for both anticipated and premature closing must be submitted with the dam safety permit application.

5.4.2.2 Minnesota Pollution Control Agency Response

As a general rule, DNR regulates water quantity issues (appropriations, dams) and MPCA regulates water quality issues (compliance with standards). MPCA issues permits for all disposal systems and discharges to waters of the state and must approve plans and specifications for all treatment and disposal systems, as well as for storage systems and circuits which have the potential for effects upon air and water quality. MPCA is the EPA designate for NPDES permitting.

Additionally, MPCA would be interested in water quantity issues in cases such as those in which the waste assimilation capacity of a receiving water might be jeopardized by an appropriation. Information on the 7Q10 of streams (i.e., the lowest weekly average flow which has a 10-year recurrence interval) would also be required and would be used in calculating effluent limits.

The resources available to MPCA to be employed in regulating water quality compliance have not kept pace with the burgeoning number of

pollutant sources, on the one hand, and increasingly stringent federal requirements, on the other. This sometimes leads to delays in permit issuance and deferment of needed inspections and compliance monitoring activities. More funding and staff are needed in order to properly address this problem.

Characterization. A thorough understanding of subsurface geology and hydrogeology is very important. Lack of such information requires MPCA to assume a worst-case condition and to write permits very conservatively (i.e., restrictively).

MPCA will require at least one year of baseline water quality data in surface water to cover all four seasons of the year. Parameters to be sampled for would be established by MPCA based on experience at similar sites, rock characterization studies and other considerations. Hardness of the waters would have to be be determined and metals should be analyzed using low-level detection methods. Baseline work should be largely accomplished before a permit is applied for.

The sources, fates, mobility, behavior and toxicity of ALL contaminants must be reported to MPCA so that mass-loading estimates can be made for permits and for nondegradation analysis purposes and to ensure that all discharges meet toxicity and/or water quality standards.

All spills must be reported to the MPCA as soon as they occur. The rules provide for a stipulation agreement and a fine of up to $10,000/day for operators who fail to report a spill. The owner is liable for the cost of the cleanup and is required to file a spill response plan prior to operation.

Protection. The policy of the state of Minnesota is nondegradation of waters of the state (both surface and ground waters) by pollutant discharges. The essence of Minn. Rules pts. 7050.0180 and 7050.0185 is that existing permitted loads that do not violate water quality standards are frozen and new or expanded discharges will be controlled so that the remaining assimilative capacity of receiving waters is not exhausted. Both point and nonpoint pollution are regulated under this rule. The essence of Minn. Rules ch. 7060 (Underground Waters) is that ground water must be protected as nearly as possible in its natural condition. This policy was recently reaffirmed by the legislature in the Water Bill of 1989 (Minn. Stat. ch. 103H).

The first step towards understanding how nondegradation applies to a specific discharge is to determine if the receiving water is an Outstanding Resource Value Water (ORVW, Minn. Rules pt. 7050.0180). If the discharge is new or expanded and the ORVW is listed in Minn. Rules 7050.0180, subp. 3, a discharge will not be allowed. If the discharge would go to an ORVW listed in subpart 6, the discharger must investigate prudent and feasible alternatives to a discharge. If there are no alternatives, then MPCA will decide whether to issue a permit and what restrictions would apply. Note

that discharges upstream from an ORVW will be controlled to protect that ORVW. Also note that MPCA has the authority to preserve the outstanding characteristics of waters not specifically listed in the rule (Minn. Rules 7050.0180 subp. 7).

If the receiving water is not an ORVW, then the "nondegradation for all waters" rule (Minn. Rules pt. 7050.0185) must be complied with. If the discharge is new or expanded and is significant, MPCA will decide whether additional control measures are reasonable to minimize the impact. Because of the complicated nature of these rules, a company anticipating a discharge must meet with MPCA for further interpretation of the nondegradation requirements.

Nondegradation Key

1. Is the discharge to an Outstanding Resource Value Water?
   A. yes.....see 2
   B. no.....see 4
2. Is the discharge prohibited or restricted?
   A. prohibited.....see 3
   B. restricted.....see 6
3. No discharge will be allowed.
4. Is the discharge upstream from an ORVW?
   A. yes.....see 5
   B. no.....see 9
5. The discharge will be controlled to assure no deterioration in the ORVW.
6. Is the discharge new or expanded as of Nov. 4, 1984 (March 7, 1988 for new ORVWs)?
   A. yes.....see 7
   B. no.....see 8
7. The discharger must identify prudent and feasible alternatives. If alternatives are not available, the MPCA will decide whether to issue a permit and what restrictions would apply.
8. Nondegradation does not apply.
9. Is the discharge new or expanded as of March 7, 1988?
   A. yes.....see 10
   B. no.....see 8
10. Is the discharge significant (200000 GPD or 1 percent increase in toxics concentration)?
    A. yes.....see 11
    B. no.....see 8
11. Using information from the discharger, the MPCA will decide whether additional control measures are reasonable to minimize an impact.

Under Minn. Rules chs. 7050 and 7060, the state's nondegradation policy applies to ground water as well as surface water. The federal Resource Conservation and Recovery Act of 1976 (RCRA) requires no elevation of contaminant levels above background concentrations. MPCA rules require that the more stringent requirement be applied in case of conflicts.

Passive wastewater treatment systems are desirable, but may not be suitable in all cases. Active treatment will be required if it is necessary to meet standards.

All disposal systems require a permit. Any waste disposal systems that include direct discharges to surface waters of the state must be permitted by MPCA prior to construction under the NPDES and SDS programs. Systems which do not discharge or discharge only to ground water must be permitted by MPCA under the SDS program, again, prior to construction. MPCA must also approve plans and specifications for all disposal systems prior to permitting, as well as other systems which have the potential to pollute the air or the waters of the state.

Lime addition is of dubious utility as the sole treatment for stockpile runoff, since the resulting supernatant may not meet discharge limits and the process will produce a sludge which may be difficult to dispose of properly.

Mine-site runoff is a wastewater, the disposal of which must be permitted by MPCA. This is also true of pumped mine water which must be discharged.

Disposal and storage facilities whose seepage or runoff would violate ground or surface water quality standards must be lined and any seepage or runoff treated before discharge. Other containment measures may be necessary, depending on the nature of the waste and its disposal location. MPCA's seepage guideline for sewage ponds is 500 gal/acre/day, corresponding roughly in typically compacted clay to a liner permeability of .0000001 cm/sec. Lining requirements for mining waste disposal facilities would likely be aimed at meeting this seepage guideline. MPCA must approve plans and specifications for all such facilities before they can be installed or operated.

If backfilling of tailings or waste rock in the mine is contemplated as a disposal technique, information must be presented which demonstrates that ground water degradation would not result. MPCA has the responsibility (under the Water Bill of 1989) to develop water resource protection requirements for activities that impact ground water quality, in order to achieve nondegradation of ground water wherever possible.

Certain information about all tanks must be disclosed to MPCA. Aboveground tanks require permits; notification of the installation of below-ground tanks is required.

Disposal of hazardous waste on-site can be permitted by MPCA, but companies probably will not choose this option due to the lengthy and costly permitting process involved and the availability of the relatively cheaper alternative of turning such wastes over to a licensed hauler. Solvents, oils and greases, waste fuels, lead-impregnated lab wastes and metal-rich wastewater treatment sludges are examples of hazardous wastes potentially

produced by nonferrous operations. MPCA requires all Minnesota industries to evaluate their wastes for hazardous characteristics and disclose the results to MPCA. Wastes which are found to be hazardous are required to be disposed of according to the hazardous waste rules.

Monitoring. Although some information needs will be site-specific, basic needs include: characterization of rock; names, locations and flow paths of surrounding surface water bodies; hydrogeologic information; mine site and facilities locations and depths; mitigation/treatment system specifications and discharge points; composition of tailings effluent; process reagents; plans for emergency situations; and plans for financial surety and closure.

Initial monitoring requirements will be broad-spectrum. Once the preoperational water quality is sufficiently characterized, the monitoring (parameters and frequency) may be reduced. There are specialists in the MPCA and EPA who can advise companies on appropriate analytical methods. MPCA requires flameless (graphite furnace) atomic absorption methods for metals data that will be used for aquatic life criteria analysis.

Adequate preoperational and upstream monitoring allows the MPCA to set accurate permit limits without factoring in conservative assumptions that may produce more restrictive limits. MPCA calculations of toxicity equations and seasonal and nondegradation limits all require preoperational monitoring data. MPCA staff also need to know the baseline water hardness (Ca as $CaCO_3$ + Mg as $CaCO_3$); the rate, timing and location of the discharges; and the 7Q10 of the receiving water.

Monitoring must continue after the site is closed until it is clear that closure has been successful and financial surety can be released.

5.4.2.3 Environmental Response

Issue Background:

Water quality impacts, along with land-use conflicts, are the issues of greatest environmental concern for any mine developed in Minnesota. The state's clean water resources provide drinking water for the citizens; support a diverse habitat of forests, prairies and wetlands; and are a watery playground for Minnesota's $700 million outdoor recreation industry.(1)

Mining regulations must protect the state's water resources from acid drainage, toxic metals and leaking tailings basins containing cyanide, arsenic and process chemicals. The approach is three part:

1. Monitoring to delineate background conditions, determine effectiveness of design, operation and closure procedures, and monitor compliance with permit requirements;

2. Permitting to assess environmental hazards, determine what pollution standards will protect the environment and follow with strict enforcement of permit requirements;

3. Comprehensive design to reduce pollution through facility design and operation, containment and treatment.

Recommendations:

Monitoring

1. Gather sufficient baseline data to make a statistically significant determination of pre-operational environmental conditions. This will require data gathered monthly over a period of at least 30 months.

2. Avoid impacts to the environment from drawdown of wetlands, ground water, lakes and streams with properly designed water appropriations.

3 Make conservative regulatory decisions to protect human health and the environment.

4. Continue monitoring a properly closed mining facility for as long as the facility presents a hazard to the environment.

Permitting

Federal and state permitting systems require wholesale reform to address the build-up of pollutants in the global environment from permitted discharges. Recommendations include:

5. Establishment of a true "nondegradation" standard which requires effluent to meet background levels at the point of discharge.

6. Eliminate the "mixing zone" concept from all permitting processes. Permit standards should be established for the point of discharge, which should be the point of compliance.

7. Examine discharges to all waters for feasible and prudent alternatives before permitting. No permit should be issued if a feasible and prudent alternative to the discharge is identified.

8. Account for synergistic effects of pollutants in permitting with a three part approach:

a. Establish individual standards for pollutants;

b. Conduct whole-effluent toxicity testing on sensitive aquatic organisms using a 7 day LD_{50} test, with the proposed effluent and existing water from the discharge point;

c. Establish a biocriteria standard using the diversity and quantity of indicator organisms as a measure of the effectiveness of permitted standards in protecting the health of the aquatic ecosystem.

9. Conduct a study to determine if existing MPCA permitting procedures adequately protect ground water. The study should consider the option of developing a distinct ground water permit.

Prevention

10. Control acid drainage by preventing acid formation, minimizing moisture infiltration and collecting and treating any remaining drainage.

11. Dispose of all hazardous waste in a licensed hazardous waste disposal facility.

12. Do not use natural wetlands as low cost replacements for water treatment systems. Discharges to natural wetlands must meet water quality standards at the point of discharge.

13. Design water treatment facilities to exceed permit requirements under all operating and climatic conditions.

Findings:

Monitoring

The first step to protecting water resources is to characterize conditions existing prior to mining with careful monitoring. Next, impacts of the proposed development must be modeled using this data to develop protective water quality standards. Finally, emergency response actions and reclamation plans are developed as a part of permitting. Monitoring continues through operation, closure and postclosure activities.

Aquatic life must also be studied in surface waters, with close attention paid to sensitive "indicator species" such as Daphnia and trout. The population fluctuations of these species can serve as sensitive monitors of the status of their environment.

Impacts to water resources of water appropriations, discharges, seepage and spills should be modeled in DNR water appropriations permitting. This modeling can help in the design of the monitoring system and helps to shape the final engineering design to minimize these impacts. Water appropriations

should be modeled both for normal climate and operating conditions, as well as maximum operations under drought conditions.

Ground water and surface water monitoring systems must be designed and implemented properly to provide answers for environmental review and permitting. Concerns must be identified for proper design of the monitoring system. They may include:

1. What is the base flow of the stream?
2. How much mercury occurs naturally in the ground water?
3. What is the seasonal variation in pH in the pond?

Next, parameters to be tested for must be identified, such as:

1. Mercury
2. Arsenic
3. Cyanide
4. Copper
5. pH
6. Organic chemicals
7. Hydrocarbons

Prior to mining, monitoring must be conducted for these parameters to establish existing conditions.

The third step is to agree upon scientifically sound analytical methods. The use of agreed-upon methods for all analysis will provide comparable data.

Fourth is establishment of undisturbed reference areas containing similar characteristics to the proposed project area (the "paired basin" approach). They should be monitored for all parameters before start-up in parallel with the project site and after project start-up to provide reference data.

Finally, a data analysis protocol should be devised and signed by all regulatory agencies and the project applicant. It should cover statistical methods, allowable variability from seasonal means, levels of compliance and noncompliance and agreed-upon responses. These should be agreed upon in advance, so there is no delay in devising and implementing remedial actions, should they become necessary.(2)

For best analysis, 30 months of data should be gathered before project start-up in order to develop an understanding of natural fluctuations. Sampling should occur monthly when establishing long-term general trends; more frequently in areas of acute concern (downgradient from a tailings basin).(3)

Monitoring must commence prior to operations and continue through operation, deactivation and closure. Monitoring must continue after closure to

assure that tailings containment structures and other similar systems are functioning properly to isolate contaminants from the environment.

Permitting

MPCA water quality permitting processes, modeled on the federal EPA processes in most instances, moderate but do not eliminate discharge of pollutants to water.

With information from hydrologic studies and monitoring, regulatory standards are developed by agencies. Permit stipulations can alter final mine and mill design or necessitate additional water treatment to reduce impacts.

The Mining Simulation studied several of the MPCA's most important water quality regulations.

Nondegradation standard: Nondegradation is an admirable goal that is not achievable with these rules; allocated discharge is a more accurate description. This approach uses the rationale of "assimilative capacity:" the concept that the environment has a capacity to assimilate a certain amount of pollution without significant effect. (It is this rationale that has permitted ocean dumping, deep well injection of hazardous wastes, and tall smokestacks on smelters.) A brief summary of nondegradation policy:(4)

1. Nondegradation applies to all significant discharges to waters of the state. All mining discharges are likely to be judged significant.

2. An "assimilative capacity" for a given pollutant is calculated for the proposed receiving water. If present levels of contaminants are less than the calculated assimilative capacity, the difference between existing levels and the theoretical capacity is available to applicants in a discharge permit, if the applicants can demonstrate public benefit from their proposal. All or only part of the remaining assimilative capacity may be granted in the discharge permit, depending on benefits to the public.

3. For most discharges, a mixing zone is designated within which contaminant concentrations may exceed standards. This zone is the dilution area, at the boundaries of which concentrations must be diluted to permittable levels.

(Permits for discharges to lakes and to streams with a potential zero base flow (7Q10=0) already eliminate mixing zone calculations in permit development.(5) Calculation of pollutant's behavior in mixing zones under various stream conditions only adds uncertainty to the permitting and enforcement process. Elimination of the mixing zone as part of the pollution treatment system would require that standards protective of human health and the environment be met at the point of discharge, before dilution. This leads to a more straightforward permitting process for discharge to all waters, a benefit to both the public and the regulated community.)

4. Designated "Outstanding Resource Value Waters" (ORVWs) receive extra protection and are classified in two categories:

a. BWCA, Voyageurs National Park, scientific and natural areas, designated wild rivers: prohibition on direct discharge to these waters. Discharges to tributary waters must have no impact on the quality of the downstream ORVW.

b. Designated waters including lake trout lakes, fens, designated scenic and recreational rivers, the upper Mississippi River and Lake Superior can have no permitted discharges unless "prudent and feasible" alternatives are not available. Upstream discharges must be controlled so as to assure no deterioration in the quality of the downstream ORVW.

Classified waters: Waters of the state are classified 1-7 and a,b or c according to their designated use.(6) Water quality standards for any given category of water are established to protect the primary use of that water: fisheries and recreation, drinking water, industrial use, etc. Standards are developed using known or calculated effects of pollutants on the aquatic environment.

Synergistic effects of pollutants are inadequately compensated for in permitting by the use of additive models that sum the health and environmental effects of individual pollutants. A prohibition on discharges that are acutely toxic (cause death of 50 percent or more of fish and other test organisms in 96 hours) is in the rules, however chronic (long-term) effects are not addressed by this approach and can impact species health or reproductive capacity.(7)(8) Permittable discharge standards vary from one water classification to the next. Generally, classifications with lower value use classifications allow higher levels of permitted discharges.

Seepage to groundwater is controlled by the MPCA through a variety of permits. No single "ground water" permit covers discharges to ground water. The nondegradation standard applies to ground water as well as surface water. All ground water is classified as drinking water, which provides for stricter standards than many other classifications.

Stipulations covering monitoring and remedial actions can be written into permits for facilities that will cause seepage, if MPCA staff identify the problem during permitting. The State Disposal System (SDS) permit, required for any disposal system, examines projected ground water impacts of the facility.

Stringent enforcement of permit requirements is needed to protect the environment. However, MPCA enforcement of existing water quality permits appears insufficient to prevent extensive and chronic violations. (See environmental comments, Section 5.4.2.3, recommendation #3.)

Prevention

Proper mine siting and mill design can limit degradation of water resources. DNR rules covering these issues are still in development. (See also sections 5.6.1 and 5.6.2.3.)

Erosion can be minimized by proper drainage control of waste piles, road shoulders, parking lots and tailings, along with prompt revegetation of those areas.

Seepage from tailings disposal facilities, run-off collection ponds, pipelines and waste-rock disposal areas must be minimized with proper design, seepage collection systems and monitoring.

Acid drainage can be controlled by prevention of acid generation and migration and by collection and treatment of acid drainage.[9][10]

1. Approaches to prevent acid generation:

   a. Remove sulfides from waste by floatation (a market must be found for the sulfides);

   b. Exclude oxygen from the acid-generating material by a covering of low oxygen-diffusing material, such as water, or saturated bog soils (soil and synthetic membranes have limited long-term effectiveness due to erosion, cracking, burrowing animals);

   c. Uniformly distribute a neutralizing base material such as coarsely ground limestone or calcareous rock throughout the waste.

2. Prevent acid migration by exclusion of water:

   a. Divert surface water away from the disposal facility: the best long-term solution is to select a site which minimizes the need for such diversion;

   b. Intercept or isolate ground water flows into the waste area and avoid areas of groundwater discharge;

   c. Prevent infiltration of precipitation - a difficult objective over the long term. The best system contains: a soil barrier, synthetic membrane cover, lateral drain and a vegetated soil cover. When intact, this system reduces seepage to .1 percent of precipitation.

3. Collection and treatment of acid drainage can be effective in the short term, but may need to continue for generations while acid mine drainage continues. Floods, fires, mechanical failure, power loss,

reagent supply interruption and loss of financing represent large risks to continuous long-term treatment. Some problems include:

a. Lime treatment produces potentially hazardous sludges whose volume may in the long run exceed that of the initial volume of wastes producing the acid drainage; disposal of the sludges is costly and potentially environmentally hazardous if future dissolution occurs;

b. Chemical treatment is effective, but may not be affordable in the long term;

c. "Wetlands treatment" (acidic metal-laden drainage is directed through a peatland, where many of the metals are accumulated in living and dead organic matter) has numerous drawbacks: questions about short-term continuous effectiveness and long-term maintenance, reduced effectiveness in winter and the long-term fate of metals accumulated in the organics.

The largest problem with wetlands treatment is that it is not a wise policy to use natural wetlands, critical for wildlife, flood control and ground water recharge, as a toxic metals dumping ground.

Above-ground and underground storage tanks for petroleum products should be of nonferrous construction or have other corrosion control systems to prevent seepage and be monitored closely for leakage. Care must be taken to contain spills and evaporation associated with filling and dispensing fuels.

Material handling, storage and disposal: Mill chemicals, lab and shop wastes, water treatment plant sludges, sewage and solid waste are all used and generated by mining operations. Many of these wastes meet the tests for classification as hazardous waste: ignitability, corrosivity, reactivity, toxicity extraction procedure (EP) toxicity, or are an oxidizer.(11) These materials must be treated and disposed of properly in licensed facilities.

Water discharges should be directed away from sensitive and high-value watersheds.

Water appropriations should be made in a manner to minimize impacts on ground water resources, wetlands and surface waters. Mitigation of surface water drawdown may be required if impacts from appropriations are large enough.

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(1) T. Kelly and W. Becker, DNR unpublished report, 1985, figure C4.
(2) Thomas Sanders, Robert Ward, et al., Design of Networks for Water Quality Monitoring (Water Resources Publications, Littleton, Colorado, 1983) pp. 248-259.
(3) Dr. Robert Ward, conversation with Don Arnosti, March 2, 1989.
(4) Minn. Rules pt. 7050.0180
(5) Minn. Rules pt 7050.0210, Subp. 7

(6) Minn. Rules pt. 7050.0200
(7) Minn. Rules pt. 7050.0210, subps. 5 (C and D)
(8) Herbert S. Garn, "Point and nonpoint source trace elements in a wild and scenic river of northern New Mexico," Journal of Soil and Water Conservation, Sept.-Oct. 1985, pp. 461-462.
(9) Dr A. MacG. Robertson, Long Term Prevention of Acid Mine Drainage, Proceedings, International Conference on Control of Environmental Problems from Metal Mines, June 20-24, 1988, Roros, Norway.
(10) Keith A. Ferguson, "Regulatory Trends in the Management of Acid Mine Drainage: Water Quality Impacts," Dec. 1988, pp. 11-13, Colorado State University
(11) Minn. Rules pt. 7045.0131

5.4.2.4 Industry Response

Insuring protection of water resources is of great importance to the industry. It requires determining baseline conditions of the ground and surface water systems, designing adequate disposal and treatment systems, monitoring operations and providing for proper closure of facilities following cessation of mining.

The responsible agencies should set reasonable and realistic standards. Except where identifiable significant risks to public health are involved, these must be such that they can be economically met within the bounds of existing practical technology.

It is important and accepted that the monitoring system be designed to adequately sample the area that can reasonably be expected to be affected by the proposed operation. Within the scope of reasonably available technology, monitoring must be sufficient to assure that the results are acceptable to all interested parties. The components to be monitored, the sampling and analytical methodology and the precision of monitoring should be appropriate to reasonable standards of public and environmental health and welfare.

Early in the process, there should be agreement between agencies and the operator as to sampling and analytical parameters, methodology, precision and reporting so that the operator is required only to submit a single consistent set of data. A consistent and appropriate set of standards -- and ways of measuring to see whether such standards are met -- is a prerequisite to being able to design and cost the facilities.

In most cases pre-permit monitoring over a period of one year, combined with historical data, should provide the necessary baseline information. This monitoring can be carried out concurrently with the environmental review process and other permitting activities. In most cases, actual mine construction (as opposed to production) will have only limited environmental impacts and further valid pre-operational monitoring can be continued during construction. This will permit acquisition of additional data and may allow for possible adjustments of proposed design or treatment methods, if required and agreed to by the appropriate agencies. Thereafter appropriate monitoring should be continued throughout operation and for a reasonable period after closure. The operator will need to know in advance of construction the

probable length of time during which post-operational monitoring and effluent treatment will probably be required.

Hazardous wastes are generally not expected to be generated in significant quantities by operations of base- and precious-metal mines. Under Minnesota rules disposal of hazardous wastes on-site requires a lengthy and difficult permitting process. In most cases, an operator will probably find it more economical to contract for disposal of such wastes with a licensed handler.

5.5 Air

5.5.1 Explanation of the issue

It is important that applicable ambient air quality standards and permit conditions be met by a mining operation. Most of the air quality issues will be addressed by the MPCA and in some cases will be reviewed by the U.S. EPA. However, some aspects of the mining operations such as dust from vehicular traffic and tailing basins, will also be addressed by DNR permitting.

5.5.2 Comments

5.5.2.1 Department of Natural Resources Response

The Department's Permit to Mine requires that tailings basins be vegetated or temporarily stabilized to control erosion (wind and water) of the tailings. Permanent vegetation is required to be established when a surface is no longer scheduled for tailings deposition. In the interim, temporary stabilization methods such as use of chemical binders, submersion under water, or temporary vegetation are required. The Department's permit also requires fugitive dust to be controlled on mine properties by such techniques as water spray, chemical binders (particularly useful on mine roads), anchored mulches, vegetation, and enclosure or containment.

5.5.2.2 Minnesota Pollution Control Agency Response

Particulates. A fugitive dust control plan will be required prior to issuance of an Air Emission permit to a mine/mill complex. Dust control is required on the crushing and other machinery as specified in the applicable New Source Performance Standard (40 CFR 60, Subpart LL). Merely en enclosing dust-producing activities is not sufficient. The operator will be required to provide additional information on the chemicals used to prevent fugitive dust on roads and stockpiles, since they may have water or air quality ramifications themselves.

Other pollutants. MPCA will require complete information on any fumes vented through laboratory hoods. Emissions of dust associated with

underground crushing when vented to the surface must comply with Minnesota Rules.

Any mining in northeastern Minnesota may raise concerns about asbestos-type emissions. These are currently regulated under the federal National Emission Standards for Hazardous Air Pollutants (NESHAPS), the PSD program (when it applies), and Minn. Rules pts. 7005.1550-7005.1610. Considerable difficulties are likely to arise if the asbestos issue is ignored until the public raises it. The occurrence of these materials in a proposed mining area must be addressed by the applicant as part of the Air Emission Facility Permit Application and in environmental review documents.

Finally, the emerging federal and state air toxics programs could require a determination of the occurrence and emissions of a very large number of otherwise unregulated substances. Prospective developers are well advised to thoroughly analyze the chemistry of the orebody and associated rocks and communicate with MPCA DAQ to determine what impact assessments will be needed.

Noise. The blasting activities must comply with MPCA noise rules (Minn. Rules ch. 7010).

Special restrictions. Mining operations within 30 miles of either BWCA or Voyageurs National Park are likely to fall under the federal PSD permit regulations. Mining within six miles makes this permit a requirement. This permit requires, among other items, that the industry perform dispersion modeling and demonstrate that the most stringent pollution control technology available is used for every pollutant emitted.

5.5.2.3 Environmental Response

Recommendations:

1. The amount of toxic HCN gas released from tailings basins containing cyanide should be estimated in advance of permitting, so that air quality impacts can be modeled and controlled through permit requirements.

2. An independent study should be conducted to ascertain the level of compliance with existing air and water quality permits. The study should determine the effectiveness of the permitting system in protecting the environment and recommend necessary changes in enforcement activities or authorities. (See also environmental comments in Section 5.4.2.3)

Issue Background:

Mining and milling operations may impact air quality with particulates, airborne toxics, vehicle exhaust noise and vibrations. Impacts on high-quality areas such as the BWCA and Voyageurs National Park are of special concern.

Smelting, the process of refining metals with heat, emits large quantities of sulfur dioxide (SO_2) (which contributes to acid rain) along with metals such as mercury, arsenic and lead. Smelting is integral to metal production, but very large ore deposits are required to consider the permitting and construction of a new smelter. It is considered unlikely that anyone would propose to build a smelter in Minnesota.

AIR QUALITY IMPACTS FROM SMELTING ARE OF A MUCH LARGER MAGNITUDE THAN FROM MINING AND MILLING OPERATIONS AND ARE CAUSE FOR GREAT CONCERN. THE IMPACTS OF SMELTING ARE OUTSIDE THE SCOPE OF THIS PROJECT.

Findings:

The manner in which existing and proposed rules and regulations would handle these issues is unknown. The MPCA and DNR have never permitted a nonferrous metal mine.

Particulates: Dust composed of rock particles, metals and ore concentrates may originate with open air blasting, rock crushing, road traffic and concentrate shipments, as well as in waste rock disposal areas and tailings basins. Airborne toxic particles may include trace metals such as antimony, arsenic, cadmium, mercury, vanadium and strontium, or primary ore metals such as chromium, cobalt, copper, lead, molybdenum, nickel, silver, titanium and zinc.

These sources generally can be controlled with proper blasting techniques; bag houses, static precipitators or wet scrubbers to collect dust from crushing; use of water or wetting agents on roads and disposal areas; prompt revegetation of disturbed areas; underwater tailings deposition; enclosed transfer facilities; and covered trucks and rail cars for concentrate shipments. These control measures must be specified in MPCA and DNR permits.

Gases such as nitrogen oxides, sulfur dioxide or carbon monoxide may be emitted by on-site heating or energy plants, as well as vehicles working above or below ground. Below ground, worker safety requires that large volumes of fresh air be circulated to keep the concentrations of vehicle emissions at safe levels. Where ventilation shafts exhaust to the surface, the gases must be controlled to conform to air quality standards.

Highly toxic hydrogen cyanide gas may be formed by improper pH control in a gold-leach circuit and as a byproduct of natural cyanide degradation in tailings basins and treatment facilities.

Vapor emissions are produced by volatile organic compounds such as solvents or fuel. Fuel storage areas at a mining facility must conform to monitoring and spill clean up procedures for gas stations. Concentrate

driers, test laboratories and product refinement operations such as for dore production are sources of air emissions that must be controlled with requirements in the MPCA air quality permit.

Noise and vibrations from blasting, rock crushing and traffic must be controlled to minimize disruption of activities on surrounding lands. Proper design and management stipulated in DNR and MPCA permits should control these impacts.

Class I air quality areas such as the BWCA and Voyageurs National Park receive extra protection. Air quality modeling requirements are placed on facilities located within 50 km; facilities within 10 km must obtain a federal "Prevention of Significant Deterioration" Permit, which requires use of best available control technology.

If air quality impacts cause concern to the federal land manager of these areas, the manager may request that the permit be denied. State permits granted in spite of this request may be appealed by the land manager to the U.S. EPA for review.(1)

(1) 40 CFR Section 52.21

5.5.2.4 Industry Response

The impacts of a base- or precious-metal mining operation on ambient air quality are anticipated to be relatively minor. Emissions to the atmosphere from the extraction and milling of a base- or precious-metal ore commonly occur in small amounts that can be contained. If open pit mining is carried on, dust palliative measures can be undertaken. Most other operations, such as crushing and grinding and tailings disposal, are all undertaken as wet operations and are not significant dust generators. Of possible greater concern are traffic-generated air quality problems related to moving people and material to and from the operation. Noise and vibration standards must also be observed, but in most cases can be met with current technology.

5.6 Design/Operation/Closure/Postclosure Care

5.6.1 Explanation of the issue

The proposed mine plan and permit application must address design, operation, closure and postclosure care. Plans for closure and post-closure care are required to be an integral part of the original mine design and permit applications, since proper planning for the later stages of the mine life will help alleviate possible problems associated with closure.

5.6.2 Comments

5.6.2.1 Department of Natural Resources Response

Proper planning is the key to a successful mineland reclamation program. The Division of Minerals' Draft Reclamation Rules require that a mine developer provide detailed information on the methods, sequence and schedule for the siting, design, operation, closure and postclosure care of each mining facility before a Permit to Mine can be granted. The rules recognize that mining plans change over time and require that the operator submit an annual report that addresses what mining and reclamation activities have been completed during the past year and what activities are scheduled for the coming year. If there are any major changes from the original mining and reclamation plan, the operator must apply for a permit amendment before proceeding.

Two years prior to anticipated closure of an individual facility, the operator must submit detailed information on deactivation activities and their schedule. At this time, the operator must also provide an update on long-term maintenance (postclosure care) of the facilities, if necessary. The purpose of the final information on deactivation is to address closure issues that cannot be projected with complete accuracy at the time of mine development when the original permit application is submitted.

An integral part of the design and operation of the mine is a plan for the control of water movement. During reclamation, natural flow patterns should be restored to the extent practicable. The focus of the Division of Waters regulatory program for water appropriations and protected waters is to assure an understanding of the natural water systems as altered by mining, mitigate unacceptable impacts and resolve water resource conflicts. To accomplish this, a thorough understanding is needed of the facility design and water-related impact throughout the life of the mine.

As mentioned in a previous section, long-term dam safety is a major concern of the Division of Waters. Tailing basins containing noxious materials may have dams classified as a high hazard (class I), requiring the application of stringent regulations for operational and post-operational monitoring and ultimate reclamation.

The Division of Waters and Division of Minerals share common permit objectives for mining. Therefore, the two Divisions work very closely on mining permits to ensure issues are addressed in a comprehensive manner while at the same time eliminating duplication in effort.

5.6.2.2 Minnesota Pollution Control Agency Response

Closure plan. It is important to plan for final closure in the pre-permitting stage in order to adequately address all post-operational

environmental concerns. A preliminary closure plan showing how the placement of waste disposal areas, containment of wastes and other potential pollutants, segregation of particularly troublesome wastes, treatment methods and other appropriate waste management and site closure techniques will be utilized to assure compliance with air and water quality standards. This plan must be approved by MPCA prior to permitting. A final closure plan based on the preliminary plan and showing how the site will be closed so as to assure compliance with standards over the long term must be submitted prior to closure as specified in the permit.

Dam and basin siting/construction. A site cannot be permitted if MPCA water quality standards would be violated. In some cases, stringent requirements may be needed to assure compliance.

Water circuit and collections system. The severe weather design is especially important for basins containing cyanide compounds or other hazardous substances. Designing for the maximum run-off event is reasonable, since the collection system creates a mini-watershed which is relatively easy to maintain. Plans and specifications for such facilities must be approved by MPCA before construction, since leaks could affect ground and surface water.

Closure of waste disposal facilities. The company should be prepared to stabilize or remove contaminated sediments, dispose of basin water, collect and treat run-off and stabilize the site to prevent erosion and to minimize infiltration. The ultimate goal of closure for MPCA purposes is to assure compliance with air and water quality standards for the indefinite future. Release from financial surety will be granted when the agency believes this has been accomplished.

5.6.2.3 Environmental Response

Design, Siting, and Operations Recommendations:

1. If waste characterization is not conclusive as to the potential for acid drainage, metal leaching or other hazards, the waste should be regulated to protect the environment against those hazards.

2. All reclamation plans must be guaranteed with bonds or other forms of financial assurance sufficient to cover the third-party costs of implementing the plan. (See Sections 5.7.1, and 7.1.7)

Environmental protection must be a top priority for facility design and siting decisions. Many problems can be created or resolved by these decisions.

3. Mining waste-disposal facilities (tailings basins, low-grade ore storage areas, and waste-rock dumps) must be:

a. Sited to avoid areas of ground water discharge and recharge, as well as surface water drainage and flow;

b. Constructed so that drain systems, liners and wastes are not in contact with ground water and surface waters;

c. Designed to be structurally stable; minimize erosion; exclude infiltration; and contain, gather and treat seepage before it is discharged to the environment;

d. Monitored during operations and after closure for as long as any hazard is present to assure that the facilities are operating as designed and, if not, to permit prompt corrective action before significant environmental damage occurs.

4. Tailings pipelines, seepage collection ponds and other components of the mill circuit must be:

a. Designed so that leaks and spills are contained: pipelines should be constructed in or along a lined trench to collect seepage, with automatic shut-down and drainage in the event of pressure loss;

b. Designed to prevent freezing and ruptures during cold weather operations.

5. Bulk transport, storage and transfer facilities must be designed to exclude precipitation, wind and other causes of material loss. (See environmental comments Section 5.5.2.3)

6. Surface runoff from the project site must be:

a. Collected for treatment in catchment basins large enough to contain runoff from probable maximum precipitation events;

b. Minimized on disturbed lands by prompt revegetation and proper contouring.

7. Water treatment facilities must be designed to meet discharge standards under all operating conditions: during maximum runoff, drought or with equipment or process problems in the mill or treatment plant itself.

Closure and Postclosure Care Recommendations:

1. A comprehensive and detailed reclamation plan must be developed as part of the permitting process. The plan must cover such issues as:

a. Designated post-mining land use: forestry/wildlife habitat, recreational lake, industrial development, etc. The rest of the plan

should describe procedures to safely accomplish these land-use objectives both during and after mining.

b. Mine development and operating procedures that will serve to implement reclamation through proper siting and design of waste rock and tailings disposal facilities, topsoil storage and handling plans, surface water run-on/run-off control, subsidence avoidance and erosion control.

c. Reference sites for vegetation and wildlife must be established and monitored to serve as measures of reclamation success.

d. A schedule of reclamation activities and revegetation objectives maps of areas requiring reclamation, estimated quantities and characteristics of mining wastes and schedules for waste deposition. Reclamation should commence as soon as a disturbance has ceased for any given portion of a site.

e. Facilities deactivation and removal plans, including sealing of shafts; access to pit bottoms; safety fencing of subsided areas, pits and other hazards; removal of equipment, buildings and utilities; drainage of tailings basins; recontouring, capping and revegetating waste disposal facilities; reclamation of roads, parking areas and rail spurs; proper disposal of all hazardous materials; and contouring and revegetation of the project site.

f. Revegetation planning, including schedules, soil types and depths, plant species, growth and cover targets, and erosion-control measures. Provisions should be made for variations in climate and season.

g. Monitoring plans for ground water, surface water, air, soil, vegetation and wildlife, including funding arrangements. Site monitoring and care must continue as long as there are any potential threats to public health or resources.

h. Costs of work described, including current estimates and future projections for use in determing financial assurance requirements.

2. The reclamation plan must be completed before permits are granted. This allows integration of final reclamation objectives into site development planning, lowering both environmental and financial costs. The plan must be periodically updated with an amendment to the mine permit.

3. The reclamation plan must contain a closure trigger. In the event of a planned or unexpected cessation of activities on all or part of a project area, the reclamation plan then in existence will direct immediate closure and reclamation to minimize impacts on human health and the environment.

Design, Siting and Operations Background:

The environmental review process requires an analysis of the impacts of proposed and alternative designs. The permitting process allows regulatory agencies to influence final design and siting through stipulations in permits or by the denial of permits.

Design, Siting, and Operations Findings:

Both the MPCA and DNR are involved in permitting the design and siting of mining facilities. Design and siting of dams, pipelines, roads, tailings basins, waste rock-disposal systems, water treatment systems and seepage collection ponds ultimately affect water quality and, to a lesser extent, air quality and are MPCA responsibilities. The MPCA must approve plans and specifications for all such facilities before they can be installed. The design and siting of these same facilities may also affect habitat for fish, plants and wildlife; rare species; dam safety; visual impacts; and revegetation planning and are DNR responsibilities.

Mining facilities must be designed, sited and operated to minimize environmental impacts. With the two agencies having different responsibilities, their professional opinions may vary as to adequacy of design and siting proposals. The final need for a single design and a single site is obvious. The inevitable pressure is to develop a compromise on standards between the two agencies, to the detriment of environmental protection. In cases where rules or laws conflict, the most stringent should apply. (See Section 7.1.2.4)

Characterizations of rock waste and tailings are critical to regulatory decision-making. In its draft reclamation rules, the DNR requires that the company work in cooperation with the DNR to determine the quantity, particle size, chemical and mineralogical composition to and surface area of projected mining wastes. Further determinations of acid-generating and acid-neutralizing potential will help to decide what are appropriate disposal facility designs and locations.(1)

Waste characterization is a complex and uncertain science. Techniques include geographical comparisons with similar mines, geologic modeling of in-place rock strata, mathematical modeling and static or kinetic geochemical tests in the laboratory or the field. The latter tests use samples of the waste to try to predict the rate and volume of acid generation and consumption and the heavy metals likely to leach. "Even though a wide range of alternatives exists for predicting acid mine-drainage potential, the process itself is complex and there will always be some degree of uncertainty, depending on the nature of the waste material and its deposition and reclamation history."(2)

Double liners with leachate collection systems are becoming standard construction for mining facilities designed to handle acid-generating, metal-leaching, cyanide-contaminated and other dangerous wastes. Synthetic membranes of 60 - 100 mils thickness (approximate installed cost $.60 - $1.00. 1 per square foot) are commonly used. The useful life of these liners is unknown, though they have proven more effective than lower-cost bentonite clay liners at reducing seepage.

Costs of properly designed environmental controls are modest relative to the value of the public resources being protected. In Ontario, the costs of environmental controls on mines range from 2-7 percent of the total capital investment.(3) The private costs of pollution prevention through proper siting, design and operation are always less than both the private financial and the public environmental costs of cleanup after a problem has been created. Exxon's $2 billion first year cleanup costs, tens of thousands of dead sea birds and hundreds of miles of heavily oiled Alaskan beaches are clear proof.

Closure and Postclosure Care Background:

Reclamation (closure) is a comprehensive process converting the project site from a mining operation to some other beneficial use. Reclamation must be planned as a part of permitting, implemented in stages throughout operations and completed upon final closure. Postclosure monitoring and care is required to insure that reclamation is safely and permanently completed.

Closure, Postclosure Care Findings:

Current language in the DNR draft nonferrous metallic minerals mineland reclamation rules is under revision.(4) It is expected that Minnesota will follow the lead of many states with mining industries in requiring thorough reclamation plans, such as are outlined in recommendations made earlier in this section prior to permitting. States with these requirements include: Montana, California, Wisconsin, South Dakota, South Carolina and Idaho.

Following closure activities, postclosure monitoring and care must continue. Depending on the nature of the mine site, this activity may range from:

1. Periodic ground water sampling and visual inspections of the site, to:

2. Frequent ground water and surface water sampling, operation of a seepage collection system and water treatment plant, biological monitoring and dam maintenance, to:

3. Remedial action such as recontouring to stop erosion, ground water pumping and treatment to remove contaminants, fertilization or irrigation of vegetation, or reconstruction of a failed containment system.

Wisconsin statutes explicitly state that "an owner of an approved mining-waste facility shall be responsible for the long-term care of the facility for 30 years after closure."(5)

A properly designed and implemented reclamation plan should preclude the necessity for remedial activities.

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(1) "Draft Metallic Mineral Mineland Reclamation Rules," DNR, April 4, 1988, pp. 14-15.
(2) Keith A. Ferguson, "Regulatory Trends in the Management of Acid Mine Drainage: Water Quality Impacts," Dec. 1988, pp 8-10, Colorado State University.
(3) Rick McMullen, District Supervisor, Ontario Ministry of the Environment, conversation with Don Arnosti, July 18, 1989.
(4) Steven Thorne, DNR Deputy Commissioner, letter to Darby Nelson and Don Arnosti, May 25, 1989.
(5) Wisconsin Administrative Code NR 182.17,2(b), 1985.

5.6.2.4 Industry Response

All mines eventually are depleted or close, though many major deposits and districts have lives that extend for tens or even hundreds of years. Requirements for consideration of closure and postclosure care are useful for planning purposes, but they should not be too rigid or or require too-detailed plans. At the beginning of operations, it is extremely difficult to forecast what the best use for the site may be once the mine is permanently closed or the technology that may be available for reclamation and postclosure care at the end of the mine's life.

The current requirement that two years notice be given to DNR and MPCA of "intent to close" is unrealistic. Closure decisions are often forced on an operator by conditions beyond his control such as market or economic factors. These may force sudden or unforeseen stoppages of either a temporary or permanent nature.

5.7 Financial Assurance

5.7.1 Explanation of the issue

Financial assurance is an important mechanism by which regulators and the public can be assured that the necessary funds are available to cover all regulatory obligations. These obligations include the costs of plant closure, site reclamation, postclosure monitoring, maintenance and any remedial action required after mining ceases. Financial assurance may take a variety of forms such as bonds, letters of credit, sinking funds or trust funds. The amount of financial assurance will have to be periodically adjusted to reflect changes in cost estimates, work performed or new work required.

5.7.2 Comments

5.7.2.1 Department of Natural Resources Response

The DNR's current reclamation rules regulating the ferrous mining industry authorize the Department to require a bond or equivalent financial assurance (such as letters of credit) if it is determined that (1) an operator is not financially capable of performing reclamation requirements of their permit or (2) if the operator fails to perform reclamation or research required by the permit. To date, the Department has not required any form of financial assurance of any taconite or natural ore mining operators. In most instances, the Permit to Mine is held by large corporations (e.g., U.S. Steel) whose financial capability is substantial, and operators are performing reclamation as required by permits.

However, it is possible that future mining of base and precious metals in Minnesota may be undertaken by smaller companies who do not have as strong a financial base as current taconite mining operators. In addition, even large, established mining companies can experience financial difficulties and file for bankruptcy protection, in which case it would be in the public's best interest to have financial assurance in place. Finally, mining of sulfide ores (which is anticipated in future base- or precious-metal mining in Minnesota) represents a high potential for impact on the environment and will likely require correspondingly higher costs for environmental control and reclamation. These considerations, coupled with the fact that precious- and base-metal markets fluctuate and can result in relatively rapid mine start-ups and shut-downs, suggest that provision of financial assurance for reclamation obligations should be provided before operations begin and not be triggered by the operator's failure to comply with permit conditions.

The commissioner may also impose such requirements in a Dam Safety Permit as may be necessary, prior to the ultimate termination of the owners' operation, to ensure that the owner will be financially responsible for carrying out the activities required for perpetual maintenance, and that adequate funding will exist.

5.7.2.2 Minnesota Pollution Control Agency Response

MPCA's requirement for financial surety is that sufficient funds for closure, postclosure care and environmental cleanup must be available in case of failure of the operator to perform. Specifically, these funds would be employed by the agency either to bring a site into compliance with air and water quality standards or assure that the site will not violate standards for the indefinite future. The availability of these funds to MPCA for these purposes must be guaranteed prior to permitting and must be kept separate from financial surety funds whose purpose is other than the above. They must include administrative costs as well as the costs of work on the ground.

An important point to remember is that release from financial surety by a state agency does not relieve an operator from liability later if violations of

air or water quality standards occur which are attributable to the closed operation.

5.7.2.3 Environmental Response

Recommendations:

1. Minnesota's statutes must be changed to require financial assurance from all explorers and for all mineral developments. The amount of financial assurance must equal the estimated costs of state oversight and of third-party reclamation, monitoring and possible remedial action. Financial assurance also must be adjusted to account for new cost estimates and new work requirements. Mining states that currently have requirements of this nature include: Wisconsin, Montana, Oregon, Idaho, Colorado, South Carolina and South Dakota.

2. Financial liability must not be limited to the amount of financial assurance required. Should reclamation or remedial actions be more costly than estimated, operator liability must extend to the parent company and be for the full extent of any costs and damages.

3. Release of financial assurance must only come after:

   a. Certification by all agencies requiring financial assurances that all regulatory requirements have been satisfactorily met and the site offers no threats to human health or the environment;

   b. The public has been provided with an opportunity for a hearing on the release.

Findings:

Current Minnesota statutes put the burden of proof on the DNR to show that there is reasonable doubt as to a company's ability to fulfill regulatory obligations before a bond or other financial assurance can be required. The MPCA has sufficient statutory authority to require financial assurance when they decide to require it.

The DNR may only require a bond to cover exploration if "the commissioner has reasonable doubts as to the explorer's financial ability to comply with requirements of law relating to exploratory boring."[1] If a mining operator "fails to take reclamation measures... fails to comply with rules and regulations... fails to perform research... or if the commissioner has reasonable doubts as to the operator's financial ability to comply with the rules and regulations," only then may the DNR require bonds or other financial assurances.[2]

Unfortunately, by the time the explorer or operator has failed those tests, they may no longer have sufficient resources to provide financial assurances.

In these days of free market free-for-all, assets turn to debt in the blink of a merger. The folly of relying solely on the collective financial resources of a large corporation, instead of a secure financial assurance arrangement was demonstrated with the bankruptcy of LTV Steel. When LTV declared bankruptcy in 1986, they abruptly closed their Reserve Mining taconite operation, leaving no liquid assets. The DNR and MPCA had no assurance that the bankruptcy court would make funds available (as it ultimately did) to pay for necessary reclamation and maintenance work.

The Federal Environmental Protection Agency (EPA) has proposed in their current Strawman rulemaking process mandatory financial assurances for all mining operations that are not owned and operated by the state or federal governments. Tailings basins and other mining waste-disposal systems will have to have financial assurances covering closure, postclosure and corrective actions.(3)

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(1) Minn. Stat. § 156a.071, subd. 3(b), 1983.
(2) Minn. Stat. §93.49, 1973.
(3) U.S. Environmental Protection Agency, Issues and Options In Draft Strawman Rule, Preliminary Working Draft, June 6, 1988, pp 40-41.

5.7.2.4 Industry Response

Flexibility in the type of financial assurance to be provided is a critical factor. The amount of assurance should be negotiated on a case-by-case basis to suit the particular circumstances. The amount to be provided must not be excessive and should be a reasonable estimate of the cost required at any particular time to do necessary remedial work. Once a reasonable level of assurance has been determined, the operator should be free to propose a method to satisfy this level of assurance that fits his or her own financial situation.

A single financial assurance package should be required to satisfy financial requirements under all permits rather than an operator having to provide separate financial packages for each permit or group of permits.

6.0 CRITICAL PATH AND DATA REQUIREMENTS

6.1 General

One of the objectives of the study was to determine a critical path for environmental review and major permits. It was believed that this would provide a useful tool to all parties for determination of generalized data requirements. It would also indicate the procedural elements of environmental reviews and major permits, as well as how they might be staged and interwoven so as to expedite review and permitting without sacrificing quality.

Therefore in this chapter the critical decision-making paths followed by MPCA and DNR in conducting environmental review and permitting processes are presented and explained. Data inputs required from the project sponsor are also indicated. The primary vehicle for this discussion and for presentation of this information is the chart for permitting and environmental review, presented as figure 1.

In this chart, the schedules prescribed by law for the various processes are superimposed on one another in an attempt to show how they can best interact to make them efficient yet comprehensive. In some cases, potential improvements to the system became apparent as the figure was created; for example, while in the past permitting processes have often not begun until environmental review was completed, agency experience has shown that conducting permitting and environmental review processes concurrently, with sharing of staff and information, can considerably cut down on time requirements while maintaining the effectiveness of the process. The centralized coordination approach envisioned in the mining MOA could, if properly employed, facilitate the achievement of this objective.

It has been apparent that a certain amount of confusion and misinformation surround the state-mandated environmental review and permitting processes. The chart and narrative presented in this chapter are an attempt to reduce the magnitude of this problem. However, factors such as insufficient data or contested case hearings may influence the duration, timing, comprehensiveness, and outcome of any given regulatory process. For this reason, this chapter and accompanying chart cannot be regarded as more than a guide to the various processes -- it is not a cookbook which spells out how a given process will go in every case. Operators must work closely with agency staff in order to deal with problems as they arise.

It is well to keep in mind several basic factors:

1. Environmental review in Minnesota is governed by the EQB Rules (Minn. Rules ch. 4410), which are administered by the EQB. Among other things, these rules prohibit project start-up and issuance of permits or other approvals prior to the completion of environmental review (Minn. Rules pt. 4410.3100, subp.1).

2. A critical component of the EIS process is scoping, which is designed to determine what issues will be addressed in the EIS and how intensively they will be addressed. Once the scope is set for an EIS, changes at a later stage in the EIS process are not likely except in extraordinary circumstances. It is thus very important to identify all issues at the outset.

3. Rules governing the issuance of MPCA permits are found in Minn. Rules ch. 7001, administered by MPCA. Among other things, these rules prohibit project start-up without a permit (Minn. Rules pt. 7001.0030). MPCA can enforce its rules even if no permit is required for a given activity.

4. The DNR Permit to Mine is governed by Minn. Rules ch. 6130. Minn. Rules pt. 6130.4200 prohibits mining without a permit. Minn. Stat. § 93.481 prohibits the issuance of a DNR permit to mine nonferrous minerals unless rules governing such permits have been adopted. These rules are presently in draft form.

5. Rules necessary for MPCA to regulate air and water quality and waste disposal by nonferrous operations are presently in place.

6. Rules governing the DNR appropriation and protected waters permits are found in Minn. Rules pts. 6115.0010 to 6115.0810 and 6115.1280.

7. A minerals lease grants an exclusive proprietary right to mine to a lessee in return for certain considerations, such as rents and royalties. It does not, however, grant or guarantee government approvals necessary to conduct a mining operation. To actually carry out the mining operation, the operator must have gone through the required environmental review and must also have obtained all the necessary state, federal and local permits.

8. Public contested case hearings before an administrative law judge are not necessarily required for permitting, but may in fact be required for nonferrous mining operations. The chart shows that such hearings, if held, will occur not earlier than the publication of the draft EIS. In cases where data is incomplete or where controversy is great, hearings can extend for many months. However, they more commonly last one to several days. If hearings are required, the permits being heard cannot be issued until the hearings are completed.

As the chart makes clear, a number of activities must take place before environmental review and permitting processes can get underway. Baseline monitoring of air and water quality will be required. The chart indicates the minimums. Waste characterization studies must begin early in the process so that sufficient time is available to properly characterize the environmental

ramifications of waste and tailings disposal. Above all, meetings as early as possible with the regulatory agencies are crucial.

Under their existing Memorandum of Agreement, MPCA and DNR plan to form a task force to manage the environmental review and permitting processes for nonferrous mining projects. This group will serve as the contact point in the operator-state relationship. The operator and the appropriate agency will discuss technical permit matters. The task force will meet with the operator periodically to share information and data and to solve problems related to keeping the permitting and environmental review processes on track. Under this plan the chart calls for the environmental review and permitting processes to be run more or less simultaneously.

6.2 General Comments on Construction of the Chart

Where reference is made in law or regulation to "working days" these have been plotted for graphic purposes as calendar days. Thus, five working days is plotted on the chart as seven calendar days. However, the number of days shown in the notes on the chart are the number of days (calendar or working) as provided in rules. Where law or regulation gives a range of days for completion of an action (for example, seven to 21 days) the maximum number of days has been used. Where the law specifies the number of days, this has been used. Other periods are estimated based on the chart's time scale.

6.3 Limitations

Although the project participants agreed to focus on four permitting activities and the environmental review process diagrammed on the chart, it is recognized that other permits could be required. Not included are, among others, the following:

a. Hazardous Waste Permits (Executing Agency: MPCA) which will be required if it is proposed to store or treat hazardous wastes on the property. This category of permit has seldom been necessary for mining activities in Minnesota in the past and will not usually be necessary if any waste produced is turned over to a licensed hauler. It is discussed further in Section 6.6.3.

b. Permits for Storage Tanks (Executing Agency: MPCA). These permits take little time to issue and the process is not complicated.

c. Permits required by other state, federal and local agencies. These permits are beyond the scope of this study.

d. U.S. EPA permits or review under the proposed mine waste rules. This program has not yet been adopted.

In addition, if Federal lands are involved, an environmental review may be required by the affected federal agency. In most cases in Minnesota this would be the U.S. Forest Service. Such an environmental review may be run in cooperation with the state EIS.

A very important caveat to the chart as presented is that it makes three major assumptions:

1. In most cases, it represents what the law and regulation provide rather than the agencies' policies and practices which have evolved over time. For example, public hearings relating to permits may be held by law immediately after issuance of a draft EIS but normally would not be held until some time later, perhaps until after the decision on the adequacy of the EIS.

2. It assumes adequate data are furnished by the sponsor to make permitting decisions. It is not until the data submitted by the sponsor are deemed complete by the regulatory agency that the applications are formally processed under the legal time frames shown in chart.

3. It assumes no legal challenge to the process.

The chart also does not show other activities which a project sponsor undertakes, including contacts with local government units, civic and resident groups and environmental organizations.

6.4 State Environmental Review Process: Responsible Government Unit: DNR

This process is represented by the top line of the chart. In Minnesota, an EIS is mandatory for any new metallic mining project. Since no permits can be issued until the environmental review process is complete, the preparation of the EIS governs the time of the final issuance of the permits. Consequently, the chart shows that final decisions to issue, deny or grant permits with conditions are not made until the EIS is declared adequate. A brief overview of the process is as follows:

1. Pre-scoping conferences. The environmental review process starts with consultation between the project proposer and regulatory agencies. Informational meetings with local government units, area residents and citizen groups may also be held at about the same time. During these conferences information is provided as to the location, size and general design of the project based on "model" studies by the sponsor.

2. EIS scoping. After study by the agencies of the data provided, a more formal "EIS scoping" phase commences. In this phase issues are raised first by the agencies and later through a public meeting. These are the issues that will be studied more thoroughly in the preparation of the

environmental impact statement. Examples of issues include the project's effects on water quality and quantity; on air quality; socioeconomic impacts; impacts on vegetation, wildlife and rare and endangered species; noise; visual impacts; impacts on cultural resources and archaeological remains; and relationship to competing land uses.

3. EIS preparation. During the preparation of the EIS, the issues identified in the scoping document are thoroughly investigated. Alternatives to the proposed project are considered.

   As a result of this review, a draft EIS is written under the direction of the "Responsible Government Unit" (RGU). In the case of nonferrous mining, this is the DNR. This draft is published for comments. A public meeting is held to gather input on the Draft EIS. Questions of completeness or accuracy are addressed. The inclusion of new issues is rare at this stage, unless new information has become available since the original scoping. Thereafter, a final EIS is published, including replies to all formal comments received.

4. Adequacy decision. As the head of the RGU, the Commissioner of the DNR makes a determination if the document is adequate and complete, unless it has been previously decided in the scoping phase to have the decision made by the state Environmental Quality Board. After an "adequacy" decision, an EIS may be challenged in court as inadequate. If the process has been inclusive and well managed, this should not occur.

6.5 DNR Permits:
Mineland Reclamation Permit (Permit to Mine)
Water Appropriation and Protected Waters Permits

The most critical inputs to these permits are the mining and closure plans which include waste and tailings disposal plans based on waste characterization studies. Detailed hydrologic data is also required. Details on required data and how it is used can be found in the responses to the individual cases more fully discussed in Vol. II, Appendices to the Final Report: Nonferrous Mineral Project. The timing and completeness of these inputs to the agencies are critical to the overall length of the regulatory process as they affect the time required to issue the permits.

The rules provide that a hearing on a DNR permit cannot commence before the draft EIS has been completed. Thus if hearings are held, the length of the actual hearing (which is not limited by law) will determine how soon after the completion of the environmental review a permit decision can be made.

6.6 Critical Decision Paths and Data Requirements for MPCA Permits

6.6.1 Water Quality Permits:

A National Pollutant Discharge Elimination System permit is required for any discharge of a pollutant into the waters of the state from a point source. A State Disposal System permit is required in order to construct, install or operate a disposal system. A minimum of one year of water quality baseline data will be required before the application is considered.

The following data requirements are culled from a new natural ore iron mine application and therefore will not be as detailed as those required of any new nonferrous mining application. However, the data requirements below can serve as a good example of minimal data requirements: a) a map of the pit, overburden stockpile and waste-rock stockpile for the first five years of operation; b) a map of the plant processing, tailings disposal and other wastewater disposal system areas for the first five years of operation; c) a map of the surface water bodies and drainageways, including surface discharges from the facility; d) a flow sheet of the plant processing steps, including additives and reagents and typical and maximum rates of their use; e) aquatic toxicity, human health and chemical composition information for additives, reagents and chemical dust suppressants; f) a water balance flow sheet including dewatering and plant operations; g) copies of the 7½ minute U.S. Geological Survey (USGS) quadrangle maps that identify the wastewater disposal system areas; h) a description of all basins, including a description of the design, construction and maintenance of the dikes, dams and cells; i) the dimensions and holding capacities of the tailings basin and any other sedimentation basins; j) a description of the inflow and outflow structures for the tailings basin and any other sedimentation basins; k) an operating plan for the tailings basin for the first five years of operation; l) an estimate of the projected water quality of the tailings basin discharge, and the basis for projected parameter concentrations; m) the maximum production rate planned for the first five years of operation; n) a brief description of planned sewage disposal at the facility; and o) a brief assessment, based upon existing information, of the hydrogeology in the area that includes the presence of any water supply and/or ground water monitoring wells in the area of the facility.

6.6.2 Air Emission Permit:

Most decisions involved in drafting an air emission permit are based on the rules and thus can be anticipated prior to submission of the permit application by an applicant. The first major decision made by the permit writer is if the permit falls under federal as well as state jurisdiction. A state new source permit would need to be public noticed if it exceeds 100 tons per year emission levels of any single pollutant, while all federal permits for new major sources must be public noticed. After the permit is drafted, it is reviewed by the unit supervisor, section chief and division director prior to being placed on public notice. The permit can be issued by the division director if all comments raised about the state new source permit during the

public notice period are resolved. If issues cannot be resolved, then this contested permit must be issued by the MPCA Board, as are all federal permits.

Data requirements specific to nonferrous mining are listed on the chart and in Volume III of this report, The Nonferrous Mining and Processing Industry: A Review of Literature and Other Information. Three items are necessary -- a fugitive dust control plan, an air toxics study and calculations of the potential-to-emit of the federal Prevention of Significant Deterioration (PSD) pollutants. The required air toxics study should include: a) an analysis of the ore samples for (at a minimum) antimony, arsenic, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, molybdenum, nickel, selenium, silver, strontium, tin, titanium, vanadium and zinc; b) an estimation of the emissions of any pollutant (including fugitive emission) from each emission source; c) dispersion modeling (alone and with the EPA's human exposure model); and d) a risk assessment study.

The PDS calculations are for the emission rates of the following pollutants: carbon monoxide, nitrogen oxides, sulfur dioxide, particulate matter, particulate matter 10 microns or less in size, ozone, lead, asbestos, beryllium, mercury, vinyl chloride, fluorides, sulfuric acid mist, hydrogen sulfide, total reduced sulfur, reduced sulfur compounds, any other pollutant regulated under the Clean Air Act and each regulated pollutant. The "trigger" emission rates (found in Volume III of this study as well as in 40 CFR 52.21(b)(23)) vary for each of these pollutants. Additional standard permit data requirements can be grouped into two areas -- what will be emitted and what controls will be used.

6.6.3 Hazardous Waste Permit:

If a mine operator generates "small" amounts of hazardous waste (within the following limits) he does not need a permit. A small-quantity generator who produces 100-1,000 kg/month of hazardous waste can store up to 3,000 kg on his site for 180 days or less. A small-quantity generator who produces up to 100 kg/month of hazardous waste can accumulate it until he reaches 1,000 kg, at which point the operator can store it on site for 180 days or less. If the hazardous waste stored by the small-quantity generator is shipped more than 200 miles for disposal, the operator can store the waste on site an additional 90 days. However, if the mine operator produces more than 1,000 kg/month of hazardous waste, he is a large-quantity generator and can store the waste only less than 90 days on his site without a permit.

If a hazardous waste storage permit is applied for, the following decision path is applicable. The permit writer decides when the information supplied is complete and technically adequate. The draft permit is then put on public notice. After all comments are resolved, the letter of technical adequacy is signed by the unit supervisor and the permit is issued by the division

director. In contested case hearings, the MPCA Board votes on whether or not to issue the permit.

The data required by the permit writer are based on Minn. Rules pts. 7045.0450 to 7045.0544. Major data areas include waste evaluation, proper labeling/containerization, site description, personnel training plans, emergency plans, contingency plans, operator record requirements, closure/postclosure plans and financial assurance for sudden/non-sudden occurrences, corrective action, closure and postclosure care.

6.7 Project Sponsor's Activities

The chart assumes that the project sponsor will initiate the the process as soon as he or she has sufficient data on which to base a decision to proceed with delineation drilling and has completed a "model" study similar in scope but somewhat greater in detail than the case studies used for this study.

The exploratory drillholes on which such a "model" study is based should provide enough information and material for initial waste characterization studies which should be started as early as possible. At the same time, acquisition of baseline water quality and hydrologic data should commence so that this baseline data accounts for seasonal variations prior to consideration of the permits. Air quality base-line data is not required prior to permit application, but one year's data is required under certain circumstances before construction. Some additional pre-operational monitoring for air and water quality purposes can be carried out during the environmental review process and during the development phase.

As delineation drilling continues during the environmental review process, concurrent metallurgical and engineering investigations and further waste characterization studies can continue. Since many of the major design parameters may be influenced by discussions during the early stages of the process, the chart shows "pre-feasibility" studies being completed just ahead of the initiation of the EIS process. Similarly, certain of the data inputs that will be required on such matters as wildlife habitat and endangered species, socioeconomic impacts, and historical and archaeological surveys will be determined by the scoping process and cannot be fully determined or carried out until the scoping decision is issued. Final project feasibility will be dependent on the actual permit conditions as determined by the entire process.

7.0 JOINT CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions and Recommendations about the Environmental Review and Permitting Process and Procedures

7.1.1 Exploratory Drilling

Although there have been instances elsewhere in the country of ground water contamination resulting from exploratory drilling for oil, gas and coal, we are unaware of instances of ground water contamination from exploratory drilling for metallic minerals in Minnesota. There are drillhole closure requirements currently in place. However, we recommend that the Commissioner of Health with the advice of the Advisory Council on Wells and Borings review additives commonly used in drilling fluids to determine which if any additives being used by exploratory drillers present potential hazards and should be restricted.

7.1.2 Environmental Review and Permitting Process/Procedure

7.1.2.1 Based on the existing Memorandum of Agreement (MOA) between DNR and MPCA, the Interagency Coordinating Committee (ICC) should establish a process to accomplish the following:

1. At the time a project proposal is submitted to the RGU, establishment of an interagency environmental review and permitting team.

2. Identification and standardization of data and map needs to the extent possible.

3. Identification of monitoring requirements as soon as possible after the pre-application conference.

4. Evaluation of the practicality of joint hearings.

5. Early development of a project-specific chart to complete environmental review and permitting.

6. Frequent meetings between the project sponsor and the interagency team to monitor project progress.

7.1.2.2 An informative and cooperative environmental review and permitting process requires early and frequent involvement of local authorities, interest groups and the general public. Both the project sponsor and the ICC should promptly develop a plan and procedure to supplement the public participation requirements of the existing process to include:

1. Holding additional public informational meetings during and prior to the environmental review process.

2. Establishing advisory committees of local government representatives and others with potential interest in the project as appropriate.

7.1.2.3 All parties recognize that a thorough, complete and germane analysis of issues will provide an efficient process and maximize environmental protection. The participants recommend that all parties to a mine development project commit to the existing environmental review and permitting processes provided in law as they may be modified from time to time.

7.1.2.4 In cases where rules or laws conflict, the most stringent requirements will apply.

7.1.3 Land Use

Land-use decisions are largely value-based. They should be grounded on an evaluation system which considers benefits and costs of the project to the affected area. Therefore, it is recommended that the Environmental Quality Board rules be amended to require a cost/benefit analysis to inventory all benefits and costs pertaining to any new mining proposal, including those costs and benefits that are not quantifiable in dollar values. The extent of the cost/benefit analysis should be established in the Environmental Review scoping process.

7.1.4 Water Quality and Quantity

Impacts on water are among the more significant environmental concerns related to any mining development in Minnesota.

The basis for the successful minimization of impacts on water is dependent on accurate and complete:

1. Collection of base-line monitoring data and information;
2. Characterization of mine wastes;
3. Determination of receiving water criteria;
4. Determination of operating procedures and mitigative measures; and
5. Collection of operational and postclosure monitoring data.

Existing and proposed regulations for base- and precious-metal mining operations in Minnesota will need to address this issue.

7.1.5 Air Quality

Existing air quality regulations, strictly applied, appear to be sufficient to handle expected impacts of mining and milling operations.

7.1.6 Design/Operation/Closure/Postclosure Care

The applications for MPCA and DNR permits must include closure/postclosure plans, a well-defined mine design and operational plans. In order to produce these plans effectively, data and information needs of these agencies must be identified and coordinated early in the process. The use of common documents to supply these needs will be considered by the agencies. The plans must be updated periodically. At the time of closure, the closure plan(s) will be reviewed and implemented.

If waste characterization is not conclusive as to acid-production potential, metal release or other hazards, the regulatory decisions should be approached in a conservative manner.

7.1.7 Financial Assurance

Financial assurance for regulatory requirements must be in place before the development of a base- or precious-metal mine. Financial assurance can be provided in a variety of forms, but must reflect projected closure/post-closure costs as well as credible accident clean-up costs. This determination must consider third party and administrative costs and be reviewed and adjusted yearly.

The use of a single financial assurance package to fulfill requirements of both agencies will be considered.

7.2 Conclusions as to Methodology of the Study

7.2.1. The case study approach was an effective technique for identifying likely "real life" issues, focusing discussion and training participants in reviewing and permitting mining development projects or other projects with high potential for disputes over environmental or land-use issues.

7.2.2. The case study approach allowed parties to consider issues on a more objective and less emotional level than would be likely if the participants first faced these issues in a real life, make-or-break, context. The case study approach facilitated understanding and accommodation of divergent viewpoints.

7.2.3. Visits to active operations and with state and provincial regulatory personnel proved useful for all participants.

7.2.4. Field trips to the case study sites, as well as the case study discussions, provided an opportunity for the members of the various communities to gain insights into others' viewpoints. Interaction should improve future communications between the groups.

7.2.5. The formal comments on the cases provide a useful background for industry sponsors of projects and will help to identify areas of agency and environmental community concern and sensitivity.

7.2.6. The literature study prepared by MPCA will provide a useful reference for all participants.

7.2.7. All recognize that there are many other interested parties who were not represented in the process who will be involved in any actual development. These include the general public; local units of government; the legislature; the executive branch; other state agencies such as the Departments of Health and Labor; applicable federal agencies which may have jurisdiction, including, among others, U.S. EPA, the Corps of Engineers, U.S. Forest Service, and Bureau of Land Management.

8.0 GLOSSARY

NPDES Permit: National Pollutant Discharge Elimination System Permit. A federal permit for wastewater discharges to waters of the state, issued to dischargers by MPCA under authority delegated from U.S. EPA.

SDS Permit: State Disposal System Permit. A state permit issued by MPCA to an operator of a disposal system.

Air Emissions Facility Permit: A permit issued by MPCA for gaseous source or fugitive emissions from a facility. May be issued under federal or state rules depending on circumstances.

PSD: Prevention of Significant Deterioration. A U.S. EPA review process conducted under certain instances to assure maintenance of air quality.

Dore: A bar of mixed gold and silver, which must be further refined to separate individual metals.

LD_{50}: Lethal Dose, 50 percent. A concentration of a substance at which 50 percent of test organisms die within the stated number of hours, e.g. 96 hour, LD_{50}.

Mining MOA: Memorandum of Agreement between MPCA and DNR governing interagency coordination of mining regulation. See Appendix A-1.

ICC: Interagency Coordinating Committee established in MOA.

RGU: Responsible Government Unit. The agency of government designated by the EQB to produce an EAW or EIS for a given project.

Scoping: As provided in the EQB rules, the public process of identifying the issues to be addressed in environmental review.

7Q10: Seven day average low stream flow occurring an average of once every ten years.

Base metals: Chemically active, common metals such as copper, lead, zinc and nickel.

Precious metals: Less reactive metals such as gold, silver or platinum-group metals.

Merril-Crowe process: Removal of gold from cyanide solution by deoxygenation and precipitation on zinc dust.

EAW or Environmental Assessment Worksheet: A 29-question document prepared to briefly summarize potential environmental impacts of a project. Sometimes prepared to help scope an EIS.

EIS or Environmental Impact Statement: A comprehensive document examining environmental impacts and possible alternative actions for a specific project.

Environmental Review: The process conducted under state Environmental Quality Board rules whereby an EAW, EIS or an alternate form of review is conducted to determine environmental consequences of a proposed action.

Nonferrous: Metals and compounds not containing appreciable quantities of iron; ores not worked primarily for their iron content.

Mining: The process of removing, stockpiling, processing, transporting and reclaiming any material in connection with the commercial production of metallic minerals.

Beneficiating: The processing of ores for the purpose of regulating the size, removing unwanted constituents and improving quality, grade or purity of the desired product.

Closure: The process of finally terminating, reclaiming and making provisions for postclosure care (if necessary) of any mining facility or land form created by mining.

Postclosure Care: Provision (as necessary) of ongoing maintenance for a mining facility or land form created by mining.

Milling: The grinding or crushing of ore.