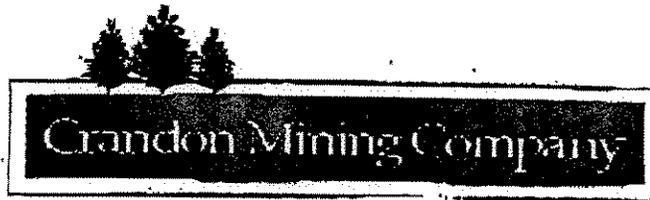


pt 38



Announcement Notice

We thought you would be interested in receiving the following important announcement, which was made today concerning the Crandon Mining Company.

Rio Algom Limited has purchased Exxon Corporation's 50 percent interest in the Crandon Mining Company. This will establish Rio Algom as the sole owner and operator of the Crandon project. A copy of the news release is attached.

Rio Algom remains committed to the project and we look forward to working with you to build and operate an environmentally sound and technically superior mining operation.

Should you have any questions, please do not hesitate to call me.

Sincerely,

Dale Alberts
Director, Public Affairs
Crandon Mining Company

(715) 478-3393 (Crandon)
(715) 365-1450 (Rhinelandar)

attachment

FYI
[Signature]

NEWS RELEASE**RIO ALGOM LIMITED****FOR RELEASE:** January 23, 1998**CONTACT:** Corey Copeland
Vice President, Corporate Affairs
Rio Algom Limited
(416) 365-6863Dale Alberts
Director, Public Affairs
Crandon Mining Company
(715) 365-1450**RIO ALGOM ACQUIRES 100% OWNERSHIP OF
CRANDON MINING COMPANY**

Crandon, Wisconsin - Rio Algom announced today that it has purchased Exxon Corporation's 50 percent interest in the Crandon Mining Company, making Rio Algom the sole owner and operator of the Crandon Project.

"Rio Algom remains committed to the Crandon project," said Pat James, President and Chief Executive Officer of Rio Algom Limited. "The project involves one of the better zinc resources remaining in the United States and, given our experience with similar mining operations, Rio Algom is well qualified to develop and operate this mine."

Mr. James added, "We look forward to working with the people of Wisconsin to build and operate an environmentally sound and technically superior mining operation that will set a new standard for the 21st century."

Rio Algom Limited continues to believe that the proposed mining moratorium legislation is unnecessary as it does not improve the existing rigorous environmental regulatory framework. The company anticipates issuance of all necessary state and federal permits in the next two years, and will commence construction shortly thereafter.

- more -

JAN 23, '98 16:01 (ET)
01/23/98 15:57 FAX

Mr. John Matthews

PAGE 3 of 3

003

NEWS RELEASE

RIO ALGOM LIMITED

"It is particularly appropriate that we are acquiring the project in 1998, the Sesquicentennial anniversary of the State," said James. "Wisconsin has a long and proud tradition of metals mining dating back hundreds of years to its first inhabitants. The Crandon project will build upon and continue the State's metal mining heritage."

Rio Algom already has a presence in the upper Midwest through its wholly owned metals distribution business, Vincent Metal Goods, which is headquartered in Minneapolis and has offices in Wisconsin.

Rio Algom Limited is a major Canadian mining and exploration company active in copper, molybdenum, uranium, coal and zinc with production in North and South America. It also operates metals distribution businesses in North America which source and distribute a wide variety of specialty metal products.

- end -



David J. Stute
Director

Suite 401
One East Main Street
P.O. Box 2536
Madison, WI 53701-2536
(608) 266-1304
FAX (608) 266-3830

*Unclear on intent
now to be taken
- gets back to vague
flaws.*

*CHUCK
HAMMER
6-09-11*

January 27, 1998

→ Could not use many Canadian sites.

**Preliminary Draft of Language to be Added to Assembly Amendment 2 to
Assembly Amendment 4, to Engrossed 1997 Senate Bill 3**

The department may not base its determination under sub. (2) (a) or (b) on a mining operation unless the department determines based upon data from groundwater and, if relevant, surface water monitoring and after consultation with and advice from the Science Advisory Council on Metallic Mining, that the mining operation has not caused significant environmental pollution of groundwater or surface water from acid drainage at the tailings site or at the mine site or from the release of heavy metals.

*Dump
into
MUN
STAT.
LAND.*

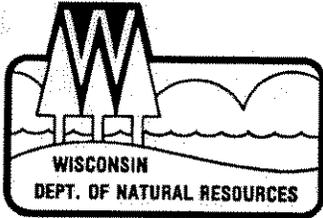
*Standards
or
applicable
provisions*

*- mandates gw & sw monitoring for a site to be
part practice. valid*
- Science Adv's Council on Met. Mining...
- "exceeded our standards as they exist today"

** Hard to verify if access is not available to conduct the monitoring or obtain data.*

*surface water... important to have data at time of discharge
groundwater... 50 yrs. later may be better*

Representative Buff



State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Tommy G. Thompson, Governor
George E. Meyer, Secretary

PO Box 7921
101 South Webster Street
Madison, Wisconsin 53707-7921
TELEPHONE 608-266-2621
FAX 608-267-3579
TDD 608-267-6897

February 2, 1998

Senator Dale Schultz
Room 514, 119 Martin Luther King Blvd.
P.O. Box 7882
Madison, WI 53707-7882

Dale
Dear Senator ~~Schultz~~:

Thank you for your hard work and suggestions regarding the mining moratorium bill, Senate Bill 3. I would suggest the following alternative to your proposed amendment.

Addition to (2)(a) and (2)(b)

(a)...from the release of heavy metals. Prior to making the determination, the department must receive a written statement from the appropriate state, federal or provincial agency which verifies, based on relevant groundwater or surface water monitoring, that the mining operation has not resulted in the concentration of substances in groundwater which significantly exceeded groundwater or surface water standards of the state, federal or provincial agency.

(b)...from the release of heavy metals. Prior to making the determination, the department must receive a written statement from the appropriate state, federal or provincial agency which verifies, based on relevant groundwater or surface water monitoring, that since closure the mining operation has not resulted in the concentration of substances in groundwater which significantly exceeded groundwater or surface water standards of the state, federal or provincial agency.

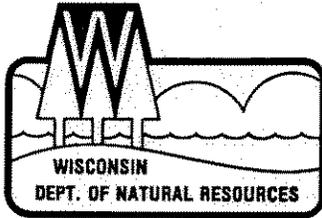
Again, thank you for your work on this issue. If you would like to discuss this proposal, please contact Stan Druckenmiller, DNR's Executive Assistant, at: 266-2136.

Sincerely,

George

George E. Meyer
Secretary

cc. Senator Robert Cowles
Representative Tom Ourada
Representative Marc Duff



State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Tommy G. Thompson, Governor
George E. Meyer, Secretary

PO Box 7921
101 South Webster Street
Madison, Wisconsin 53707-7921
TELEPHONE 608-266-2621
FAX 608-267-3579
TDD 608-267-6897

February 2, 1998

Senator Kevin Shibilski
Room 402, 100 N. Hamilton Street
P.O. Box 7882
Madison, WI 53707-7882

Kevin
Dear Senator ~~Shibilski~~:

Thank you for your hard work and suggestions regarding the mining moratorium bill, Senate Bill 3. I would suggest the following alternative to your proposed amendment.

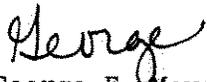
Addition to (2)(a) and (2)(b)

(a)...from the release of heavy metals. Prior to making the determination, the department must receive a written statement from the appropriate state, federal or provincial agency which verifies, based on relevant groundwater or surface water monitoring, that the mining operation has not resulted in the concentration of substances in groundwater which significantly exceeded groundwater or surface water standards of the state, federal or provincial agency.

(b)...from the release of heavy metals. Prior to making the determination, the department must receive a written statement from the appropriate state, federal or provincial agency which verifies, based on relevant groundwater or surface water monitoring, that since closure the mining operation has not resulted in the concentration of substances in groundwater which significantly exceeded groundwater or surface water standards of the state, federal or provincial agency.

Again, thank you for your work on this issue. If you would like to discuss this proposal, please contact Stan Druckenmiller, DNR's Executive Assistant, at: 266-2136.

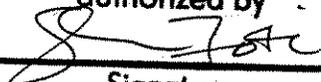
Sincerely,



George E. Meyer
Secretary

cc. : Senator Robert Cowles
Representative Tom Ourada
Representative Marc Duff

This distribution has been
authorized by


Signature



WISCONSIN LEGISLATIVE COUNCIL STAFF MEMORANDUM

One East Main Street, Suite 401; P.O. Box 2536; Madison, WI 53701-2536
Telephone (608) 266-1304
Fax (608) 266-3830

DATE: January 21, 1998
TO: REPRESENTATIVE THOMAS D. OURADA
FROM: William Ford, Senior Staff Attorney
SUBJECT: Assembly Amendment ____ (LRBa1359/1) to 1997 Senate Bill 3, Relating to
Issuance of Metallic Mining Permits for the Mining of Sulfide Ore Bodies

This memorandum responds to your request for an interpretation of LRBa1359/1 ("the Amendment"). This Amendment is explained in a memorandum, dated January 21, 1998, to Speaker Scott Jensen and Representative Marc Duff, from myself.

The Amendment specifies what constitutes the violation of an environmental law and is intended to clarify the definition of pollution under the Bill. The Amendment specifies that violation of an environmental law includes a determination by an administrative proceeding, a civil action, a criminal action or other legal proceeding which affords the alleged violator due process rights of notice and an opportunity for a contested hearing. In addition, the Amendment provides that a stipulated fine, forfeiture or other penalty is considered a determination of a violation of an environmental law, regardless of whether there is a finding or admission of liability.

It has been stated that the Amendment would allow a mining permit to be issued in instances where a mine had caused pollution of groundwater or surface water but where no action was taken to prove that an environmental law had been violated because there was no responsible party to bring the action against. You ask whether a similar situation could occur under the Engrossed Bill. I believe the answer to your question is that the Engrossed Bill could (although it would not have to be) interpreted this way.

The Engrossed Bill provides that a mine must have been opened and closed for the applicable period without violating an environmental law but does not specify what the term violating an environmental law means. This language would require the Department of Natural Resources (DNR) to make a determination what this means. A reasonable interpretation of this language, which appears to have been adopted by the DNR, is that it must be shown that there was a *formal determination* that an environmental law had been violated. In instances where a

state or provincial regulatory agency had no person to proceed against, it is unlikely that such a determination would be made.

Please contact me at the Legislative Council Staff offices if I can be of further assistance.

WF:lah

POSSIBLE AMENDMENTS TO SB 3

As passed by the Senate, SB 3 is vague. This vagueness leaves it up to the DNR to interpret the language in SB 3, causing possible legal problems for the state. Below are some amendments we are contemplating. Please note these are summaries, and not the actual language.

1. Information Verification: SB 3 requires the DNR to determine, *based on information provided by the applicant*, that a mining operation has operated for 10 years without causing pollution and has been closed 10 years without causing pollution. The DNR has asked that an amendment be adopted that would require the department to verify the information provided by the applicant. This language strengthens the bill by requiring the DNR to verify whether or not the information provided by the applicant is accurate or proper.
2. Acid Generation: SB 3 includes language stipulating that the mine examples must be located in an ore body which *is not capable of neutralizing acid mine drainage*. We have an amendment to make this more specific by simply stating the mine must be located in an ore body that is capable of generating acid mine drainage.
3. Pollution Definition: SB 3 defines pollution as degradation that results in a violation of an environmental law. The DNR has asked that this definition be made more specific, strengthening the state's position during the resulting legal battle. We have an amendment that makes the definition more specific while matching the way the DNR would interpret the definition as passed by the Senate.
4. Mine Waste Facility: SB 3 refers only to tailings sites and ignores the other types of mine waste facilities used in mining (i.e. waste rock dumps, heat bleach pads, waste rock ponds). We have an amendment to change tailings site to mining waste facility.
5. Tribal Lands: SB 3, and all current mining laws, do not apply to mines on tribal lands. Rep. Handrick has an amendment that would state that the moratorium sections would not apply until all lands within the borders of Wisconsin are covered by state mining and environmental laws.

Contingent Amendment

If Rep. Black attempts to include an amendment precluding mines before 1977 from being used as an example of a successful mine, we would propose a better alternative. We would propose an amendment that would replace "closed mine" with "reclaimed in accordance with an approved reclamation plan or permit." This is better because it excludes old mines which did not operate under a plan or permit and also enhances the bill by requiring reclamation.

GOLDEN DREAMS, POISONED STREAMS - BENEATH THE INFLAMED RHETORIC: HERE'S WHAT THIS NEW BOOK REALLY SAYS

INTRODUCTION

The Mineral Policy Center's (MPC's) new book, *Golden Dreams, Poisoned Streams* ("*Golden Dreams*") has received numerous enthusiastic endorsements from mining opponents across the country, including the Mining Impact Coalition of Wisconsin. As self-appointed critics of the hardrock mining industry, the MPC is a Washington, D.C.-based organization attempting to influence Congressional and other public policy decisions about mining.

The Defenders of Wildlife's recent comments in an Internet press release praising *Golden Dreams*, for chronicling "...the pervasive and ongoing destruction of US water resources caused by modern hardrock mining"... are representative of the acclamation that the anti-mining community is heaping on this new book. Similarly, the Mining Impact Coalition of Wisconsin, in the Fall/Winter 1997 issue of their electronic newsletter, "Downstream", lauds the MPC's new book for assessing "the destructive impact hardrock mining has on water resources [and] provid[ing] an expert scientific and legal framework that concerned citizens can use to understand the problem..."

Typical of materials developed by anti-mining organizations, the MPC's book, *Golden Dreams*, relies on vivid -- but dated-- images of mining of the past to provoke public concern about mining and the environment, and to foment opposition to proposed mining projects. The book is a skillful exercise in selective distortion and misinformation-through-omission that asserts modern mines are as likely to cause groundwater and surface water pollution as mines developed decades ago.

It is not at all surprising that the Mining Impact Coalition of Wisconsin has embraced the skewed emphasis of *Golden Dreams*, thereby spreading and perpetuating the misinformation and distortion in the MPC's book. They should, however, be cautious about ignoring how the strengths of Wisconsin's mining regulations and the design of the proposed Crandon Mine actually stack up - even when measured against the tough standards proposed by the MPC. Nor should they lose sight of what may be *Golden Dreams*' most important message: "We Know How to Stop Mining Pollution", even though the MPC has submerged this significant theme in the murky waters of environmental problems at old mines.

This paper compares Wisconsin's system of mining regulations and the proposed design of the Crandon Mine against the MPC's own recommendations, and answers the question: "What, Beneath All the Rhetoric, Does *Golden Dreams* Really Say?"

WE KNOW HOW TO STOP MINING POLLUTION

"We Know How to Stop Mining Pollution" is the name of an entire chapter, (Chapter 4), in *Golden Dreams*. This chapter describes in detail how today's mining industry can effectively protect the environment using modern environmental protection and pollution prevention

technology. In their own words, here's what the MPC has to say about this technology and its effectiveness; (the citations refer to pages in *Golden Dreams*):

"Polluted water is not an inevitable "price we must pay" to use metals in our lives. We have the scientific knowledge and the practical technology to prevent water pollution from mining." (page 93)

"Just as our scientific understanding of the toxic damage that heavy metals like mercury, lead, and copper have on the health of human beings and natural systems has advanced in recent decades, so has our knowledge of mining methods to prevent pollution. Today, the mining industry has the means to design and operate clean mines to prevent hazards such as acid mine drainage, metals release, and stream sedimentation. The industry can produce minerals profitably while utilizing these methods." (page 93)

"Mine operators can protect water resources by adopting a number of practices to prevent, control, and clean up mining-caused pollution." (page 94)

"The mining industry can protect our water resources while producing minerals profitably. The techniques to do this are simple and straightforward:

The mining industry can plan carefully before mining to design mines which will not pollute water. It can make sure that waste piles are located properly, and that they are lined and capped adequately to cut off sources of pollution. It can use a variety of known methods to treat and neutralize acid mine drainage and metal leaching. It can carry out reclamation efforts that are contemporaneous with mining to minimize the amount of mine waste material exposed to the elements. It can reclaim mined lands so that they are productive after mining has ceased and do not cause long-term water quality problems. It can practice more efficient mining, to reduce waste and water use.." (pages 118-119)

Clearly, statements like these coming from the MPC, a group highly critical of the mining industry, are proof enough that the use of appropriate modern technology and environmental protection measures make environmentally responsible mining a reality today. Not surprisingly, the Mining Impact Coalition of Wisconsin and other mining opponents have chosen to ignore this aspect of the MPC's book. In doing so, they fail to provide useful information about mining and the environment - information that is critical to sound public policy decisions about mining in Wisconsin or elsewhere.

Golden Dreams is not the only recently published source of information about environmental protection technology, mining, and the environment. A paper entitled "*Environmentally Responsible Mining: Results and Thoughts Regarding a Survey of North American Metallic Mineral Mines*" by J. W. Todd and D. W. Struhsacker, published in 1997 by the Society for Mining, Metallurgy and Exploration, provides valuable information about the successful use of environmental protection and pollution prevention technology at modern mines: For example, this paper states:

"Today's mines are highly regulated and make extensive use of pollution prevention and environmental protection technology. In contrast, old mines were largely unregulated, and operated with few if any measures to protect the environment. Therefore, it is inappropriate to use environmental problems at antiquated mines to predict what will occur in the future at modern mines." (page 3)

Regrettably, most anti-mining activists, including the MPC, insist upon doing just that - pointing to environmental problems at old mines and asserting that similar problems will develop at proposed mining projects. Rather than engaging in a productive dialogue about modern mining practices and the tremendous advancements in environmental protection technology from the last twenty years that can be applied to mining, mining opponents typically present an anachronistic picture of mining in an attempt to provoke public concern and opposition.

Cecil D. Andrus' recent remarks at the Keynote Session of the 1997 Northwest Mining Association convention provide additional compelling evidence of the progress today's mining industry has made in addressing environmental problems of the past and in preventing environmental problems at new mines. As a four-term Governor of Idaho and Secretary of Interior during the Carter administration, Andrus has at times been an outspoken critic of the mining industry. For example, he vigorously opposed the development of the proposed White Cloud Mine during his first gubernatorial campaign. The former Governor made the following comments about today's mining industry:

"There was a time, not that many years ago, when the only appearance I thought I would make before this group was to be hung in effigy. I truly believe the reason an occasional critic of your industry has been asked to stand in this spotlight today is because the mining industry has changed. These changes are welcome. They are absolutely necessary, in my view, if the industry is to move ahead and prosper. There is no doubt the industry has made the conscious choice to operate in new and better ways. There is a modern mining ethic that is real, meaningful, and above all, it is the right thing to do."

THE MPC ENDORSES PRECISELY THE TYPE OF ENVIRONMENTAL PLANNING BEING USED FOR THE CRANDON MINE

Chapter 4 of *Golden Dreams* explains how careful environmental planning is the key to developing an environmentally responsible mine and to preventing acid mine drainage: "Carried out properly, planning will eliminate many potential pollution problems" (page 98). As described below, Crandon Mining Company (CMC) has employed environmental planning measures identical to those recommended by the MPC in designing the proposed Crandon Mine:

The MPC's Environmental Planning Recommendations:

- "Proper planning before mining begins is critical in locating and designing a mine to prevent the discharge and migration of acid, metals, sediments, cyanide, and other chemicals." (page 94)

- "Preventing pollution requires a multi-pronged approach. To begin, a mine operator must compile detailed information about the site's terrain, climate, surface and groundwater hydrology, and geochemistry...With this information, the mine can be designed to minimize risk." (page 95)

The Comprehensive Studies for the Crandon Project Satisfy the MPC's Recommended Requirements: The Crandon Mine is one of the most meticulously studied mine proposals anywhere in the world. Over 150 highly qualified environmental scientists and engineers have invested more than 140,000 hours studying and designing the Crandon Mine. These studies have examined in detail all aspects of the physical, biological, and human environments. The study results have been submitted to the Wisconsin Department of Natural Resources (DNR), and interested members of the public can review these studies at DNR offices and selected public libraries throughout Wisconsin.

The MPC's Recommended Approach to Preventing Acid Mine Drainage:

- "The environmentally-responsible mine operator should do everything possible to prevent water contamination at the outset, through proper mine planning and management of wastes. A key prevention goal is to isolate sulfidic wastes from water and oxygen, because these two substances trigger the generation of acid mine drainage." (page 94)
- "As a rule, waste facilities should be located in "high and dry" areas outside of the paths of flowing waters and removed from springs." (page 96).
- "Knowing the chemical composition of the ore and waste rock that will be encountered in mining is an essential part of mine planning. Before mining, the operator should implement a thorough system of rock sampling and testing to determine the acid generation potential of the range of rock types that will be encountered in mining....simple reliance on acid-base accounting...often has led to errors in predicting acid mine drainage. Instead, the operator should use kinetic testing methods to assess the potential for acid generation in response to environmental factors - such as air temperature, moisture, and bacterial action - that are likely to be present at the mine site. Accurate information on the likelihood of a particular waste type to generate acid also can allow the mine operator to handle riskier waste types separately by isolating them from the elements." (page 96)

The Crandon TMA is Designed to Prevent Acid Mine Drainage:

The proposed Crandon Mine Tailings Management Area (TMA) has been specifically designed to contain and isolate the sulfide-bearing mine wastes from water and oxygen through the use of engineered liners and caps as discussed in more detail under the heading "The Crandon TMA Incorporates All Of The MPC's Recommended Design Elements" Prior to selecting the proposed TMA site, CMC evaluated a number of alternative tailings management sites. The proposed site was selected in large part because it satisfies the "high and dry" criterion as recommended by the MPC.

As part of the environmental studies performed for the proposed Crandon Mine, CMC has conducted extensive tests, called waste characterization tests, on the tailings to determine the acid generation characteristics of this material. The Crandon waste characterization tests include kinetic tests (the type of waste characterization tests specifically endorsed by the MPC). Moreover, the long-term column kinetic testing program for the Crandon tailings far exceeds the scope and duration of the MPC's recommended testing program. The Crandon waste characterization tests have provided a great deal of accurate and useful information about the chemical composition and geochemical behavior of the Crandon tailings, all of which CMC has used to optimize the TMA design.

The MPC's Design Recommendations for Preventing Acid Mine Drainage:

"There are a number of basic methods in current practice that can be utilized to contain mining wastes, and to isolate them from water and oxygen. The methods outlined below have records of cost-effectiveness and success" (page 97):

- "Sound Tailings Impoundment Design - ... when properly constructed and maintained, they (tailings impoundments) can prevent serious environmental contamination." (pg. 98)
- "Secure Protective Liners - Requiring a secure, multiple lining system underneath waste rock piles, tailings impoundments, leach heaps, and solution ponds can prevent contamination from migrating into surface and groundwater." (pg. 99) "Operators must build redundant, multiple-liner systems to provide a back-up protective shield to prevent leaking contaminants from migrating into the environment." (pg. 100)
- Capping Waste Rock, Tailings, and Heaps - "When waste rock dumps, tailings impoundments, and heaps are retired, more complete isolation from the elements is accomplished by covering or *capping* the waste. Caps can be constructed by covering the wastes with materials such as clay, soil, or synthetic material (or some combination of these materials). The purpose of the cap is to seal off the waste from air and water, thereby inhibiting the process of acid formation." (pg 101)

The Crandon TMA Incorporates all of the MPC's Recommended Design Elements:

- Sound Tailings Impoundment Design - The Crandon TMA is designed using proven and effective engineering design principles.
- Secure Protective Liners - The Crandon TMA is designed with a multi-layer liner system underneath the tailings consisting of impermeable natural materials and a synthetic layer to prevent contamination of groundwater.
- Capping Waste Rock, Tailings, and Heaps - The Crandon TMA will be closed and reclaimed with an impermeable cap that is a multi-layer system similar to the TMA liner. This cap will protect the tailings from water and air, and inhibit the process of acid formation. (The Crandon Project does not involve surface disposal of waste rock or a heap).

Table 1 shows the many aspects of the proposed Crandon TMA that conform to the MPC's own recommendations for the appropriate siting, design, operation and closure of a tailings disposal facility.

Table 1
The Proposed Crandon Mine Tailings Management Area
Meets All of the Mineral Policy Center's Recommendations

MPC Recommendation Described in <i>Golden Dreams, Poisoned Streams</i>	Proposed Design and Wisconsin Requirements for the Crandon TMA
<ul style="list-style-type: none"> • Compilation of detailed information about the site's terrain, climate, surface and ground-water hydrology, and geochemistry so the mine can be designed to minimize risk 	<ul style="list-style-type: none"> ✓ Over 140,000 hours of engineering, scientific and other technical studies were performed and have been incorporated in the Crandon Mine TMA design.
<ul style="list-style-type: none"> • Locating mine waste facilities in "high and dry" areas outside of the paths of flowing waters and removed from springs 	<ul style="list-style-type: none"> ✓ CMC performed a detailed site selection study prior to selecting the proposed "highest and driest" available site for the TMA.
<ul style="list-style-type: none"> • Isolation from natural elements such as air and water that can mobilize and transport contaminants 	<ul style="list-style-type: none"> ✓ The TMA will be built with engineered liner and cap systems that will isolate the tailings from air and water.
<ul style="list-style-type: none"> • Natural and synthetic multi-liner systems to provide a back-up protective shield to prevent tailings from leaking into surface water and groundwater 	<ul style="list-style-type: none"> ✓ The TMA liner will be a six-foot thick multi-layer liner system consisting of layers of both plastic and low-permeability clay materials under the tailings.
<ul style="list-style-type: none"> • Complete isolation at the end of mining by covering or capping the mine waste 	<ul style="list-style-type: none"> ✓ The TMA cap will be an eight-foot thick multi-layer top liner system consisting of both plastic and low-permeability clay materials.
<ul style="list-style-type: none"> • Require long-term kinetic tests on mine wastes to characterize the potential for acid mine drainage to develop 	<ul style="list-style-type: none"> ✓ CMC has performed long-term kinetic tests on the tailings.

Table 1 (Continued)
The Proposed Crandon Mine Tailings Management Area
Meets All of the Mineral Policy Center's Recommendations

MPC Recommendation Described in <i>Golden Dreams, Poisoned Streams</i>	Proposed Design and Wisconsin Requirements for the Crandon TMA
<ul style="list-style-type: none"> • Require post-mining water quality monitoring to ensure that acid mine drainage does not develop over time 	<ul style="list-style-type: none"> ✓ Water quality and other environmental parameters will be monitored at the TMA, and the entire mine site both during and after mining.
<ul style="list-style-type: none"> • Assign long-term liability for water quality 	<ul style="list-style-type: none"> ✓ 1. Wisconsin law exposes Wisconsin mine owners to perpetual liability for the environmental integrity of a Wisconsin mine waste disposal facility; 2. Wisconsin mine operators must contribute to the Environmental Repair Fund at a rate of one cent per ton of mine waste; and 3. Wisconsin mining companies must also pay an additional groundwater fee at a rate of one cent per ton of mine waste. The DNR may use the groundwater fee funds for groundwater projects.
<ul style="list-style-type: none"> • Prior to mining, require post reclamation bonds that cover the potential cost of long-term treatment of acid mine drainage and other pollutants 	<ul style="list-style-type: none"> ✓ Section NR 132.09, Wis. Admin. Code requires mining companies to provide a bond or other security to guarantee reclamation of the site. The bond amount is calculated on the basis of what it would cost the state to reclaim the mine site, if for any reason, the mining company cannot do so.
<ul style="list-style-type: none"> • Require frequent regulatory inspections 	<ul style="list-style-type: none"> ✓ The DNR will inspect and monitor the TMA and the entire mine site on a regular basis during construction, operation, and post-closure.

WISCONSIN'S MINING REGULATIONS INCLUDE ALL OF THE MPC'S RECOMMENDATIONS FOR AN IDEAL REGULATORY PROGRAM

Wisconsin's existing mining regulatory program compares very favorably to the MPC's "wish list" for ideal national mining environmental regulations. In fact, as shown in Table 2, Wisconsin's existing mining regulations meet or exceed the recommended requirements listed on pages 116 through 118 of the MPC's book. Additionally, Wisconsin's mining laws have none of the shortcomings the MPC describes in Chapter 8.

Table 2
How Do Wisconsin's Mining Laws And Regulations Stack up
When Compared to The MPC's Ideal National Mining Regulatory Program?

MPC's Ideal National Mining Regulations	Already in Wisconsin Regulations?
<ul style="list-style-type: none"> • Require complete assessment of surface and groundwater hydrology prior to mining 	<ul style="list-style-type: none"> ✓ Extensive surface water and groundwater hydrology baseline studies required as a condition to a mining permit (Wisconsin Metallic Mining Reclamation Act and Chs. NR 131 and 132 Wis. Admin Code)
<ul style="list-style-type: none"> • Require characterizing ore and waste rock, using static and kinetic tests before and during mining, to determine the potential to generate acid 	<ul style="list-style-type: none"> ✓ Require a Feasibility Report containing detailed information and data about the chemical and physical nature of the waste material and its acid generating and leaching potential (Ch. NR 182 Wis. Admin Code)
<ul style="list-style-type: none"> • Designate sensitive areas as unsuitable for mining 	<ul style="list-style-type: none"> ✓ Chs NR 131 and 132 Wis. Admin Code declare numerous areas unsuitable for mining as well as other stringent locational criteria
<ul style="list-style-type: none"> • Establish specific contamination standard for mining pollutants 	<ul style="list-style-type: none"> ✓ Include specific groundwater quality protection standards, protective action limits and intervention boundaries (Ch. NR 182.075 Wis. Admin. Code)
<ul style="list-style-type: none"> • Require pollution prevention and pollution containment techniques in all phases of mine operation 	<ul style="list-style-type: none"> ✓ Prohibit violations of surface water or ground water quality standards and criteria, and establish detailed minimum design and operational requirements for mine waste disposal facilities
<ul style="list-style-type: none"> • Establish comprehensive standards and definitions for mine reclamation activities 	<ul style="list-style-type: none"> ✓ Include detailed minimum reclamation standards that address all mine components (Ch. NR 132.08 Wis. Admin. Code)

Table 2 (Continued)
How Do Wisconsin's Mining Laws and Regulations Stack up
When Compared to the MPC's Ideal Regulatory Program?

MPC's Ideal National Mining Regulations	Already in Wisconsin Regulations?
<ul style="list-style-type: none"> • Require stringent "best available technology and practices" standard of performance 	<ul style="list-style-type: none"> ✓ Wisconsin's perpetual liability and financial guarantee provisions provide a strong impetus for implementing "best available technology and practices"
<ul style="list-style-type: none"> • Require post-mining water quality monitoring to ensure that acid mine drainage does not develop over time 	<ul style="list-style-type: none"> ✓ Include requirements for long-term, post-closure care and monitoring for at least 40 years, and longer if necessary. Operators must demonstrate financial capability to meet the long-term care and monitoring requirements (Ch NR 182 Wis. Admin. Code)
<ul style="list-style-type: none"> • Require posting of reclamation bonds, prior to mining, that cover the potential cost of long-term treatment of acid mine drainage and other pollution 	<ul style="list-style-type: none"> ✓ Require a comprehensive reclamation bond prior to mining to cover all costs of reclaiming the site (NR 132.09), plus additional financial assurances for long-term care (NR 182) ✓ Additionally, Sections 107.30 through 107-35 Stats., subject mine operators to perpetual liability for future environmental problems at Wisconsin mine sites
<ul style="list-style-type: none"> • Require regular mine inspections by regulators and require mandatory citation of all violations of law 	<ul style="list-style-type: none"> ✓ NR 132.14 authorizes mine inspection at any time by the DNR ✓ Section 293.83 Stat. requires the DNR to issue an order if a violation of law or unapproved deviation from a permit is found, and to request the Department of Justice to initiate action
<ul style="list-style-type: none"> • Provide the public with full rights to participate in the mining regulatory process, including the right to compel regulatory enforcement by citizen suits and the right to accompany mine inspectors 	<ul style="list-style-type: none"> ✓ Citizens can bring civil actions against a mine operator alleged to be in violation of the Wisconsin Metallic Mining Reclamation Act, or against the DNR if their is belief the agency is not fulfilling its duties. Citizens can also compel the DNR to hold hearings on alleged or potential environmental contamination (Sec.293.89, Stats.)

Table 2 (Continued)
How Do Wisconsin's Mining Laws and Regulations Stack up
When Compared to the MPC's Ideal Regulatory Program?

MPC's Ideal National Mining Regulations	Already in Wisconsin Regulations?
<ul style="list-style-type: none"> • Provide the public with full rights to participate in the mining regulatory process, including the right to compel regulatory enforcement by citizen suits and the right to accompany mine inspectors (continued) 	<ul style="list-style-type: none"> ✓ Sections 293.33 and 293.41, Stats. provide for the formation of local impact committees and the negotiation of local agreements with mining permit applicants. Such local agreements can (and have) included provisions to allow citizen representatives to observe inspections and environmental testing at mine sites
<ul style="list-style-type: none"> • Prohibit any mine operator who has not cleaned up environmental problems and violations at their other mines from obtaining any new mining permits 	<ul style="list-style-type: none"> ✓ The "Bad Actor" provisions in Wisconsin's mining law (Sec. 293, 49, Stats.) requires the DNR to deny a permit to any company with a history of noncompliance or forfeited reclamation bonds
<ul style="list-style-type: none"> • Establishes a hardrock abandoned mine reclamation program 	<ul style="list-style-type: none"> ✓ Wisconsin does not have a pervasive problem with abandoned mines, but existing laws and regulations allow for abandoned mine reclamation on a case-by-case, as needed basis

More information about Wisconsin's laws and regulations governing metallic mining can be found in the recent Wisconsin Geological and Natural History Survey's publication "*An Overview of Metallic Mineral Regulation in Wisconsin, Revised Edition*".

WISCONSIN'S REGULATIONS DO NOT HAVE THE SHORTCOMINGS DESCRIBED BY THE MPC FOR SOME STATES' MINING REGULATIONS

Chapter 8 of *Golden Dreams* criticizes state and federal regulatory requirements for mining, alleging that in many states, mining regulations are a hodgepodge with lots of loopholes. As discussed below, many of the issues raised in Chapter 8 simply do not pertain to Wisconsin:

- **MPC Criticism: Lack of Adequate Surface Water Discharge Permit Requirements -**
 The MPC claims that mines in many states do not have permits to discharge waste water to surface water. (It should be noted that mines in arid climates are not permitted to discharge to surface waters and therefore no discharge permit is required).

- **Wisconsin Reality: Stringent Surface Water Discharge Permit Requirements** - Mine operators must obtain a Wisconsin Pollutant Discharge Elimination System (WPDES) permit to discharge treated waste water into Wisconsin surface waters. The WPDES permit establishes stringent water quality standards that must be met before water from a mining operation can be discharged to a surface water body or stream. For example, the water quality requirements in the WPDES permit for the Flambeau Mine in Ladysmith, Wisconsin were established to protect the most sensitive species of aquatic life - a tiny invertebrate in the adjacent Flambeau River. As result, the treated Flambeau mine water is clean enough to drink, and discharge of the treated mine water has caused absolutely no adverse impacts to wildlife or water quality in the Flambeau River.
- **MPC Criticism: Lack of Specific Mine Waste Disposal Regulations in Some States** - The MPC is critical of many state mining programs because "Regulation of mining waste at the state level is based primarily on a mining reclamation program or a water pollution control (i.e., groundwater) program, or some combination of the two. In most states, mining wastes are not regulated under state hazardous or solid waste programs" (page 200).
- **Wisconsin Reality: Mine Waste Disposal is Governed by Special Regulations** - Mine wastes (waste rock and tailings) are specifically regulated by ch. NR 182, Wis. Admin. Code. As part of Wisconsin's solid waste disposal regulations, ch. NR 182 includes requirements for waste characterization studies, waste disposal facility siting criteria, groundwater quality protection, minimizing wetlands disturbance, and comprehensive financial guarantees. Wisconsin's thorough mine waste regulations meet the MPC's recommendations for a mine waste regulatory program.
- **MPC Criticism: Multiple Agencies Regulate Mining in Many States** - The MPC criticizes those state mining regulatory programs with shared jurisdiction in which two or more state agencies have responsibility for regulating mining.
- **Wisconsin Reality: The DNR Has Complete Jurisdiction Over Wisconsin's Mining Environmental Regulatory Programs** - In Wisconsin, the DNR is the environmental regulatory body with sole responsibility for regulating all aspects of mining and the environment. This omnibus approach to mine regulation ensures a coordinated approach in which no issues get overlooked or fall through the cracks between different regulatory agencies.

HERE'S THE REST OF THE STORY

To borrow a phrase from Paul Harvey, *Golden Dreams* fails to tell "The Rest of the Story" about how today's mining industry is aggressively and successfully addressing environmental problems at old mine sites and operating new mines in an environmentally responsible manner. In describing mines at which there are pollution problems, *Golden Dreams* blurs the distinction between old and new mines to create the misimpression that problems at operating mines cannot be avoided, or are not being corrected.

To make matters worse, the MPC has omitted important information about the proactive measures today's mine operators are taking to correct historic environmental problems at their sites. In the case of several mines discussed in the book, the MPC has completely ignored information provided by mining companies that describe their efforts to address environmental issues.

For example, the book's extensive discussion of Pegasus Gold Corporations' (Pegasus') Zortman-Landusky Mine in Montana makes no mention of information that Pegasus provided to the MPC regarding environmental issues at this mine. Instead, the MPC chose to describe this mining operation in a sensational and inaccurate manner. The following paragraphs present two specific instances in which *Golden Dreams* presents a distorted, and incomplete picture.

- **MPC's Version:** "In 1982, 780 gallons of cyanide-tainted solution leaked from a containment pond...only a few months later, in October, a section of piping used in the mine's cyanide sprinkling system ruptured, releasing 52,000 gallons of cyanide solution onto lands and into creeks. A few days after the incident, a mine employee smelled cyanide -- which has an almond smell -- in his tap water. Testing revealed a cyanide concentration of 3.2 milligrams per liter (mg/l). These discoveries forced the shutdown of a local community water system." (page 73)
- **What Really Happened:** The cyanide leak happened at night. As soon as it was detected, it was addressed instantly. The affected residents (an unauthorized trailer camp on the mine property) were supplied with bottled water. Within days, Pegasus drilled a new community water well at its expense into a deeper, more reliable aquifer. The Company continues to supply water at no charge to the residents of Zortman, Montana.
- **MPC's Version:** "Animal deaths provided the most dramatic evidence of cyanide contamination. In August 1983, two bighorn sheep were found dead on a cyanide heap leach pile" (page 73).
- **What Really Happened:** In 1983, Pegasus received a letter from the Regional Manager for the Montana Department of Fish and Game which stated that the leach pads should not be fenced because the agency did not have evidence of direct impacts to bighorn sheep. The agency wanted the company to put out salt blocks. Later in 1983, following the bighorn sheep deaths, this same Regional Manager stated that the salt block interception program did not work and directed Pegasus to construct fences to exclude wildlife from the pads. Pegasus subsequently constructed a fence around the heap leach facility.

It is unfortunate that mining activist groups like the MPC and those who cite the MPC's materials as authoritative, frequently resort to misinformation and distortion in their efforts to generate and sustain public opposition to mining. Their alarmist message about environmental problems at old mine sites, and their incomplete and inaccurate descriptions of environmental incidents at modern mines can only contribute confusion and controversy to public policy debates about mining.

The truth about the modern industry can be found by visiting an operating mine and observing the many environmental safeguards and pollution prevention techniques used at these sites, and talking

to state and federal mine regulators about the environmental track record of today's mines. In making public policy decisions about mining, it is imperative that both decision makers and the public have access to accurate, relevant, and factual information, to enable them to discriminate between fact and fiction.

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An Overview of Metallic Mineral Regulation in Wisconsin, Revised Edition, 1996, Evans, T. J., Wisconsin Geological and Natural History Survey, Special Report No. 13, Madison, Wisconsin.

DRAFT REVISION TO SB 3

[COMMENT: What follows are proposed changes to SB 3. Some of the changes are taken from Assembly Amendment 1 to SB 3. All changes are annotated so that the reader can determine where the change originated and why the change is being proposed. This draft includes a 10 year period of experience with technology applied to mining operations. It is the intent of this draft to address the concerns of those who do not want Wisconsin to serve as the laboratory for application of mining technology. At the same time, it eliminates the requirement that only mines designed and operated from the nineteenth century through the early 1970's be used to evaluate whether acceptable technology exists to address environmental concerns associated with mining.]

[Beginning with Section 2. of SB 3]

Section 2. 293.50 of the statutes is created to read:

293.50 Moratorium on issuance of permits for mining of sulfide ore bodies.

(1) In this section:

(a) "pollution" means degradation ~~that results in a violation of an environmental law of groundwater or surface water that has been confirmed by a finding by a state, provincial or federal agency of a violation of an environmental law or regulation it administers.~~

[This revision is being suggested by Department staff. The existing version of SB 3 is imprecise and allows for different interpretations regarding how the Department should determine whether there have been violations of the laws of other jurisdictions. The Legislative Council has agreed with the Department that, as worded, SB 3 lacks direction. The proposed language specifically requires the Department to learn whether state or federal agencies responsible for overseeing mining operations elsewhere have determined violations of law or rule have occurred which have caused degradation of groundwater or surface water. Specific reference is made to degradation of groundwater and of surface water because that is the concern identified in paragraph (2)(a).]

(b) "sulfide ore body" means a mineral deposit in which metals are mixed with sulfide materials.

(2) Beginning on the effective date of this subsection . . . [revisor inserts date], the department may not issue a permit under s. 293.49 for the mining of a sulfide ore body until the following conditions are satisfied:

(a) The department determines, based on information that is provided by an applicant for a permit under s. 293.49, and that is verified by the department, that there exists in the United States or Canada, a mining operation has operated in a sulfide ore body that, together with the host rock in which the ore body is located and in which the mining waste is deposited, which is not capable of neutralizing acid mine drainage in the United States or Canada, which operated for at least 10 years since January 1, 1977, without, at any time, the pollution of groundwater or surface water from acid drainage or

from the release of heavy metals at the tailings site or at the mine site or from the release of heavy metals.

[This proposed change, along with the proposed replacement of (b), below, corrects several shortcomings of SB 3 as written. First, it precludes, as examples, use of mines that were operated long before there were any environmental regulations—mines that were operated and closed in the last century or early decades of this century. This would be allowed by the existing SB 3, which has been highlighted by the department in earlier testimony before the Legislature. Second, it applies the test to present-day mining operations. Existing SB 3, particularly paragraph (2)(b) which this proposal calls for replacing, virtually guarantees that only old technology—that designed prior to adoption of the major environmental laws of this nation—could be evaluated. Use only of such old technology to make judgments in the late 1990's would be unsound environmental regulation.]

Some of the changes being suggested have come directly from Assembly Amendment 1. Others were taken from Assembly Amendment 1, but adjusted to make the provisions more readable. Other suggested changes are new to this draft.

~~(b) The department determines, based on information provided by an applicant for a permit under s. 293.49, that a mining operation that operated in a sulfide ore body which is not capable of neutralizing acid mine drainage in the United States or Canada has been closed for at least 10 years without the pollution of groundwater or surface water from acid drainage at the tailings site or at the mine site or from the release of heavy metals. The department determines, based on information that is provided by an applicant for a permit under s. 293.49, and that is verified by the department, that there exists proven technology, appropriate for application in Wisconsin, which would prevent pollution of groundwater or surface water from acid drainage or from the release of heavy metals at the proposed mine site and at any associated mining waste site.~~

at least 100 yrs

[As noted, the language in paragraph (b) is deleted because, as written, it mandates a look only at mines that were designed well over 20 years ago—at the very minimum. A flip side of the same coin highlighted by the former paragraph (b), is that a well designed and well operated mine—operated for any number of years—cannot be evaluated if it has not been closed. This would preclude viewing any application of present technology. The former paragraph (b) also appears to be based on two flawed technical assumptions. It assumes 1) that problems can only be found after a mine has been closed, and 2) that the arbitrary period of 10 years should provide comfort that no problems exist. The proposed revised paragraph (b) incorporates requirements which are similar to the concepts proposed in AB 236. This would require an applicant to demonstrate that there exists appropriate proven technology for use in a proposed project.]

(3) This section applies without regard to the date of submission of the permit application.

DRAFT REVISION TO SB 3

[Beginning with Section 2. of SB 3]

Section 2. 293.50 of the statutes is created to read:

293.50 Moratorium on issuance of permits for mining of sulfide ore bodies.

(1) In this section:

(a) "pollution" means degradation of groundwater or surface water that has been confirmed by a finding by a state, provincial or federal agency of a violation of an environmental law or regulation it administers.

(b) "sulfide ore body" means a mineral deposit in which metals are mixed with sulfide materials.

(2) Beginning on the effective date of this subsection . . . [revisor inserts date], the department may not issue a permit under s. 293.49 for the mining of a sulfide ore body until the following conditions are satisfied:

(a) The department determines, based on information that is provided by an applicant for a permit under s. 293.49, and that is verified by the department, that there exists in the United States or Canada, a mining operation in a sulfide ore body that, together with the host rock in which the ore body is located and in which the mining waste is deposited, is not capable of neutralizing acid mine drainage, which operated for at least 10 years since January 1, 1977, without, at any time, pollution of groundwater or surface water from acid drainage or from the release of heavy metals at the tailings site or at the mine site.

(b) The department determines, based on information that is provided by an applicant for a permit under s. 293.49, and that is verified by the department, that there exists proven technology, appropriate for application in Wisconsin, which would prevent pollution of groundwater or surface water from acid drainage or from the release of heavy metals at the proposed mine site and at any associated mining waste site.

(3) This section applies without regard to the date of submission of the permit application.

Assembly Substitute Amendment 1 to Senate Bill 3

Background

Representative Black's ASA 1 to 1997 SB 3 is the same language contained in the original versions of 1997 Assembly Bill 70/1997 Senate Bill 3.

ASA 1 states that before a mining permit can be issued in Wisconsin there must be proof that a mine has operated in the US or Canada for at least 10 years **without polluting** groundwater or surface water, and that the mine has been closed for 10 years **without polluting** groundwater or surface water. Furthermore, it requires a mining company to demonstrate that no groundwater or surface water pollution has occurred in a sulfide ore body of "**similar geological characteristics.**"

Zero Impact or Activity Standard

The substitute amendment establishes a zero impact or activity standard because it states that a mining company must provide evidence that a sulfide mining operation has operated for ten years "**without the pollution** of groundwater or surface water" and that a sulfide mining operation has been closed for at least ten years "**without the pollution** of groundwater or surface water".

Pollution is defined under Wisconsin statutes as "contaminating or rendering unclean or impure the waters of the state . . ." Under this standard, any change to background level would be considered pollution regardless of whether it has an adverse impact on human health or the environment.

There are no other industries subjected to a zero impact or activity standard, nor are there any state or federal regulations which require such a standard. The reasons for this are obvious. A zero impact or activity standard is not necessary to protect public health, welfare or the environment. Second, such a standard is neither technically or economically feasible. To require a zero impact or activity standard for mining operations would be a substantial departure from the entire federal and state regulatory scheme.

"Similar Geological Characteristics"

ASA 1 is tied to an ambiguous reference point. It requires a mining company to demonstrate that no groundwater or surface water pollution has occurred from mining operation in "a sulfide ore body of similar geological characteristics." To some extent, all geological characteristics are unique. Even if parameters could be determined, the real issues that should be examined are the size, location, nature of the operation and hydrologic considerations associated with the ore body, not the geological characteristics (see attachment).

Requires Old Technology

ASA 1 is definitely a step in the wrong direction because it *requires* that old technology be examined for current or future mining projects in light of today's technology. Mining projects currently operating are using the most state-of-the-art technology of today and continuously upgrade operations to ensure that the environment is being protected.

SIMILAR GEOLOGIC CHARACTERISTICS

1. Background.

Senate Bill 3 requires that an applicant for a mining permit demonstrate that a mining operation has operated in a sulfide ore body of similar geological characteristics in the United States or Canada without the pollution of groundwater or surface water. Because the concept of "similar geological characteristics" is both scientifically and legally invalid, the proposed amendment would delete this language.

2. Scientific Problems.

There are two fundamental scientific problems with the concept of similar geologic characteristics.

First, the term is broad and ambiguous. Lawyers, if not geologists, could argue endlessly over whether an ore deposit does or does not have similar geological characteristics. Geological characteristics encompass a wide range of factors including the physical characteristics of the surrounding rocks, the characteristics of the ore body itself and the environmental factors in which the ore body is situated. A partial listing of the types of geologic parameters that could be used to define similar geologic characteristics is attached.

This is not simply an academic exercise. Some persons would argue that the Flambeau deposit has similar geologic characteristics to the Crandon deposit, while others would vehemently deny such a characterization. In short, from a scientific standpoint, these terms would do nothing but promote ambiguity, confusion and uncertainty.

Second, the term is neither relevant nor germane. Whether a mining operation has operated in a "sulfide ore body of similar geological characteristics" is irrelevant to whether the operation has caused pollution of groundwater or surface water from acid drainage. A sulfide ore body in its natural state does not produce acid drainage. That potential only arises when the ore body is mined and the minerals processed. When mined and processed, all sulfide ore bodies have the potential to generate acid drainage, not merely those of similar geologic characteristics.

Potential acid drainage impacts are not primarily determined by the geologic characteristics of the ore body but rather by how and where the mining operation takes place. Environmental factors (such as surface water drainage patterns and precipitation levels), regulatory factors, and type of processing operation each have a substantially greater impact on the potential of the mining operation to produce acid drainage than the geological characteristics of the ore body.

3. Legal Problems.

There are a host of legal problems that stem from the scientific problems noted above. This is not merely a technical problem of attempting to better define what similar geologic characteristics might mean — the concept itself is flawed. There are at least four constitutional problems with the concept.

First, the statute violates substantive due process. The substantive due process requirement was recently summarized by the Wisconsin Supreme Court in *Interest of Reginald D.*, 193 Wis. 2d 299, 307, 533 N.W.2d 181 (1995) as follows:

Government action violates 'substantive due process' when the action in question, while adhering to the forms of law, unjustifiably abridges the constitution's fundamental constraints upon the content of what government may do to people under the guise of the law. This court has recognized that 'due process requires that the means chosen by the legislature bear a reasonable and rational relationship to the purpose or object of the enactment; if it does, and the legislative purpose is a proper one, the exercise of the police power is valid.'

Here, even if one could define what a similar geologic characteristic is, there is no rational relationship between the geologic characteristics of a sulfide ore body and the potential to create acid drainage.

Second, the statute violates equal protection. The equal protection clause prevents the Legislature from treating people differently (creating classifications) unless such a classification meets the following test:

[T]he classification must be based upon substantial distinctions which make class really different from another; second, the classification must be germane to the purpose of the law; third the classification must not be based upon existing circumstances only and must not be so constituted as to preclude addition to the numbers included within a class; fourth, to whatever class a law may apply, it must apply equally to each member thereof; and fifth, the characteristics of each class should be so far different from those of other classes as to reasonably suggest at least the propriety, having regard to the public good, of substantially different legislation.

GTE Sprint Communications Corp. v. Wisconsin Bell, Inc., 155 Wis. 2d 884, 194, 454 N.W.2d 797 (1990).

Here, the proposed statute creates several layers of improper classifications. On the most general level, it singles out the metallic mining industry from all other industries in the State. No other industry must prove that similar operations have operated elsewhere without violations. There is no rational basis to treat the mining industry different than any other industry. On a more specific level, there is no rational basis to treat similar sulfide ore bodies differently from dissimilar sulfide ore bodies. As noted above, all sulfide ore bodies

have the potential to produce acid mine drainage. Whether they will do so depends on how and where the mine is designed and operated not the similarity of the ore body.

Third, the statute is unconstitutionally vague. In *Richland School District v. Dept. of Industry Labor and Human Relations*, 174 Wis. 2d 878, 498 N.W.2d 826 (1993), the Wisconsin Supreme Court stated:

The constitutional 'void for vagueness' doctrine is grounded in the due process guarantee of the Fourteenth Amendment to the United States Constitution. This court has said 'unless a statute is so vague and uncertain that it is impossible to execute or to ascertain the legislative intent with reasonable certainty, it is valid.'

The question here is whether it is possible to execute or ascertain the legislative intent with respect to the terms similar geologic characteristics. Given the many geologic characteristics or combination of characteristics make an ore body similar or dissimilar, it simply cannot be done.

Fourth, the effect of the statute is to take private property without compensation. The Fifth Amendment of the United States Constitution like Article 1, § 13 of the Wisconsin Constitution prohibits a state from taking anyone's property without paying for it. The Wisconsin Supreme Court has noted that this protection applies with respect to mining interests no less than other property interests. In *Noranda Exploration, Inc. v. Ostrom*, 113 Wis. 2d 612, 335 N.W.2d 596 (1983), the Court held that there was an unconstitutional taking when a Wisconsin statute required a mining company to disclose its drilling logs and cores to the public. Here, the potential taking is substantially more dramatic. The statute requires that a mining company meet an unknowable and unattainable standard thereby prohibiting a mining company from exercising any of its mineral rights.

4. Conclusion.

The mining industry can, in fact, point to examples throughout the country and the world where sulfide or bodies have been successfully mined and reclaimed. The sole purpose of inserting the language "similar geological characteristics" is to prevent such comparisons and ensure that whatever the evidence, mining is prohibited in Wisconsin. Such an effort is neither scientifically nor legally supportable.

ADJUDICATED DETERMINATION

1. Background.

Senate Bill 3 requires that an applicant for a mine permit show that another mining operation has operated in the United States or Canada for ten years "without the pollution of groundwater or surface water from acid drainage at the tailings site or at the mine site or from the release of heavy metals." The term pollution however, has been so broadly defined in Wisconsin and elsewhere that virtually any human impact to the environment could constitute pollution.

To prevent endless lawyers' arguments about what is or is not pollution, the proposed amendment requires that pollution be defined in the context of an adjudicated violation of a state or federal permit limit relating to ground or surface water.

2. Definition of Adjudicated.

The Amendment uses the term adjudicated. Blacks Law Dictionary (6th Ed. 1990) defines adjudicated rights as, "Rights which have been recognized in a judicial or administrative proceeding." Adjudication means, "The legal process of resolving a dispute. ... It implies a hearing by a court after notice, of legal evidence on the factual issues involved." As these definitions indicate, an adjudicated determination of a permit violation would mean that there has been a determination by a court or an administrative body after an evidentiary hearing.

3. Reason for Use of Term.

The use of the term adjudicated has been included for three reasons.

- **First, it provides certainty.** Lawyers can and do argue every day about whether certain monitoring results are or are not a permit violation. (Even where there is a measured exceedance, lawyers can argue about whether the sample was representative, whether there was lab error, whether the permit limit was valid, etc.). An adjudicated finding prevents all such arguments.
- **Second, it provides fairness.** An adjudicatory finding can only be made after each side has presented all of their evidence and made all of their arguments. It gives everybody their day in court and if there are valid defenses allows those to have been raised and resolved.
- **Third, it provides a broad scope of coverage.** "Adjudicated" is a very broad term that encompasses civil and criminal proceedings in courts as well as formal administrative proceedings.

SIMILAR GEOLOGIC CHARACTERISTICS

1. Background.

Senate Bill 3 requires that an applicant for a mining permit demonstrate that a mining operation has operated in a sulfide ore body of similar geological characteristics in the United States or Canada without the pollution of groundwater or surface water. Because the concept of "similar geological characteristics" is both scientifically and legally invalid, the proposed amendment would delete this language.

2. Scientific Problems.

There are two fundamental scientific problems with the concept of similar geologic characteristics.

First, the term is broad and ambiguous. Lawyers, if not geologists, could argue endlessly over whether an ore deposit does or does not have similar geological characteristics. Geological characteristics encompass a wide range of factors including the physical characteristics of the surrounding rocks and the characteristics of the ore body itself in addition to various environmental factors in which the ore body is situated. A partial listing of the types of geologic parameters that could be used to define similar geologic characteristics is attached.

This is not simply an academic exercise. Some persons would argue that the Flambeau deposit has similar geologic characteristics to the Crandon deposit, while others would vehemently deny such a characterization. In short, from a scientific standpoint, these terms would do nothing but promote ambiguity, confusion and uncertainty.

Second, the term is neither relevant nor germane. Whether a mining operation has operated in a "sulfide ore body of similar geological characteristics" is irrelevant to whether the operation has caused pollution of groundwater or surface water from acid drainage. When mined and processed, all sulfide ore bodies have the potential to generate acid drainage, not merely those of similar geologic characteristics.

Potential acid drainage impacts are not primarily determined by the geologic characteristics of the ore body but rather by how and where the mine is designed and operated. Environmental factors (such as surface water drainage patterns and precipitation levels), regulatory factors, the type of processing operation and the types of engineering safeguards utilized by the operation, each have a substantially greater impact on the potential of the mining operation to produce acid drainage than the geological characteristics of the ore body.

3. Legal Problems.

There are a host of legal problems that stem from the scientific problems noted above. This is not merely a technical problem of attempting to better define what similar geologic characteristics might mean — the concept itself is flawed. There are at least four constitutional problems with the concept.

First, the statute violates substantive due process. The substantive due process requirement was recently summarized by the Wisconsin Supreme Court in *Interest of Reginald D.*, 193 Wis. 2d 299, 307, 533 N.W.2d 181 (1995) as follows:

Government action violates 'substantive due process' when the action in question, while adhering to the forms of law, unjustifiably abridges the constitution's fundamental constraints upon the content of what government may do to people under the guise of the law. This court has recognized that 'due process requires that the means chosen by the legislature bear a reasonable and rational relationship to the purpose or object of the enactment; if it does, and the legislative purpose is a proper one, the exercise of the police power is valid.'

Here, even if one could define what a similar geologic characteristic is, there is no rational relationship between the geologic characteristics of a sulfide ore body and the potential to create acid drainage.

Second, the statute violates equal protection. The equal protection clause prevents the Legislature from treating people differently (creating classifications) unless such a classification meets the following test:

[T]he classification must be based upon substantial distinctions which make class really different from another; second, the classification must be germane to the purpose of the law; third the classification must not be based upon existing circumstances only and must not be so constituted as to preclude addition to the numbers included within a class; fourth, to whatever class a law may apply, it must apply equally to each member thereof; and fifth, the characteristics of each class should be so far different from those of other classes as to reasonably suggest at least the propriety, having regard to the public good, of substantially different legislation.

GTE Sprint Communications Corp. v. Wisconsin Bell, Inc., 155 Wis. 2d 884, 194, 454 N.W.2d 797 (1990).

Here, the proposed statute creates several layers of improper classifications. On the most general level, it singles out the metallic mining industry from all other industries in the State. No other industry must prove that "similar" (whatever those might be) operations have operated elsewhere without violations. There is no rational basis to treat the mining industry different than any other industry. On a more specific level, there is no rational basis to treat similar sulfide ore bodies differently from dissimilar sulfide ore bodies. As

noted above, all sulfide ore bodies have the potential to produce acid mine drainage. Whether they will do so depends on how and where the mine is designed and operated not the similarity of the ore body.

Third, the statute is unconstitutionally vague. In *Richland School District v. Dept. of Industry Labor and Human Relations*, 174 Wis. 2d 878, 498 N.W.2d 826 (1993), the Wisconsin Supreme Court stated:

The constitutional 'void for vagueness' doctrine is grounded in the due process guarantee of the Fourteenth Amendment to the United States Constitution. This court has said 'unless a statute is so vague and uncertain that it is impossible to execute or to ascertain the legislative intent with reasonable certainty, it is valid.'

The question here is whether it is possible to execute or ascertain the legislative intent with respect to the terms "similar" geologic characteristics. Given the many geologic characteristics or combination of characteristics that make an ore body similar or dissimilar, it simply cannot be done.

Fourth, the effect of the statute is to take private property without compensation. The Fifth Amendment of the United States Constitution like Article 1, § 13 of the Wisconsin Constitution prohibits a state from taking anyone's property without paying for it. The Wisconsin Supreme Court has noted that this protection applies with respect to mining interests no less than other property interests. In *Noranda Exploration, Inc. v. Ostrom*, 113 Wis. 2d 612, 335 N.W.2d 596 (1983), the Court held that there was an unconstitutional taking when a Wisconsin statute required a mining company to disclose its drilling logs and cores to the public. Here, the potential taking is substantially more dramatic. The statute requires that a mining company meet an unknowable and unattainable standard thereby prohibiting a mining company from exercising any of its mineral rights.

4. Conclusion.

The mining industry can, in fact, point to examples throughout the country and the world where sulfide ore bodies have been successfully mined and reclaimed. The sole purpose of inserting the language "similar geological characteristics" is to prevent such comparisons and ensure that whatever the evidence, mining is prohibited in Wisconsin. Such an effort is neither scientifically nor legally supportable.

**Partial List Of Geologic Parameters That Could Be Used
To Define Similar Geology Of An Ore Deposit**

Host Rock Characteristics (i.e., Characteristics of the Surrounding Rocks)

Host rock lithology (composition)
Geologic age
Tectonic setting
Type and degree of alteration
Type and degree of fractures and faulting
Degree of weathering
 Presence of supergene enrichment

Orebody Characteristics

Ore mineralogy
Sulfide mineral content
Sulfide mineral morphology
 crystalline - euhedral or anhedral, grain size - fine grained or coarse grained
Gangue minerals
Type and degree of alteration
Spatial distribution of the ore relative to surrounding host rocks
 (i.e., cross-cutting, stratiform, vein, stockwork, disseminated, etc.)
Orebody position (vertical, horizontal, or tilting)
Age of mineralization

Environmental Factors

Position of the groundwater table relative to the orebody
Surface water drainage patterns
Terrain characteristics (topography)
Climate (precipitation levels)
Vegetation
Habitat types
Surrounding land uses
Environmental impacts due to historic mining

Sheet1

	lbs/yr	lbs/mo	
Arsenic	0.74	0.0617	
Chromium	12.29	1.0242	
Copper	14.00	1.1667	→ 149 nickels
Cyanide	24.57	2.0475	
Lead	0.04	0.0033	
Silver	0.06	0.0050	
Zinc	7.13	0.5942	→ 102 pennies
Mercury	0.1	0.0083	

24 million gallons
per month of
discharge.

Based on Average discharge at 560 gallons per minute
Exceeds Drinking water standard except for Cyanide

20 1/4 million gallons
per hour for Wis. River
(14.6 BILLION GALS./mo.)

Copper discharge about equal to 200 pennies / month

DRAFT

Response to Rep. Mark Duff

- The appearance of large numbers implies that there is an impact on the river. DNR is charged with the responsibility of assessing these impacts. But did you know that:
 - by considering only background concentration in the Wisconsin River ; the total amount of copper, lead, arsenic, and cyanide would exceed 290 tons. By considering all the constituents the total loading to the river is far greater.
 -
 - Crandon Mining Company's discharge for cyanide will be a factor of 20 less than the drinking water standard and will represent less than 0.2 % that exists in the river now.
 -
 - Mercury concentrations will be 50 times less than the drinking water standard and less than 2 % of the existing background concentration.
 -
 - yes; numbers can be confusing, so why not let the DNR determine if there is an impact.
 -
- Crandon Mining Company's discharge would:
 - discharge less than a small fraction (less than 1%) of the natural low flow in the Wisconsin River during dry periods.
 -
 - will meet all DNR discharge standards and water quality below Hat Rapids Dam.
 -
 - by comparing the drinking water standards with the proposed CMC discharge concentration; our discharge is only a fraction of that concentration (see Table 1). Water quality data and publish information at a public meeting in Tomahawk, Crandon Mining Company's discharge is a small contributor to the river loading. Data calculated for selected parameters in Table 2.
 -
 - Crandon Mining Company's contribution to the Wisconsin River is small and is better than the DNR standards for all constituents.
 -
 - Note corrections to page two of ECCOLA calculations
 - + average flow is 560 not 900 gpm
 - + BOD value includes COD; calculations are incorrect
 - + mercury standard will be 1.3 not 40 as stated
 - + concentration of parameters recorded by ECCOLA are incorrectly higher than recorded in the Preliminary Engineering Report.

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Parameter	Units	Drinking Water Standard	Crandon Discharge Concentration	Reduction of Crandon Discharge Compared to Drinking Water
Arsenic	ug/L	50	0.300	167
Chromium	ug/L	100	0.380	263
Copper	ug/L	1300	5.700	228
Cyanide	mg/L	0.2	0.010	20
Lead	ug/L	15	0.016	938
Silver	ug/L	100	0.024	4,166
Zinc	ug/L	5000	2.900	1,724
Mercury	ng/L	2000	40.000	50

WISqual.XLS

TABLE 1

DRAFT

WISQUAL.XLS

TABLE 2

Parameter	Units	Drinking Water Standard	Background Water Quality for Wisc. River	Lbs per year for Average Flow at 337,500 GPM	Crandon Discharge Concentration	Lbs per year for Average Discharge at 560 GPM	% of total loading
Arsenic	ug/L	50	0.5	741	0.3	0.74	0.1
Chromium	ug/L	100	0.3	489	0.4	12.29	2.5
Copper	ug/L	1300	0.4	652	5.7	14.00	2.1
Cyanide	mg/L	0.2	0.0	14,813	0.0	24.57	0.2
Lead	ug/L	15	0.3	3,968	0.0	0.04	0.0
Silver	ug/L	100	0.0	15	0.0	0.06	0.4
Zinc	ug/L	5000	1.7	2,577	2.9	7.13	0.3
Mercury	ng/L	2000	3.89	6	40	0.1	1.7
COD	mg/L		25	37,035,710	17	41782.3	0.11
BOD	mg/L		1.5	2,221,877	5	12288.9	0.55

What's Exxon Planning to Dump into the Wisconsin River?

Mercury, Toxins & Oxygen-Consuming Pollutants

Published 08/04/97
Skepper Stopper

Information provided by ECCOLA

Toxins

- ❑ Over the proposed 28-year life of the Crandon mine, nearly 7 1/2 tons of toxins ranging from copper and lead to arsenic and cyanide will flow into the Wisconsin River.
- ❑ More than half of the toxic discharge will be cyanide at 315 lbs./year.

Mercury

- ❑ With conventional water treatment technology, Exxon's proposed wastewater would exceed mercury pollution standards by a factor of 20.
- ❑ Exxon would dump enough mercury (4.7 lbs.) into the Wisconsin River over the next 28 years to contaminate 1/2 million pounds of fish.
- ❑ Studies in Wisconsin have shown that a fraction of mercury makes its way into the food chain where very small amounts can contaminate fish.
- ❑ Fish that are already contaminated at a level of .5 parts per million (ppm) (DNR fish-advisory level 1) may be pushed into a concentration of 1.0 ppm that would make them unfit to eat.

Oxygen-Consuming Pollutants

- ❑ Exxon plans to dump about 50 tons per year of oxygen-consuming pollutants into the Wisconsin River. Some of these pollutants such as organic matter consume oxygen when they decompose.
- ❑ The Wisconsin River between Hat Rapids and Grandfather's Dam in Tomahawk is currently out of compliance with the Clean Water Act because of low oxygen levels. Summer time levels of dissolved oxygen in the Wisconsin River sometimes drop below 5 parts per million (ppm) which is a minimum requirement for fish and other aquatic life. (This is the stretch of the river where the Crandon Mine pipeline plans to discharge its wastewater.)
- ❑ Adding a new load of pollution will only make the problem worse.

Effluent concentrations and discharge amounts for some of the pollutants Exxon's proposed mine wastewater pipeline will discharge into the Wisconsin River:

Toxins			Lbs. per year	Project Life--Total Lbs
Chromium	0.005 mg/L ✓	900 GPM	19.6	549.0
Copper	0.010 mg/L ✓	900 GPM	84.5	2,367.0
Lead	0.003 mg/L ✓	900 GPM	11.7	328.5
Silver	0.001 mg/L ✓	900 GPM	3.8	108.0
Zinc	0.02 mg/L ✓	900 GPM	78.9	2,209.5
Arsenic	0.004 mg/L ✓	900 GPM	15.7	441.0
Cyanide	0.08 mg/L ✓	900 GPM	315.8	8,842.5
TOTAL			530.0	14,845.5
Mercury	40 ng/L ✓	900 GPM	0.168	4.725
Oxygen-Consuming Pollutants			Tons Per Year	Project Life-Tons
COD	10 mg/L ✓	900 GPM	19.7	
BOD	5 mg/L ✓	900 GPM	29.6	
TOTAL			49.3	1,381.7

For this analysis, it is assumed that Exxon's discharge will be 900 gallons per minute. These pollution estimates are also deemed conservative because it's assumed that Exxon will be able to enjoy foolproof technology in cleaning wastewater to the estimated purities. Pollutant concentrations are derived from the latest available figures which were presented in Exxon's permit application (Feb. 1996) to the EPA, in New Sources and New Discharges—Application for Permit to Discharge Process Wastewater (form 2D).

For more information, contact ECCOLA: P.O. Box 537, Minocqua, WI 54548 or call 715-453-6015.

[Back to the Crandon Mine Editorial Campaign home page](#)



The Department of the Treasury

Percentage Composition Of Metallic Elements In Current United States Coins

Minor coins of the United States are the 1-cent and 5-cent pieces. Two types of cents now circulate - the standard 95% copper and the 5% zinc cent and a copper-plated zinc cent introduced in 1982. The new cent contains 97.5% zinc and 2.5% copper. It is identical in size, color and design to the standard copper cent but weighs 2.500 grams as opposed to 3.110 grams for the old cent. Both coins were produced in 1982, and circulate simultaneously. However, the 95/5 alloy was discontinued at the end of that year and all subsequent cents produced are copper-plated zinc.

The composition of the 5-cent piece is a homogeneous alloy containing 75% copper and 25% nickel.

Prior to the passage of the Coinage Act of 1965, all U.S. circulating silver coins - the dollar, half dollar, quarter and dime - were composed of a silver-copper alloy containing 90% silver and 10% copper.

The coinage Act of 1965 removed all silver from the dime and quarter. These are now "clad metal" or "bonded" coins. The outside layers are bonded to the core, and represent 1/3rd of the total thickness of the coin. If the coin were to be melted, the composition would be 91.67% copper and 8.33% nickel.

The same Act reduced the silver content of the half dollar from 90% to 40%, making it a "clad metal" coin, with outside layers composed of a silver-copper alloy containing 80% silver and 20% copper. The core contains 20.9% silver and 79.1% copper. The outer layers represent a little less than 1/3rd of the total thickness of the coin. If the coin were to be melted, the resulting metal would be 40% silver and 60% copper.

Coinage legislation approved December 31, 1970, removed all silver from the circulating dollar and half dollar coins. Now none of our coins produced for circulation contain silver.

The last of the 90% silver-10% copper dollars were minted in 1935. Dollar coinage was not resumed until 1971, when the Eisenhower design was issued. Also a layered, or bonded piece, the outside is a 75% copper and 25% nickel alloy, with a core of pure copper. Melted down, it would contain 91.67% copper and 8.33% nickel. The Eisenhower dollar, while still an acceptable medium of exchange, is no longer being manufactured. Coinage ceased December 31, 1978.

A new small-sized dollar coin was authorized by Public Law 95-446, approved October 10,

1978. Larger than the quarter but smaller than the half dollar, and bearing the likeness of Susan B. Anthony, it was introduced into the coinage system in July of 1979, replacing the familiar 1-1/2 inch dollar coin. It too, is cupronickel clad, 75% copper and 25% nickel alloy on the outside, with a pure copper core. If melted, the Anthony dollar would contain 87.5% copper and 12.5% nickel.

- The United States Mint: A Brief History; 1792-1995
- The United States Mint: A Bureau of The Department of Treasury
- The Production of a Coin: From Die Manufacturing to Coin Distribution
- The History of Mint Marks
- Coin Specification Chart Circulating Coins
- The History of "In God We Trust."

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168 pennies = 1 lb.
 96 nickels = 1 lbs. → .75 lbs copper

$$\frac{.75 \text{ copper}}{96} = \frac{1.1667 \text{ lbs}}{x}$$

.75 x =

168 pennies
 168 lbs

168 = .975 lbs zinc

~~168~~ $\frac{.975 \text{ lbs}}{168} = \frac{0.5942}{x}$ 102 pennies

.975 x = 99.8256

Characteristics of Modern MSW Landfill Performance

Rudolph Bonaparte and Majdi A. Othman

Introduction

Landfills have long been used for the permanent land disposal of municipal, industrial, and hazardous solid wastes. U.S. federal and state regulations require that these facilities be designed to function for an active life, plus a post-closure period, typically 30 years.

In most cases, however, waste will remain in the landfill for a much longer period of time, possibly hundreds or thousands of years. One potential environmental impact of landfills is groundwater contamination resulting from landfill leachate. In order to protect ground water, landfill leachate containment and collection systems must perform satisfactorily during the entire period of significant leachate generation.

GeoSyntec Consultants (GeoSyntec)

is currently under contract to the United States Environmental Protection Agency (USEPA) to perform research on the design, construction, and performance of landfills. GeoSyntec is a co-principal investigator for this study along with the Geosynthetic Research Institute (GRI) at Drexel University and the Department of Civil Engineering at the University of Texas at Austin.

GeoSyntec is specifically responsible for collecting and evaluating data on the field performance of landfill liner systems. In particular, data on flow volumes and flow constituents for the leachate collection and removal system (LCRS) and the leakage detection system (LDS) components of double-liner systems are of primary interest.

GeoSyntec recently completed a similar project for the USEPA on the

field performance of liner systems at 36 landfills and surface impoundments. The results are presented in a USEPA report entitled "LDCRS Flow from Double-Lined Landfills and Surface Impoundments" (Bonaparte and Gross, 1993).

For the previous study, only flows from the LDSs of double-lined facilities were considered. The scope of the original study is significantly expanded in this current project by including data on LCRS and LDS flow quantities and flow constituents. The new study considers not only the 36 facilities from the original study, but also many new facilities.

The data analysis for the project will attempt to answer the following questions:

- What are the quantity and chemical

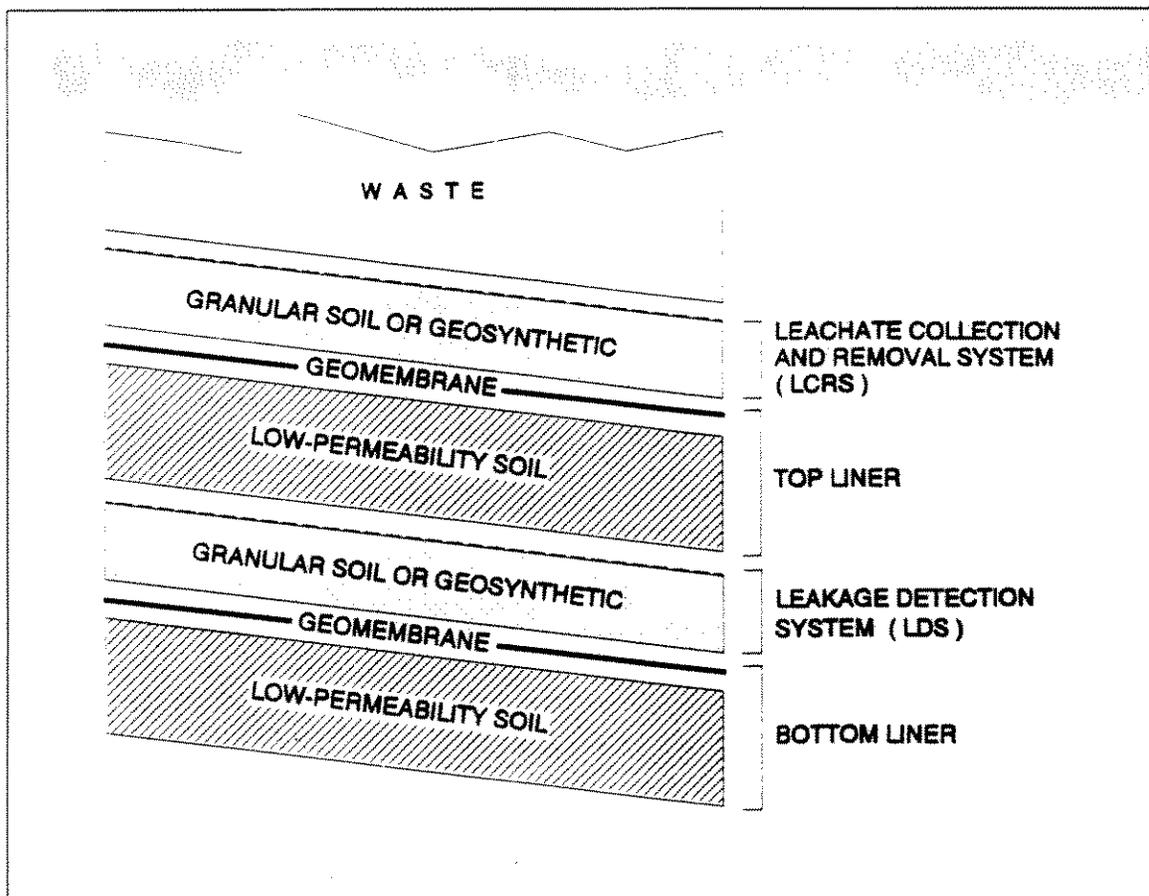


Figure 1. Components of double-liner system.

quality of the leachate generated in modern municipal solid waste (MSW) waste containment units, both during and after closure?

- How effective are final cover designs in minimizing long-term leachate generation?
- How does the quantity and chemical quality of leachate vary geographically?
- What impact are USEPA's land disposal restrictions having on leachate quantity and chemical quality?
- What are the quantities and chemical qualities of the liquid flows from the LDSs of the units?
- What are the sources of the liquid flows from the LDSs?
- What conclusions can be drawn from the available LDS data on the performance of top liners and, by extrapolation, on the performance of the entire liner system?
- Is there any indication that units with one type of LCRS or LDS design are performing better than the units with a different type of design?

Data collection and analysis are currently in progress. In this article, a few preliminary results are presented. Portions of this article have been excerpted from a paper by Bonaparte (1995).

Description Of Landfill Liner System

A liner system consists of a combination of one or more drainage layers and low-permeability barrier layers (i.e., liners). The functions of the liners and drainage layers are complementary. The liner impedes the migration of leachate out of the landfill and improves the performance of any overlying drainage layer. The drainage layer limits the buildup of hydraulic head on the underlying liner and conveys to a sump the liquid that percolates into the layer. Figure 1 illustrates the components of a double-liner system, with top and bottom composite liners. From top to bottom, the components shown in Figure 1 are:

- LCRS, which consists of a permeable soil and/or geosynthetic drainage system, and possibly a network of perforated liquid conveyance pipes;
- top liner, which may consist of a geomembrane alone or a composite liner having a geomembrane upper component and a low-permeability soil lower component;
- LDS, which consists of a permeable soil and/or geosynthetic drainage system, and possibly a network of perforated liquid conveyance pipes; and

- bottom liner, which may consist of a geomembrane alone or a composite liner having a geomembrane upper component and a low-permeability soil lower component.

The following comments are made regarding Figure 1.

- the low-permeability soil component may be constructed of natural clay soils, admixture-modified soils, or geosynthetic clay liners (GCLs); and
- while not indicated by the figure, the geomembrane and soil components of a composite liner are designed to maintain "intimate" contact between the two materials.

Leachate Generation Rates

Leachate may be defined as liquid that has percolated through solid waste extracting waste constituents in either dissolved or suspended form. Modern landfills generate leachate primarily as a result of the direct infiltration of rain into the waste. Moisture from other sources is relatively unimportant in the generation of leachate at modern U.S. MSW landfills because: (i) current regulations prohibit the disposal of liquids in landfills; (ii) municipal solid waste (MSW) and most other wastes disposed in modern landfills have moisture contents below field capacity at the

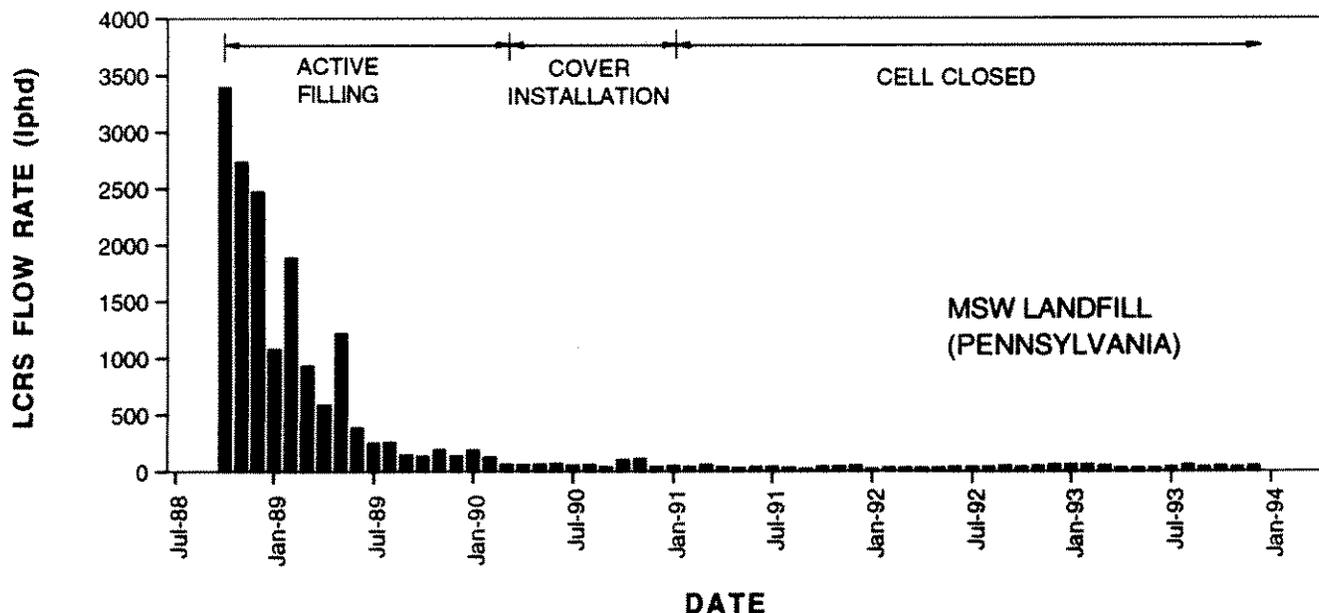


Figure 2. Leachate generation rates at a modern MSW landfill in Pennsylvania. Average annual precipitation at the landfill site is 1.0 m/year. Closure included installation of a geomembrane cover.

time of disposal; and (iii) current regulations require landfills to be designed to prevent surface-water run-on. In the context of this article, a modern landfill is defined as a landfill designed to meet current U.S. regulations and constructed and operated to the state of practice in the U.S. from the mid to late 1980s forward.

In the absence of supplemental moisture addition (e.g., leachate recirculation or the placement of sludge or other high moisture content waste in the landfill), the leachate generation rate will be highest early in the landfill active life, with the rate decreasing as the landfill is filled and progressively closed.

Most new landfills will require geomembrane final covers. Functioning properly, these covers will virtually eliminate infiltration and thus long-term leachate generation.

This trend in leachate generation rates can be seen in Figure 2, which presents normalized LCRS flow rate data for a double-lined MSW landfill in Pennsylvania having a geomembrane/GCL composite top liner and a geomembrane final cover. Monthly average leachate generation rates during the period of cell filling were up to 3,400 liters per hectare/day (lphd). Rates for the first three years of the post-closure period have averaged only 70 lphd. For

comparison, normalized LDS flow rates for this same facility are shown in Figure 3. Most of the observed LDS flow during the active filling period is attributed to water from precipitation that percolated into the LDS sand layer during construction and water expelled from the sand due to compression under the weight of the overlying waste.

Leachate Characteristics

Leachate characteristics vary widely between facilities based on waste properties, waste age, moisture availability, temperature, and other factors. Select chemical data for leachate from 14 modern U.S. landfills are shown in Table 1. These data are from lined facilities that accepted only MSW, with limited amounts of construction and demolition waste (CDW). The data were obtained by the authors as part of the ongoing study being performed for the USEPA. It is noteworthy that the constituent concentrations in this table are at the low ends of the ranges of concentrations reported by others (e.g., Bagchi, 1990; Ehrig, 1988; Tchobanoglous et al., 1993; USEPA, 1988).

One possible explanation for the lower concentrations is that the environmental initiatives of the past decade are causing a reduction in hazardous chemical loadings to MSW facilities. These

initiatives include increasing the number of chemicals listed as Resource Conservation and Recovery Act (RCRA) hazardous wastes, lowering the cut-off levels for small-quantity hazardous waste generators, and implementing household hazardous waste pick-up programs.

Liner System Performance

Liner system performance can be evaluated by monitoring the LDSs of double-lined landfills. This approach provides an indication of the performance of the top liner of the double-liner system. Data on LCRS and LDS flow rates can be used to draw conclusions on the containment efficiency of the top liner, and thus on the containment efficiency of the entire double-liner system. Comparison of LCRS and LDS chemical data can provide additional insight into advective or diffusive contaminant transport through the top liner.

Evaluations of LDS data have been reported by Bonaparte and Gross (1990, 1993), Bergstrom et al. (1993), Feeney and Maxson (1993), Haikola (1994), Maule et al. (1993), and Workman (1994). With a few exceptions, the data have been limited to LDS flow rates, as early monitoring programs often did not include chemical analyses. The most extensive LDS data collection and evalu-

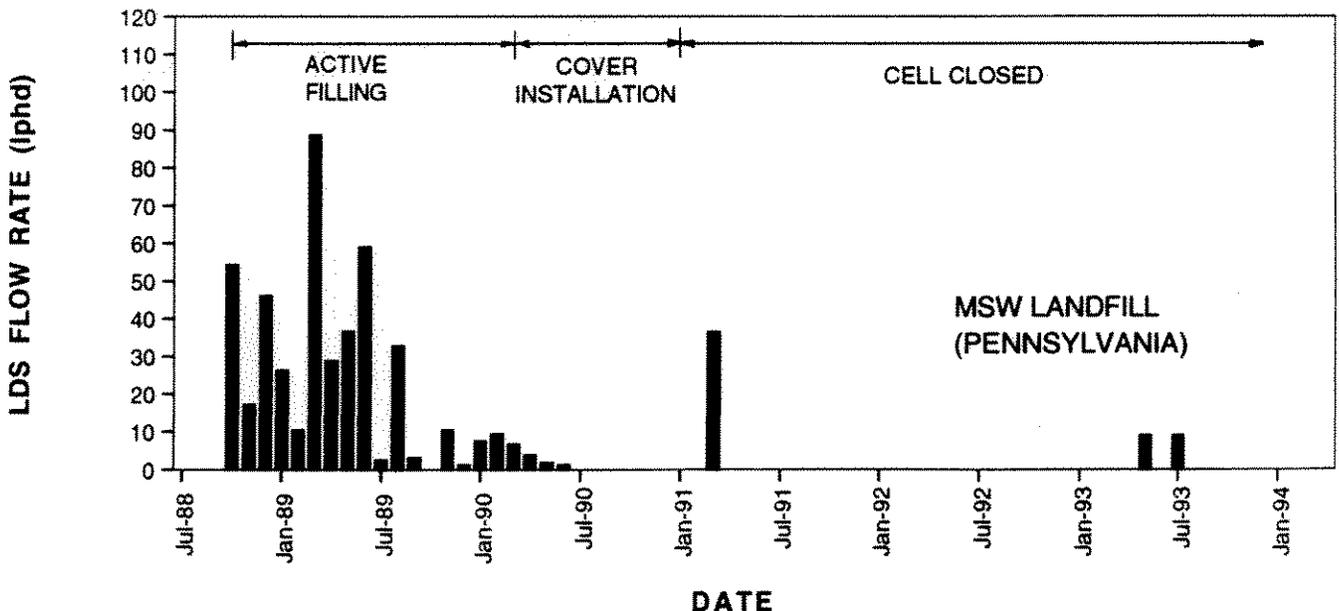


Figure 3. Leakage detection system flow rates for a modern MSW landfill in Pennsylvania (leachate generation rates at this landfill are shown in Figure 2).

FACILITY (with dates of waste placement (month/year) and dates of leachate sampling (month/year))

LEACHATE CHARACTERISTIC ^{1/}	FACILITY (with dates of waste placement (month/year) and dates of leachate sampling (month/year))													
	California A (10/90-2/91) (4/91-1/93)	Pennsylvania A (7/88-7/89) (5/90-12/93)	Pennsylvania B (8/87-to date) (5/88-5/93)	New Jersey A (2/87-11/92) (7/91-4/94)	Kansas A (4/88-11/88) (1/91)	Florida A (5/92-to date) (8/92-4/93)	Michigan A (10/90-to date) (10/90-4/94)	Michigan B (1/89-to date) (11/93)	North Carolina A (12/90-to date) (4/91-2/93)	Louisiana (3/89-9/91) (11/93)	New York A (7-to date) (2/91-10/93)	New York B (11/91-to-date) (11/91-12/93)	New York C (4/88-to-date) (3/92-12/93)	New York D (11/92-to date) (11/93-2/94)
pH	6.5		6.6	6.3	7.3	5.9	7.4		6.8		7.8	6.5	7.2	6.7
Specific Conductance	2600	7080	5890		2110	4100	1066		1121		23,140	10,000	3,438	2,910
Alkalinity	1260	3280	1775				503				1,000	1,614	1,508	203
TDS	1890		2959	1533				1600	1011		7,217	2,740		
COD	680	5040	1746	1499			330		546		4,784	3,573		
BOD ₅			1460	572				337				1,957		
TOC	183		632	520			147	93	144		1,334	947		45
Sulfate	17	120	21	27			26	110	17		191	95		750
Calcium	372	600	319				159	1			1,176	261		508
Magnesium	88						33	120		290	1,929	115		62
Sodium	91	460	209	99			28	1			936	282		115
Chloride	142	610	351	118			47	580	56		2,598	199		19
Arsenic	70		10			<10		4	<10	190	<5	9		<2
Lead	<2 ¹⁰		<16		<5	<5	<90	50	<50	23	20	1		1
Chromium	<40		<40		<10	<24	<38	25	<20	67	<10	<50		32
Nickel	<40				<20			50	<25	1,190	<50	<50		202
Cadmium	<20		<5		<2	<5	<2	20	<8	<5	<5	<1		11
1,1,1-Trichloroethane	40		30	18	<4	35	<2	<1	<1	8	<1	<1		96
1,1-Dichloroethane	290	<75	251	239	<5	260	<1	<1	<1	14	<1	<1		54
1,2-Dichloroethane	<10	<30	3	7	<5	<25	<2	<1	<1	<5	<1	<1		<10
Benzene	<20	<30	10	14	<4	<25	<1	<1	<1	<5	<1	<1		<10
Ethylbenzene	<70	<50	69	21	<7	49	<1	<1	<1	<5	<1	<1		29
Methylene Chloride	<10	400	1139	90	<3	260	<5	<1	<1	<5	<1	<1		200
Trichloroethene	<10	<30	18	7	7	<25	<1	<1	<1	60	<1	<1		290
Toluene	285	490	981	204	<6	230	<3	<1	<1	<5	<1	<1		<10
Vinyl Chloride	<10	<70	7	9	<10	<25	<1	<1	<1	14	6			144
Xylenes	122	<80	213			160	<5	<1.5		<5	<1			
cis-1,2-Dichloroethene	200	<50	79			<25	<1	<1			<1			
trans-1,2-Dichloroethene	<10	<50	79	16	<7	<25	<1	<1		18				

Notes: (1) A modern landfill is defined as one constructed after the mid to late 1980s, underlain by either a double-liner system or single-composite liner system, and with no disposal of liquids or sludges with the MSW. Reported results typically represent the mean of ten separate measurements.
 (2) Specific conductance is given in units of microhm/cm, pH is dimensionless, alkalinity through chloride are given in units of mg/l, arsenic through trans-1,2-dichloroethene are given in units of µg/l.
 (3) Values preceded by "<" indicate the method detection limit, non-detect analytical results were obtained for these constituents.

Table 1. Average LCRS liquid quality data for 14 modern⁽¹⁾ MSW landfills

(a) Landfills with CQA	Average	Maximum Monthly	Maximum Weekly
Less than 50 lphd	6	5	-
From 50 to 200 lphd	5	4	1
From 200 to 500 lphd	2	-	1
From 500 to 1,000 lphd	1	-	3
More than 1,000 lphd	-	-	-
(a) Landfills without CQA	Average	Maximum Monthly	Maximum Weekly
Less than 50 lphd	-	-	-
From 50 to 200 lphd	1	-	-
From 200 to 500 lphd	-	-	-
From 500 to 1,000 lphd	1	-	2
More than 1,000 lphd	5	-	4

(b) Landfills with CQA	Average	Maximum Monthly	Maximum Weekly
Less than 50 lphd	7	2	-
From 50 to 200 lphd	14	8	1
From 200 to 500 lphd	10	5	3
From 500 to 1,000 lphd	3	-	4
More than 1,000 lphd	3	3	6
(b) Landfills without CQA	Average	Maximum Monthly	Maximum Weekly
Less than 50 lphd	-	-	-
From 50 to 200 lphd	1	-	-
From 200 to 500 lphd	2	2	-
From 500 to 1,000 lphd	2	1	-
More than 1,000 lphd	-	2	-

Table 2. Comparison of average and maximum measured flow rates from LDSs: (a) landfills with geomembrane top liners; (b) landfills with composite top liners (from Bonaparte and Gross (1993))

ation effort to date was performed by Bonaparte and Gross (1993) for USEPA. A summary of normalized LDS flow rate data from their study is presented in Table 2. Conclusions from the study on LDS flow rates, considering geomembrane and composite liners separately, were as follows:

- Twenty-one active landfill cells with geomembrane top liners were evaluated. The cells were subdivided into those that had been subjected to construction quality assurance (CQA) monitoring and testing (14 cells) and those that were constructed without a CQA program (seven cells). LDS flows attributed by the authors to leakage through the geomembrane top liner are reported in Table 2(a). From this table, it can be seen that of the 14 cells that had a CQA program, six had average LDS flow rates less than 50 lphd, and eleven had average flow rates less than 200 lphd. Of the seven cells that did not have a CQA program, one cell had an average flow rate less than 200 lphd, and five cells exhibited average flow rates greater than 1,000 lphd. A comparison of the CQA and non-CQA data provides evidence of the value of CQA programs. The data also suggests that leakage rates through geomembrane top liners at active landfills constructed using state-of-practice CQA programs will typically be less than 200 lphd.
- LDS flows from active landfill cells with composite top liners, summarized in Table 2(b), were attributed primarily to consolidation of the clay component of the composite liner. From this table, it can be seen that significant LDS flows (typically in the range of 50 to 500 lphd) may occur in the LDSs of double-lined landfills with composite top liners. These flows are primarily attributable to consolidation of the clay components of the composite liners. Water expelled during consolidation can mask any small amounts of leakage that may be occurring through the composite liners.

Preliminary Conclusions

Data on LCRS and LDS flow rates and flow constituents are being collected and analyzed for a large number of landfills as part of a USEPA sponsored study to evaluate the performance of landfill liner systems. A few preliminary conclusions can be drawn from the data analysis performed to date:

- flow rate data for LDSs indicate that top liners at the double-lined landfills monitored to date are performing well for the period of monitoring; flows attributed to top liner leakage are generally smaller than would be predicted with current liner leakage models;
- leachate generation rates at modern landfills with no supplemental moisture addition are highest early in the landfill active life and decrease significantly as the landfill is filled and progressively closed; and
- leachates from 14 modern MSW landfills have constituent concentrations that are at the low ends of the ranges of concentrations reported in the technical literature.

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Rudolph Bonaparte, Ph.D., P.E., Principal and Majdi A. Othman, Ph.D., Project Engineer, GeoSyntec Consultants, 1100 Lake Hearn Drive, Suite 200, Atlanta, Georgia 30342-1523, U.S.A. Tel: (404) 705-9500 Fax: (404) 705-9400

PRELIMINARY RESULTS OF COMPOSITE LINER FIELD PERFORMANCE STUDY

Majdi A. Othman and Rudolph Bonaparte
GeoSyntec Consultants, Atlanta, Georgia, USA

Beth A. Gross
GeoSyntec Consultants, Austin, Texas, USA

ABSTRACT

This paper presents preliminary results of a study of the field performance of composite liners. The purpose of the study is to evaluate the ability of composite liners to contain municipal solid waste (MSW) leachate. The paper presents data for double-lined MSW landfills having composite top liners consisting of a geomembrane (GMB) upper component and a compacted clay liner (CCL) lower component. Data on flow volumes and flow constituents for the leachate collection and removal system (LCRS) and the leakage detection system (LDS) components of the double liner system are analyzed to assess whether leakage has occurred through the composite top liner. Data for nine MSW landfill cells with monitoring periods of up to eight years are presented. Preliminary results indicate that the nine composite liners are performing well and are effective in containing MSW leachate.

INTRODUCTION

Landfills have long been used for the land disposal of MSW. Federal (U.S.) and state regulations require that these facilities be designed to function for an active life, plus a post-closure period, typically 30 years. In most cases, however, waste will remain in the landfill for a much longer period of time, possibly hundreds or thousands of years. One potential environmental impact of landfills is ground-water contamination resulting from leachate migration from the landfill. Liner systems are used to prevent ground-water contamination. To be effective, these systems must perform satisfactorily during the entire period of leachate generation.