American Exploration &
Mining Association

AEMA Statement of Environmental Principles

In support of its mission to advance the mineral industries, the American Exploration & Mining Association is committed to principles that embody the protection of human health, the natural environment and a prosperous economy. Accordingly, the NWMA and its membership recognize environmental protection as an essential element of mining and hereby affirm these principles:

• That the business of the mineral industries should be conducted in a manner that integrates the protection of human health and of the natural environment with the benefits of economic and social growth;

• That facilities should be designed, developed and operated based upon the efficient and economic use of energy resources and materials; the protection of the environment; and the minimization of waste;

• That from project inception through closure, potential environmental impacts should be comprehensively identified, and appropriately evaluated, managed and mitigated;

• That research into, and education pertaining to, the most effective and efficient methods of mitigation of environmental impacts should be supported and the results shared and openly discussed;

• That environmental practices should comply with statutory and regulatory requirements and, in the absence of formal regulation, that appropriate practices should be applied;

• That environmental protection, not just compliance with statutory and regulatory requirements, should be the goal, and that technically and economically sound improvement in environmental performance should continually be sought and implemented;

• That affected parties, including the company, its employees, suppliers and contractors, and the local community, should be kept informed and involved on technical, legislative and regulatory issues;

• That open and constructive partnerships should be forged with governmental bodies, affected parties, and the general public for the formulation of an effective, efficient and equitable legislative and regulatory framework to support mineral industries which are both economically vibrant and environmentally responsible; and

• That the understanding should be promoted through educational programs and other means, within and beyond the mining industry, that mining and environmental protection are compatible, and that mineral products make possible both the development of our society and the mitigation of modern society's impact on the environment.

Adopted and approved by AEMA Trustees

October 2, 1998

American Exploration &
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Testimony of Laura Skaer
Executive Director
American Exploration & Mining Association
In Support of Senate Bill 395

Senator Tiffany, Representative Hutton and members of the Committee, my name is Laura Skaer, and I am the Executive Director of the American Exploration & Mining Association (AEMA), headquartered in Spokane, Washington, a position that I have held for more than 20 years. AEMA is a 122-year-old, 2,000 member, national association representing primarily the hardrock mining industry with members residing in 42 U.S. states, including Wisconsin, seven Canadian provinces or territories and 10 other countries. AEMA is the recognized national voice for exploration, the junior mining sector and maintaining access to public lands and represents the entire mining lifecycle from exploration to reclamation and closure. Our broad-base membership ranges from exploration geologists and small miners to the largest mineral producers in the country.

AEMA was formerly known as the Northwest Mining Association, and in October, 1998, became the first U.S. mining trade association to adopt a Statement of Environmental Principles. Those principles are attached to this testimony. I would like to highlight three of the nine principles.

- That from project inception through closure, potential environmental impacts should be comprehensively identified, and appropriately evaluated, managed and mitigated;

- That environmental protection not just compliance with statutory and regulatory requirements should be the goal, and that technically and economically sound improvement in environmental performance should continually be sought and implemented;

- That the understanding should be promoted through educational programs and other means, within and beyond the mining industry, that mining and environmental protection are compatible, and that mineral products make possible both the development of our society and the mitigation of modern society's impact on the environment.

While we were the first mining association to adopt environmental principles, today, these principles guide every aspect of mining from exploration through development, construction, operation and closure.

I am appearing today to testify in support of Senate Bill (SB) 395, especially the repeal of WIS. STAT. §293.50, the Mining Moratorium section.

We have a history with this provision of Wisconsin law. In 1997, I participated in a conference in Milwaukee entitled *Environmentally Responsible Mining: The Technology, The People, The Commitment.* The conference demonstrated that modern mining is environmentally responsible mining. Our Association also opposed the Mining Moratorium provision when it was debated and adopted in 1998. Nicolet Minerals was a member and we supported their efforts. The Moratorium was unnecessary then and even more antiquated and unnecessary now.

Two of our members prepared the report that was filed on behalf of Nicolet Minerals to meet the unnecessary requirements of the law. Repealing the Mining Moratorium allows each mine to be evaluated on its own merits, as was the case when the Flambeau Mine was originally permitted. It also is the case in every state that has mining operations from sulfide ore bodies as well as the two federal land management agencies, the Bureau of Land Management (BLM) and the United States Forest Service (USFS). No other jurisdiction or regulatory body in the U.S. or Canada bans mining from sulfide ore bodies. A ban is unnecessary because if a mining company can't demonstrate that its mine plan will comply with all applicable environment laws and regulations, then it won't receive a permit; and that is how we strongly believe it should be.

The Mining Moratorium is unnecessary to protect Wisconsin waters and the environment, and it certainly does not help grow the Wisconsin economy. Wisconsin's stringent water quality standards and reclamation requirements combined with modern mining technology and practices will protect the environment.

Wisconsin has a rich mining history dating back to the 1820s. Environmental regulation of mining, like any other industrial activity, did not begin until the late 1960s and early 1970s with the adoption of the National Environmental Policy Act (NEPA), the Clean Water Act (CWA), the Clean Air Act (CAA) and other environmental statutes. In other words, there was more than 140 years of mining in Wisconsin and the United States prior to the enactment of the first environmental law. As the attached White Paper, *How Changing Values and Changing Law Caused Hardrock Mines to Design, Build and Operate for Long-term Closure and Reclamation: a Federal and State Regulatory Success Story* documents, the development and evolution of federal and state programs for hardrock mining and milling facilities is a success story of environmental protection. Since 1990, the BLM and the USFS have approved more than 3,300 mine plans of operation, and none of those mines are on the U.S. Environmental Protection Agency's National Priority List (NPL) of environmental cleanup sites.[1] This is in stark contrast to mines designed and built prior to 1970 when there were no regulatory approvals for such facilities and societal values were much different.

[1] BLM response dated June 21, 2011 and Senator Vilsack response dated July 20, 2011 to a March 8, 2011 letter from Senator Lisa Murkowski (R-AK) which asked how many mining and beneficiation plans of operation has your agency approved since 1990, and how many of those sites have been placed on the CERCLA (Superfund) NPL. The BLM answered 659 and zero. The USFS answered 2,685 and zero.

In 1999, The National Academies of Sciences/National Research Council (NRC) produced a comprehensive report at the request of Congress entitled *Hardrock Mining on Federal Lands* to assess the adequacy of the regulatory framework for hardrock mining on federal lands. The peer-reviewed report found:

> The overall structure of the federal and state laws and regulations that provide mining-related environmental protection is complicated but generally effective.
>
> ...simple: one-size-fits-all" solutions are impractical because mining confronts too great an assortment of site specific technical, environmental and social conditions. Each proposed mining operation should be examined on its own merit....[2]

The development of effective hardrock mine regulation and reclamation did not occur overnight. An important aspect of this development was a major shift in societal values from industrial and manufacturing to a need to protect our environment from industrial and manufacturing pollution. This change in societal values is described in the White Paper and is reflected in our Association's Statement of Environmental Principles and in the robust laws and regulations Wisconsin relies on to protect its own environment.

Hardrock mines designed and built prior to 1970 were developed to maximize production and minimize cost with little or no regard for environmental values. By the mid-1990s, mines were being designed, built and operated for long-term closure and protection of the environment. It was a continual learning process. It is important to highlight this regulatory success story because one cannot rationally use information about environment issues, closure and reclamation costs from hardrock mines designed and approved prior to the 1990s to evaluate today's mining projects. As I recall the debate over the Mining Moratorium, the proponents cited historic, pre-regulation legacy mining issues to support the Moratorium. This is the equivalent of showing a picture of a 1957 Chevrolet Bel Air and stating that it does not have seat belts, air bags, pollution control devices or meet CAFE requirements, and therefore GM should not be allowed to produce new cars in 2017.

Given Wisconsin's strong mine regulatory and financial assurance program, the fact that each hardrock mine is unique in terms of geology, geography and climate, and the fact that modern mines are not on EPA's NPL, it is time to repeal the Mining Moratorium and allow Wisconsin's professional regulators to do their job and examine each new mine proposal on its merits, as the NRC recommended in 1999.

Wisconsin is a state rich in important non-ferrous minerals such as copper, zinc and lead. Mining is an important economic contributor to local communities, states and nationally. Nationwide, metal mining has a direct and indirect contribution to gross domestic product of almost $155 billion. Average wages at hardrock mines across the country are $85,000 plus benefits. These are true generational family wage jobs, especially for rural Wisconsin.

Everything begins with mining. Think about all of the products that make modern life possible -- they all came from a hole in the ground. As our country seeks to rebuild its manufacturing base and repair and restore its aging infrastructure, mining will be essential. The United States

[2] *Hardrock Mining on Federal Lands*, National Academy Press (1999) at Page 5.

currently imports 100% of 20 strategic and critical minerals and is more than 50% import reliant on 43 minerals. Most of these minerals have deposits in the United States, including many in Wisconsin.

Producing minerals in Wisconsin will help reduce America's dependence on foreign sources of minerals, most of which come from China while providing significant economic benefits to the state. But in order to reap the economic benefits of mining, there must be a transparent and fair process for evaluating a mining project on its merits. Today, mining companies will not invest in a project if they are not convinced it can be done economically and safely while protecting the environment. Companies want their projects evaluated with respect to environmental protection in a process that is open and transparent to the public, consistent, and encompasses stringent water quality, air, ecological and land use standards. The U.S. mining industry accepts this and is proud of its record. The industry is only asking that the process be fair, unambiguous and has certainty. This bill will accomplish that by rescinding the Mining Moratorium which is viewed by mining companies, investors and Wisconsin citizens as Wisconsin saying "Wisconsin is not open for business."

Other states such as Minnesota and Michigan have considered similar moratoriums such as Wisconsin's and rejected them. That rejection has proven to be an economic lifesaver for many places in those regions. Those states rightfully trust their regulators to evaluate each project on its merits and assure compliance with all applicable federal and state environmental laws. To this day, the dire predictions of out-of-state anti-mining groups have wholly fallen flat.

We urge you to rescind the Moratorium and allow Northern Wisconsin to benefit from its mineral wealth by passing SB 395.

I will be happy to answer any questions. Thank you very much for this opportunity.

Respectfully submitted,

Laura Skaer

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Executive Director

Foth

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Written Testimony of Stephen V. Donohue, P.H.

Senate Hearing September 7, 2017

1. Introductory Comments

Good morning Senator Tiffany and Senators of the Sporting Heritage, Mining and Forestry Committee. Thank you for allowing me to speak to this committee. We appreciate the commitment that you have made to the important discussion on the regulation of mining in Wisconsin by coming to Ladysmith, the location of the most recent hard rock mineral mine to have been successfully operated, closed, and reclaimed in our State. I am appearing today as an employee of Foth Infrastructure & Environment, LLC in De Pere, Wisconsin. Foth has served and continues to serve various mining interests across the U.S., Canada, South America, and Central Asia. Our services extend from the exploration stage, through permitting, operations, closure, and reclamation.

I am a licensed Professional Hydrologist here in the state of Wisconsin. I have been appointed to the Examining Board for Professional Geologists, Hydrologists, and Soil Scientists through appointments by Governors Thompson, McCallum, and Doyle where I served as Chair of the Hydrology Section and Chair of the Examining Board. For nearly 30 years I have worked at Foth Infrastructure & Environment, LLC in Green Bay. We are an employee-owned Wisconsin based engineering consulting firm comprised of a wide variety of engineers and geo-environmental scientists, many of them educated with advanced degrees earned through the University of Wisconsin System.

My role at Foth is Vice President of Mining. I have had the pleasure of being involved in numerous metallic mining projects here in the Great Lakes Region and internationally. My colleagues and I have been involved in the permitting, construction, operations, and reclamation of the very successful Flambeau Mine, the only metallic mine permitted and reclaimed under Wisconsin's current statutory and regulatory framework. Our company was involved in the permitting effort for the Eagle Mine project in Michigan's Upper Peninsula, the first nonferrous project permitted under Michigan's new mining law. Ore from that mine is being processed at a converted iron mine site that is being used for milling the ore and management of mill tailings. This site was also permitted under Michigan's nonferrous mining law and is contributing to the economic vitality of northern Michigan. Michigan is experiencing the economic benefits of mining and also protecting their environment.

My testimony that I am providing to you today is my own. I am not here today representing any client that I am currently working for or have worked for or may work for. In short, my testimony has not been vetted by any mining company.

2. Mining is Vital to Our Economy

Mining of metallic minerals is a foundational industry upon which our economy and society is built. When I woke up this morning, I took a vitamin and mineral supplement along with my breakfast. That vitamin had everything in it from "A to zinc". The zinc in that vitamin tablet did not come from a plant. It came from a mine. Vitamin and mineral supplements added to our food are a basic product of our pharmaceutical industry and are vital to the nutritional health of our citizens and virtually every person on this planet. The pharmaceutical industry that we rely on for so many health care products and lifesaving medicines would not exist without mining. Our transportation system, including hybrid and electric cars, would not exist without mining. The renewable energy industry would not exist without mining. Our agricultural industry could not produce the food required to feed the human population on this planet without mining. Our homes, places of business, schools and universities, cities, healthcare system, and manufacturing industry would not exist and could not be maintained without mining industrial and metallic minerals.

Simply put, if we are to maintain our society, grow our economy, create jobs and improve the quality of life for our citizens and impoverished populations in less fortunate countries, a moral responsibility that I believe we all have, we cannot do so without responsible mining.

3. Wisconsin's Regulatory Climate and Metallic Mining

Wisconsin's history is steeped in mining from the lead district of southwestern Wisconsin to the iron mines of the north. Our state flag has a miner on it. Yet today, in a state known for a wealth of metallic resources, there is no metallic mining activity in the state and fleeting interest.

In the Michigan's Upper Peninsula, the Michigan Department of Environmental Quality has issued four nonferrous mining permits in the last 10 years for new nonferrous metallic mining projects. Michigan is also home to several large operating iron mines. To the northwest in the state of Minnesota, the iron mining industry remains vibrant and permits for new mining operations are progressing. The permitting of new copper/nickel and platinum and palladium group metal mines is also progressing in Minnesota. Exploration work on mineral deposits in Michigan and Minnesota is so active that at times it is hard to find drill rigs to support the exploration needs of the industry in those two states.

We need to ask why Michigan and Minnesota are able to attract mining investments, leading to the permitting of new metallic mine projects, when mining investment in Wisconsin is dormant. Is it due to geology? The answer is no. All three states enjoy similar geologic histories that gave rise to the occurrence of mineralized resources suitable for mining. Certainly the citizens of Michigan and Minnesota value their natural environment, clean water and clean air as much as Wisconsin citizens.

The basic reason there is no investment in this state from the metallic mining industry is due to regulatory uncertainty and ambiguous rules embedded in Wisconsin's current statutory and regulatory framework for the development of metallic resources. It is the open-ended review process and ambiguous rules that drive investment away from the state. In fact, it should be pointed out that there is much to like about Wisconsin's mining statute and rules. The requirement for rigorous baseline environmental studies, environmental impact analysis, sound engineering plans, environmental monitoring, reclamation, post reclamation monitoring, compliance with groundwater quality standards, surface water quality standards and air quality standards, and financial assurance are not hindrances to investment in this state by the mining industry.

Objective environmental protection standards do not need to be relaxed to attract mining investment in the state. However, the environmental review process and ambiguous rules and statutes need to be reformed. The Amendments to Wisconsin's Nonferrous Mining Laws contained in the Bill before you address much needed reforms. I would like to comment on one aspect of the legislation that addresses necessary reforms without relaxing important environmental protections standards. Specifically I would like speak about the Mining Moratorium and the history of the Flambeau Mine.

4. Rescinding the Moratorium on Issuance of Permits for Mining of Sulfide Ore Bodies

In 1998 the state of Wisconsin amended its mining statute to include a moratorium on issuance of mining permits for so called sulfide ore bodies. This statute was passed in light of legacy issues related to historic mining operations. Like many industries that generate waste that needs to be managed properly to prevent environmental impairment, this is a waste management issue that requires engineering and science to resolve, not prohibition of the industry.

The law is vague and prone to endless litigation on what type of a site would be acceptable to the state or a judge for demonstration of the requirements written into the moratorium law. The industry looks at this provision of state law and the potential for drawn out litigation as if it were a sign at the boarder of Wisconsin saying "Not Open for Your Business." Mine somewhere else...but we will continue to use the products of your mining operations in our manufacturing industry.

The legislature is right to consider rescinding this provision of state law. There would be no relaxation in environmental protection if the state were to make this one change. Moreover, this law should be rescinded based on the success of the Flambeau Mine Project, which fulfills the intent of the moratorium and was done right here in Wisconsin.

This committee went on a tour of the Reclaimed Flambeau Mine yesterday. Allow me to speak to a few pertinent aspects of that project as it relates to rescinding the Mining Moratorium.

Flambeau Mine History

The reclaimed Flambeau Mine is located in Rusk County, Wisconsin, approximately 1.5 miles south of Ladysmith.

The total reclaimed site is approximately 181 acres. The open pit covered about 35 acres of the site.

The Flambeau Mine began in 1991 and after 10 years, filed in 2001, a Notice of Completion for Reclamation. During its mine life the Flambeau Mine produced 181,000 tons of copper, 334,000 ounces of gold, and 3.3 million ounces of silver.

- Discovered in 1969
- 1987-1991 Permitting
- 1991-1993 Construction/Pre-production
- 1993-1997 Operations
- Fall 1997 Backfilling Complete
- 1998-1999 Reclamation, Revegetation, Re-Establish Intermittent Streams, and Monitoring
- Industrial Outlot Left In Place at Request of City of Ladysmith
- 2001 Flambeau Mine Files Notice of Completion for Reclamation
- 2002 Wisconsin Department of Natural Resources (DNR) Concurs on Notice of Completion
- 2007 Certification of Completion Granted
- 2007+ Ongoing Long-Term Monitoring

Environmental Monitoring at Flambeau Mine

Throughout the life of the Flambeau Mine, environmental monitoring program was conducted to evaluate the surrounding environment and to determine if the project was complying with permit requirements. Flambeau Mining Company (FMC) was required to regularly monitor groundwater levels, groundwater quality, air quality, surface water quality, wastewater effluent quality, etc.

Monitoring was conducted and the results were submitted to the DNR. Monitoring of groundwater and surface water quality continues to this day. The DNR also conducted independent sampling to verify the results obtained by the company. Groundwater monitoring will continue at the site for several decades to measure conditions within and around the backfilled pit.

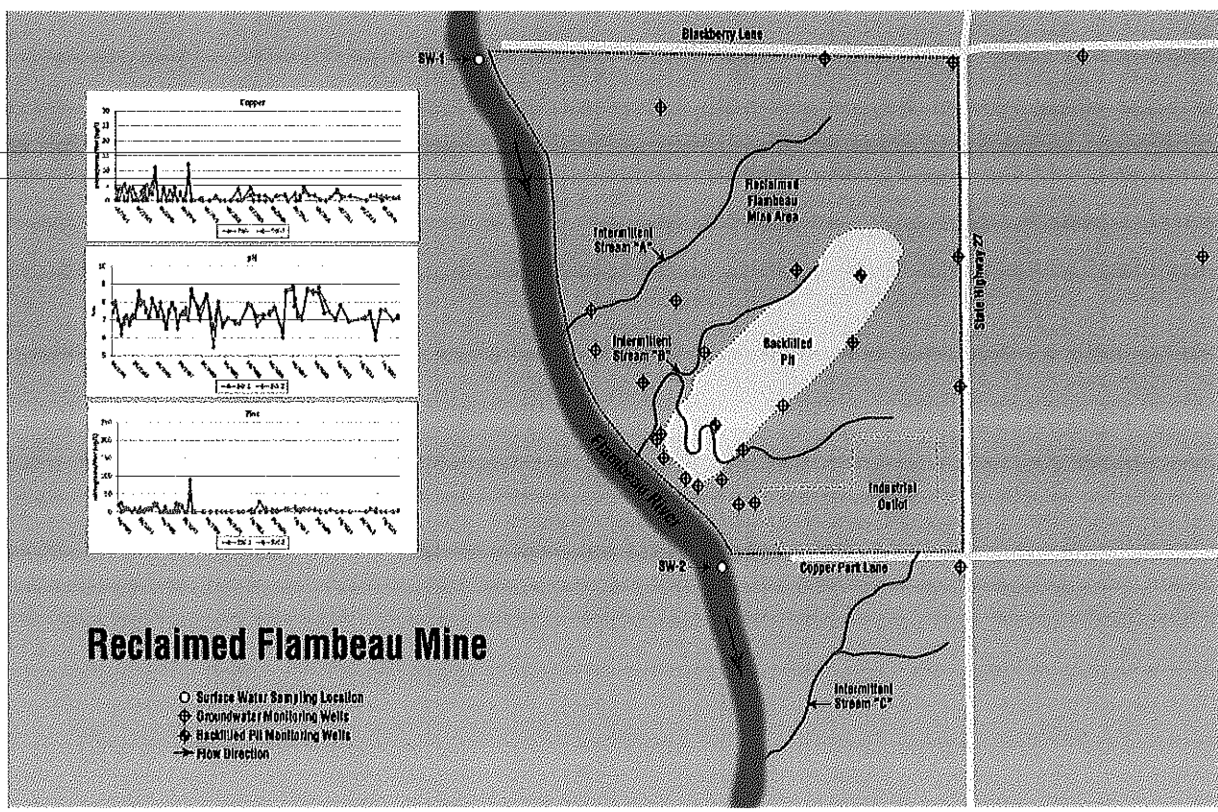
The DNR's website on the Flambeau Mine states that "Throughout the life of the project, the company has remained in substantial compliance with all permit conditions and applicable standards." The website notes that air monitoring indicated several exceedances of suspended particulate limits, only one of which was attributed to activities on the mining site: dust from a delivery of an uncovered load of crushed limestone. There were no exceedances of any effluent (treated wastewater) limits during the period of discharge. Monitoring of water quality and other characteristics in the Flambeau River similarly did not show any impacts from the effluent discharge.

Monitoring results show that groundwater levels have recovered. Most groundwater at the site flows through the till and very little water is moving through the bedrock and backfill material. Resaturation of the waste rock by groundwater infiltration is the primary mechanism by which oxidation of the remaining sulfides will be controlled.

The first few rounds of well samples collected from the backfilled material in 1999 indicated that elevated levels of sulfate, copper, manganese, and iron were present. These results were not a surprise and were approximately equal to or slightly greater than the concentrations originally predicted. Analyses to date indicates there is no acid production in the pit, groundwater elevations have generally stabilized since recovering in 2003, and metals concentrations in the in-pit water are stable and are not at levels that pose a threat to water quality in the Flambeau River.

In addition to the wells located within the backfilled pit, groundwater samples are collected quarterly at wells surrounding the backfilled pit. Some of these wells recorded increases in concentrations of copper, sulfate and/or manganese since mine pumping stopped in 1997. These increases were not unexpected. Recent data shows levels for these parameters have steadily decreased since the wells have fully recovered. The data continues to demonstrate that Flambeau Mine is in compliance with groundwater quality provisions in the Mine Permit and that the groundwater quality is protected at the limits of the compliance boundary.

In addition, water quality in the Flambeau River has not been affected by the mine project as many project opponents predicted. Included in my written testimony is a graphic of the site showing the location of the reclaimed mine and upstream and downstream monitoring stations.



Data from these monitoring stations shows that there has been no change in water quality in the Flambeau River due to the mine. FMC will continue monitoring conditions at the reclaimed Flambeau Mine for many years.

Groundwater and surface water in the Flambeau River at the reclaimed mine site continues to be monitored and evaluated in an annual report submitted to the DNR in January of every year. The data and annual reports document that the backfilled mine is not impacting water quality in the Flambeau River.

2012 Clean Water Act Lawsuit

In 2012 long standing opponents to the Flambeau project filed a lawsuit in federal court under provisions of the federal Clean Water Act. The plaintiffs alleged unlawful discharge of pollutants from the Industrial Outlot and impairment of water quality in the Flambeau River. Specifically, the plaintiff's alleged that FMC did not have a Storm Water Discharge Permit for storm water derived from the Industrial Outlot and that the storm water was carrying pollutants from the Industrial Outlot into regulated federal water ways. The plaintiffs alleged that the pollutants were impairing water quality in Stream C and the Flambeau River, which received the storm water runoff.

In pre-trial motions FMC sought to have the case dismissed by noting that storm water runoff was regulated by the DNR under provisions of the Mine Permit. The DNR supported FMC's position. The trial judge disagreed with FMC and the DNR and allowed the case to go to trial. The trial judge ruled that there were technical or *de minimis* violations of the Clean Water Act ~~lawsuit~~ and levied a penalty of $275 against FMC. FMC appealed the trial court's decision which was over turned. The United States Court of Appeals stated in their opinion that Flambeau was in compliance with the Clean Water Act and the case should have been dismissed. Thus there has been no violation of the Clean Water Act.

The Appeals Court Ruling, while significant, does not capture the significance of the lawsuit. For that, one must read the Judge's ruling which praised the company's environmental record, commitment to its neighboring community, and exemplary efforts to protect water quality in the

Flambeau River and more. She questioned the motives of the plaintiffs in bringing the lawsuit. Moreover, the **written opinion from Judge Barbara Crabb is clear that there was no pollution or impairment of water quality in the Flambeau River as the plaintiff's alleged.**

The Judge's decision is best summed up in these key quotes:

1. "Plaintiffs cannot make a plausible argument that the quality of the water in the river is affected by the discharges from the biofilter. They can continue to enjoy the river for fishing, recreation, and wildlife viewing without any concern for the river's water quality resulting from biofilter discharges, not only because the biofilter is being replaced but because it never threatened the river's water quality during the period at issue in this suit." (Decision, Page 36)

2. "Although plaintiffs seem to be motivated by an admirable concern for the environment, it remains unclear to me why they would have expended so much time and energy litigating against a company that seems every bit as committed as they (the plaintiffs) are to the protection of the environment and preservation of water quality." (Decision, Page 37)

3. "I will enter judgment for plaintiffs on liability, but I will impose only a pro forma penalty on defendant (this was subsequently overturned by the Appeals Court), not only because the discharges of pollutants were so slight, but because of defendant's exemplary efforts to protect the environment during its mining operations and reclamation effort. These efforts deserve commendation, not penalties." (Decision, Pages 3 & 4)

4. "It would have been less expensive for defendant to have refused the city's request to keep the outlot and the buildings, removed them and dug up the outlot. It incurred the extra costs only because it wanted to help out a city that was struggling economically." (Decision, Page 33)

5. "…I will take into account the extensive efforts that defendant made to protect the environment of the Flambeau Mine site, both during the mining operation and afterwards during the reclamation effort. It would not advance the goals of the Clean Water Act to impose anything but a pro forma penalty on a company that was compliant with the Act and with the directives of the state's Department of Natural Resources and acted in all respects as a good neighbor." (Decision, Page 34-35)

6. "Moreover, plaintiffs have not proven that they have suffered irreparable injury from any biofilter discharge. At no time has a discharge contained a concentration of copper close to the level formerly allowed under the permit." (Decision, Page 36)

7. "The evidence shows that the Flambeau River has a higher level of copper upstream of the mouth of Stream C than downstream, indicating that any discharge that makes its way to Stream C is not impairing the water in the river. The evidence also shows that the level of copper in Stream C, which is generally higher than that of any biofilter discharge, is not toxic to the species most likely to be affected, which are the biota in the stream. (Decision, Page 36)

Finally, it should be noted that the Judge denied the plaintiff's appeal for the company to cover plaintiff's legal fees and costs for the trial, and in fact ruled that the plaintiff's had to reimburse the company for certain legal costs associated with the trial.

Summary

The Flambeau Mine was one of the state's most contentious projects. It received extensive regulatory oversight, was operated in a water-rich environment on the banks of the Flambeau River, was reclaimed, was and is protective of the Flambeau River and is a great success. It is an engineering achievement and should be celebrated by the state by rescinding the moratorium. What the state was seeking when it passed the moratorium has been met right here in Wisconsin and the proof is sitting in boxes of expert witness reports and testimony in Federal Court in Madison. Rescinding the moratorium will signal that state is open for investment from this important industry and the economic benefits and jobs that are created through that investment. Rescinding the moratorium will not diminish environmental protection one bit. It is noted that efforts to pass similar moratorium legislation in Michigan and Minnesota have repeatedly been rejected in those states.

5. Other Provisions of SB 395

I would like to now comment briefly on other key provisions of SB 395 that address key reforms that will reduce regulatory uncertainty without altering important environmental protection standards.

The bill addresses uncertainty with respect to regulatory timelines. Under current law there is no timeline for review and issuance of permits. The environmental review and permitting timeline is completely open ended. The Bill addresses this in a responsible manner that addresses stakeholder needs. First, the Bill requires consultation with federal agencies that may be involved in the process. Second the Bill provides for DNR to make two requests for additional information. If the Secretary of the DNR determines that there is a substantial modification of the mining plan during the review process, the timeline starts over. Finally the DNR and the applicant can agree to modify the timeline. At the end of the review and permitting process, the DNR issues a Final Environmental Impact Statement and Final Permits. A contested case hearing may be requested within 30 days of the final decision on permits. This is similar to how our neighboring states administer their review and permitting process.

The Bill provides to the DNR the ability to determine the depth of the DMZ in the Precambrian bedrock. Right now the DNR does not have this latitude and is forced to extend the DMZ to depths at which the groundwater is not usable or hydrologically connected to other important sources of water. SB 395 also provides that predictive modeling of the mine waste storage facilities shall be the operating period plus 250 years.

The Bill retains financial assurance for reclamation and long-term care. By removing the irrevocable trust, which is in place in perpetuity, it puts Wisconsin on an equal playing field with adjacent states. This is a much needed reform that will not alter any environmental protection standard.

The Bill creates a provision that allows a company performing exploration work, to bulk sample up to 10,000 tons. The bulk sampling process requires the applicant to get a permit, which requires reclamation of the site, and also allows for DNR review and public input. Again, this provision puts Wisconsin on a similar playing field to Michigan.

Other provisions of the Bill address needed reforms related to wetlands, water withdrawal, and fees. These provisions represent responsible updates to Wisconsin's Nonferrous Mining Law.

I would like to thank you for allowing me to speak to this committee on the important matter of reforming Wisconsin's nonferrous metallic mining statute.

WISCONSIN STATE SENATE

Public Hearing

Written Testimony

Nathan Podany

Name

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Street Address or Route Number

54501

City/Zip Code

Organization (*if applicable*)

Date 9/7/17

Subject 395

Registering: In Favor ☐ Against ☒

I moved here from Milwaukee, away from manicured lawns, cities that smelled of garbage and bumper to bumper traffic. Spring Conservation congress meetings showed that voters are overwhelmingly against repealing the moratorium. This bill removes environmental law that is catered to allowing unsafe mining tactics. This bill is an affront to the people of this state.

Mr. Tiffany, I understand you were born in Minnesota, let me be the first to tell you, Wisconsin's motto is forward! Not backwards

Fractured bedrock and the above aquifers do infact exchange groundwater. This is known. You are sacrificing both our surface and groundwater.

Please return this slip to a messenger promptly.

WHAT YOU SHOULD KNOW ABOUT AQUILA RESOURCES' BACK FORTY PROJECT

By Al Gedicks
Executive Secretary, Wisconsin Resources Protection Council

June 28, 2017

Aquila's Back Forty Project is not accurately described in the Mine Permit Application (MPA) and Environmental Impact Assessment (EIA)

*** Aquila Resources wants to develop a large open pit (2000 ft. wide, 2500 ft. long and 750 ft. deep) massive gold-zinc sulfide mine, 150 feet from the Menominee River, encroaching upon the floodplain. Underground mining plans have not been disclosed to the Michigan Department of Environmental Quality (DEQ), but could include mining under the Menominee River. Aquila's permit application says the Life of Mine (LOM) operation is planned to be APPROXIMATELY 7 YEARS, but the Back Forty is actually described as a 16-YEAR MINE in every press release published by Aquila Resources.**

*** Aquila's mine permit application asserts that mining facilities are sealed to accommodate the life of the mine, i.e. THEIR FACILITY IS DESIGNED FOR A 7-YEAR MINE. By minimizing LOM, the company can misrepresent all of the mine's impacts-- including tailings capacity, size of waste rock storage areas, total limestone needed for neutralizing total waste rock, total need for importing and storing cyanide and other chemicals used in the processing of ore, total crushing and processing throughput, milling equipment capacity, water treatment plant capacity, de-watering and drawdown estimates, air pollution quantities, noise, pit backfilling estimates, remediation planning, post-closure timelines, and more.**

The track record of sulfide mining across the United States is terrible.

There are no examples of metallic sulfide mines which have not polluted both surface and groundwaters. Metallic sulfide mines will pollute up to 27 billion gallons of fresh water per year. (see Lisa Sumi and Bonnie Gestring, 2013, *Polluting the Future: How Mining Companies Are Contaminating Our Nation's Waters in Perpetuity.* Washington, D.C: Earthworks). The main reason is acid mine drainage (AMD), which occurs when mineral deposits containing sulfides are exposed to air and water during excavation.

Acid Mine Drainage is a Perpetual Pollution Machine.

According to the Great Lakes Indian Fish & Wildlife Commission (GLIFWC), "Mining can significantly accelerate the acidification process, because mining raises the sulfide minerals to the surface and crushes them, thereby exposing more surface area to water and oxygen. A mine can generate AMD for hundreds--or even thousands--of years, until all of the sulfur in its tailings (the by-products of processing left over after a mine removes the valuable ores), waste rock stockpiles, and exposed mine pits has been consumed in the acid generation process. AMD can kill fish and other aquatic life and severely contaminate surface and groundwater. (*Metallic Mineral Mining: The Process & the Price.* Odanah, Wisconsin 2016, pp. 28-29).

"In addition to acidifying ground and surface water, AMD accelerates the dissolution of metals such as copper, lead and mercury into groundwater and surface water. Uncontrolled acid generation from AMD results in an ecosystem with high levels of metals, dissolved solids, sulfates and acidity. A mine draining acid

water can devastate rivers, streams, and aquatic life for many years." (p. 29, *Metallic Mineral Mining*). The U.S. Environmental Protection Agency estimates that the headwaters of more than 40% of the streams in the western United States are contaminated by acid mine drainage.

"A substantial and unquantifiable risk to water quality and fisheries"

A recent literature review for the U.S. Fish and Wildlife Service concludes that "NO HARD ROCK SURFACE MINES EXIST TODAY THAT CAN DEMONSTRATE THAT AMD CAN BE STOPPED, ONCE IT OCCURS ON A LARGE SCALE. Evidence from literature and field observations suggests that permitting large scale surface mining in sulfide-hosted rock with the expectation that no degradation of surface water will result due to acid generation imparts A SUBSTANTIAL AND UNQUANTIFIABLE RISK TO WATER QUALITY AND FISHERIES" ("Acid Mine Drainage and Effects on Fish and Ecology: A Review," Reclamation Research Group, Bozeman, Montana, June 2008; http://www.pebblescience.org/pdfs/Final_Lit_Review_AMD.pdf)

The federal government has invested more than $41 million to clean up the lower part of the Menominee River.

The Menominee River is the largest river system in the Upper Peninsula, with a 4,000 square mile area that drains into Lake Michigan. Together with the other Great Lakes, Lake Michigan contains 21% of the world's fresh water. More than 40 million people depend on the Great Lakes for drinking water, jobs, and their way of life.

Both Michigan and Wisconsin DNR have worked over the past decades to again make the Menominee River a viable habitat for sturgeon. Fish biologists believe that almost half of all adult Lake Michigan Sturgeon exclusively use the Menominee River for spawning. In April 2017 the conservation group, American Rivers, listed the Menominee River as ONE OF AMERICA'S 10 MOST ENDANGERED RIVERS, DUE TO THE THREAT FROM SULFIDE MINING.

Aquila's plan to keep water from the Menominee River out of the pit, particularly during flooding events, is not convincing, according to Chuck Brumleve, a geologist working for the Keweenaw Bay Indian Community. "The top of bedrock where the cut-off wall will be keyed in, is weathered, fractured, and permeable. Climate has become more unpredictable, with multiple major rain events recorded sequentially in the upper Midwest." (Comments on Aquila's MPA, February 16, 2016).

Metallic sulfide mines are a major taxpayer liability.

Copper sulfide mines are the largest source of taxpayer liability under the EPA's Superfund cleanup program (*Nationwide Identification of Hardrock Mining Sites,* Report 2004-P-00005, EPA Office of Inspector General, March 31, 2004). A recent report from the Center for Western Priorities found that cleaning up mines in Western states could cost taxpayers up to $21 billion and has already left communities with widespread water pollution (*The Mining Burden Why State Land Seizures Could Cost Billions*, December 2015; westernpriorities.org/miningburden).

<u>Sulfide-bearing waste rock is the major product of the Back Forty project</u>.

Because the high grades of gold, copper and zinc have already been mined out, only the lower grade ores containing trace amounts of metals are found in large rock deposits. In order to extract these lower grade ores, enormous amounts of sulfate-containing waste rock have to be blasted, crushed and pulverized to extract the gold and zinc. Over 97% of the rock excavated ends up as sulfide-bearing waste rock that is stored in tailings and waste rock dams, or is backfilled into the abandoned pit. ALL of the 11.8 MILLION TONS OF TAILINGS and 75% of the 54 MILLION TONS of WASTE ROCK ARE EXPECTED TO GENERATE ACID (Dr. David Chambers, Center for Science in Public Participation report, February 24, 2016).

<u>Tailings Dams Pose Significant Environmental Risk.</u>

Tailings are the wastes left over from the crushing, grinding and chemical processing (INCLUDING CYANIDE) of mineral ores. Tailings containing sulfur have the consistency of talcum powder and can be a source of AMD. Tailings often contain residual minerals-- including lead, mercury, arsenic, cadmium and selenium, that can be toxic if released to the environment.

According to the Great Lakes Indian Fish and Wildlife Commission," A mine's tailings, basins, caps and liners, and stockpiles must be designed to withstand a number of challenges-- including temperature changes, heavy rain and snow, freezing and thawing soils, as well as future climate change effects that are not yet fully understood...ALMOST ANY TYPE OF FACILITY FOR

STORING THESE MINE WASTES EVENTUALLY WILL LEAK CONTAMINANTS INTO WATER." (P. 9, P. 35)

Poorly regulated tailings frequently discharge wastes into the environment, as in the January 2000 spill of 100 tons of cyanide-contaminated water which destroyed fishing along the Tisza River in Hungary.

The LARGEST MINING DISASTER in Canadian history occurred at the Mount Polley Mine in British Columbia, Canada, when 6.3 billion gallons of contaminated process water and tailings spilled into the lakes of the Fraser River watershed, and beyond, in August 2014. A local state of emergency was called, and a ban was put on using surface and groundwater in the area. THE MINE WAS A STATE OF THE ART, modern copper mine, that had been touted as an example of how sulfide mining can co-exist with clean water. ~~Scientists say it is "virtually impossible to clean up" the mess left~~ behind this spill.

A new study reveals that catastrophic mine failures are increasing in frequency, severity and costs, all around the world. Nearly half of all recorded serious failures happened in modern times, between 1990 and 2010 (Lindsay Newland Bowker and David M. Chambers, *The Risk, Public Liability & Economics of Tailings Storage Facility Failures.* Washington, D. C: Earthworks, 2015).

AQUILA DOES NOT HAVE A CONTINGENCY PLAN IN THE EVENT OF A MAJOR SPILL, AND DISMISSES THE POTENTIAL IMPACTS OF SPILLS AS "MINIMAL." AQUILA PROVIDES ALMOST NO INFORMATION ON THE IMPACTS OF A SPILL, HOW LONG THE IMPACTS WOULD LAST, AND WHETHER THE IMPACTS COULD BE REVERSED.

Who Pays for Mining Accidents, Spills and Disasters?

On day one, when Scott Pruit took over as director of the U.S. EPA, he directed his new staff to delay an initiative that would require mining companies to prove they can clean up after themselves.

If there is a catastrophic release of toxic waste from the 65 million tons of mine waste at the headwaters of the Menominee River, the TAXPAYERS OF WISCONSIN will be responsible for the cleanup costs in the billions of dollars. Even then, it may be virtually impossible to clean up the mess left behind after such a spill.

De-Watering the mine pit can lower groundwater levels around the mine.

Because the proposed pen pit is constructed below the water table, the operator must pump water out of the mine before the ore can be mined. By continuously removing groundwater, it can lower the water table for miles around the mine, causing what is known as a CONE OF DEPRESSION. This can harm the Shakey Lakes Savanna, a 1,520-acre Natural Area, part of the Escanaba State Forest.

Air Quality Impacts

"When rock is excavated, crushed, and transported to the surface, it can release contaminants into the air," according to GLIFWC. "Dust generated by mining contains particulates that may affect human and animal health, if inhaled, and contain pollutants which can contaminate soil, water and vegetation. Gaseous air pollutants may contain sulfur dioxide, which irritates the lungs and can

damage or kill plants, especially evergreens." (p. 19, *Metallic Mineral Mining: The Process & the Price,* 2016).

Exploratory activity at the Back Forty site has already disturbed soils containing a deadly fungus (BLASTOMYCOSIS), that has taken the life of Cliff Nelson, Jr., Aquila's Vice President of U.S. Operations.

AQUILA'S MINE PLAN COMPLETELY FAILS TO ANALYZE ANY RISKS TO ON-SITE WORKERS. Nor does the plan include a Health Risk Assessment of the effects of mercury, manganese, lead, arsenic, and other pollutants on people living downstream.

Aquila's Mine Plan is Based Upon a Misrepresentation of the Flambeau Open Pit Sulfide Mine in Ladysmith, Wisconsin as a Successfully Reclaimed Mine.

"Flambeau was a very successful mining operation, and the two sites are very similar, so we've been able to use the engineering work done on Flambeau as a template for the Back Forty mine." ***Steve Donohue, Vice President of Mining at Foth Infrastructure & Environment,*** **a consultant on the Flambeau mine and the Back Forty project.**

The two sites are each open pit sulfide mines close to nearly rivers--the Flambeau and the Menominee. THE SIMILARITY ENDS THERE.

The Flambeau was 220 feet deep; the Back Forty pit is 750 feet deep. The Flambeau open pit was 32 acres. The Back Forty is 83 acres, or 3 times the size of Flambeau.

The Flambeau mine produced 1.9 million tons of ore and 9 million tons of waste rock. The Back Forty is estimated to produce 12.5 million tons of ore, 54 million tons of waste rock and 11.8 million tons of tailings. THERE WAS NO ON-SITE PROCESSING AT FLAMBEAU, AND THUS NO TAILINGS STORAGE ON SITE, AND NO WASTE ROCK ON THE SURFACE POST-CLOSURE.

In contrast, according to Dr. David Chambers, "retaining acid-generating material on site at Aquila will likely require diligent water management of the tailings and waste rock management facilities (TWRMF) leachate in perpetuity and may require in-perpetuity water treatment." (Center for Science in Public Participation, p. 3) WHO WILL PAY FOR IN-PERPETUITY WATER TREATMENT?

Flambeau's environmental footprint was 181 acres, compared to 865 acres at the Back Forty--or 4.5 times the size of Flambeau.

Despite the advantage of being a much smaller mine than the Back Forty project, and not processing the ore on site, the Flambeau Mining Company (FMC) has been far from a model operator; it is a proven polluter that has failed multiple attempts at cleanup at the site. In 2012 FMC was found guilty by U.S. District Judge Barbra Crabb, of eleven counts of violating the Clean Water Act by polluting Stream C, a tributary of the Flambeau River (Wisconsin Resources Protection Council, Center for Biological Diversity and Laura Gauger [plaintiffs] v. Flambeau Mining Company [Defendant]; United States Court for the Western District of Wisconsin, Case No. 11-cv-45, Document 256 [Decision], filed July 24, 2012).

Subsequently, the Wisconsin DNR completed an investigation of water quality at the Flambeau Mine site and placed Stream C on its list of impaired waters for "acute aquatic toxicity" caused by copper and zinc contamination. The U.S. EPA agreed and listed the stream as impaired in 2014. A 2009 review of groundwater monitoring wells between the mine pit and the Flambeau River showed metals exceeding predictions used to obtain permits. FMC itself issued a report in 2015, documenting 33 violations of drinking water standards in various wells at the mine site, and the contamination persists to this day. NO CITATIONS HAVE BEEN ISSUED, BECAUSE WISCONSIN LAW IS CRAFTED TO ALLOW MINING COMPANIES SIGNIFICANT GROUNDWATER SACRIFICE ZONES AT MINE SITES WHERE DRINKING WATER STANDARDS ARE NOT ENFORCED BY THE DNR, EVEN IF THE WATER IS HIGHLY CONTAIMINATED.

While a federal court of appeals overturned Judge Crabb's decision, the court did not dispute the fact of pollution in a tributary of the Flambeau River. Instead, the court decided that it would be unfair to hold FMC to the legal standards, because the Wisconsin DNR told the company it did not need a permit for its discharge.

If Flambeau's mine contractor, Foth Infrastructure & Environment, couldn't protect the water at the much smaller Flambeau mine--where there were no tailings dams to worry about--there is no reason to expect that the clean waters of the Menominee River watershed will be protected from acid mine drainage and catastrophic mine failures.

The Back Forty project lacks a "Social License to Operate."

The Michigan DEQ has issued three of the four permits for Aquila's proposed mine. These are regulatory licenses. However, the mining industry has come to recognize that there is a SOCIAL LICENSE TO OPERATE, THAT IS INTANGIBLE AND UNWRITTEN, AND CANNOT BE GRANTED BY THE DEQ OR ANY OTHER STATE AGENCY OR LEGAL AUTHORITY.

A Social License is essentially a set of demands and expectations, held by local stakeholders--like citizens, environmental groups, and Indian Nations--for how a business should operate. Not having a Social License was once seen as a threat to the economic value of a project, because it delayed cash flows. Now it is seen as a potential project destroyer, according to industry risk analysts.

According to Ernst & Young, an industry risk analysis consultant, the fourth greatest risk to mining investors comes from "ignoring community voices and their environmental and public health concerns. Mining projects that generate protests and civil unrest are bad for business." (*Top 10 Business Risks Facing Mining and Metals, 2016-2017,* p. 4).

"The mining world has changed dramatically," wrote Wayne Dunne in a special report to *The Northern Miner,* a Canadian mining industry newspaper. "Projects can be stopped dead by local people and communities, dashing shareholders' hopes and often destroying executives' careers. Project management has become exponentially more complex, as social issues no longer take a distant back seat to technical issues." (90:28, 9/3/04, p. 6)

The list of resolutions opposing the Back Forty project includes county, city, town and tribal governments, intertribal organizations as well as environmental, sportfishing and faith organizations. A complete list is attached. This project lacks a Social License to operate.

LISTS:
Local Units of Government
Marinette County, Wisconsin
Menominee County, Wisconsin
Menominee County, Michigan
Brown County, Wisconsin
Door County, Wisconsin
Oconto County, Wisconsin
Shawano County, Wisconsin
City of Peshtigo, Wisconsin
~~Town of Wagner, Wisconsin~~
Town of Porterfield, Wisconsin
Menominee Indian Tribe of Wisconsin
Oneida Nation of Wisconsin
Bad River Band of Ojibwe, Wisconsin
Stockbridge Munsee Band of Mohican Indians of Wisconsin
Lac du Flambeau Band of Ojibwe, Wisconsin
Keweenaw Bay Indian Community of Michigan
Pokagon Band of Potawatomi Indians, Michigan
Saginaw Chippewa Indian Tribe, Michigan

National Indian Gaming Association
Midwest Alliance of Sovereign Tribes (MAST)

Intertribal Organizations
Great Lakes Inter-Tribal Council Inc. (GLITC)
National Congress of American Indians
National Indian Education Association
United Tribes of Michigan
Wisconsin Indian Education Association

Letters of Support from Tribal, Environmental, Sportfishing, Faith Organizations

Chippewa Ottawa Resource Authority of Michigan
Red Cliff Band of Ojibwe, Wisconsin
American Rivers
Clean Water Action Council, Green Bay
Save the Wild U.P. (SWUP)
River Alliance of Wisconsin
Wisconsin Resources Protection Council
International Federation of Fly Fishers
Wisconsin Smallmouth Alliance, Ltd.
Northern Illinois Fly Tyers
Badger Fly Fishers
Dupage Rivers Fly Tyers
M&M Great Lakes Sport Fisherman
Dominican Sisters of Sinsinawa, Wisconsin

EXPLORE, ENJOY, AND PROTECT THE PLANET

Wisconsin John Muir Chapter

Legislators Urged to Preserve Mining Moratorium Law Study Reveals Flambeau Mine Deeply Flawed

April 13, 2017

Today the Sierra Club and Wisconsin Resources Protection Council today released an open letter and a policy briefing paper urging Wisconsin legislators to preserve Wisconsin's common sense "Prove It First" Mining 'Moratorium' Law.

(https://sierra.secure.force.com/actions/Wisconsin?actionId=AR0070644&_ga=1.12948146.489012365.1447869143)To date, 50 organizations, including Midwest Environmental Advocates, Trout Unlimited, the River Alliance of Wisconsin, the Mining Impact Coalition of Wisconsin, Clean Wisconsin, the Wisconsin League of Conservation Voters, the League of Women Voters, the Alliance for the Great Lakes and many more statewide, regional and national groups such as the Natural Resources Defense Council are joined together in opposition to efforts announced by state Senator Tiffany (http://host.madison.com/ct/opinion/column/sen-tom-tiffany-how-wisconsin-can-help-america-make-things/article_8e651144-33f0-5888-97be-fe7b8ee4b246.html) to repeal this landmark law. A letter sent to the legislature concludes with (https://sierraclub.org/sites/www.sierraclub.org/files/sce-authors/u560/Moratorium%20Signon%20to%20Legislature%204%2017%20Final.pdf): **"We, the undersigned representatives for our organizations, respectfully call upon you to preserve and protect the Mining Moratorium Law to guard our natural resources and our right to live in a clean, healthy environment."**

The letter was delivered with 'The Mining Moratorium ("Prove It First")' briefing (https://sierraclub.org/sites/www.sierraclub.org/files/sce-authors/u560/Briefing%20on%20WI%20Mining%20Moratorium%20Law%204%2013%2017.pdf) that includes this background information:

- To this day, the mining industry has yet to offer a single example of a successfully operated and closed mine in metallic sulfide minerals.
- The Flambeau mine violated the Clean Water Act, has ongoing water contamination issues and cannot be an example to satisfy the Moratorium law.
- The history including the votes of current legislators and elected officials who voted for the Moratorium in 1997, including:
  1997 Wisconsin State Senate:
  Passed 29-3 on March 11, 1997
  Including current Senators Cowles (R), Darling (R), Fitzgerald (R), and Risser (D), and Wirch (D)

  1998 Wisconsin State Assembly:
  Passed 91-6 on February 4, 1998
  Including current Senators Harsdorf (R), Lasse (R), Olsen (R), and Nass (R), Representative Young (D), and Governor Scott Walker

The organizations also released the summary of ongoing research revealing new details about water contamination from the Flambeau mine (https://sierraclub.org/sites/www.sierraclub.org/files/sce-authors/u560/Wisc%20Flamb%20REM%20Summary%204.11.2017%20%281%29_0.pdf). Robert E. Moran, Ph.D. - a Geochemist and Hydrogeologist with 45 years of domestic and international experience with mining and water quality issues in both the public and private sectors - has reviewed the development of the mine including permitting efforts, the short operating period and years of monitoring.

Dr. Moran was asked to review public documents related to the Flambeau mine to help determine the state of public resources – ground and surface waters – impacted by the mine during and after mining. The summary released today includes important new findings:

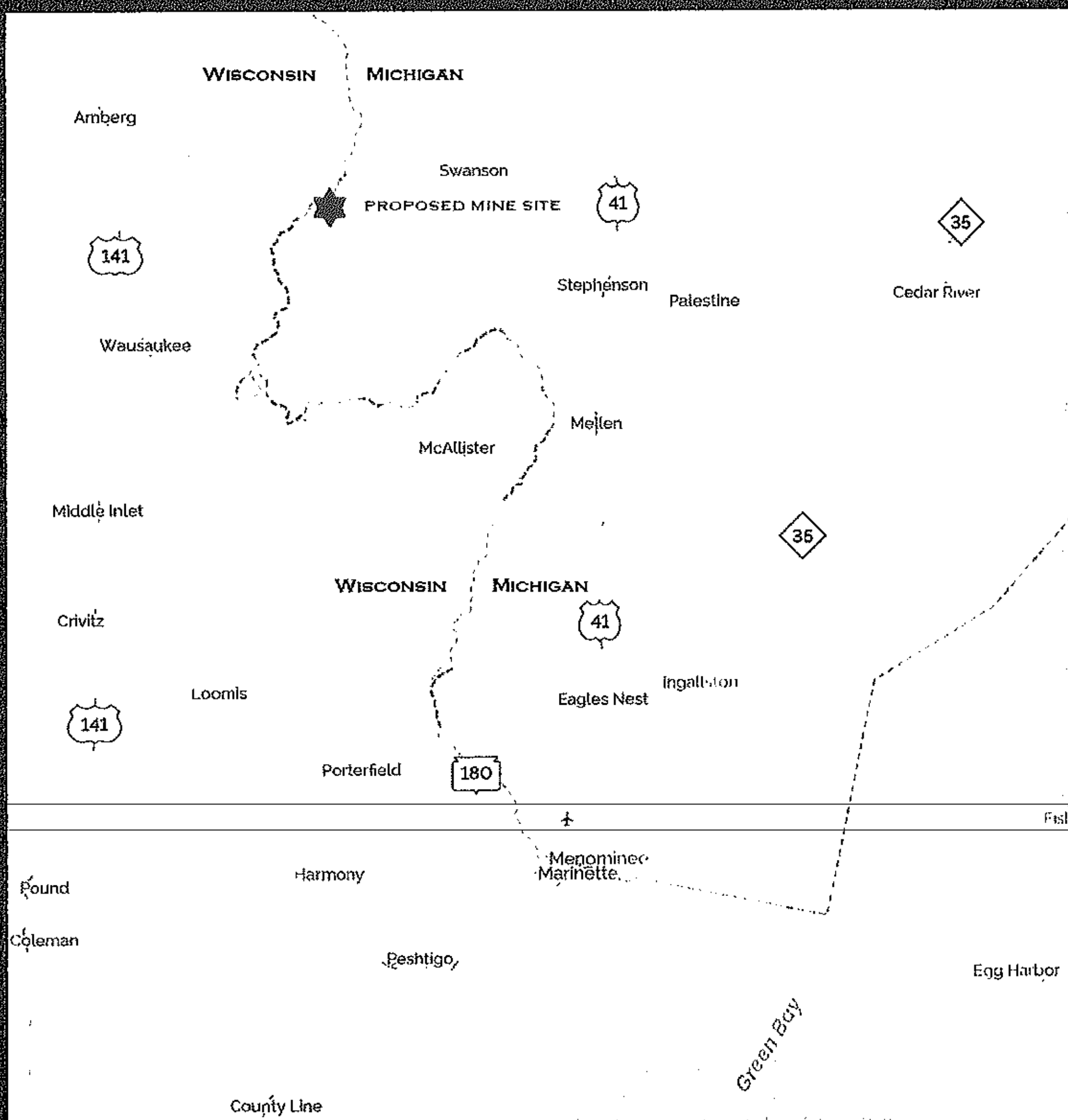
- Ground and surface water quality is being and has been degraded at the Flambeau mine site—despite years of industry public relations statements touting the success of the Flambeau mining operation.
- The Flambeau mine is an example of a deeply flawed permitting and government oversight process. The opposite of a clean mining operation, groundwater quality data shows contaminants that greatly exceed baseline data and water quality and aquatic life criteria.

- The Flambeau mining and remediation practices are not a sustainable, long-term solution. The mining company may have satisfied state oversight and disclosure requirements, but site ground waters are contaminated and treatment would be extremely costly.

Dr. Moran's summary will be followed soon by a report that includes full documentation of the conclusions reached in his research. The summary is being released ahead of the full report to counter the ongoing false claims that the Flambeau mine safely mined in metallic sulfide ore without causing contamination of public waters. A one-page summary of critical points can be found here. (https://sierraclub.org/sites/www.sierraclub.org/files/sce-authors/u560/Critical-Points_04.13.2017_Final.pdf)

From 1994-97, a large network of state and regional organizations including environmental and conservation groups, Wisconsin tribes, unions, churches and other citizen groups joined together to oppose the Crandon mine proposal and pass the Mining Moratorium law with overwhelming public support and signed by Governor Thompson in 1998. The network's efforts successfully educated the public on the dangers of mining in metallic sulfide minerals.

Protecting the Public from the Proposed Back Forty Mine



Out of 250,000+ rivers in the United States the Menominee River was named the 10th most endangered river due to the threats from the proposed Back Forty Mine

People over Profits

noback40.org

Protecting the Public's Interests

The proposed Back 40 Mine project poses significant risks to the clean water supply of communities near the mine site as well as down river and Lake Michigan communities. In addition, the surrounding ecosystem and sites of historic, cultural and religious significance to the Menominee Indian Tribe face the threat of destruction. The proposed open pit metallic sulfide mine would sit a mere 50 yards on the Michigan side of the Menominee River, which serves as the border of Northern Wisconsin and Michigan's Upper Peninsula. The proximity to this major bi-state/interstate commerce waterway increases the risk of widespread and irreversible damage when this project results in acid mine drainage, metal contamination and other pollution. Based on the industry's track record, its not a matter of if the project will pollute, it's a matter of when and to what extent the project will pollute. These significant risk are inherent, unavoidable and are greatly increased when the potential for natural catastrophes (flood, tornado, earthquake) or human errors are factored in.

Lack of Financial Assurances

The Back Forty mining permit requires a financial assurance "sufficient" to cover the cost of reclamation and remediation of contamination in violation of the mining permit. 75% of the total required shall consist of a cash equivalent security with the remaining 25% consisting of a statement of financial responsibility. What is "sufficient" will rely heavily on the anticipated risks, which according to the company "There will be no acid mine drainage". Similarly, the serious risks have been downplayed by relying on technology and engineering which is known to fail. In this type of an arrangement companies have every motivation to predict lower risks to lower their required financial assurance. Acid Mine Drainage can occur for hundreds of years and where will the company be in one hundred years?

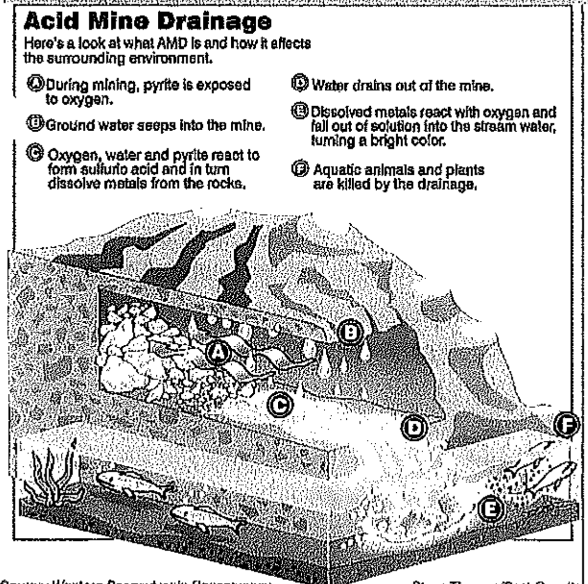
The history of sulfide mining is filled with companies going bankrupt or lacking the financial resources to respond to pollution from their mines. When this happens, guess who is on the hook for cleanup— the taxpayers. Its common practice for companies created for specific mining projects to go out of business when that mine closes. The backlog of clean up costs for hardrock mines is the U.S. are estimated at $20-$45 billion, and new sites are being added to the list of unfunded liabilities every year.

Examples of costs left to the taxpayers—

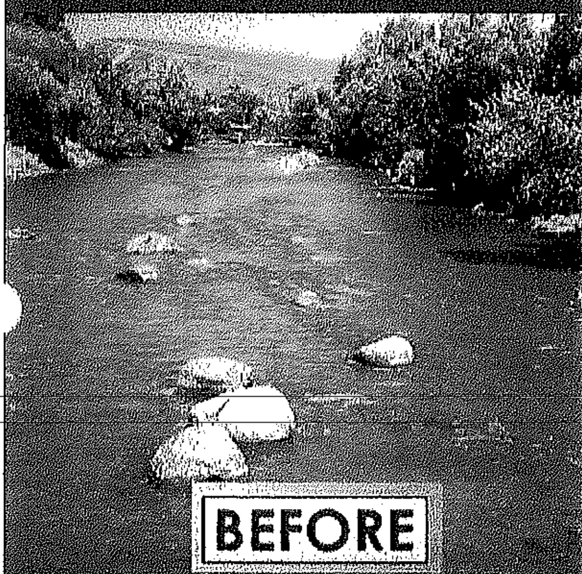
- **Summitville Gold Mine, Colorado**—The company filed for bankruptcy, leaving cleanup costs to the public. Costs are expected to be over $235 million and take 100+ years.
- **Zortman Landusky Mine, Montana**—In 1998 the company abandoned the site and filed for bankruptcy. Following the company's bankruptcy, its estimated Montana taxpayers could remain on the hook for up to $90 million dollars.
- **Gilt Edge Mine, South Dakota**—The parent company, Dakota Mining, went bankrupt and abandoned the mine in 1999 with its $6 million dollar bond insufficient to even cover water treatment for one year. Costs of $100 million plus continue to grow.

Examples of unanticipated major mining disasters in the last 3 years—

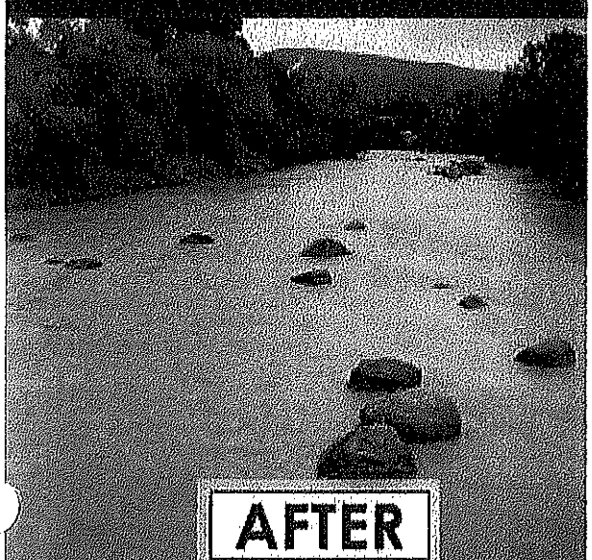
- **Gold King Mine, Silverton Colorado**—In 2014 the EPA found metals emanating from Cement Creek posed serve risks to the aquatic environment for several miles downstream and impairment for at least 30 miles downstream. On August 5, 2015 the EPA was conducting an investigation of the mine to assess the on-going water release from the mine. While excavating, pressurized water began leaking above the mine tunnel, spilling over 3,000,000 gallons of water into Cement Creek, a tributary of the Animas River.
- **Mt. Polley Mine, British Columbia Canada**—On August 4, 2014, a tailing pond breach at the Mt. Polley Mine, sent 6,600,000,000 gallons of toxic wastes and waste water into Polley Lake and eventually into the Cariboo River. An engineering panel named by the British Columbia government found the design of the tailing dam was faulty and build on unstable glacial solid. The spill is one of the biggest environmental disasters in modern Canadian history.



Source: Western Pennsylvania Conservancy — Steve Thomas/Post-Gazette



Before and After of the Animas River, Colorado



Understanding Acid Mine Drainage

Among the most dangerous risks associated with metallic mineral mining, acid mine drainage (AMD) stands out, due to its potential to permanently and irreparably damage the surrounding ecosystem. AMD originates when minerals containing sulfur interact with oxygen and water. This chemical reaction generates the acid, which can continue for hundreds or even thousands of years.

In the Great Lakes area the high grade ore deposits have been depleted leaving only the small traces of precious metals in large rock deposits. This means to get to the precious metals at the Back 40 project an enormous amount of sulfate containing waste rock is produced (54 million tons). It is this waste rock, when exposed to oxygen and water, that generates the AMD.

Even with existing technology, AMD is virtually impossible to stop once it begins. To permit an acid generating mine, means future generations will inherit the responsibly for a mine that could require management in perpetuity.

Understanding the Added Dangers of Tailings Ponds

The proposal to mine at the Back Forty site also includes plans to process the ore onsite. To accomplish separating the valuable metals from the ore requires the use of dangerous and toxic chemicals such as cyanide. The materials left over after this process are known as tailings, also called mine dumps, culm dumps, slimes, tails, refuse, leach residue or slickens. Tailings are distinct from overburden, which is the waste rock or other material that overlies an ore or mineral body and is displaced during mining without being processed.

Tailings storage facilities are a significant risk due to the vast quantities of hazardous materials stored in the tailings ponds. At the Flambeau Mine in Ladysmith, Wisconsin no tailings were generated as 100% of the ore was shipped to Canada. By contract the back forty mine as proposed with a 7 year life would produce approximately 11,800,000 tons of tailings to be managed.

A Cautious Approach on Economic Figures

A 2015 University of Minnesota report shows mining represents less than 1% (0.8%) of the jobs in the four county region (Delta, Dickenson, Menominee Counties MI, and Marinette County, WI). By contrast the tourism and hospitality industry represents 11% of the regions employment.

The same 2015 study commissioned by Aquila, noted to readers, "readers are encouraged to remember the BBER an entity of the UMD Labovitz School was asked to supply an economic impact analysis only. Any subsequent recommendations should be based on the "big picture" of total impact". The risks to tourism and impacts on 11% of the region's employment, the loss of property values and subsequent permanent impacts to property taxes were not considered.

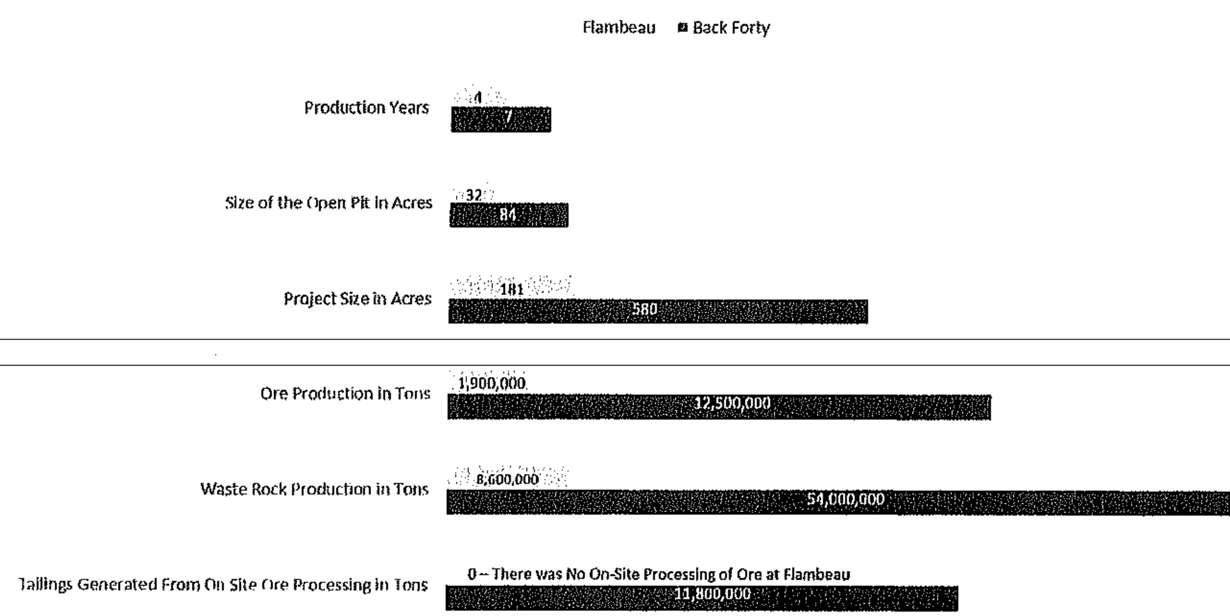
The Flambeau Mine Myth

"Flambeau was a very successful mining operation, and the two sites are very similar, so we've been able to use the engineering work done on Flambeau as a template for the Back Forty mine". — Steven Donahue (Foth Infrastructure & Environment)

Proponents of the proposed Back 40 mine, such as Steven Donahue, a consultant on the Flambeau mine and the Back 40 project, point elected officials and the public to selective facts and carefully worded statements about the Flambeau Mine. This attempt to influence public opinion, relies on elected officials and the public to wholesale adopt these statements without questioning their accuracy. Independent review of the information ensures an objective view and empowers us to be in a position to make educated decisions.

Everyone is entitled to their own opinion, however everyone is not entitled to their own facts. The fact is the Flambeau Mine is not a good comparison for the proposed Back 40 Mine (See Chart 1). The Flambeau Mine's economic impact on Rusk County was minimal. (See Chart 2) The Flambeau Mine has and continues to pollute the area's environment (See Chart 3). Foth's predictive modeling on the Flambeau Mine's impact was drastically off according to the company's own numbers. (See Chart 4)

Comparing the Flambeau Mine vs the Back Forty Mine (Apples vs. Oranges)



What impact did the Flambeau Mine have on Rusk County?

A common tactic used by mining companies is the promise of high paying jobs and other economic stimulation. "Over Promise and Under Deliver" is unfortunately a common theme as most local citizens will not qualify for the high paying jobs and local economic numbers rarely materialize. Rusk County's Per Capita Income (Wisconsin Blue Book) and the Unemployment Rate (Wisconsin Department of Workforce Development) were considered in terms of ranking amongst Wisconsin's 72 counties. The ranking relative to Wisconsin's other 71 counties ensures national or other widespread economic factors are not mistaken for increases or decreases in a specific county. Ask yourself — did the Flambeau Mine result in the high paying jobs or major economic stimulation promised to Rusk County, WI?

Rusk County Rank out of 72 WI Counties	Per Capita Income	Unemployment Rate
1991	70	70
1992	69	71
1993	71	72
1994	71	72
1995	71	71
1996	70	70
1997	70	71
1998	70	63
1999	70	59

For more detailed information on the Flambeau Mine visit https://flambeaumineexposed.wordpress.com/

Environmental Impacts of the Flambeau Mine?

In 2012 a Flambeau River tributary, known as "Stream C", was officially added to the EPA's list of impaired waters due to high levels of copper and zinc. This continued acute aquatic toxicity designation by the EPA remains in place today. The existence of high levels of minerals in the water have also had a measurable impact on the wildlife. For example testing on Walleye livers was required until 2011. The results of this testing shows increase levels of Copper, Zinc, and Iron in the downstream testing sites.

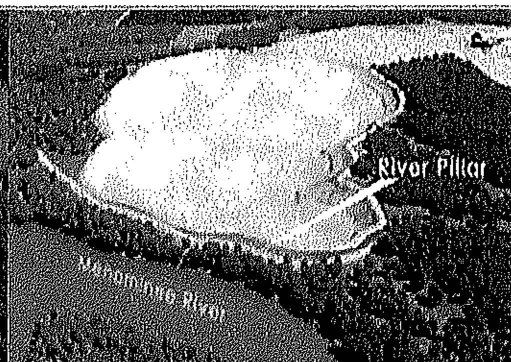
Walleye Liver Tests	Year	Upstream Site (mg/kg)	Downstream Site (mg/kg)	Difference
Copper	Average 1993-1997	18.4	19.8	+1.4
Copper	Average 1998-2011	19.2	27.2	+8.0
Iron	Average 1993-1997	70.6	106.2	+35.6
Iron	Average 1998-2011	89	115	+26
Zinc	Average 1993-1997	21.6	22	+.04
Zinc	Average 1998-2011	21.9	23.8	+1.9

What has the Flambeau Mine taught us about predictive modeling?

A mining company and its consultants can develop outcome orientated predictions during the permitting stage to "predict" minimal impacts. In fact it is in the mining company's interest to have lower predictive modeling. As we see first hand from hard data, Foth was drastically off in their predicted levels at the Flambeau Mine. Below are the numbers on file with the Wisconsin Department of Natural Resources from the Flambeau Mine. What assurances does the public have that Back 40 predicted impacts are valid or are we being asked to blindly place our trust in Aquila and their consultants?

Contaminant	Flambeau baseline	Foth Prediction on levels	Foth Prediction on duration	Max levels reported to date by Flambeau Mining Company
Copper	**11 mcg/l**	**14 mcg/l**	>4,000 years	**810 mcg/l** **(58 X higher than Foth predicted)**
Iron	**50 mcg/l**	**320 mcg/l**	>4,000 years	**15,000 mcg/l** **(47 x higher than Foth predicted)**
Manganese	**230 mcg/l**	**550 mcg/l**	3,920 years	**42,000 mcg/l** **(76 x higher than Foth predicted)**
Sulfate	**5 mcg/l**	**1,360 mg/l** **1,100 mg/l** **832 mg/l**	0-8 years 8-132 years 132-2,850 years	**2,400 mg/l** **(2 x higher than Foth predicted)**

Following heavy rains the Flambeau River came within 20 horizontal and 4 vertical feet of spilling into the Flambeau mine pit. (Photo Bob Olsgard of Saron WI, 9.17.94)



Rendering of the proposed Back 40 Mine Pit which would exist 50 yards from the banks of the Menominee River

The White Rapids dam is located 1/4 of a mile upriver from the proposed Back 40 mine site. The 90 year old dam (1927) has an average water flow of 3,000 cubic feet per second.

Restoring the Menominee River Area of Concern

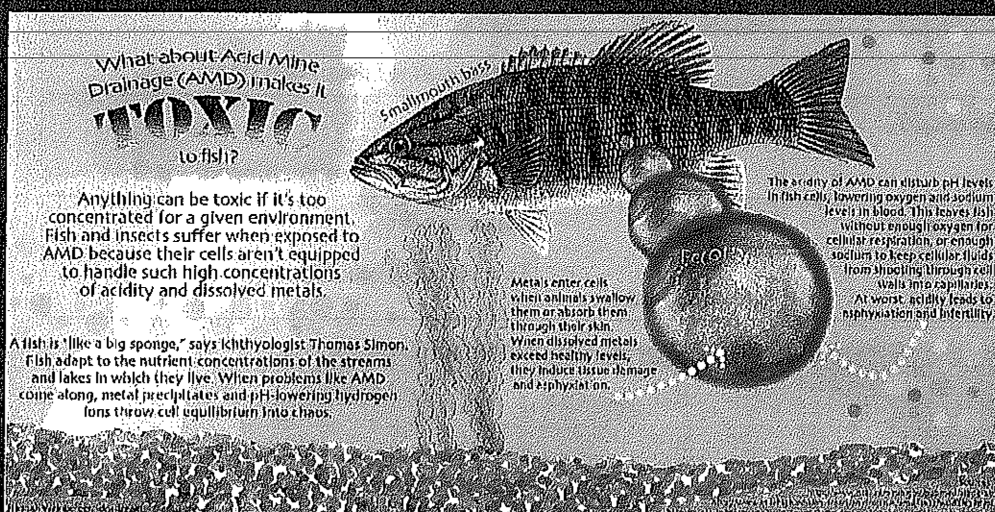
The Menominee River was designated as a Great Lakes Area of Concern (AOC) under the 1987 Great Lakes Water Quality Agreement. Significant public/private funding and resources have went into the clean up effort including from the City of Marinette, Wisconsin, City of Menominee, Michigan, WI Dept. of Natural Resources, MI Dept. of Environmental Quality, Tyco, University of Wisconsin Extension, US Army Corps and US EPA. Five of the original six environmental impairments remain. The US EPA monitors and evaluates the environmental conditions in the AOC to determine when the area is restored and can be delisted from an AOC. As the area moves towards delisting, why approve new threats?

Restoring the Lake Sturgeon Habitat

Lake Sturgeon are identified as a threatened species in Michigan, a species of special concern in Wisconsin and a federal species of concern by the US Fish and Wildlife Service. Fish biologists believe close to half of all adult Lake Michigan Sturgeon exclusively use the Menominee River for spawning. Habitat loss and fragmentation caused by the presence of dams, have resulted in artificial barriers to migration and spawning. Millions of Wisconsin, Michigan, Federal and private dollars have went into efforts to restore Lake Sturgeon habitat including sophisticated fish passages, which address the artificial barriers.

Protect Menominee River Fishing

Citizens, fishing clubs, river guide companies and area businesses are concerned about the health of the river and the world class fishery it supports. The Menominee River is considered a world class smallmouth bass fishery and the fishing industry, reliant on a healthy Menominee River, supports a great deal of jobs and local economic activity. This year the Menominee River will host Cabela's National Walleye Tour Championship August 16-18, 2017.



How Can You Get Involved?

Visit www.noback40.org/HowToHelp.aspx to learn more about our efforts and how to:

- **Raise public awareness**
- **Join ongoing efforts**
- **Engage with political leaders**
- **Engage with the investors**
- **Donate to Menominee efforts**

Menominee Indian Tribe of Wisconsin

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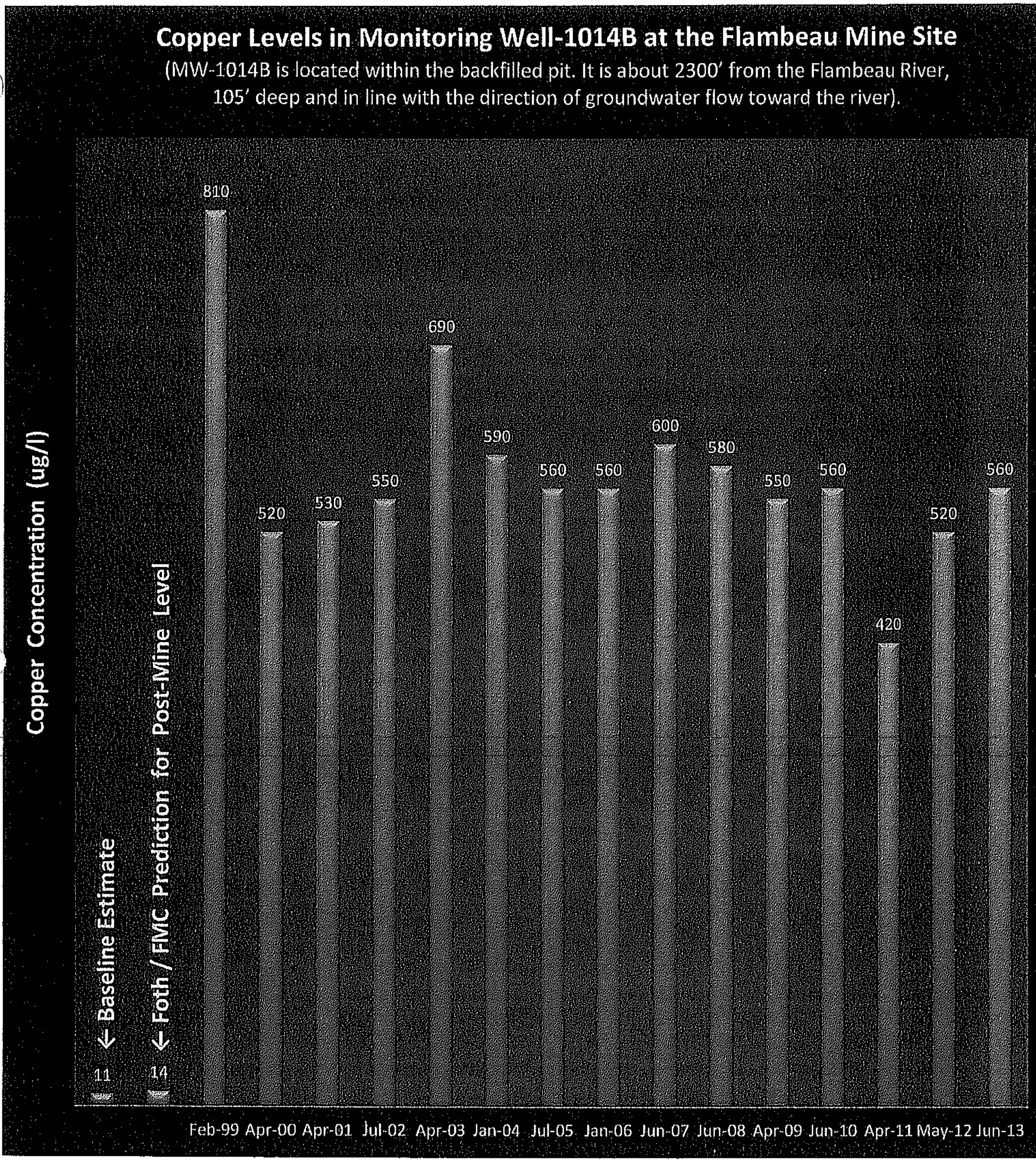
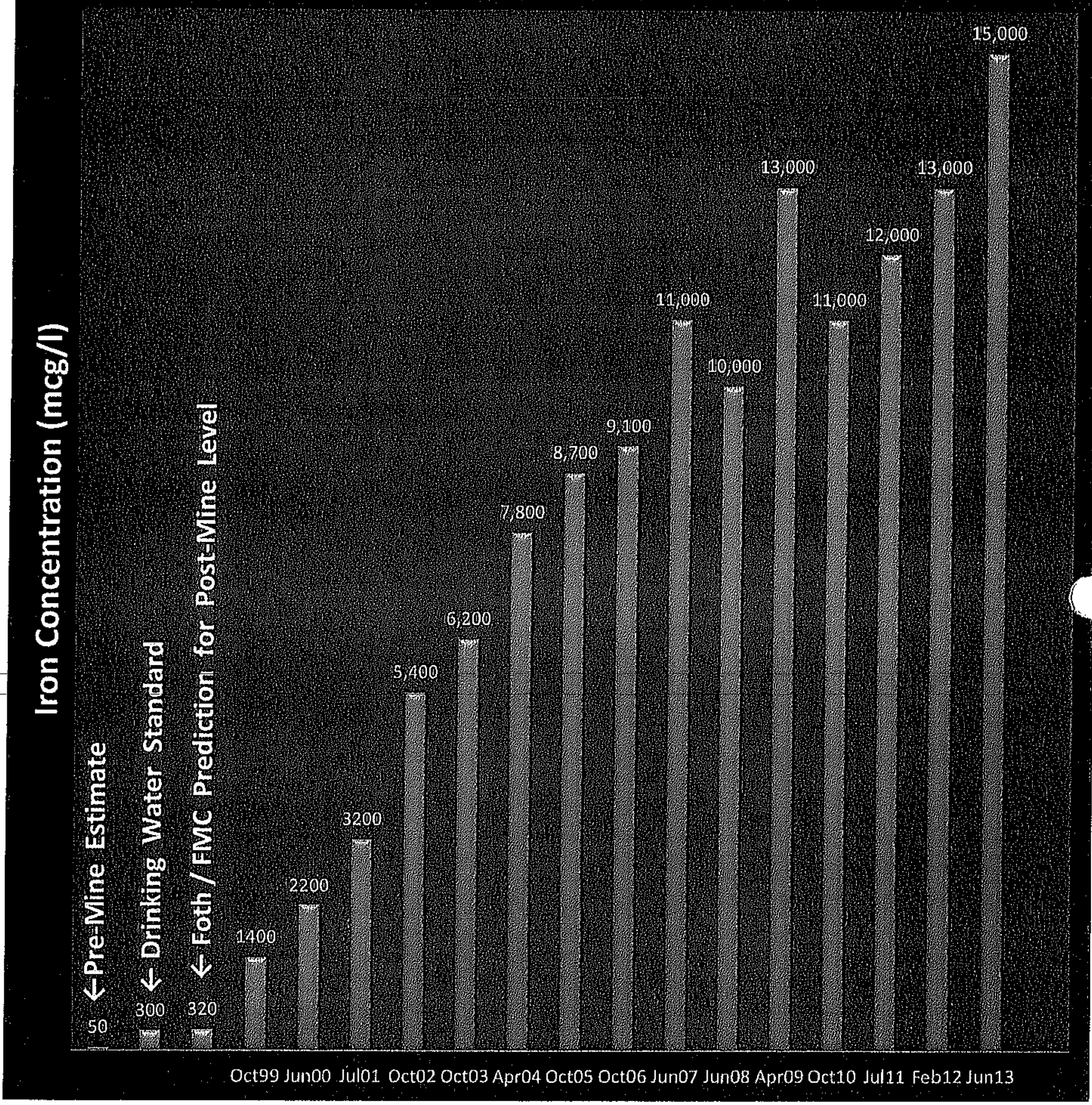


Data Source: Flambeau Mine Permit (1991) and Flambeau Mining Company Annual Reports (1999-2013).
Graph created by Laura Gauger of Duluth, MN.
For additional information go to: http://flambeaumineexposed.wordpress.com/

Iron Levels in Monitoring Well-1013C at the Flambeau Mine Site

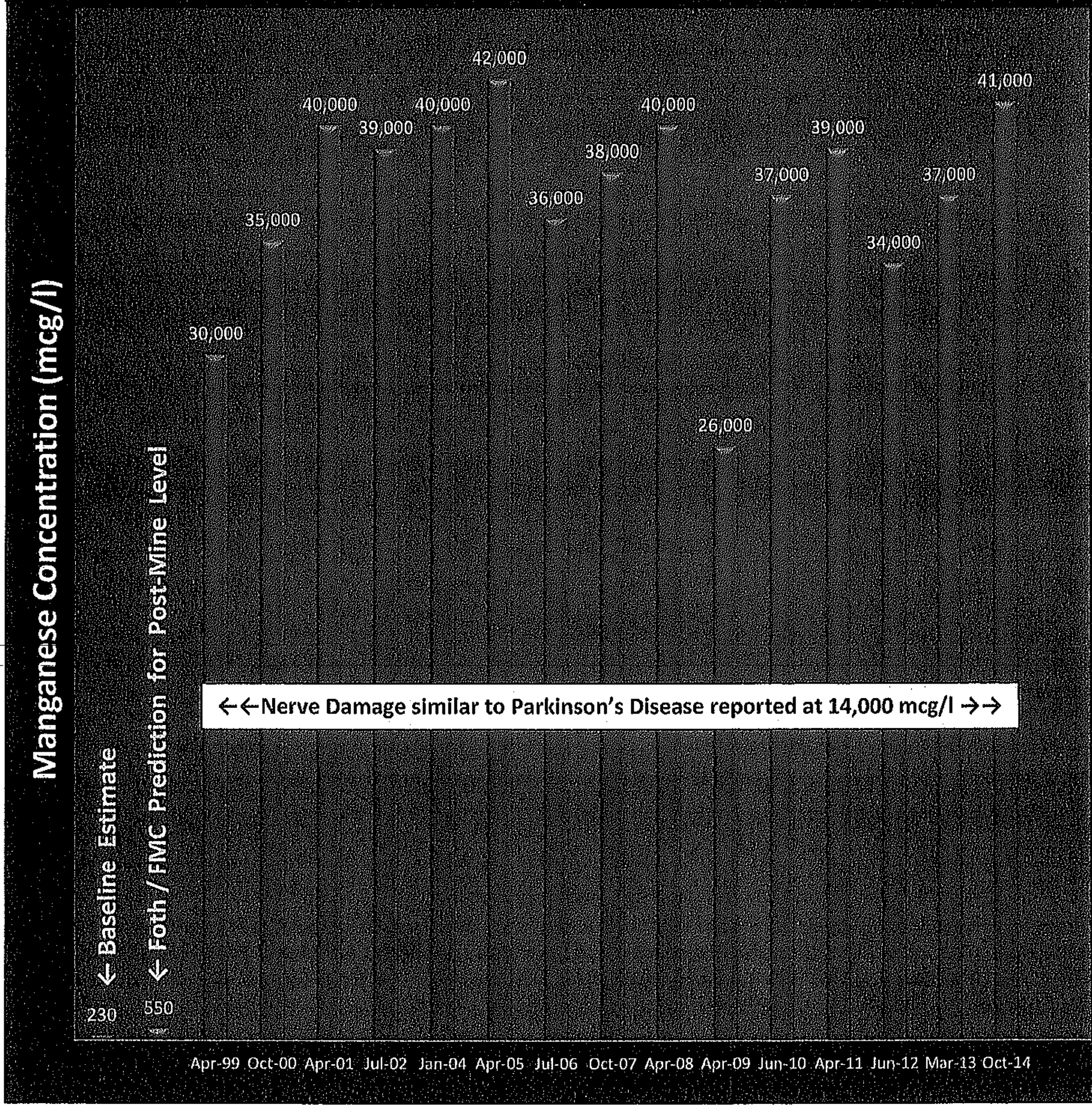
(MW-1013C is located within the backfilled pit. It is about 600' from the Flambeau River, 202' deep, and in line with the direction of groundwater flow toward the river).



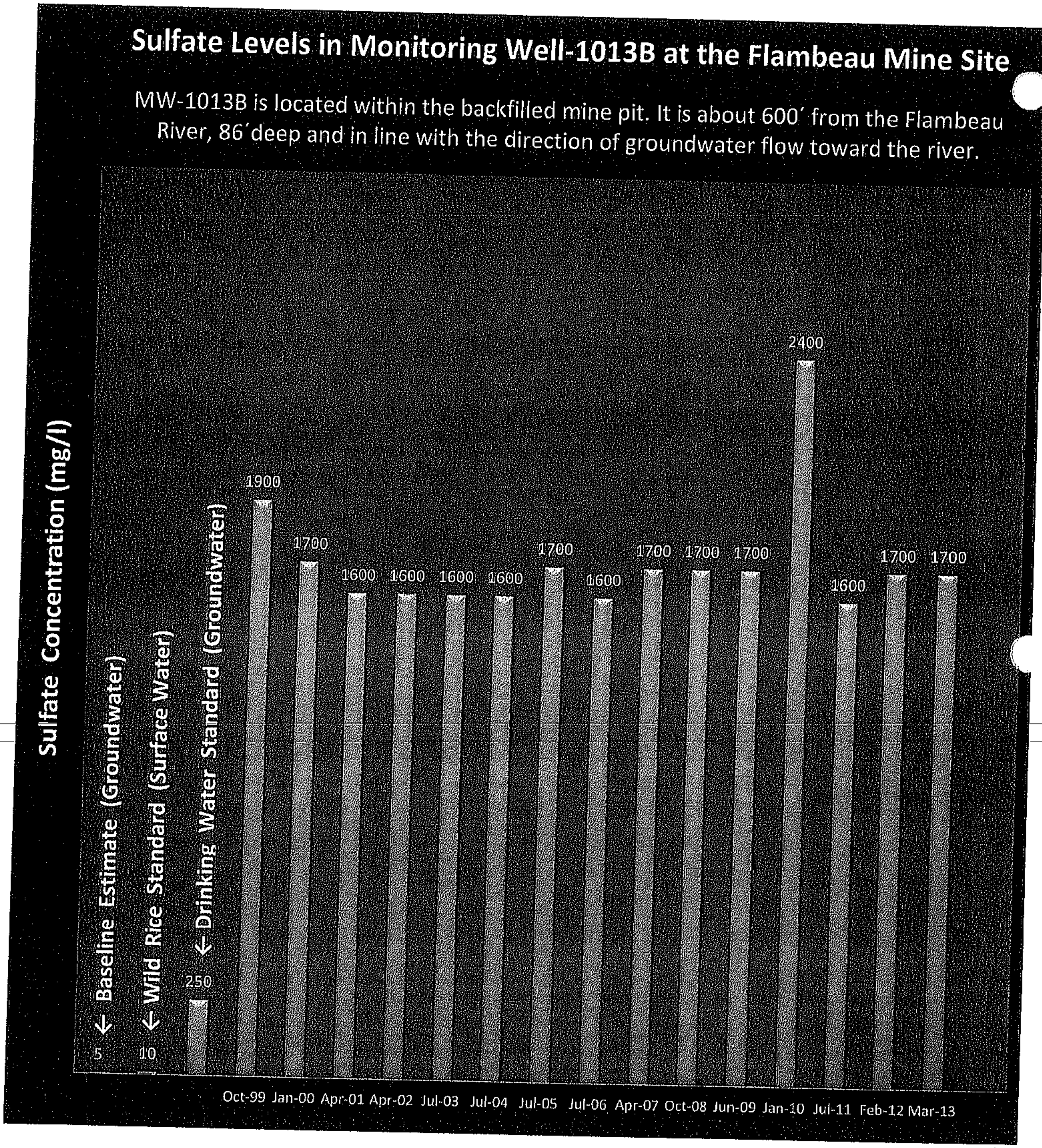
Data Source: Flambeau Mine Permit (1991) and Flambeau Mining Company Annual Reports (1999-2013).
Graph created by Laura Gauger of Duluth, MN.
For additional information go to: http://flambeaumineexposed.wordpress.com/

Manganese Levels in Monitoring Well-1013B at the Flambeau Mine Site

MW-1013B is located within the backfilled mine pit. It is about 600' from the Flambeau River, 86' deep and in line with the direction of groundwater flow toward the river.



Data Source: Flambeau Mine Permit (1991) and Flambeau Mining Company Annual Reports (1999-2014).
Graph created by Laura Gauger of Duluth, MN.
For additional information go to: http://flambeaumineexposed.wordpress.com/



Data Source: Flambeau Mine Permit (1991) and Flambeau Mining Company Annual Reports (1999-2013).
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Flambeau River Monitoring
at the Flambeau Mine
Rusk County, Wisconsin

1. Flambeau River Sediments
2. Macroinvertebrates
3. Crayfish
4. Walleye Tissue Monitoring

Analysis, Comments and
Recommendations

Prepared for
Wisconsin Resources Protection Council

Dr. Ken Parejko
Prof. Emeritus
Biology Department
University of Wisconsin-Stout

April 10, 2009

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at the Flambeau Mine
Rusk County, Wisconsin

1. FLAMBEAU RIVER SEDIMENTS
Analysis, Comments and
Recommendations

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INTRODUCTION

Lentic (lake and pond) and lotic (river and stream) sediments are a complex matrix, whose present composition is determined by historical, natural and anthropogenic factors. In northern Wisconsin, most lake and stream sediments were deposited as the last glaciers receded, and further modified by post-glacial natural forces such as storms, floods, the activities of fish and wildlife, forest fires and the subsequent aerial deposition of particulates, and so on. These natural forces established the sediment characteristics, which especially in river and streams are continually worked and re-worked. Human (anthropogenic) activities impacted lakes and streams for thousands of years, but that impact grew significantly with the arrival of European immigrants into Wisconsin in the 18th and 19th centuries. These impacts continue, and include agricultural, residential, and commercial activities such as mining.

River sediments such as those in the bed of the Flambeau River in northern Wisconsin provide an important ecosystem inhabited by mostly invertebrate species such as immature insects, clams, and so on. The chemistry of the sediments, itself consisting of complex dynamic interactions with the surface waters and affected to some extent by the organisms themselves, impacts that ecosystem. Potentially toxic materials in the sediment, whether natural or anthropogenic, not only affect the sediment inhabitants, but since many of these species are food for organisms higher on the trophic pyramid, by bioaccumulating these potential toxins the sediments, via the sediment organisms, directly affect species perhaps of more interest to humans, such as the fish community, or other vertebrates such as birds which prey on the invertebrates.

Because of the importance of the sediments to the riverine community, and because sediment chemistry is one measure of human impacts on the river, industries located along riverways are sometimes required to conduct sediment sampling. Such was the case with Flambeau Mining Company (FMC), a subsidiary of Kennecott Minerals of Salt Lake City, Utah that constructed an open pit copper sulfide mine on the banks of the Flambeau River in the mid 1990s. The river formed the western boundary of the project area, and the pit itself was constructed to within 150 feet of the river. The Flambeau Mine was operational for four years. It ceased production in 1997 and has since been reclaimed.

The sediment monitoring program instituted by Flambeau Mining Company was part of a broader monitoring program designed to ascertain any effects the Flambeau Mine might have on the Flambeau River ecosystem, including surface water, sediment and aquatic life. These effects could occur during excavation of the mine, during its operation, and beyond the date of its operation if substances such as metals or other potential toxins or erosional runoff might be making their way through surface or groundwater into the river or its tributaries.

The present report is an assessment of FMC's Flambeau River sediment data as well as data from Stream C, a small tributary of the Flambeau River that receives surface water runoff from the mine site.

FLAMBEAU RIVER AND STREAM C SEDIMENT STUDIES

In 1988, FMC conducted baseline sediment testing at three different sites in the Flambeau River, one upstream and two downstream of the mine site. This was followed by an annual series of sampling events that took place between 1991 and 2000 and again from 2006 to 2008. In addition, sediment was tested in 2008 at two different locations in a navigable stream (Stream C) that carries storm water runoff from the mine site to the Flambeau River and also receives overflow from a 0.9 acre wetland/biofilter situated in the southeast corner of the mine site.

During the time period in question, a number of different activities took place at the Flambeau Mine site which had the potential to impact Flambeau River and Stream C sediments. These included:

1991-1993:	Pre-production stripping and preparation of the site for excavation
1993-1997:	Blasting and ore production
1997-2001:	Partial reclamation of the site (backfilling the pit, recontouring the surface, revegetation)
2003+:	Sporadic and ongoing reclamation/remediation activities (e.g., removal of contaminated soils in the Industrial Outlot portion of the mine site)

Over the years, six different sites in the Flambeau River were utilized at one time or another for sediment analysis. Local landmarks associated with the sampling sites include Gokey Road, Blackberry Lane, the Stream C outfall, Sister's Farm, the site of the former Port Arthur Dam (the dam was removed in 1968) and Thornapple Dam, as described below and shown on the maps included in Appendices I, II and III:

1. Gokey Road (about 1 mile upstream of the open pit site and 0.3 mile upstream of Blackberry Lane; sampled 1988 only)
2. Blackberry Lane (about 0.7 mile upstream of the open pit site; sampled 1991-2000 and 2006-2008)
3. Stream C Outfall (about 0.3 mile downstream of the project area, below the mouth of Stream C but above the mouth of Meadowbrook Creek; sampled 2008 only)
4. Sister's Farm (about 1.5 miles downstream; sampled 1993-2000 and 2006-2008)
5. Port Arthur (about 3.1 miles downstream, in the vicinity of the former Port Arthur Dam; sampled 1988 and 1991-1993)
6. Thornapple Dam (about 7.6 miles downstream, within the dam's impoundment; sampled 1988 only)

With regard to the studies conducted between 1991 and 2008, samples were collected using sediment traps that consisted of one-quart canning jars. Three (1991-1994) or four (1995-2008) jars were placed at each sampling location and retrieved after exposure windows ranging from 22-80 days. Samples from each site were then composited and analyzed for a suite of trace elements (aluminum [Al], silver [Ag], arsenic [As], cadmium [Cd], chromium [Cr], copper [Cu], iron [Fe], mercury [Hg], manganese [Mn], nickel [Ni], lead [Pb], selenium [Se] and zinc [Zn]). In 2007 and 2008 samples were only analyzed for copper, iron, manganese and zinc. Sediment was also characterized in terms of % total solids, % total volatile solids and grain size. As discussed below, sampling site location and procedures were not always consistent from year to year.

Sediment sampling in Stream C took place as a one-time event in 2008. As described in FMC's *Stipulation Monitoring Results, December 30, 2008*, two locations within the stream bed were sampled, one which was "downstream from the overflow of the 0.9 acre biofilter and approximately 20 yards south of Copper Park Lane where Stream C is a gaining stream, in an area of sediment deposition." The second sampling site was chosen to be "approximately 120 yards downstream of Copper Park Lane, where Stream C is a losing stream, in an area of deposition." As reported by FMC, Stream C sediment samples were collected "using a hand trowel to dig below ground surface due to dry conditions in the stream bed." It appears that only a single sediment sample was collected at each of the two sampling sites. Samples were analyzed for copper, iron, manganese, zinc and % total solids.

BASELINE STUDIES – 1988

Before presenting and analyzing the Flambeau River and Stream C sediment data reported by FMC between 1991 and 2008, it would be prudent to first examine any baseline data collected by the company. No such information was reported for Stream C, but the company did perform some baseline sediment studies in the Flambeau River in 1988. As reported in the *Volume 2: Environmental Impact Report, April 1989,* a single sediment sample was taken at the Gokey Road (upstream) and Port Arthur (downstream) sampling sites in August of 1988 using a polyvinyl chloride (PVC) core sampler. Each sample was analyzed for arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, zinc and sulfur. Measurable levels of each element were detected, except for cadmium, lead and mercury.

Three sites within the Thornapple Dam impoundment (FL-1, FL-2 and FL-3) were also sampled in March of 1988 as part of the baseline study, with three, two and three cores taken from each site, respectively. Cores were separated into soft and stiff components, which were composited and analyzed for the same panel of elements listed above. Cadmium and sulfur were below the detection limits at all three sites within the impoundment.

Table 1 below shows the coefficient of variation, expressed as a percentage, from data provided in Table 3.7-2 of the *Volume 2: Environmental Impact Report, April 1989.* These cores were all taken at Thornapple Dam, FL-1, FL-2 and FL-3. The "soft" portions of the core were the upper portion, the "stiff" portions lower. The coefficient of variation is the standard deviation divided by the mean, and provides a rough estimate of the amount of variation in the samples vs. the mean. Coefficients of variation could not be calculated for the Gokey Road and Port Arthur samples because only one sediment sample was collected at each site.

Table 1: Coefficients of variation (as %) for various metals sampled in August, 1988, at the Thornapple Dam site.

	Coefficient of Variation "soft" samples	Coefficient of Variation "stiff" samples
Arsenic	18 %	35 %
Chromium	6.5 %	26 %
Copper	5.9 %	34 %
Iron	17 %	20 %
Lead	10 %	40 %
Manganese	29 %	37 %
Mercury	21 %	31 %
Zinc	14 %	20 %
Mean coefficient of variation	**15 %**	**30 %**

Just for matter of comparison, the coefficient of variation for height in adult human populations, according to two studies[1,2], is about 3.8%. The coefficients of variation shown in Table 1 indicate relatively high variation in metal concentrations among samples taken at the Thornapple Dam site (though we should remember that each of these samples is itself a composite of several subsamples; the individual variation could even be higher). When population or sample variance is higher, the number of samples required to achieve a desired degree of confidence in statistical tests increases rapidly. For example, only 2 replicates at each site are required to conclude that a doubling of the copper concentration from 17 (the average for the "soft" samples in Table 1) to say 34 mg/kg is statistically significant with 95% confidence, using a coefficient of variation of 5.9% such as found in the "soft" samples above. (Minitab-15 power calculation.) But the number of replicates required goes up to 8 at each site to demonstrate that a doubling of copper concentration is statistically significant at 95% confidence when the coefficient of variation increases to 34%, as found in the "stiff" samples for copper. In other words, significant changes in sediment metal concentrations might occur, but not be statistically demonstrable, under conditions of relatively high variability, unless adequate replication is used. The evaluation of sampling variability is therefore crucial when designing monitoring programs such as those undertaken by FMC.

Coefficients of variation can and likely will vary depending on sampling location and sampling methodology. This became an issue when reviewing FMC's baseline and follow-up sediment data, as will be discussed below.

I. SAMPLING & REPORTING ISSUES REGARDING BASELINE DATA COLLECTION

Flambeau Mining Company failed to gather adequate baseline data regarding Flambeau River sediment composition upstream and downstream from the mine site prior to commencement of the mine project. In addition, no baseline data whatsoever was gathered for Stream C. Noted sampling and reporting issues fall into the following four categories which are further discussed below:

1. Lack of replication
2. Changes in sampling site location
3. Inconsistency in sampling methodology
4. Failure to gather any baseline data for Stream C

1. Lack of replication at the Gokey Road and Port Arthur sediment sampling sites

As mentioned above, coefficients of variation could not be determined for the Gokey Road (upstream) and Port Arthur (downstream) sampling sites in the Flambeau River, since only a single sediment sample was collected at each of these locations in 1988. As a result, it is not possible to know how many replicate samples would be needed at each site to conclude with any degree of statistical confidence that baseline sediment composition at the two sites was either the same or that it differed. To make such a determination, FMC would have had to conduct a more extensive evaluation of baseline sediment composition, similar to what was done at the Thornapple Dam site (see specific recommendations below).

In other words, because only one replicate was taken at the Port Arthur and Gokey Road Sites, we have no idea what the among-sample variability was for these sites. The relatively high coefficients of variation demonstrated for the Thornapple samples (Table 1) may or may not represent variance at the other two sites, and without some reasonable estimate of that variance it is not possible to make any statistically reliable statements comparing samples among or between the sites. Consequently one can have little confidence in the statement made by FMC regarding the two sediment samples collected at the Gokey Road and Port Arthur sampling sites: "The results of laboratory analysis of these samples … indicate no significant difference between upstream and downstream samples" (*Volume 2: Environmental Impact Report, April 1989*).

A separate but related issue concerning coefficients of variation in the FMC study is that the values used to calculate those coefficients for the Thornapple Dam site in 1988 (Table 1) were from analyses of core samples, a different sampling procedure than that adopted for the remainder of sediment monitoring (sediment traps.) FMC did not provide any baseline replication data for sampling with sediment traps. As a result, variation cannot be estimated for the sediment traps, which again prevents one from determining the power of any statistical test to demonstrate significant differences between sampling sites within a given year. As mentioned above, without the confidence replication provides statistical tests, statements regarding whether or not there has been a mining effect in any given year cannot be made with any reasonable certainty.

Because of the importance of establishing baseline monitoring information, replicate rather than single or composite samples should always be taken at each site, and the same sampling methodology should be utilized throughout the duration of the study. One suggested procedure might involve at least five replicate samples taken at each site, from which an estimate of variance in the values can be calculated. Based on this a power calculation for the metal/site combination with highest variance can be done which will provide the number of replicates necessary to demonstrate a significant difference, if it exists, at a chosen level of confidence, say 90% or 95%. That number of replicates should then be taken at each sample site for each year sampled, using the same sampling methodology. If this procedure is followed, inferences about the presence or absence of significant differences between sample sites will be greatly strengthened.

2. Changes in sampling site location when transitioning from baseline to follow-up sediment studies

Flambeau Mining Company changed the locations of its sediment sampling sites in the Flambeau River when transitioning from baseline to follow-up studies. Only one of the three sites used for collecting baseline data in 1988 (Port Arthur) was in the same approximate location of any of those sampled in later years. In addition, the Port Arthur site was eliminated from the sampling program altogether after 1993. This inconsistency in sampling locations adds unwanted confounding effects to interpretation of the data. See Table-2 for a side-by-side comparison of where the various sampling sites were located and when they were sampled.

Table 2. Flambeau River Sediment Sampling Sites

Sampling Location	Code	Years in which Site was Sampled						
		1988 Baseline	1991	1992	1993	1994-2000	2006-2007	2008
Gokey Road (about 1 mile upstream of open pit site)	-	√	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled
Blackberry Lane (about 0.7 mile upstream of open pit site)	S-1	Not Sampled	√	√	√	√	√	√
Stream C Outfall (about 0.3 mile downstream of project area)	S-4	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled	√
Sister's Farm (about 1.5 miles downstream of project area)	S-3	Not Sampled	Not Sampled	Not Sampled	√	√	√	√
Port Arthur Vicinity (1) (about 3.1 miles downstream of project area)	-	√	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled
Port Arthur Vicinity (2) (about 600 feet upstream of 1988 Port Arthur site)[a]	S-2	Not Sampled	√	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled
Port Arthur Vicinity (3) (about 120 feet downstream of 1991 Port Arthur site)	S-2	Not Sampled	Not Sampled	√	√	Not Sampled	Not Sampled	Not Sampled
Thornapple Dam (about 7.6 miles downstream of project area)	FL-1 FL-2 FL-3	√	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Not Sampled

[a] Location of 1991 Port Arthur site relative to the 1988 sampling location was determined by comparing Figure 3.7-1 (*Volume 2: Environmental Impact Report, April 1989*) with Figure 4-2 (*Flambeau Mining Company 1993 Annual Report*). No diagrams of sampling site locations were included in FMC's 1991 or 1992 annual reports.

3. Inconsistency in sampling methodology when transistioning from baseline to follow-up sediment studies

As mentioned above, sediment sampling done in the Flambeau River from 1991 onward used a different sampling procedure than that used for the 1988 baseline study. Instead of PVC core samples, three (up until 1995) and subsequently, four sediment traps (one-quart Mason jars) were used at each site to collect sediments. This change in procedure alone throws the 1988 data into question as useful background information; because of the change in sampling procedure it cannot be reliably compared to that obtained at later dates. In addition, the 1988 sampling & analyses contained four fewer elements (aluminum, silver, nickel and selenium) than were done in 1991 – 2006.

Since the sampling methodology adopted in 1991 remained somewhat consistent for the duration of the study, and since blasting and ore production did not commence at the mine site until May of 1993, on first glance it might appear that the 1991-1992 data could be used to establish baseline sediment composition. This, however, presents its own set of problems. First, the downstream sediment sampling site utilized in 1991 and 1992 (Port Arthur) was switched to a new location in 1993 (Sister's Farm), making the 1991-1992 data less useful for comparative purposes. Second, using the 1992 data as baseline is suspect because by the time the sediment jars were installed in the river in May of 1992, nearly 90 acres of land at the mine site had already been cleared of vegetation and topsoil during the pre-production stripping phase of the project. In addition, the company's erosion control system had washed out at three different control points in early September 1991 after a rainfall of 5.2 inches over several days. (This erosional input occurred *after* the 1991 sediment sampling and *before* the 1992 sediment sampling.) WDNR officials issued a report confirming that "water laden with fine sediments" had entered the Flambeau River after the erosion control system failed and that "existing sediment basins and bail dikes did not provide nearly enough retention time to settle out clay size particles." As a result, the mine project had already impacted the Flambeau River prior to the 1992 sediment study, invalidating use of that data as a true baseline.

4. Failure to gather baseline sediment data for: (1) Stream C; and (2) Flambeau River at Stream C outfall

Stream C, as described in the 1991 Flambeau Mine Permit, "originates on the east side of Highway 27, drains the southeast corner of the project site and enters the Flambeau River immediately north of the mouth of Meadowbrook Creek." The permit also states that "based on flow records and physical evidence at the site, Stream C has ... been determined to be navigable."

Part of the Stream C channel was rerouted during mine construction and culverts were installed to facilitate drainage in the vicinity of the mine's rail spur and access road. As of 1998, drainage from the southeast corner of the mine site has also been routed to Stream C from a biofilter/detention basin located where a surge pond was situated during mine operation. Stream C enters the Flambeau River about 0.3 mile downstream of the boundary of the mine itself.

Despite the clear potential for Stream C to be impacted by mine activities (1991-1997) and reclamation activities (construction of the biofilter/detention basin in 1998), until 2008 no baseline or follow-up sediment data was ever collected in this tributary. Nor til then was there any baseline or follow-up sediment sampling in the Flambeau River, immediately downstream of the Stream C outfall.

In May 2007, per the terms of a Stipulation and Order negotiated during a contested case hearing, FMC agreed to sample sediment in Stream C at two different locations within the stream channel and to also sample sediment in the Flambeau River in the vicinity of the Stream C outfall. The one-time sampling event took place in 2008, approximately eleven years after cessation of mining. While the study results are of great interest, having no baseline data makes it more difficult to interpret the results.

II. SAMPLING & REPORTING ISSUES
REGARDING DATA COLLECTION IN FOLLOW-UP STUDIES

Sampling and reporting issues exist not only with regard to the baseline sediment studies conducted by FMC (1988), but the follow-up studies conducted to assess potential mine impacts (1991-2008). The most significant issues of concern regarding FMC's follow-up sediment studies fall into the following categories:

1. Insufficient baseline data (discussed above and summarized below)
2. Changes in sampling site location
3. Inconsistency in sampling methodology
4. Insufficient replication

1. Insufficient baseline data

Flambeau Mining Company failed to gather adequate baseline data regarding Flambeau River sediment composition upstream and downstream from the mine site prior to commencement of the mine project. As discussed in the previous section, the insufficiencies were related to: (a) lack of replication; (b) changes in sampling site location when transitioning from baseline to follow-up studies; (c) inconsistency in sampling methodology; and (d) failure to gather any baseline data for Stream C.

Adequate and reliable baseline data is the foundation of any sound scientific study. FMC's failure to sufficiently characterize baseline sediment conditions in the Flambeau River and Stream C severely limits one's ability to make reliable inferences about the effect of the Flambeau Mine on the associated ecosystem.

2. Changes in sampling site locations

FMC did not keep the same upstream and downstream sampling sites when transitioning from baseline to follow-up sediment studies. The Gokey Road site, about 1 mile upstream from where the open pit was eventually constructed, was replaced by the Blackberry Lane site in 1991, about 0.7 mile upstream from the open pit. Downstream, the Thornapple Dam site was sampled only once in 1988 and then eliminated from the sediment monitoring program altogether. Diagrams submitted by FMC also suggest that in 1991 the remaining downstream site at Port Arthur was moved about 600 feet upstream of its original (1988) location. River sediments are relatively heterogeneous environments, requiring consistency in sample sites. These changes in site location, as well as the change in sampling methodology discussed above, seriously detract from the usefulness of the 1988 baseline data.

During follow-up sediment studies (1991-2008) the company consistently used the Blackberry Lane site to gather upstream data. For various reasons, however, the downstream monitoring site at Port Arthur was itself moved twice.

First, for the 1992 study, because of streambank erosion observed in 1992 in the vicinity of the Port Arthur sampling site, the site was moved approximately 120 feet downstream from its original (1991) location. When the 1992 data was analyzed, results for Blackberry Lane were fairly consistent with the 1991 results. At the Port Arthur site, however, the sediment showed a large decrease in percent solids (from 77 to 35%), an increase in volatile solids, and an increase in concentrations of 12 different metals, relative to 1991. In a letter to the Wisconsin Department of Natural Resources dated September 24, 1992 (*FMC 1992 Annual Report: Appendix H)*, FMC's consultant suggested this was due to erosional sedimentation of old Port Arthur Dam impoundment sediments near the sampling site (the Port Arthur Dam was removed in 1968) rather than a mine effect. No specific mention was made in the report of the September 1991 breach of the mine's erosion control system, which may or may not have affected the 1992 study results as well. The consultant did, however, include a side-by-side comparison of the 1992 Port Arthur results with the composition of topsoil and till at the mine site (1988 data) and concluded that "project activities have had no bearing on the 1992 Port Arthur Dam sediment results."

In 1993, due to continued concerns over proximal erosion and the additional concern that the new Port Arthur site had a much different substrate matrix (more organic and more silty) compared to the upstream Blackberry Lane site (primarily cobble and gravel), FMC's consultants decided to move the downstream sampling site once more, this time to a location known as Sister's Farm. The new site was about 9500 feet upstream of the 1992 sampling location and, as discussed in the FMC *1993 Annual Report*, had a substrate similar to that found at the Blackberry Lane site. In addition, the river-bank at Sister's Farm, where the river is in a straight run, was characterized as "not highly susceptible to erosion" (*FMC 1993 Annual Report: Appendix E*).

While changing conditions do sometimes require changing sampling procedures, the necessity to change downstream sampling sites not once but twice during monitoring suggests the first downstream sites (Thornapple Dam and Port Arthur) were not well chosen. Variables such as local river curvature and velocity (affecting stream-bank erosion) and substrate composition could have and should have been evaluated previous to beginning the annual series of samples. Moving the Port Arthur site 120 feet downstream from the original location in 1992 and subsequently moving that site to the Sister's Farm location in 1993, of course, adds unwanted confounding effects to interpretation of the data.

2. Inconsistency in sampling methodology in follow-up sediment studies (1991-2008)

FMC changed its sampling methodology when transitioning from baseline (1988) to follow-up studies, utilizing a PVC core sampler in the former and sediment jars in the latter instance. After initiating follow-up studies in 1991, the company further altered its sampling techniques, as will be discussed below. This, of course, again confounds data analysis.

In 1994 (*FMC 1994 Annual Report: Appendix D*) the observation was made by FMC's consultant that sediment jars in previous years sometimes contained crayfish or minnows, which seemed to have stirred up the sediment in the jar, possibly allowing for re-suspension of the sediment and affecting the results. The solution, placing a mesh on the sediment jars, seems appropriate, but the necessity of doing so brings into question some or all of the sediment results from previous years. Also because of the change in sampling procedure, in 1994 sufficient sediment for total solids and total volatile solids analyses were not collected, requiring additional sediment jars to be put in place in subsequent years. These details of sampling methodology should be worked out beforehand, not during actual sampling.

Another variable that was not kept constant from year to year in the FMC sediment studies was the exposure window for the sediment jars. For example, in 1991 the jars (3 upstream at the Blackberry Lane site and 3 downstream at the Port Arthur site) were installed on May 30 and retrieved on July 2, giving an exposure window of 33 days. In 2000, the jars (4 upstream at the Blackberry Lane site and 4 downstream at the Sister's Farm site) were installed on June 12 and retrieved on August 29, giving an exposure window of 78 days, more than double that of the 1991 exposure window. Throughout the course of the study exposure windows varied from 22 days (2007) to 80 days (1999). It is unclear what such a wide variation might mean for the resultant data and its interpretation.

An additional unfortunate and unintentional change in sampling methodology took place in the 2007 sediment study. The sediment jars were removed from the downstream site at Sister's Farm on October 4, but when FMC's consultant went to the Blackberry Lane site later that day to remove the upstream jars, they could not be retrieved due to heavy rain and high water. The jars were eventually retrieved on October 15, eleven days after the downstream jars (*FMC 2007 Annual Report: Appendix C*). While FMC did not have control over stream conditions, it's important to point out that when either upstream or downstream sediment jars remain in situ for a longer period than the other, upstream-downstream comparisons become questionable. E.g. if there was a pulse of metals which came downriver between Oct. 4 and Oct. 15 from some non-mining-related source, the upstream sediment jars would have picked up that pulse while the downstream jars would not have. A better procedure would have been to have left the downstream jars in situ until Oct. 15.

3. Insufficient replication in follow-up sediment studies (1991-2008)

Coefficients of variation or other measures of sample variance were not determined by FMC for the upstream (Blackberry Lane) and downstream (Port Arthur and later Sister's Farm) sampling sites or for the sampling methodology utilized (sediment traps). Hence, it is not possible to know how many replicate samples would be needed at each site to conclude with any degree of statistical confidence that, within a given year, sediment composition at the upstream and downstream sites was either the same or that it differed. Instead, the company composited samples from the 3 or 4 upstream sediment jars into a single sample for analysis each year and did the same thing with the downstream jars.

The availability of only 1 composite sample/site/year (1991-2008) limited the ability to do statistical analyses and draw meaningful conclusions regarding potential changes in sediment composition. This is especially true for any given year's data. While it was possible, using data gathered over a number of years, to make statistical inferences concerning metal concentrations in sediment, without in-year replication, this is not possible for any given year. E.g. in 1993 the copper concentration in sediment collected upstream (at the Blackberry Lane site) appeared to be slightly higher than in the downstream (Sister's Farm) sample (7.0 mg/kg vs. 6.7 mg/kg.) But in 1994 those differences had reversed themselves (5.8 mg/kg vs. 7.1 mg/kg.) The change in copper levels is noteworthy; but without replication we can't know anything about the statistical significance of that difference. In other words, without in-year replication, we have to wait for a number of years' data to make statistical inferences about the differences observed. An important goal of monitoring is to provide current information about the status of an ecosystem, so management decisions can be made in a timely fashion, based on reliable statistical analyses. As it is, without in-year replication, these decisions require waiting for multi-year sampling results which only allow statements such as "Yes, there *was* a difference in parameter X between sampling sites," rather than, "Yes there *is* a difference in parameter X between sampling sites."

Additional in-year replication will naturally also increase the reliability of statistical inferences when comparing data over a number of years.

RESULTS

Keeping in mind the caveats mentioned above regarding sampling issues which detract from the reliability of the data, Figures 1-7 below show upstream and downstream concentrations of sediment metals over time. Vertical lines at 1993 and 1997 indicate the period of active mining.

The appropriate use of data-points below analytical detection limit in statistical analyses is controversial, so for those analyses which sometimes provided values below detection limits, neither figures nor statistical analyses are shown (arsenic, cadmium, sulfur, mercury, silver and selenium.)

When examining Figures 1-7, several factors should be borne in mind:

1. 1988, 1991 and 1992 data points were not included in the graphs because of sampling methodology differences in 1988 (sediment samples were collected in 1988 using a PVC core sampler, from 1991 on using sediment traps), and sampling site issues (downstream sediments were collected in 1988, 1991 and 1992 at Port Arthur, from 1993 on at the Sister's Farm site.)

2. The Flambeau River experienced a 100-year flood in mid-September 1994 due to excessive precipitation events. This resulted in a breach of the Ladysmith Dam, roughly 3 miles upstream of the Blackberry Lane sediment sampling site. In addition,

surface water runoff at the mine site flooded the bottom of the open pit, was subsequently routed to an on-site wastewater treatment plant and from there discharged into the Flambeau River. The 1994 sediment study was completed before the flood occurred (jars were retrieved on August 9, 1994) and therefore was not impacted by the event.

3. Blackberry Lane (upstream) and Sister's Farm (downstream) sediments were sampled three times in 2007 (August, October and November) to correlate with a three-phase work project on the North Dairyland Dam on the Flambeau River. This dam is located roughly 4.5 miles upstream of the Ladysmith Dam and 7.5 miles upstream of the Blackberry Lane sediment sampling site. FMC was apparently concerned that the renovation project might mobilize metals in the sediment of the Dairyland Flowage (Lake Flambeau), thereby confounding the results of the company's Flambeau Mine sediment study. During the August 2007 sampling event, sediment jars at Blackberry Lane became exposed due to low river levels. Because the August sediment metal values appear to be outliers, data used in the following figures and statistical analyses for 2007 are an average of the October and November values.

4. Starting in 2007, sediment was tested only for copper, iron, manganese and zinc.

Fig. 1: Flambeau River Sediment Aluminum, mg/kg

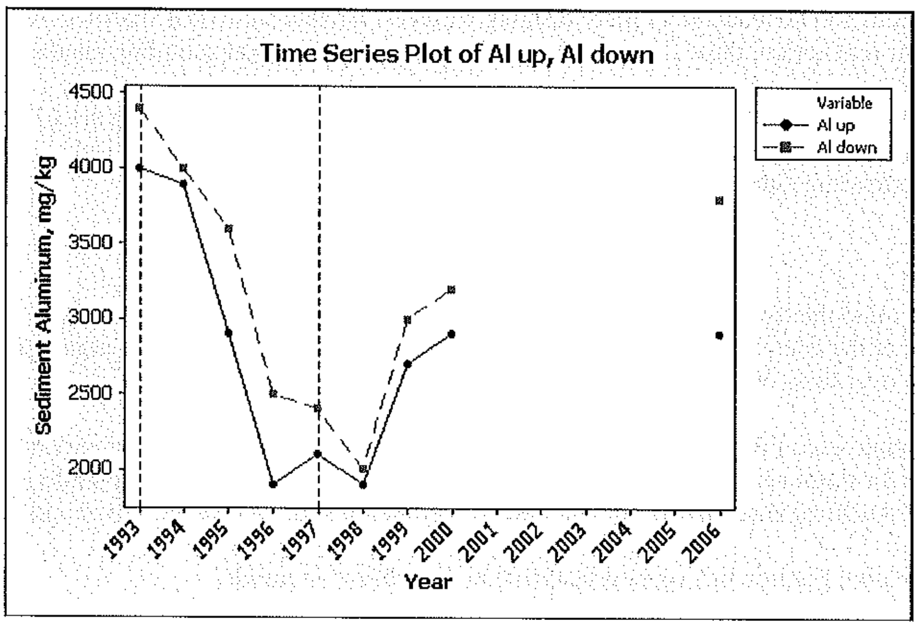


Fig. 2: Flambeau River Sediment Chromium, mg/kg

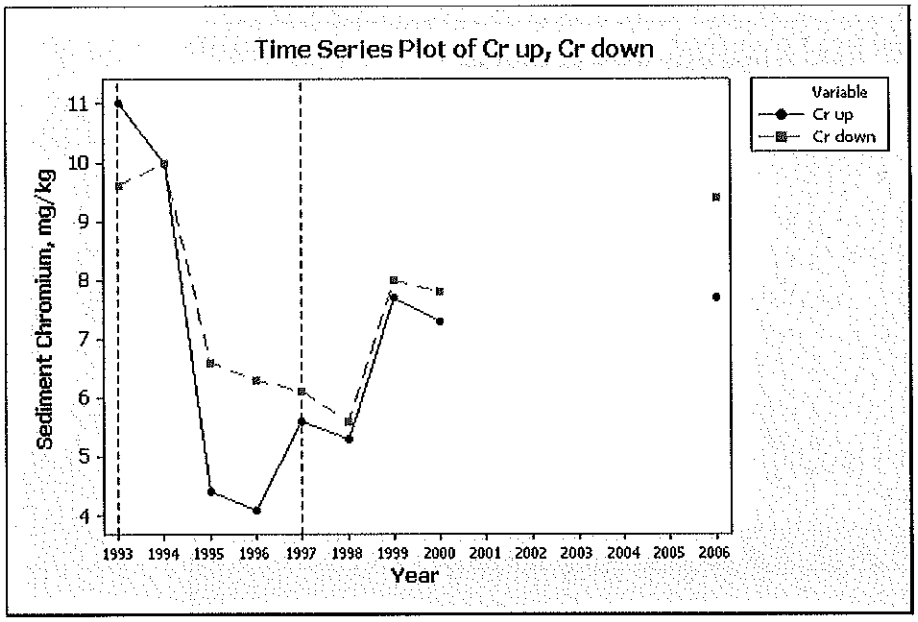


Fig. 3: Flambeau River Sediment Copper, mg/kg

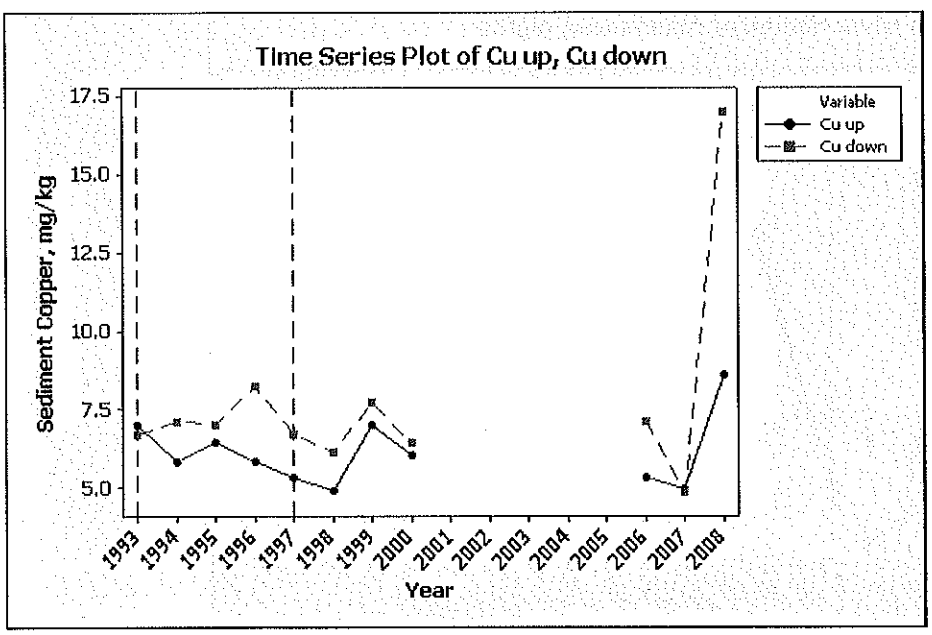


Fig. 4: Flambeau River Sediment Iron, mg/kg

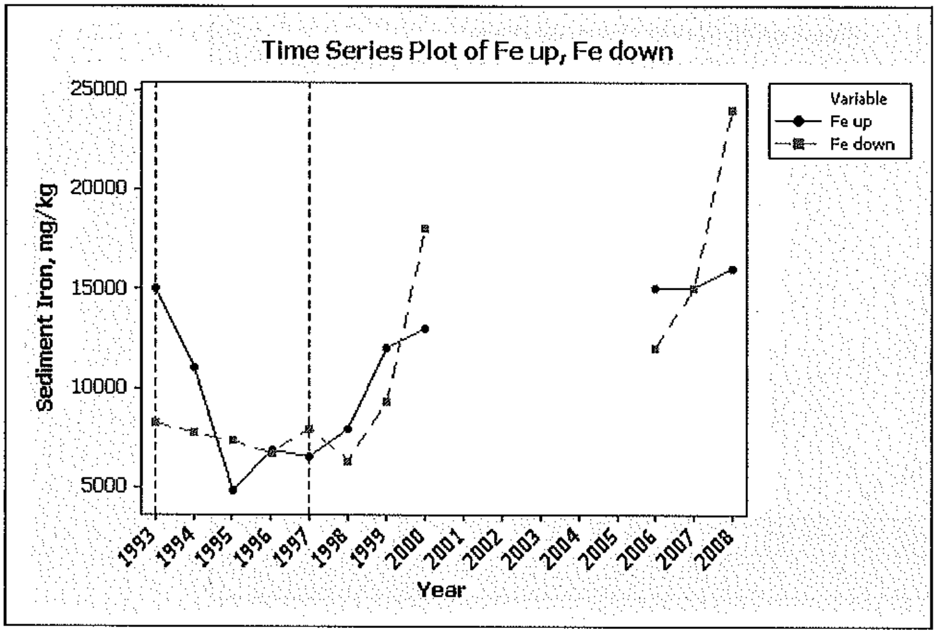


Fig. 5: Flambeau River Sediment Manganese, mg/kg

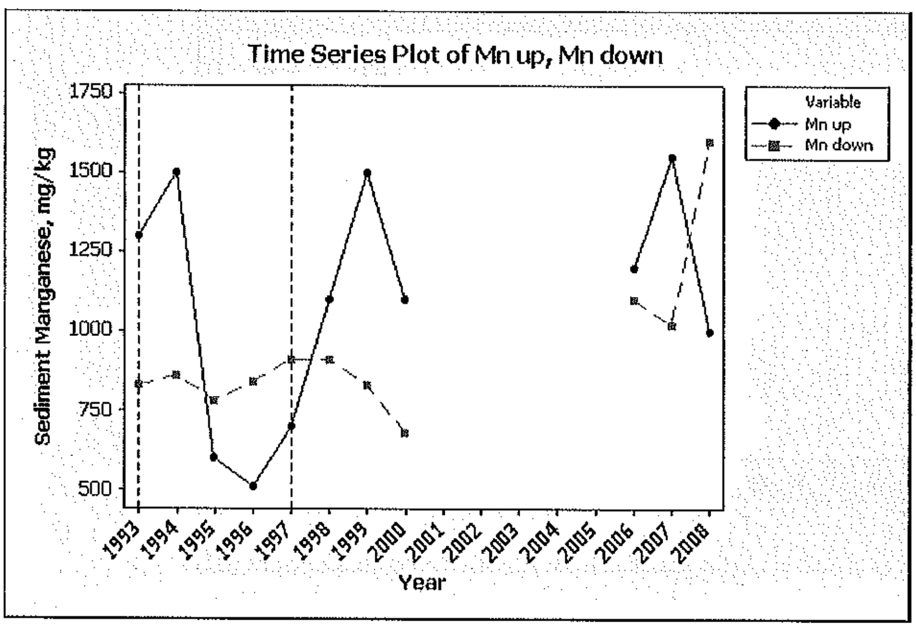


Fig. 6: Flambeau River Sediment Nickel, mg/kg

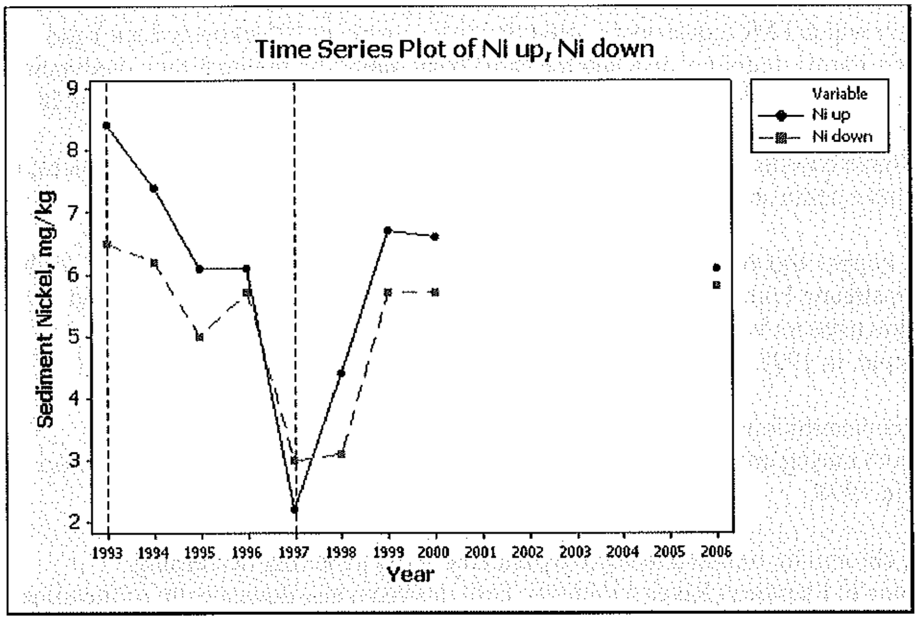
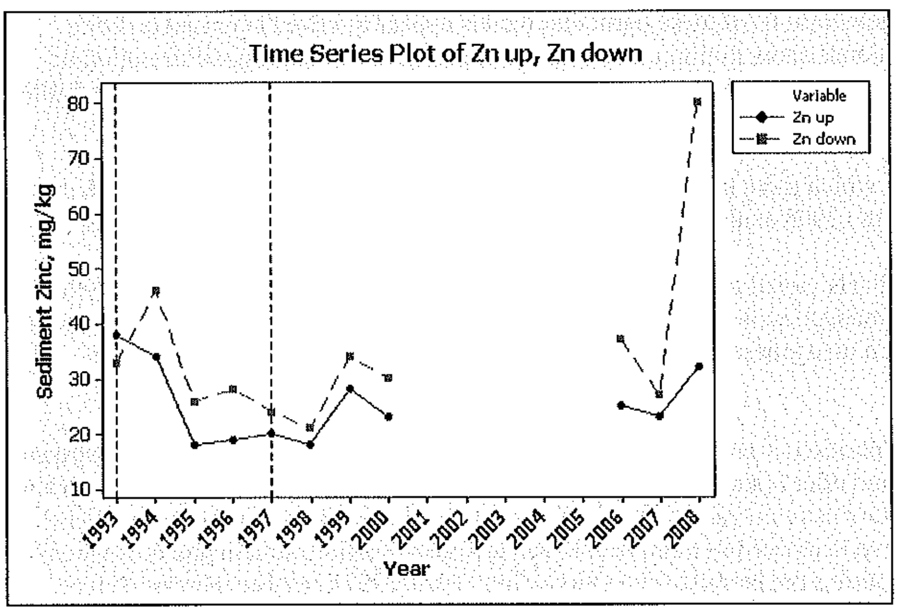


Fig. 7: Flambeau River Sediment Zinc, mg/kg



DISCUSSION OF RESULTS

The following discussion focuses on study results reported between 1993 and 2008, since these are the years in which FMC consistently used the same upstream (Blackberry Lane) and downstream (Sister's Farm) sampling sites and the same basic sampling methodology (sediment traps). While it would be preferable to have baseline data included in the present discussion, it simply does not exist for the Sister's Farm sampling site.

Lacking reliable baseline data on which to make stronger, statistically-based inferences, it is still possible to make some comments on the results shown in Figures 1-7.

1. Chromium, copper and zinc concentrations were almost always higher downstream of the mine than upstream, both during and after operation of the mine. The only sample in which the downstream values are below upstream values for these metals is the first reliable sample, in 1993, at the beginning of ore production.

2. Aluminum concentrations were always higher downstream of the mine site than upstream, both during and after operation of the mine, even at the very beginning of ore production in 1993.

3. Aluminum, chromium, iron and to some extent zinc show generally decreasing concentrations in Flambeau River sediments, both upstream and downstream of the mine, during the period of mine operation (1993-1997.) Visual inspection of the data also suggests that the 100-year flood of the Flambeau River in September 1994 (after the 1994 sediment study had already been completed) did not result in higher levels of these metals being measured at either of the two sediment sampling sites in the river. If anything, sediment concentrations of these particular metals appear to have decreased in 1995. Most of the metals show minimum or near-minimum levels at the time of cessation of mining activities, and appear to be on the increase since 1998 (the mine pit was backfilled in 1997).

4. For years for which there is data, copper concentrations were generally stable, with the exception of the 2008 analysis, which showed a spike in downstream copper levels.

5. Manganese levels varied greatly, especially at the upstream sampling site. Since 1998, downstream manganese levels have always been lower then upstream levels, but a spike in downstream manganese levels occurred in 2008 while upstream levels showed a decline.

6. Nickel concentrations were almost always higher upstream of the mine than downstream, both during and after operation of the mine. The only sample in which the upstream value is below the downstream value is the 1997 sample, at the end of ore production. Nickel appears to have decreased in Flambeau River sediments, both upstream and downstream of the mine, during the period of mine operation (1993-1997), but has increased since, with some evidence of subsequently leveling off.

7. Trends in zinc sediment concentrations very closely mimic trends in copper concentrations in the sediments, including a spike in downstream zinc levels in 2008.

8. Sediment samples collected upstream and downstream of the mine site during the second and third phases of the North Dairyland Dam renovation project in 2007 showed levels of copper, iron, manganese and zinc fairly consistent with levels measured in previous years (as explained earlier, data collected during the first phase of the renovation project was excluded from consideration because the sediment jars became exposed due to low water levels in the river). The 2007 study results suggest that the North Dairyland Dam project had no immediate impact on FMC's monitoring program.

While the visual observations noted above are of interest, it is important, from a scientific viewpoint, to ascertain whether or not those observations would hold up under the scrutiny of statistical analysis. Due to limitations imposed by FMC's study design (most notably, lack of replication within any given year), some, but not all of the above observations can be put to such a test.

An example of FMC data that cannot be confirmed by statistical analysis is the downstream vs. upstream levels of chromium, copper and zinc measured in sediment samples in 1993. It would be helpful to know whether or not the levels measured in the single composite downstream sediment sample were in fact lower than the levels measured in the composite upstream sample, as suggested in Figures 2, 3 and 7. Whether or not these downstream values are significantly below the upstream values cannot, of course, be determined because of the lack of sample replication at each site. To further illustrate this point, I refer you to Figure 7 in the Walleye report. Only when a sufficient number of replicate samples are collected within a given year (as FMC did when determining mercury levels in walleye fillets) can 95% confidence intervals be established for that year's data. Only then is it possible to determine whether downstream and upstream values overlap, or if they are indeed distinct.

A second issue regarding the evaluation of FMC's data is that there is no reliable background data on sediment metal concentrations. Therefore, it is not possible to compare pre-mining with mining or post-mining levels, a critically important if not the primary purpose of the monitoring. However, it is possible using statistical analyses such as those shown in Table 3 below to at least test for differences in these concentrations over time, and between upstream and downstream sites, starting with the 1993 data set.

Table 3. Results of Two-Way ANOVA and Mann-Whitney- U analyses of sediment metal concentrations, using available data for 1993-2008

Metal	ANOVA Significance 1993-2008 data**	Mean or median concentration, mg/kg	Mann-Whitney – U test on site difference, Significance at C.I. 95%
Aluminum (1993-2006)	Year p <0 .001 Site p = 0.002	mean Up = 2800 mean Down = 3211	N.A.
Chromium (1993-2006)	Year p = 0.001 Site p = 0.11	mean Up = 7.0 mean Down = 7.7	N.A.
Copper*	Year p = 0.003 Site p = 0.002	median Up = 5.8 median Down = 7.0	p = 0.05
Iron	Year p = 0.01 Site p = 0.97	mean Up = 11,180 mean Down = 11,130	N.A.
Manganese	Year p = 0.45 Site p = 0.26	mean Up = 1096 mean Down = 942	N.A.
Nickel* (1993-2006)	Year p < 0.001 Site p = 0.001	median Up = 6.1 median Down = 5.7	p = 0.11
Zinc*	Year p = 0.002 Site p = 0.001	median Up = 23.0 median Down = 30.0	p = 0.06

*Minitab-15 flagged copper, nickel, and zinc data as non-normal at p = 0.05; in these cases ANOVA analyses were done after Johnson Transformation; results of Mann-Whitney-U nonparametric tests for these metals are also shown in the right-hand column.
**For the year 1993, the Flambeau River was sampled at both the Port Arthur and Sister's Farm downstream sites. ANOVA analyses used data for the Sister's Farm site.

In terms of changes over time (1993-2008), Table 3 indicates that at a significance level of p< .05, all the metals except manganese show significant changes.

ANOVA analyses indicate that significant site differences existed for aluminum, copper, nickel and zinc. Median or mean values of all but nickel were higher downstream than upstream, while nickel was higher upstream than downstream, using transformed data when necessary. These statistical analyses corroborate the comments made above based on visual observation of Figures 1-7.

Mann-Whitney-U nonparametric tests for those data suggested to be non-normal verified the downstream/upstream differences at a significance of p = .05 for copper, and also suggest differences at or near p = 0.10 for nickel and zinc. Given the lack of reliable baseline data, an important question that cannot be answered, however, is how the upstream (Blackberry Lane) and downstream (Sister's Farm) metal concentrations compared *before* any mining activities (including pre-production stripping of the surface) took place.

The 2008 downstream copper sample (17 mg/kg) is flagged by Minitab-15 as an outlier. Analyses were repeated having removed the 2008 data. By removing the 2008 data, the copper data were considered normal and it was possible to do a two-way ANOVA analysis on untransformed data. Neither year (p = 0.66) nor site (p= 0.47) were considered significant after removing the 2008 values. Without the 2008 values, median copper concentrations were 6.85 mg/kg downstream and 5.80 mg/kg upstream (means 6.79 mg/kg and 5.85 mg/kg, respectively).

Sediment copper concentrations appear to be higher downstream than upstream (whether statistically significant or not depends on whether the 2008 downstream data-point is left in or removed as an outlier.) In addition whole-body crayfish copper concentrations and walleye liver copper concentrations were found to be significantly higher downstream than upstream, suggesting a possible mine effect (see Crayfish and Walleye Reports.) Continued monitoring of the river sediments and its biota are necessary to determine if the 2008 sediment copper sample is an outlier or not, and whether the trend of somewhat higher downstream copper concentrations in sediment continues. Additional replications for each year's sediment analyses would also help very much in clarifying whether the within-year sediment copper differences upstream vs. downstream are in fact significant or not.

In its 2006 sediment report (*Flambeau River Sediment Memorandum, FMC 2006 Annual Report*) FMC's consultants state that... "Data from the years of sediment analysis indicate that, in general, no increase or decrease in parameter concentration in sediments is occurring. Moreover, downstream samples continue to compare favorably with upstream sediment samples indicating no impacts due to mine activities during the closure time window."

Because of lack of baseline information, and the sampling issues mentioned above (most importantly, lack of within-site replication), and also when considering the results of statistical analyses in Table 3, which show in some cases significantly higher downstream than upstream metal concentrations in sediment, the statement from the 2006 sediment report that there is "no increase or decrease in parameter concentration in sediments...[and that] downstream samples continue to compare favorably with upstream sediment samples" is questionable. It is also certainly not possible, especially given the limitations of the monitoring outlined above, to state with any reasonable certainty whether there has or has not been impacts due to mine activities.

RESULTS FOR STREAM C SAMPLING

Table 4 shows the results of analyses for several metals in sediment samples collected in 2008 at two different locations in intermittent Stream C (Sites SC-1 and SC-2). This one-time sampling event also included sediment testing at a new location in the Flambeau River (Site S-4, in the vicinity of the Stream C outfall). In addition, the traditional sediment sampling sites in the Flambeau River at Blackberry Lane (Site S-1) and Sister's Farm (Site S-3) were tested. All of these sampling locations are shown in the map found in Appendix III.

FMC was asked to expand its sediment monitoring in 2008 to include the SC-1, SC-2 and S-4 sampling sites because of some evidence Stream C could be carrying potentially toxic levels of some substances into the Flambeau River. Site SC-1 is in the bed of intermittent Stream C, downstream from the overflow of the mine's 0.9-acre biofilter/detention basin and at the approximate boundary of the mine site itself. Site SC-2 is not quite halfway along that streambed toward its mouth at the Flambeau River, and Site S-4 is in the Flambeau River, close to the mouth of Stream C. The exact location of Site S-4, however, is uncertain. FMC's consultants describe it as being "below the mouth of Stream C but above the mouth of Meadowbrook Creek," (*Stipulation Monitoring Results, Flambeau Mining Company, December 30, 2008*). But on the map provided in the same report it appears to be *above* the mouth of Stream C (See Appendix III for map). For purposes of discussion, it is assumed that the former is correct. We turn to FMC for clarification of this, however, because these different locations are important in teasing out the potential impact of Stream C on the Flambeau's sediments.

Table 4: Metal concentrations in sediments of intermittent Stream C and the Flambeau River, sampled in 2008, all mg/kg [1]

Metal	Metal Concentration in Sediment, July 2008 (mg/kg)				
	Stream C		Flambeau River		
	Site SC-1	Site SC-2	Site S-1 (Blackberry Lane)	Site S-3 (Sister's Farm)	Site S-4 (Close to Stream C Outfall)
Copper	180	7.2	8.6	17	24
Iron	20,000	8,400	16,000	24,000	22,000
Manganese	490	150	1,000	1,600	1,200
Zinc	330	27	32	80	81

1. Source: *Stipulation Monitoring Results – Flambeau Mining Company, December 30, 2008.*

While it is very difficult to draw conclusions from one year's sampling without replication, sediments at the SC-1 site in Stream C do show very high copper concentrations compared with those found in Flambeau River sediments at any other time or place in the FMC study. The next highest value encountered (prior to 2008) was 24 mg/kg, at the downstream (Port Arthur) sampling site in 1992. As mentioned above, median copper concentrations upstream (Blackberry Lane) or downstream (Sister's Farm) of the mine site for the 1993 - 2008 sampling regime were less than 10 mg/kg. The reported value of 330 mg/kg for zinc at Site SC-1 in Stream C is also notably higher than those found at the Flambeau River sampling sites, the next highest (prior to 2008) having been measured in 1992 as 79 mg/kg at the downstream (Port Arthur) site. Iron and manganese concentrations encountered in the sediments of Stream C do not exceed those encountered in the river. The unusually high copper and zinc sediment concentrations in the bed of intermittent Stream C suggest sampling at these sites, as possible avenues of entrance of metals into the Flambeau River, would have been useful before and throughout the history of the mining activity.

Metal levels measured at the new Flambeau River sediment sampling site (S-4) are also of interest. The reported copper level of 24 mg/kg and zinc level of 81 mg/kg are among the highest encountered by FMC in the bed of the Flambeau River during the entire study period (1991-2008). Only in 1992, when the company's consultant attributed the high metal levels measured at Port Arthur to erosional sedimentation of old Port Arthur Dam impoundment sediments, have copper and zinc levels been as high as those reported in 2008 at Site S-4 (S-4 is upstream of the Port Arthur sampling site). As in the case of the Stream C sediments, this suggests that sampling at the S-4 site in the river would have useful before and throughout the history of the mining activity.

RECOMMENDATIONS

Because some of the suggested improvements to FMC's Flambeau River sediment monitoring program that were mentioned earlier cannot be implemented retroactively but could be useful in the design of monitoring programs in the case of future mining activity, recommendations are listed in two different categories: (1) General recommendations, based on perceived shortcomings of monitoring in the present case, to improve the utility of similar monitoring programs undertaken by others in the future; and (2) Recommendations for how to continue and augment the present study to better track potential impacts of the Flambeau Mine on the associated ecosystem.

1) The FMC sediment study does not provide adequate baseline data to make any reasonable conclusions about the long-term effect of the Flambeau Mine on the sediment chemistry of the Flambeau River. Samples were taken in 1988, upstream and downstream from the mining site, but were done with a different sampling procedure (PVC cores) than used at later times (sediment traps.) In addition, the 1992 samples, supposedly "background" i.e. before mining began, were actually taken after the failure of erosion-control fences which might have introduced sediment into the river due to on-site pre-mining activity. Gathering useful background information about an ecosystem potentially impacted by human activities is critical to understanding whether those activities have or have not had an effect on that ecosystem. Changing sampling procedures (and sites, see below) greatly reduces our ability to make any inferences about the effect of that human activity on that ecosystem.

Recommendation for similar studies in the future: *Sampling protocol should specify that baseline studies be conducted using the same sampling methodology employed in follow-up studies. In addition, baseline studies must be completed before any significant pre-mining activity such as pre-production stripping takes place.*

2) In addition to changing sampling procedures from the 1988 to later samples, exposure windows for the sediment jars were not held constant from year to year. Slight changes were also made to the sediment jar procedure between 1994 and subsequent years, to keep larger organisms from disturbing the collected sediments. The admission of the presence of some of these organisms in earlier samples reduces the reliability of those samples, and once again a change in procedure is made "mid-stream" as it were in the sampling period.

Recommendation for similar studies in the future: *Sampling methodology should be thought out ahead of time and remain, as much as humanly possible, unchanged during the sampling regime.*

3) The FMC sediment study provided inadequate replication to make inferences with any reasonable degree of confidence visavis possible mining effects on the sediments of the Flambeau River. As pointed out in the "Sampling & Reporting Issues" section of this report, replicate rather than composite samples would greatly improve the procedure.

Recommendation for similar studies in the future: *Early on in background sampling, enough replicate samples (I suggest at least five) should be taken to provide a reasonable estimate of variance in metal concentrations at each site. The metal/site combination with highest variance should be used in a power calculation to provide the number of replicates necessary to demonstrate a significant difference, if it exists, at a chosen level of confidence, say 90% or 95%. That number of replicates should then be taken at each sample site for each year and metal sampled. If this procedure is followed, inferences about the presence or absence of significant differences between sample sites will be greatly strengthened.*

4) FMC changed its upstream and downstream sediment sampling sites in the Flambeau River when transitioning from baseline (1988) to follow-up (1991-2008) studies. In addition, the downstream sampling site established in 1991 at Port Arthur was changed twice during the period of follow-up sampling. Between 1991 and 1992, the Port Arthur site was moved approximately 120 feet downstream, and starting in 1994 was moved about 9500 feet upstream, to the Sister's Farm site. This unfortunately confounds the ability to make comparisons of year-to-year results.

A separate but related issue regarding sampling site location was the belated addition of Site S-4 to the sampling regime. Site S-4 is located in the Flambeau River, immediately below the Stream C outfall. Despite the fact that Stream C was and is being utilized as a drainage-way from the mine site to the Flambeau River, Site S-4 was not tested until 2008, eleven years after the cessation of mining activities. Additional information related to Stream C is included in Point # 6 below.

Recommendation for similar studies in the future: *More thought should be put into carefully choosing sampling sites BEFORE the annual sampling regime is begun. Once those sites are chosen, sampling protocol should specify that the same sampling locations be utilized for the duration of the study (baseline and follow-up).*

5) When FMC moved its downstream sediment sampling site from Port Arthur to the Sister's Farm site in 1994, the collection sites for macroinvertebrates and crayfish were not moved to the same location, despite the fact that the monitoring plan referenced in the Flambeau Mine Permit specified that the downstream monitoring site was to "*coincide* with the sediment sampling location near the old Port Arthur Dam"[3] (emphasis added).

Crayfish body copper concentrations were found to be significantly greater downstream than upstream of the Flambeau Mine site (see Crayfish Report), and several macroinvertebrate species appear to have declined (see Macroinvertebrate Report). But having different sampling sites for sediment chemistry and the crayfish and macroinvertebrate communities themselves makes it difficult to draw inferences about the organismal copper concentrations. The sediment microhabitat is an environmental matrix whose chemistry and potential toxicity have a profound influence on these organisms. Events, whether anthropogenic or natural, affecting the sediment chemistry and mineral dynamics, can occur at one location while not at another. The sediments are a notoriously heterogeneous matrix, even at relatively small scales. It is therefore difficult to make reasonable inferences about putative effects of mining activities on the macroinvertebrate and crayfish communities when the sediment metal concentrations are not being monitored in situ, but at a site distant from where the organisms are collected.

Recommendation to augment FMC's sediment monitoring program: *In my Macroinvertebrate Report a recommendation is made for an additional six to ten years of sampling, perhaps done every other year. In my Crayfish Report a recommendation is also made that monitoring continue on a regular basis for at least 10 years. The historic downstream sampling site for macroinvertebrates and crayfish coincides with Site S-4 in the Flambeau River, where sediment was sampled as a one-time event in 2008. It is recommended that sediments at Site S-4 continue to be sampled in conjunction with the recommended macroinvertebrate and crayfish studies. Sediment sampling should also continue at Site S-1 (Blackberry Lane), which coincides with the upstream macroinvertebrate and crayfish sampling location, and Site S-3 at Sister's Farm.*

6) Stream C is an intermittent stream that drains the southeast corner of the Flambeau Mine site and receives overflow from a 0.9-acre biofilter/detention basin constructed by FMC in 1998. Stream C, classified as navigable, enters the Flambeau River about 0.3 mile downstream of the project area. Discussions indicated the possibility of water and sediments being carried through this intermittent stream, some possibly with high levels of potential toxins, into the Flambeau River. Consequently for 2008 FMC agreed to sample sediment within the bed of Stream C and in the Flambeau River, immediately below the mouth of this stream. Elevated levels of copper and zinc were detected. The belated testing of the sediment in a navigable stream used as a drainage-way from the mine site to the Flambeau River, as well as the belated testing of the sediment in the Flambeau River immediately below the stream's outfall, suggest that choice of sediment sampling sites for the entire period of monitoring was not as carefully done as one would expect.

Recommendation to augment FMC's sediment monitoring program: *Sediment sampling at Site S-4 in the Flambeau River, immediately below the Stream C outfall, should continue for at least ten years. This sampling should be coordinated with sediment testing at sites S-1 and S-3 and the macroinvertebrate and crayfish sampling indicated above. If significant changes are detected during the expanded monitoring period, an additional five years sampling beyond the ten years recommended should be required. These changes could be triggered statistically (the precautionary principle suggests using* $p = 0.10$*) by the monitoring results, or even if not exactly statistically significant, by apparent unexplained spikes in metal concentrations in the sediment.*

Additional sediment sampling within Stream C could also provide useful information, especially should relatively high sediment metal concentrations be encountered within the river during the extended sediment sampling period.

7) The measured level of metal concentrations in biota and sediments during monitoring are to an important degree affected by surface water metal concentrations. The interplay of sediment and surface water toxins on the biotic community is complex and differs for particular metals, species, and ecotypes. In case continued monitoring of the biota and sediments discloses unforeseen changes in the community structure or metal concentrations, it would be useful in attempting to explain those changes to have as much information on hand as possible visavis all possible causal mechanisms. It would therefore be amiss to not continue surface water monitoring of the Flambeau River.

Recommendation to augment FMC's sediment monitoring program: *Surface water monitoring of the Flambeau River should continue for as long as sediment studies are being conducted in the river (at least ten years), drawing on water quality data collected as part of the expanded monitoring programs recommended for macroinvertebrates, crayfish and walleye (see other reports). Additional surface water sampling should be undertaken co-located temporally and spatially with sediment monitoring if significant increases in sediment metal concentrations (statistically significant at* $p = 0.10$ *or notable spikes which may or may not result in statistical significance) are observed.*

CONCLUSIONS

Inadequate baseline data and sample replication, combined with changing sampling procedures make it very difficult to draw any conclusions regarding the presence or absence of a mining-related effect on the sediment of the Flambeau River. The combined observation of statistically significant increased copper concentrations in crayfish (whole-body specimens), walleye (liver tissue) and sediment (when 2008 downstream copper measurements are included) downstream from the mine site raises the possibility of a causal relationship. Unusually high copper and zinc concentrations in a sampling site within the bed of intermittent Stream C indicate a possible entrance-point for some potential toxins into the Flambeau River. In hindsight, having additional historic data from Stream C and the Flambeau River would prove very useful.

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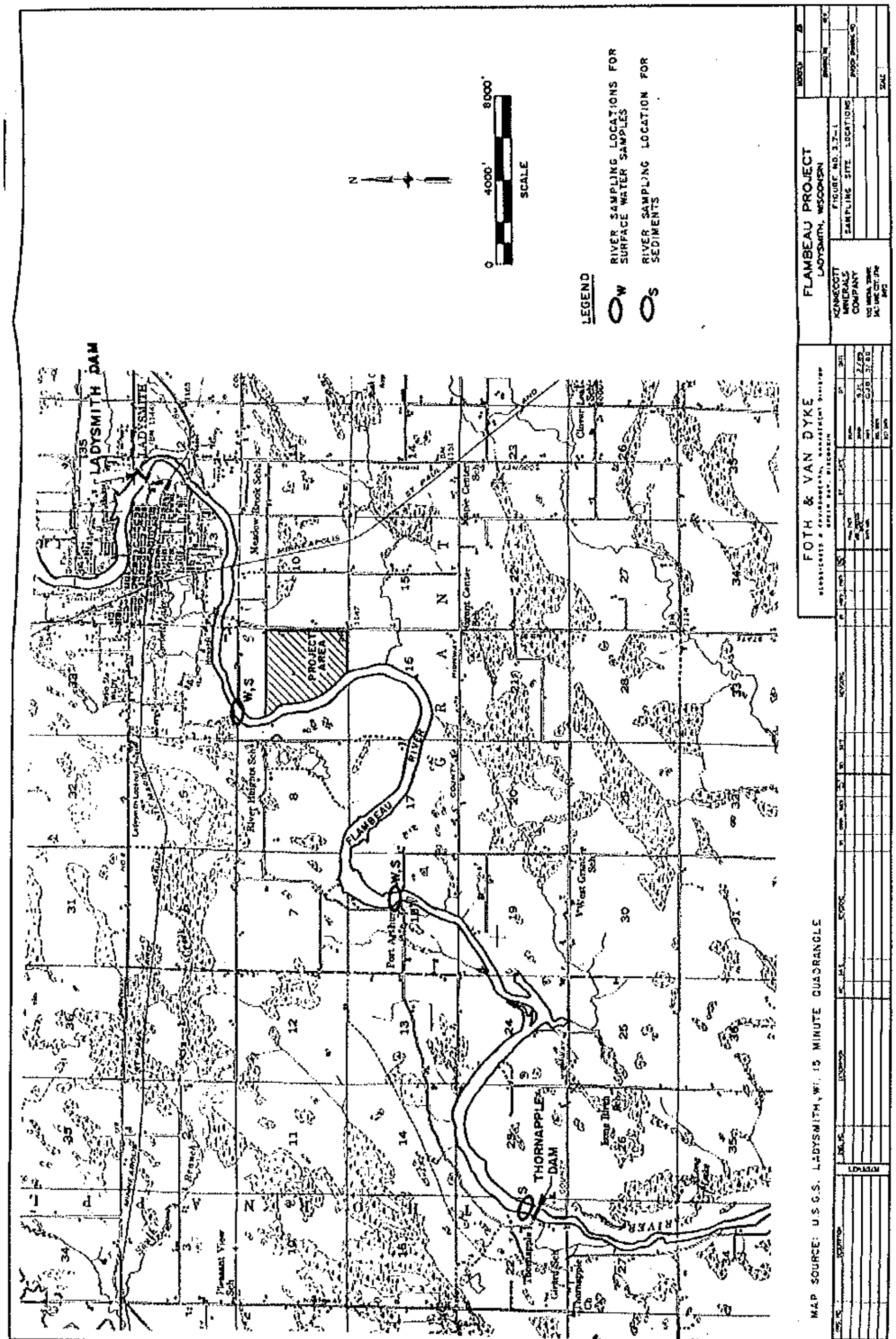
1. *J. Am. Med. Assoc.* (1938) 110: 651
2. *Annals Human Biol.* (2003) 30(5): 563
3. *Updated Monitoring Plan for the Flambeau Project* (1991)

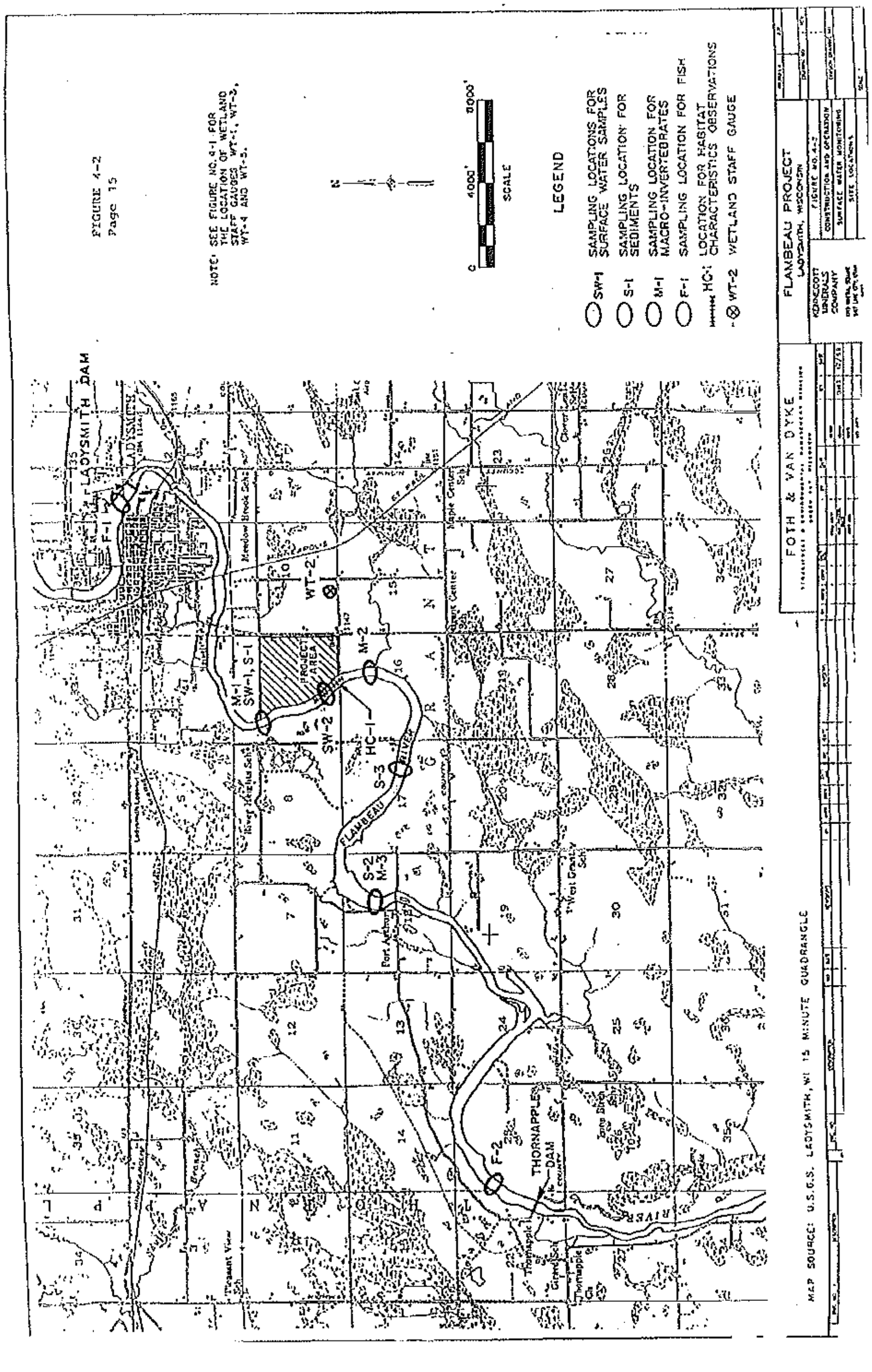
Appendix I

Flambeau River Sediment and Surface Water Sampling Sites used in Baseline Studies (1988)
(Source: *Volume 2: Environmental Impact Report for the Kennecott Flambeau Project, 1989*)



Appendix II

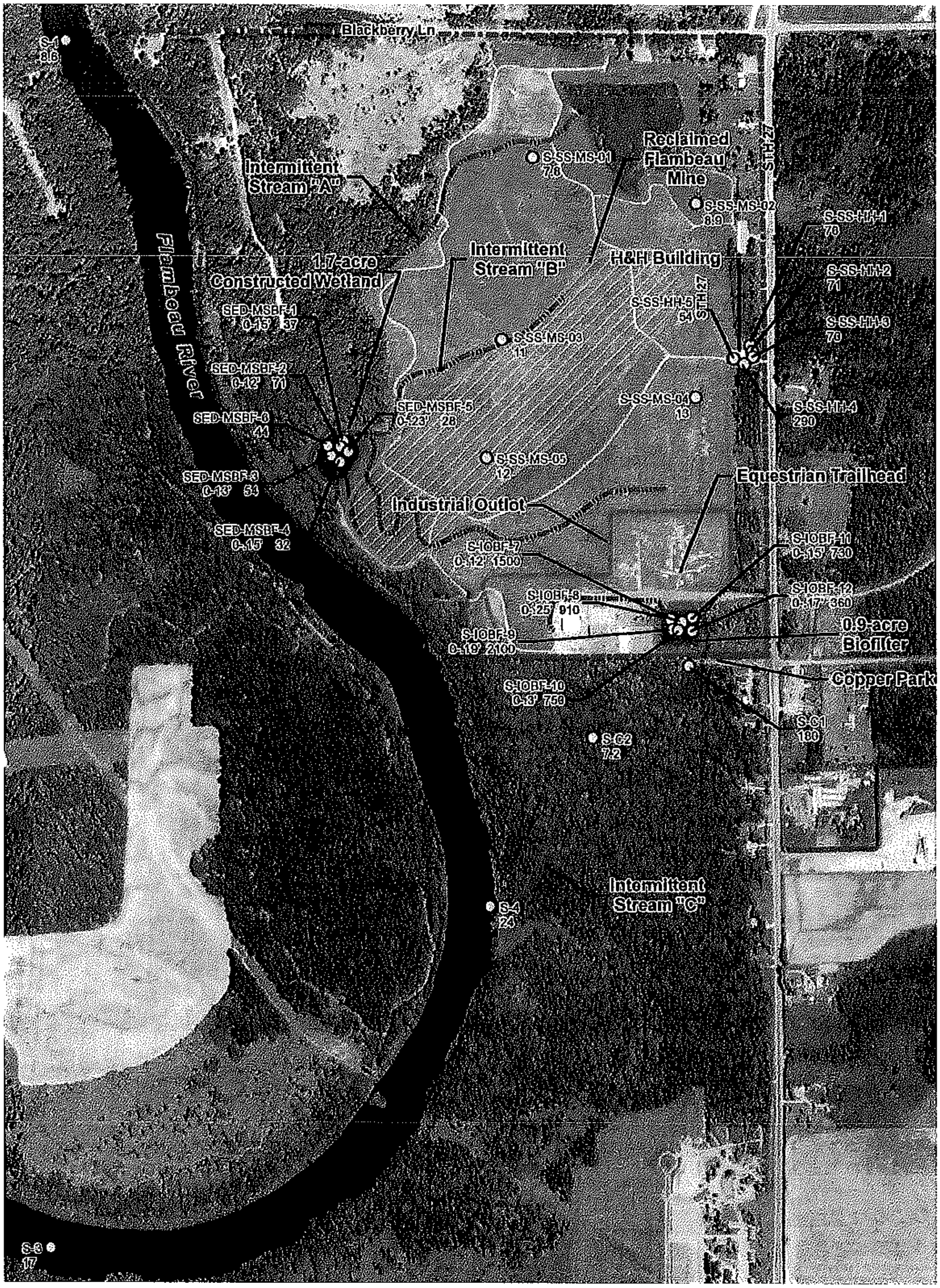
Flambeau River Surface Water, Sediment and Biota Sampling Sites Used at One Time or Another between 1991 and 2007 (Source: *Flambeau Mining Company 1993 Annual Report*)



Appendix III

Soil and Sediment Sampling Sites (2008)

(Source: *Stipulation Monitoring Results, Flambeau Mining Company, December 30, 2008*)



Flambeau River Monitoring
at the Flambeau Mine
Rusk County, Wisconsin

2. MACROINVERTEBRATES --
Analysis, Comments and
Recommendations

prepared for
Wisconsin Resources Protection Council

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INTRODUCTION

Biodiversity is considered an important ecosystem parameter. A number of agencies administer and monitor regulations concerning biodiversity. The goal of these efforts is to protect endangered or threatened species (see below), and when possible to maintain the overall biodiversity of our natural communities. One measure of biodiversity, the simplest and most intuitive, is how many species are present in that community. In most cases determining the actual number present is not an easy thing, but using appropriate sampling protocols it is possible if sampling efforts are identical between sites and across years, to at least look for trends in biodiversity. In rivers, these biotic communities can be affected by the temperature of the water, the amount of oxygen in the water or sediments, the presence of predators or toxic substances in the water or sediments, occasional flooding events ("spates") which scour the substrate and carry downstream those individuals unable to hold on or bury themselves, and various other factors.

The bottom sediments of lakes, streams and ponds are inhabited by a complex community of organisms without backbones called macroinvertebrates. While immature stages of insects are the most commonly encountered taxa and individuals, macroinvertebrates include many other kinds of organisms, such as oligochaetes (aquatic relatives of earthworms), flatworms, leeches, clams, etc. These are all the larger members of that community, and do not include the smaller bacteria, protozoa, or rotifers, the microinvertebrates. While lakes and ponds usually contain a complex planktonic (floating or swimming) community, rivers (e.g. the Flambeau River in northern Wisconsin) do not, because these organisms by and large cannot maintain their location by swimming against the currents. A small planktonic macroinvertebrate community may be found in backwaters or bays which do not have such currents, but none would be expected in reaches of the Flambeau River considered in the present report.

Potentially toxic materials in the surface water or sediment of rivers, whether natural or anthropogenic, not only affect the macroinvertebrate population, but since many of these species are food for organisms higher on the trophic pyramid, by bioaccumulating these potential toxins the macroinvertebrates directly affect species perhaps of more interest to humans, such as the fish community, or other vertebrates such as birds which prey on the invertebrates.

Because of the importance of macroinvertebrates to the riverine community, and because macroinvertebrate sampling is one way to measure human impacts on the river, industries located along riverways are sometimes required to conduct macroinvertebrate surveys. Such was the case with Flambeau Mining Company (FMC), a subsidiary of Kennecott Minerals of Salt Lake City, Utah that constructed an open pit copper sulfide mine alongside the Flambeau River in the mid 1990s. The river formed the western boundary of the project area, and the pit itself was constructed to within 150 feet of the river. The Flambeau Mine was operational for four years. It ceased production in 1997 and has since been reclaimed.

The macroinvertebrate sampling program instituted by FMC was part of a broader monitoring program designed to ascertain any effects the Flambeau Mine might have on the Flambeau River ecosystem, including surface water, sediment and aquatic life. These effects could occur during excavation of the mine, during its operation, and beyond the date of its operation if substances such as metals or other potential toxins or erosional runoff might be making their way through surface or groundwater into the river or its tributaries. While a spectrum of organic pollutants, or oxygen-depleting substances have been shown to affect river biotic communities, those anthropogenic impacts were not expected to affect the river from the Flambeau Mine. There has been concern, however, about possible effects from metals such as copper, zinc and manganese possibly making their way into the river. A large literature exists showing the sensitivity of either total macroinvertebrate diversity or individual macroinvertebrate taxa to metal concentration in sediments or water. [e.g. 1, 2, 3, 4, 5, 6, 7]

MACROINVERTEBRATE STUDY DESIGN UTILIZED BY FMC

FMC conducted baseline macroinvertebrate studies on the Flambeau River between 1987 and 1988. In 1991 the company launched an annual sampling regime that continued through 1998. Additional studies were conducted in 2004 and 2006. During this time period a number of activities took place at the Flambeau Mine site which had the potential to impact Flambeau River macroinvertebrates. These included:

1991-1993:	Pre-production stripping and preparation of the site for excavation
1993-1997:	Blasting and ore production
1997-2001:	Partial reclamation of the site (backfilling the pit, recontouring the surface, and revegetation)
2003+:	Sporadic and ongoing reclamation/remediation activities (e.g., removal of contaminated soils in the Industrial Outlot portion of the mine site)

Over the years at least six different sites on the Flambeau River were utilized by FMC at one time or another for macroinvertebrate surveys. Local landmarks associated with the sampling sites include Tiews Road, Blackberry Lane, the Flambeau Mine pit, Meadowbrook Creek and the site of the former Port Arthur Dam (the dam was removed in 1968), as described below and shown on the maps included in Appendices I and II:

1. Tiews Road (Site M-1 on the Appendix I map; about 1.8 miles upstream of the open pit site and 1.1 miles upstream of Blackberry Lane; sampled 1987-1988 only)
2. Blackberry Lane (Site M-2 on the Appendix I map and Site M-1 on the Appendix II map; about 0.7 mile upstream of the open pit site; sampled 1987-1988, 1991-1998, 2004 and 2006)
3. Flambeau Mine Pit (Site M-3 on the Appendix I map; sampled 1987-1988 only)
4. North of Meadowbrook Creek (Site M-5 on the Appendix I map and Site M-2 on the Appendix II map; actual sampling site is about 150 feet north of the mouth of Meadowbrook Creek and about 0.3 mile downstream of the project area; sampled 1987-1988, 1991-1998, 2004 and 2006)
5. South of Meadowbrook Creek (Site M-4 on the Appendix I map; actual sampling site is about 150 feet south of the mouth of Meadowbrook Creek and about 0.3 mile downstream of the project area; sampled 1987-1988 only)
6. Port Arthur (Site M-3 on the Appendix II map; about 3.1 miles downstream of the project area, in the vicinity of the former Port Arthur Dam; sampled 1991-1998, 2004 and 2006)

The predominant procedure used by consultants hired by the Flambeau Mining Company (FMC) to conduct macroinvertebrate surveys in the Flambeau River between 1991 and 2006 was kick-sampling, a standard limnological procedure used for sampling the bottom of rivers and streams for the macroinvertebrates found there. Additional methodologies employed by FMC at one time or another included Surber sampling, hand-picking, dip netting, dredge and drift net sampling, sweep netting and kick-seining. Specimens were preserved with formalin or alcohol and sent to the laboratory for identification and enumeration. As will be discussed below, sampling site locations and procedures were not always consistent from year to year.

SAMPLING & REPORTING ISSUES

Before presenting and analyzing the macroinvertebrate data reported by FMC between 1987 and 2006, it would be prudent to point out any perceived flaws in the study design implemented by FMC or inconsistencies in how data has been reported. This includes an examination of both baseline and follow-up studies. Following are the most significant issues of concern:

1. Inconsistency in sampling site locations when transitioning from baseline to follow-up studies

Changes in sampling site location, as well as changes in sampling methodology (discussed below) seriously detract from the usefulness of baseline data. In terms of the former, Flambeau Mining Company eliminated and/or changed the locations of some of its macroinvertebrate sampling sites when transitioning from baseline to follow-up studies. The 1987-1988 baseline studies utilized five different sampling sites on the Flambeau River, referred to as M-1, M-2, M-3, M-4 and M-5 in the 1989 *Environmental Impact Report* for the mine project (see Appendix I for a map showing site locations). Starting in 1991, however, only two of those sites, one upstream (Blackberry Lane) and one downstream (north of Meadowbrook Creek) of the mine site were utilized. In addition, a new macroinvertebrate sampling site was established at Port Arthur. See Table-1 for a side-by-side comparison of where the baseline sampling sites were located relative to the sites used in later years. The issue of concern is not the reduction in the number of sampling sites but that no baseline data exists for the Port Arthur site.

Besides eliminating and changing some of the sampling site locations when transitioning from baseline to follow-up studies, FMC also changed their code numbers. In particular, the sites labeled as M-1 (Tiews Road), M-2 (Blackberry Lane) and M-3 (Flambeau Mine Pit) in the company's 1987-88 baseline study are not the same as the sites referred to as M-1 (Blackberry Lane), M-2 (Meadowbrook Creek) and M-3 (Port Arthur) in later reports. So as to avoid confusion, I will hereafter refer to sampling sites by name (e.g., Blackberry Lane) rather than code number whenever possible.

Table 1. Codes for Flambeau Mine Macroinvertebrate Sampling Sites:

Sampling Location	Code utilized in FMC Baseline Surveys (1987-1988) (See Appendix I Map)	Code utilized in FMC Follow-Up Surveys (1991+) (See Appendix II Map)
Tiews Road (Approximately 9700 feet upstream from the open pit site[1])	M-1	Site not surveyed
Blackberry Lane (Approximately 3800 feet upstream from the open pit site[1] - at the end of Blackberry Lane [2])	M-2	M-1
Flambeau Mine Pit (Opposite the open pit site[1])	M-3	Site not surveyed
Meadowbrook Creek, North (Approximately 150 feet north of the mouth of Meadowbrook Creek[1] - immediately above the confluence of the Flambeau River with Meadowbrook Creek [2])	M-5	M-2
Meadowbrook Creek, South (Approximately 150 feet south of the mouth of Meadowbrook Creek[1])	M-4	Site not surveyed
Port Arthur (Site of the former Port Arthur Dam[2])	Site not surveyed	M-3

1. Location of sampling site, as described in *Environmental Impact Report for the Kennecott Flambeau Project V. II (Report Narrative)*, 1989, pp. 3.8-1 – 3.8-2.
2. Location of sampling site, as described in *2004 Macroinvertebrate Memorandum, Appendix D, FMC 2004 Annual Report*, p. D-1.

2. Inconsistency in sampling methodology when transitioning from baseline to follow-up macroinvertebrate studies

Macroinvertebrate sampling done in the Flambeau River from 1991 onward used a different sampling procedure than that used for baseline studies conducted in 1987-1988. This throws the baseline data into question as useful background information.

Collection techniques utilized in the 1987-1988 baseline studies included Surber sampling, handpicking and dip-netting. Semi-quantitative sampling was also undertaken, being a composite of three square-meter Surber samples from each location. FMC reported collecting some seventy-two taxa using these techniques. Relative abundances (abundant, common or rare) were also recorded. (As an aside, macroinvertebrate sampling was also conducted in the vicinity of the mine site in 1969 and 1973, when FMC first attempted to secure and was subsequently denied a mine permit. The results of these surveys were utilized in an April 1992 *Supplement to the Environmental Impact Statement* for the project that was eventually permitted. Some eighty different macroinvertebrate species were encountered in these surveys, which included not only the Surber sampling used in subsequent monitoring, but also dredge and drift-net sampling.)

Protocols adopted by FMC for macroinvertebrate sampling from 1991 onward differed from earlier surveys in that they primarily relied on Surber sampling and/or kick-seining. As the company states in its 1991 report, "It should be noted that previous studies included truly benthic analysis (substrate analysis), while collection techniques reported herein rely on the disturbance of substrates but not necessarily collecting and picking substrates. For this reason, species encountered may not be identical." Since sampling methods varied in sampling procedure and intensity up to the October 1991 sample, the earlier results cannot be used for the purposes of this report.

The first macroinvertebrate surveys using the sampling protocol adopted for subsequent years were conducted in late October 1991. Since the three sampling locations utilized from 1991 forward were standardized (and sampling techniques to a lesser extent), the 1991 data may be a more appropriate baseline to use for comparative purposes than the 1987-88 study. Utilizing this data as baseline, however, presents its own set of problems. Specifically, by the time the 1991 study was conducted in late October, nearly 90 acres of land had already been cleared of vegetation and topsoil during the pre-production stripping phase of the mine project. In addition, the company's erosion control system had washed out at three different control points in early September 1991 after a rainfall of 5.2 inches over several days. WDNR officials issued a report confirming that "water laden with fine sediments" had entered the Flambeau River after the erosion control system failed and that "existing sediment basins and bail dikes did not provide nearly enough retention time to settle out clay size particles." It is therefore possible that the mine project may have impacted the macroinvertebrate community of the river prior to the first round of sampling in 1991. In other words, even though the data was collected prior to the onset of actual ore production in 1993, substantial work had already been done at the mine site. For this reason I place quotation marks around the word "baseline" when referring to the 1991-1992 data sets in the present report.

3. Inconsistency in sampling methodology during follow-up macroinvertebrate studies

Besides inconsistencies in sampling methodology when transitioning from baseline to follow-up macroinvertebrate surveys, there were also inconsistencies from year to year in the follow-up surveys conducted by FMC between 1991 and 2006. For example, some sweep netting was utilized in limited areas along the shore between 1993 and 1996 but is not documented to have occurred in other years. Variations also existed in terms of the time window utilized for collection. For example, in 1993 in-stream sampling was conducted for a period of two hours with periods of kicking lasting about 12 minutes per effort. In 1994, in-stream sampling was conducted for a "minimum of one hour" with periods of kicking lasting "about five minutes per kick (longer if few organisms were observed to be collected)." The reports generated for 1991 and 1992 do not indicate the time windows utilized for sampling or kicking at all, while most other reports (with the exception of 1994 and 1995) indicate a sampling window of 2 hours. To assess long-term trends in macroinvertebrate populations, sampling methods must be the same from year to year. FMC, however, failed to do this, making interpretation of the resultant data difficult.

4. Insufficient spatial and temporal co-location of sampling sites

FMC's Flambeau River monitoring program included not only macroinvertebrate surveys, but collecting sediment, crayfish, walleye and surface water samples upstream and downstream of the mine site for metals analysis. The sampling sites utilized by FMC for these various studies were not all the same; whenever possible, they should be. When sites are not co-located, trends from individual sites may be due to differing confounding factors, which decreases the reliability of inferences visavis mining effects.

In 1991 and 1992, one of the downstream sampling sites utilized by FMC for macroinvertebrates and crayfish (M-3; Appendix II) was co-located with the Port Arthur downstream sampling site for sediments (S-2; Appendix II). This is appropriate, because sediment chemistry is likely to have an important effect on both macroinvertebrates and crayfish. But from 1993 on, the downstream sampling site for sediments was moved by FMC to the Sister's Farm site (S-3; Appendix II), about 1.6 miles upstream of the sampling site for macroinvertebrates and crayfish at Port Arthur. In addition, the downstream sampling site for surface water (SW-2; Appendix II) was about a quarter mile upstream of where macroinvertebrates and crayfish were sampled at Meadowbrook Creek (M-2; Appendix II). As a result of a negotiated agreement reached between opposing parties at a contested case hearing in 2007, a new surface water sampling site (SW-3; Appendix III) and sediment sampling site (S-4; Appendix IV), co-located with the macroinvertebrate sampling site above Meadowbrook Creek (M-2; Appendix II) were added to the study regime, but no such reference points exist for biological data collected prior to that time.

Temporal co-location (performing different types of sampling on the same day or being consistent from year to year in terms of when that sampling is performed) is also important to decrease the likelihood of potentially confounding factors occurring. FMC, however, sometimes failed to do this. For example, in 1994 crayfish were collected for analysis on August 8, the macroinvertebrate survey was conducted on October 3 and walleye were sampled on October 16-17. In addition, the dates for the annual macroinvertebrate survey ranged from mid-August (2004) to late October (1991).

5. Inconsistencies in Reporting Protocols

Reporting protocols utilized by FMC for macroinvertebrate data were not always consistent or transparent. The company's macroinvertebrate reports for 2004 and 2006 contained two data tables: Table 1, which contained results from the most recent survey; and Table 2, which was a compilation of results from the most recent survey alongside data from previous years. It appears that Table 1 is the rougher data as reported back from FMC's consultant, which is then interpreted and placed into Table 2 of each report. While this facilitates comparing results from one year to the next, inconsistencies in reporting were sometimes noted between the two tables. It was noticed, e.g. that no platyhelminthes, hydrocarina, hemiptera, hirudinae or isopoda data at all are in Table 1 for 2006, though for those taxa absences are recorded in Table 2. As it is, Table 1 makes it appear these taxa were not even looked for during the survey, even though they had been observed in previous years. There is also an inconsistency in this: Table 1 does have a row for Pelecypoda, though none were found in 2006.

There are also inconsistencies in the reporting of data within Table 2 itself. The table consists of three separate sections, one for each of the three sampling sites utilized for the collection of macroinvertebrate data (i.e. Blackberry Lane, Meadowbrook Creek and Port Arthur Dam). Yet, the same basic list of taxa and species is not utilized for reporting the presence (or absence) of species at each sample location. For example, the absence of *Helobdella stagnalis* and *Placobdella ornata* (two types of leeches) was noted in the Meadowbrook Creek and Port Arthur Dam sections of Table 2, but the Blackberry Lane section of the table had no row to record the presence (or absence) of any species within the hirudinae (leech) taxon.

When a taxon or particular species within a taxon is encountered in a previous sampling at any site, a row for recording the presence or absence of that species should appear in Table 1 and all three sections of Table 2 in all subsequent years. FMC's submissions, however, deviated from this common standard of practice. Interpretation of sampling results would be facilitated by consistency across sampling sites, i.e. listing the same taxa in all tables for all sites. These tables may change, naturally, as new taxa are encountered, but this kind of across-year and across-site consistency would be very helpful to insure that data is interpreted correctly.

Another concern regarding transparency in reporting of information is that FMC did not always include the complete assemblage of data in hard copy and electronic versions of documents that were supposedly identical (i.e., reports with the same title and from the same year). This became an issue, e.g., when for the 2006 macroinvertebrate sampling, Table 1 of the report was posted on the company's website, but Table 2, the compilation of data over years, was not. Table 2 was eventually made available to me scanned off a hard copy of the document.

6. Inconsistencies in Levels of Taxonomic Specificity Utilized for Reporting

Just as we have a taxonomy of our human relations – brother, sister, cousin, second cousin, uncle, aunt, etc. – biologists have created a taxonomy of organismal relationships. Members of the same species can, and do, interbreed. Species which are closely related to one another belong to the same genus. And so we climb up the taxonomic tree – species/genus/family/order/class/phylum/kingdom/domain. When measuring biodiversity in an ecosystem, or tracking the effect of natural or human disturbance on an ecosystem, biologists most commonly count the number of species of different organisms – frogs, insects, trees, birds, etc. Though there exist subspecies, races, and ecotypes, in many ways the species is the fundamental biological and taxonomic unit. So, in comparing two ecosystems or an ecosystem at different times, one common method is to record the number of species present – the *species* diversity.

It is very important when examining data for trend analyses or in comparing different sites that sampling and reporting methodology be unchanging and consistent. E.g. taxa should be identified to the same degree of specificity from year to year, whether family, genus or species. If this is not done, it is not possible to compare the number of taxa from year to year, since a number of different species might in some years be combined into a single genus. It is also not possible to do community similarity comparisons – an important biotic community descriptor -- across sites when different levels of taxonomic specificity are employed.

For whatever reason, this fundamental principle was not followed by FMC in the 2006 sampling year and/or data presentation, as demonstrated by the following examples listed below (Unless otherwise noted, reference in this section to macroinvertebrate data for 2006 is from Table 1 of the *2006 Macroinvertebrate Memorandum, Appendix D, FMC 2006 Annual Report.*):

a. Oligocheates in 2006 were not ID'd to genus, as previous years' were, but only to the order level, so for this taxon, the 2006 data cannot be used. This is especially problematic, because in previous years a total of ten different genera or families were encountered, in some years (e.g. 1993) up to four taxa. Consequently there is no way to infer actual number of total taxa for 2006.

b. Gastropods were only ID'd to family level in 2006. In previous years they were ID'd to genera. As with oligochaetes, this detracts from the overall usefulness of the data. In Table 2 of FMC's *2006 Macroinvertebrate Memorandum* a new taxon is added, the Ancylidae. But the genus *Ferrissia,* previously found, belong to the Ancylidae. It is likely the snails found in 2006 ID'd as Ancylidae were also *Ferrissia*. But we don't know that, and adding an entire new family-level taxa due to ID'ing only to family level in 2006 is inappropriate and, for some purposes, fatally confounds the data.

c. One mayfly in 2006 sampling was ID'd as an *Acanthopotamus*. There is no genus of mayfly with that name (*pers. comm.*, Dr. Patrick McCafferty, Purdue Univ.) It is probably meant to be *Anthopotamus*, which is a common genus encountered in previous years. In fact the genus to which it was entered into Table 2 of FMC's *2006 Macroinvertebrate Memorandum* was *Anthopotamus.*

d. For this year only (2006), totals in Table 1 were given as number of individuals rather than total taxa encountered. This was corrected in Table 2.

e. Because of these inconsistencies in how taxa were identified over years (especially a & b above), it is not possible to determine a reliable actual number of total taxa encountered for 2006, to compare with previous years. Because of these identification/recording problems, 2006 total taxa of macroinvertebrates was considered fatally flawed and not included in analyses of total taxa below.

6. Unacceptable Levels of Reporting Errors

Examination of data tables showing macroinvertebrate results (Table 2 of FMC's *2004 Macroinvertebrate Memorandum* and Table 2 of the *2006 Macroinvertebrate Memorandum*) for 1991-1998 and 2004 indicate an unacceptable number of reporting errors. Total number of taxa shown at the end of each table often did not correspond with the actual number of taxa collected, by summing the taxa for which individuals were counted for each year. This is summarized in Table 2.

Table 2: FMC Macroinvertebrate Reports in which the Numbers of Observed Taxa Were Incorrectly Totaled

Survey Year	Reported Sum of Observed Taxa[1] / Actual Sum of Observed Taxa[2]		
	Blackberry Lane	Meadowbrook Creek	Port Arthur
1991	31/30	37/34	42/39
1992	39/38		28/46
1993			
1994	25/24		
1995			25/24
1996	26/25	43/44	
1997		48/49	34/33
1998	38/37		
2004			30/29

1. Reported sums of observed taxa are taken from: *Table 2. Macroinvertebrates Collected from Flambeau River, Ladysmith, WI 1991-1998, 2004* as it appeared in the *2004 Macroinvertebrate Memorandum, Appendix D, FMC 2004 Annual Report.*
2. I determined the actual sums of observed taxa by manually counting the individual taxa listed in *Table 2. Macroinvertebrates Collected from Flambeau River, Ladysmith, WI 1991-1998, 2004* as it appeared in the *2004 Macroinvertebrate Memorandum, Appendix D, FMC 2004 Annual Report.*

Note that 13 of a possible 27, or nearly 50%, of cells show different actual sums of observed taxa than those reported by FMC. While in almost all cases the numbers differ by only one taxon, the 1992 Port Arthur dam total is widely different. This level of reporting inaccuracy is unacceptable, and along with the other reporting issues mentioned above casts a shadow of doubt over the overall reliability of the macroinvertebrate data and therefore our ability to make reliable inferences about the status of the macroinvertebrates in the Flambeau River.

ENDANGERED AND THREATENED SPECIES IN THE FLAMBEAU RIVER

Several species of Wisconsin endangered or threatened species of invertebrates were found in the Flambeau River in the vicinity of the mine site in May/June 1991, after mine permits had been issued by Hearing Examiner David Schwarz but prior to the commencement of mining. The subsequent discovery of endangered species by WDNR divers who were working on an unrelated project resulted in a lawsuit filed by the Lac Courte Oreilles Ojibwe and Sierra Club in July 1991. The issue was deemed serious enough by the courts that a temporary injunction on mine construction was handed down by Judge George Northrup (Dane County Circuit Court, Madison, WI) in August 1991. As the Judge wrote:

> *All permits issued [to FMC] which relate to either site preparation or mining operations and activities shall be suspended pending completion of a Supplemental Environmental Impact Study by the Department of Natural Resources.*

As a result of survey work completed during the supplemental EIS process, a number of Wisconsin endangered or threatened species were confirmed to exist in the vicinity of the mine site, including the following: the purple wartyback mussel, the bullhead mussel, and three species of dragonflies (the pygmy snaketail, extra-striped snaketail, and St. Croix snaketail.)

In their *Supplement to the Environmental Impact Statement for the Flambeau Mine Project, April 1992* the Wisconsin DNR describes their survey of the river for endangered and threatened species and evaluates the potential for the mining activity to impact these species. An attempt to further delay construction activity at the mine to afford additional protection to these species was dismissed in a June 12, 1992 court ruling which declared there was not sufficient evidence these activities would harm these species. It appears that beyond the DNR survey of the Flambeau River, FMC was not asked to, nor did they, undertake additional monitoring to ascertain the location and/or populations trends of these species near the mine. Since these species were not encountered again during regular sampling protocols, they are not discussed further in this report. The lack of appropriate close monitoring of any endangered or threatened species in ecosystems potentially impacted by mining activities should be viewed as a significant shortcoming of efforts to protect these ecosystems.

RESULTS: TAXON RICHNESS

Keeping in mind the above-mentioned caveats about the data, *corrected* total taxa data were used to examine several indices which are used to describe a biotic community. It is not possible to call this analysis "species richness," since not every group of organisms was identified to the species level, as mentioned above. But for those organisms which were consistently identified to the same taxonomic level – species in some cases, genus or family in others – we can create what might be called "taxon richness." These richness numbers – the total taxa encountered at a site for a given year -- represent the biodiversity present, though not always identified to the species level. A decrease in biodiversity is shown as a negative number, an increase as a positive number.

Table 3: Macroinvertebrate diversity as measured by total taxa encountered, 1991-2004

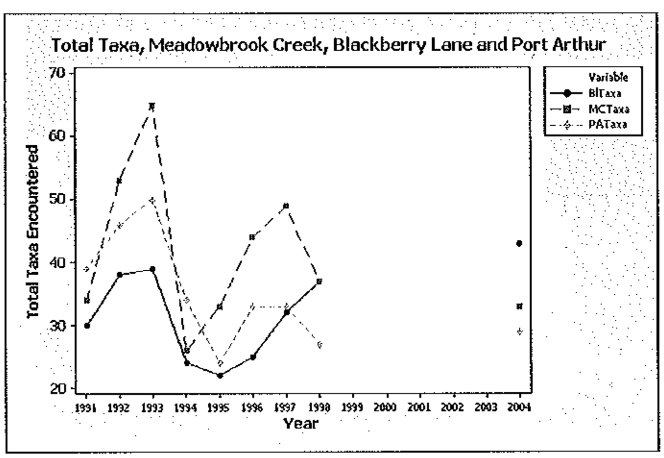
Parameter	Trends in Number of Taxa		
	Blackberry Lane	**Meadowbrook Creek**	**Port Arthur**
Total taxa average 1991-04	32.2	41.6	35.0
Taxa richness 91-94 vs. 95+	- 1.0	- 5.3	-12.5
Taxa richness 91-95 vs. 96+	+ 3.7	- 1.5	- 8.1
Means 91-92 vs. 97-98, % change	+ 1.5%	- 1.1%	- 29%
Means 91-92 vs. 98-04, % change	+ 17.6%	- 22%	- 34%
Regression of trend, slope and significance	slope = +.74 p = .31	slope = -0.89, p = .46	slope = -1.3 p= 0.09

Because sampling effort has a large influence on results, when comparing periods of years' sampling, it is important that equal sampling efforts (e.g. number of years) be compared. Because there were 9 reliable years' effort (1991-1998 and 2004), it was not possible to divide the years into two equal halves. So in calculating means for total taxa, 1991-1994 vs. 1995+ data, which provides 4 years' data for first category, and 5 years' for second were used, then 1991-1995 and 1996+. In other words, because there were an odd number of years' good data, both analyses were done (see Table 3.) Note though the 1991-1992 years are the closest to what might be considered "baseline" data, it would not be appropriate to use 1991-92 vs. all later years because there is less total sampling in 2 years than in the coming eight, so those total sampling efforts would not be comparable. Instead, those 2 years' sampling was compared with two separate later sampling periods,1997-98 and 1998 plus 2004.

Minitab- release 15 was used for statistical analyses.

Figure 1 summarizes the trends in total taxa encountered at the three sampling sites.

Figure 1: Trends in total number of taxa encountered (1991-2004)



Figures 2-4 below show the results of Minitab Trend Analysis for total taxa for each site. Minitab Trend Analyses do not provide significance tests for the trends. In the figures, "MAPE" is the average amount each point is away from the trend line, in percent. "MAD" is the mean absolute deviation and "MSD" the mean squared deviation, both accuracy measures based on standard deviation of the data.

Figure 2: Trend analysis, Blackberry Lane Taxa (1991-2004)

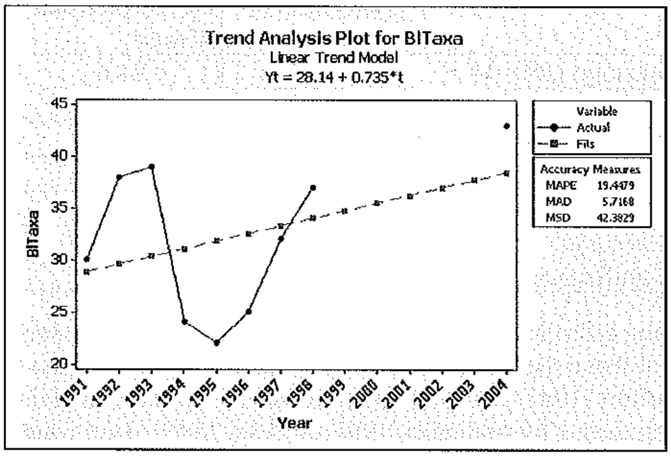


Figure 3: Trend analysis, Meadowbrook Creek Taxa (1991-2004)

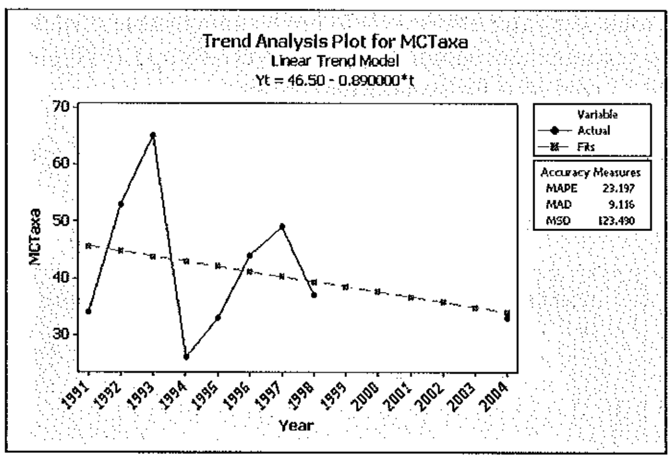
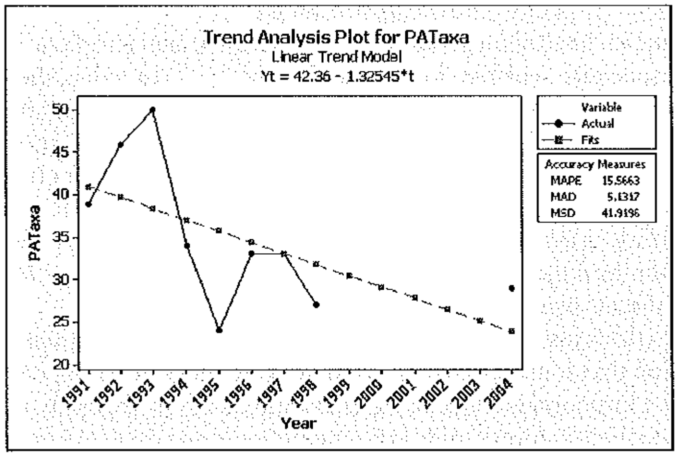


Figure 4: Trend Analysis, Port Arthur Dam Taxa (1991-2004)



Two-Way ANOVA Analysis of total taxa encountered over the years for all three sites indicated that the trend in years was significant at p= 0.008, and site was significant at p= 0.03. This means both the trends over the years and the actual sample site itself had a strong influence (significant at p =.05) on how many taxa one would expect to find in a sample at a particular sample site, with time apparently having a somewhat stronger effect than site.

DISCUSSION OF OVERALL TAXA RICHNESS

There is an apparent trend of a slight increase in macroinvertebrate diversity for Blackberry Lane (upstream from the mine) but a decrease in macroinvertebrate diversity for Meadowbrook Creek and an even more pronounced decrease at the Port Arthur Dam site (both downstream from the mine site), shown by several ways of examining the data. The Port Arthur Dam regression analysis suggests a decrease of about 30% in taxa richness, significant at p = 0.10, when comparing "baseline" to post-mining data.

In September of 1994 an unusually heavy rain caused flooding in the Flambeau River and a breach in the Ladysmith (Peavey Mill) dam, upstream of all sampling sites. This event likely affected the riverbed and macroinvertebrate community via the rapid spate and churning of the waters, scouring the bottom and washing some species but not others downstream. Macroinvertebrate sampling for 1994 took place on Oct. 4, after that breach, and the decrease in taxa diversity for 1994 and 1995 could in part at least be explained by this event. The subsequent increases in taxa richness would represent recolonization of those sites (see Figure 1). The Blackberry Lane site (upstream) however shows a more robust rebound to previous biodiversity levels than the downstream sites, suggesting the possibility of some other factor affecting these downstream sites. This is discussed in more detail below.

RESULTS FOR EPHEMEROPTERA, TRICOPTERA AND PLECOPTERA

The Hilsenhoff Biotic Index (HBI), often used to estimate the degree of human impact on streams, was not considered appropriate in this case. The HBI was developed primarily as an index based on the sensitivity of taxa to a low-oxygen environment, when the waters are impacted by organic pollutants such as sewage, manure, pulp mill wastes, etc., the decomposition of which cause a low-oxygen environment. There was little expectation of this kind of impact to the Flambeau River. In addition, the Flambeau over the reach of this study is a rapidly-flowing stream with primarily gravel and pebble substrate, and is not expected to be oxygen-limited.

A number of studies have shown that the insect orders Ephemeroptera, Plecoptera, and Tricoptera (EPT) are especially sensitive to metal pollution.[8, 9, 10] An index, the EPT index, has been developed and to some degree tested which estimates the possible effects of anthropogenic pollutants such as metals on the macroinvertebrate community.[11] The EPT index is variably reported as the total number of Ephemeroptera (mayflies), Plecoptera (stoneflies) and Tricoptera (caddisflies) taxa encountered, or the total number of these taxa (EPT) encountered vs. total taxa, in which case I express it as % EPT. The reporting issues noted above for total taxa did not appear to confound these three orders of insects, so data from the 2006 sampling were included. Figures 5 – 7 show the trends in these three common taxa of insects encountered.

I note here that Clements, Cherry and VanHassel[12] question the applicability of the EPT index to all streams. They caution that some species of Tricoptera are metal-tolerant, and that while some authors use an EPT divided by Chironomidae index (the chironomids being generally pollution-tolerant), their results suggest some species of chironomids are actually more sensitive to copper pollution (25 mcg/L for 10 days) than some tricopterans or ephemeropterans. They develop their own index, the ICS, Index of Community Sensitivity, which however requires laboratory toxicity studies. These authors make clear the danger in over-applying a particular Index to a particular macroinvertebrate community.

Figure 5: Trends for Ephemeroptera, Plecoptera, and Tricoptera (EPT) at Blackberry Lane (1991-2006)

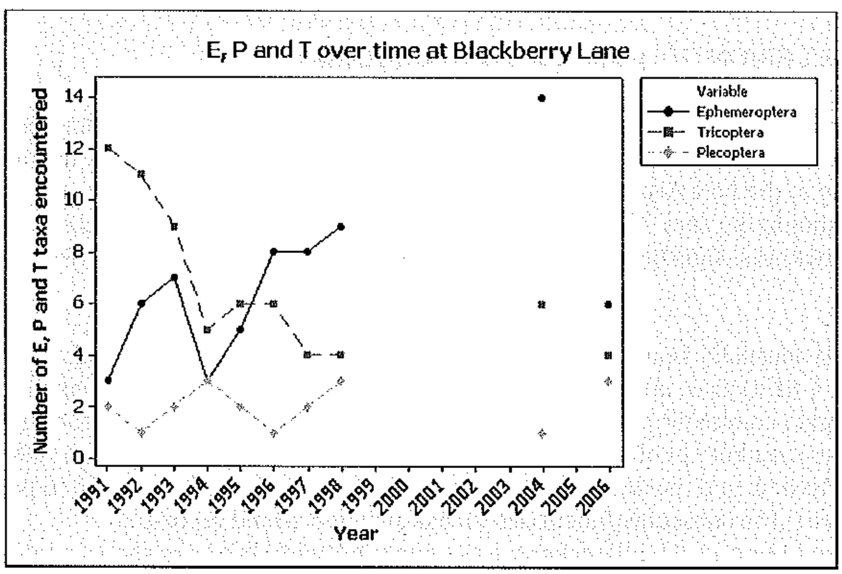


Figure 6: Trends for Ephemeroptera, Plecoptera, and Tricoptera (EPT) at Meadowbrook Creek (1991-2006)

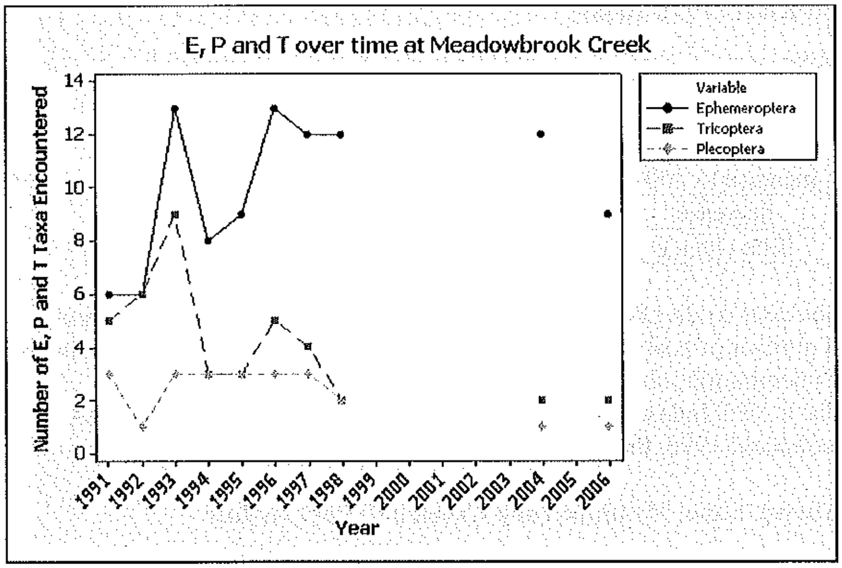
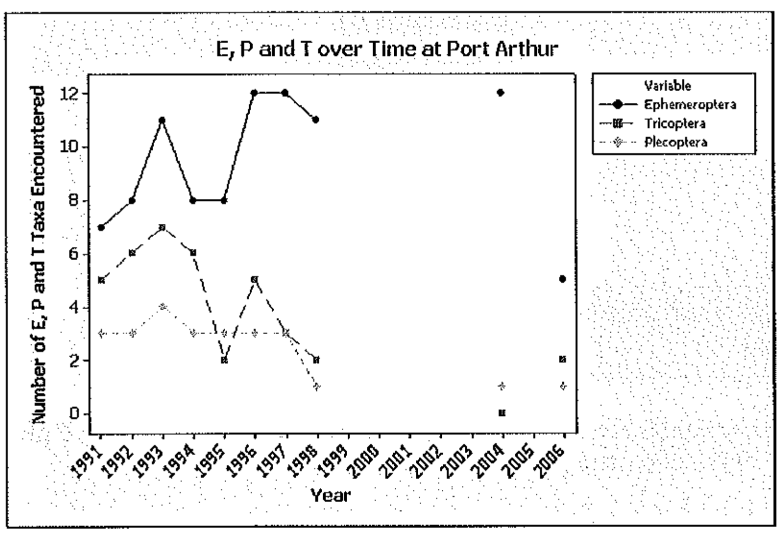


Figure 7: Trends for Ephemeroptera, Plecoptera, and Tricoptera (EPT) at Port Arthur (1991-2006)



The overall trends in Ephemeroptera, Tricoptera and Plecoptera shown in Figures 5-7 are summarized in Table 4:

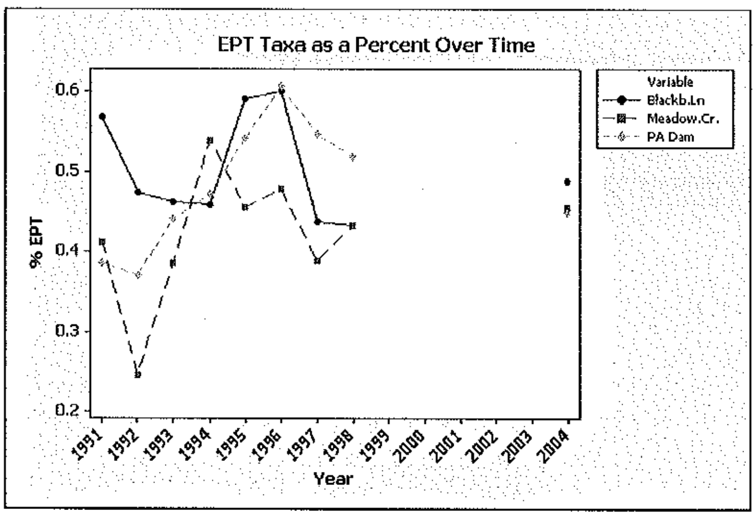
Table 4: Summary of overall trends in Ephemeroptera, Tricoptera and Plecoptera at three sampling sites in the Flambeau River (1991-2006)

Taxon	Trend		
	Blackberry Lane	**Meadowbrook Creek**	**Port Arthur**
Ephemeroptera	increase to 2004	slight increase	increase to 2004
Tricoptera	decrease	decrease	decrease
Plecoptera	little change	slight decrease	slight decrease

A % EPT Index was calculated by dividing the total taxa of Ephemeroptera, Plecoptera and Tricoptera encountered by total number of taxa encountered. It was not possible to calculate this index for the 2006 sample because of uncertainties about the total number of taxa, noted above.

Figure 8 below shows the % EPT Index over time at all three sites. There appears to be an increase in the % EPT to approximately 1995, then a falling off and leveling off.

Figure 8 EPT Index for Blackberry Lane, Meadowbrook Creek and Port Arthur Sites (1991-2004)



There was also no evidence of a significant difference in the number of individuals of E, P plus T sampled in the years 1991-1995 vs. 1996-2006 (data not shown, all p>0.50).

According to the EPT index, if there is a negative effect of metals in the river water or sediment downstream from the mine, everything else being equal, one would expect all of Ephemeroptera, Plecoptera and Tricoptera to decline downstream. How then can one explain the absence of a decrease (at least until the 2006 sampling) of Ephemeroptera at all three Flambeau River sampling sites, despite the fact that Tricoptera have decreased at each site and Plecoptera have either stayed basically the same (Blackberry Lane) or decreased (Meadowbrook Creek and Port Arthur Dam)?

One possible explanation has to do with community interactions at the sampling sites. Plecoptera (stoneflies) are considered top invertebrate predators, and are known to prey efficiently on Ephemeroptera (mayflies) and can have significant effects on prey populations.[13, 14, 15] Wooster[16] concludes based on a meta-analysis of a large number of predation studies in the macroinvertebrate community that "prey density is significantly lower in the presence of predators than in predator-free enclosures." This is not surprising. It is a well-known principle in ecology that predator populations can reduce prey populations, and prey populations often increase subsequent to predator removal.

Table 5 shows total number of Plecoptera individuals counted in the first five sampling years of the study (1991-1995) versus the last four years (1996-2006.) As can be seen, there is a decline in Plecoptera populations at all three sampling sites, with a greater decline at the downstream sites.

Table 5: Number of Plecoptera individuals – not taxa – encountered (1991-2006)

Sampling Site	# of Plecoptera 1991-1995	# of Plecoptera 1996-2006	% change	Statistical significance*
Blackberry Lane	227	171	- 25%	p= 0.41
Meadowbrook Creek	233	36	- 85%	p= 0.16
Port Arthur Dam	219	60	- 73%	p= 0.10

* Actual numbers of individual Plecopterans counted for each year's sampling (raw data) were used for the t-test rather than the totals for year-classes shown in this table. Though some sites showed a large decrease, high variance in the numbers collected and limited number of years' data decreased the power of the statistical tests.

Another way of looking at the data in Table 5 is not through t-tests but through ANOVA analysis. A Two-Way ANOVA analysis of number of Plecoptera individuals sampled (using each year's data as a data-point, not just the summed data, e.g. 1991-95, as shown in Table 5) of 1991-95 vs. 1996-2006 year classes and site, indicated that year class was significant at p=.013, though site was not (p=0.516.) This indicates, as suggested by the t-test results shown in Table 5, that there was a significant change in how many Plecopterans were encountered over time, and this change over time explains more of the difference in numbers than the sites do.

The commonest species of stoneflies found in the Flambeau River (*Agnetina capitata, Acroneuria abnormis,* and *Neoperla clymene*) are all known to be effective predators of mayflies.[17, 18, 19] Removal of the pressure of stonefly predation on the mayfly community downstream from the mine, whatever its cause, could have allowed the Ephemeroptera to rebound from the decrease in taxa after the 1994 flooding, even in the presence of somewhat higher metal concentrations or other stressors, natural or human-caused. I can find no clear explanation for the apparent decrease in the Ephemeroptera in 2006. Without further monitoring it is not possible to know whether that apparent downturn is the beginning of a trend.

POTENTIAL IMPACT OF METALS ON MACROINVERTEBRATE POPULATIONS

The potential toxicity of metals such as copper, zinc, manganese, aluminum, etc. to the macroinvertebrates in the Flambeau River depends on a combination of concentration of specific toxin and time of exposure. The exposure can come through either surface water or sediments. High doses of metals in short periods can lead to acute responses, while low doses over longer periods of time can have chronic effects. Little is known about the possible synergistic effects of small increases in individual metals when other metal concentrations also increase.

Between July 1991 and July 1998 FMC tested Flambeau River surface water on a quarterly basis, in 1999 three times, and since then apparently twice a year only, and at two different locations in the river - one upstream (SW-1; Appendix III) and one downstream (SW-2; Appendix III) from the project area. It is important to point out, however, that while the surface water sampling site historically labeled by FMC as its "downstream" site is about 100 yards downstream of the open pit site, it is about a quarter mile upstream of where runoff from the mine site enters the Flambeau River via an intermittent stream known as Stream C. This study design deficiency was exposed at a contested case hearing over the issuance of a Certificate of Completion for site reclamation in May 2007. As a result, a third sampling site (SW-3; Appendix III) was added to the monitoring regimen immediately downstream of the confluence of Stream C with the Flambeau River. Even with the additional monitoring site, however, the infrequency of sampling and the overall limited number of sites makes it difficult to ascertain potential mine impacts to surface water. It is possible – though of course there exists no evidence for this – that between samplings higher concentrations of metals may be making their way into the Flambeau River, perhaps especially downstream of Stream C.

It is difficult to calculate mean values for many of the metals in the surface waters of the Flambeau River, because of a significant number of analyses being below detection limit. There is no agreed-upon protocol for dealing with those values. However it is safe to say that sampling results revealed no obvious pulses of high concentrations of metals, nor did average individual metal concentrations exceed toxicity standards. An exception, however, occurred in January 1998 when a copper measurement of 12 mcg/L was recorded at the downstream sampling site (SW-2; Appendix II), exceeding the acute and chronic toxicity standards for Cu of 8.1 and 5.7 mcg/L, respectively (*NR 105, Wisconsin Administrative Code, Nov. 2008*). The upstream (SW-1; Appendix II) measurement, at the same time, of 7.6 mcg/L exceeded the chronic but not the acute limit.

Hickey and Clements [8] found virtual elimination of Ephemeroptera and Plecoptera at sites in New Zealand waters high in metals. These sites had copper concentrations in the water of 1.2 mcg/L to 30.6 mcg/L plus Zn concentrations of 120 to 8200 mcg/L, in combination with relatively high Cd concentrations (7-63 mcg/L.) Flambeau River surface water concentrations did at times exceed 1.2 mcg/L Cu, but Zn and Cd did not reach those concentrations. Clements, Cherry and VanHassel, cited above, also found complete elimination of some species of Ephemeroptera, and significant (>50%) reduction in all Ephemeroptera studied (6 species), and some Tricoptera and Dipterans by exposing these populations to 25 mcg/L copper for 10 days.

Nehring [20] determined TL_{50} (the concentration lethal to 50% of individuals in a study population during, in this case, 14 days of exposure) of about 200 mcg/L for the mayfly *Ephemerella grandis*, and 10-14 mg/L for the stonefly *Pteronarcys californica* for Cu. Zn TL_{50} was greater than 9 mg/L for the mayfly and even higher for the stonefly. All these concentrations are well above levels found in the Flambeau River during this study. (Nehring reported TL_{50} concentrations, but did not report lowest levels of metal exposure which showed some effect on survivability or reproduction.) Nehring found that these insects did bioaccumulate the metals considerably, so fish eating them would be exposed to even higher levels. The mayfly, depending on level of exposure, accumulated copper to almost 10 mg/gm. Stoneflies accumulated less. Zinc was also accumulated less in both insects. In general, these metals were accumulated in proportion to their concentration in the water. The average bioconcentration factor for both species & all metals was about 200-fold.

As discussed earlier, Plecopterans (stoneflies) and Tricopterans (caddisflies) show evidence of declines in the Flambeau River downstream from the Flambeau Mine site over the course of sampling, although Ticopterans appear to have declined upstream as well. The number of Gastropoda taxa (mollusks) also decreased at both downstream sampling sites from 1991 + 92 pooled vs. 1998 + 04 pooled samples (complete data not shown.) At Meadowbrook Creek it decreased from 4 taxa to 1, and at

Port Arthur Dam from 3 to 1, while remaining at 1 taxon at the upstream site. Gastropods are known to be sensitive to metals. For example, the gastropod *Amnicola limosa* (*Aminicola* sp. were found in the Flambeau River) has been recorded as having an LC_{50} for aluminum of 400 mcg/L.[21] The LC_{50} is the concentration lethal to 50% of a study population. Baseline (1987-1988) aluminum levels reported by FMC in the Flambeau River ranged from 42-111 mcg/L. In 1992 aluminum levels both upstream and downstream from the mine were reported variously at 420-750 mcg/L. These levels, considerably higher than others reported during the monitoring period, may be analytic or sampling outliers. Levels fluctuated considerably during the years of ore production, at times exceeding 200 mcg/L at both the upstream and downstream monitoring sites. The last time aluminum levels were tested (June 2000), the upstream value was 42 mcg/L and the downstream 160 mcg/L. No additional data is available.

One study of copper toxicity in Gastropods reported an LC_{50} for the snail *Campeloma decisum* treated with 1.7 mg/L for 96 hours, and an LC_{50} for *Physa integra* of only 39 mcg/L when treated for 96 hours, and *Thiara tuberculata* an LC_{50} of 2.2 mg/L for 72 hours,[22] all considerably higher than copper concentrations reported in the Flambeau River.

In addition to exposure to potential toxins in the surface waters, most of the macroinvertebrates (including all the immature insects) are also exposed to metals in the sediments of the river. Sediment metal toxicity dynamics are very complicated. E.g. burrowing into the sediments by the insects themselves can release copper into the water.[23] Median copper levels in Flambeau River sediments downstream from the mine from 1993-2008 were 7.0 mg/kg, slightly higher than upstream (5.8 mg/kg.) Median Zn concentrations for the same period are 30 mg/kg downstream and 23 mg/kg upstream. But the levels of copper in the sediments which appeared to show an effect on macroinvertebrate numbers in the Keweenaw Canal of Upper Michigan (reference 11, below) were 140-930 mg/kg, many times those encountered in the Flambeau River.

Concentrations of aluminum, copper and zinc in Flambeau River sediments were found to be higher downstream than upstream of the Flambeau Mine (see Sediments Report.) Because sediment metal toxicity is dependent on many factors such as the chemical form of the element (free ion, complexed or precipitated), pH, redox potential, type of sediment, water hardness, etc., and because individual organisms, ecotypes and species can differ significantly in their toxicity to different forms of these elements, even at different life-history stages, it is difficult to assign a causal relationship between higher downstream sediment metal concentrations and trends in macroinvertebrates. However, it is in my opinion equally difficult to argue that these causal relationships do not exist.

RECOMMENDATIONS

Because some of the suggested improvements to FMC's Flambeau River macroinvertebrate monitoring program that were mentioned earlier cannot be implemented retroactively but could be useful in the design of monitoring programs in the case of future mining activity, recommendations are listed in two different categories: (1) General recommendations, based on perceived shortcomings of monitoring in the present case, to improve the utility of similar monitoring programs undertaken by others in the future; and (2) Recommendations for how to continue and augment the present study to better track potential impacts of the Flambeau Mine on the associated ecosystem.

1) Flambeau Mining Company failed to gather adequate baseline data regarding macroinvertebrate populations upstream and downstream from the mine site prior to commencement of the mine project. Although some macroinvertebrate sampling occurred previous to October, 1991, the procedures used varied and were not those later adopted, disallowing comparisons with later data. Standardized sampling of the kind later used ought to have occurred previous to October 1991, since nearly 90 acres of land had already been cleared of vegetation and topsoil by that time during the pre-production stripping phase of

the mine project and the mine's erosion control system had failed six weeks earlier. Given the natural variability of populations due to intrinsic and extrinsic non-human factors, making reliable inferences about the pre-mining populations requires several years' sampling – the more, the better. The paucity of baseline data in this case makes questionable any statements about whether the mine either has or has not impacted the aquatic biota.

Recommendation for similar monitoring programs in the future: *Sampling protocol should specify that baseline studies should be conducted using the same sampling methodology employed in follow-up studies. In addition, baseline studies should entail several years' sampling and must be completed before any significant pre-mining activity such as pre-production stripping takes place.*

2) FMC changed one of its two downstream macroinvertebrate sampling sites in the Flambeau River when transitioning from baseline to follow-up studies. Hence, no baseline data exists for that site (Port Arthur).

Recommendation for similar monitoring programs in the future: *More thought should be put into carefully choosing sampling sites BEFORE the annual sampling regime is begun (also see point # 3 and point # 4 below). Once those sites are chosen, sampling protocol should specify that the same sampling locations be utilized for the duration of the study (baseline and follow-up).*

3) Throughout most of the study at hand, FMC failed to appropriately co-locate its downstream macroinvertebrate sampling sites (Port Arthur and Meadowbrook Creek) with sites being utilized for sediment testing. With regard to the Port Arthur site, FMC tested sediment there for three years (1991-1993) and then moved the sediment sampling site to Sister's Farm (see Sediments Report). At that time the collection site for macroinvertebrates (including crayfish) was not moved to the same location, despite the fact that the monitoring plan referenced in the Flambeau Mine Permit specified that the downstream monitoring site for macroinvertebrates was to "*coincide* with the sediment sampling location near the old Port Arthur Dam"[24] (emphasis added).

With regard to the Meadowbrook Creek macroinvertebrate sampling site, sediment was not tested there until 2008, seventeen years after the macroinvertebrate study commenced.

Having different sampling sites for sediment chemistry and macroinvertebrates makes it difficult to draw inferences about organismal metal concentrations. The sediment microhabitat is an environmental matrix whose chemistry and potential toxicity have a profound influence on these organisms. Events, whether anthropogenic or natural, affecting the sediment chemistry and mineral dynamics, can occur at one location while not at another. The sediments are a notoriously heterogeneous matrix, even at small scales. It is therefore difficult to make reasonable inferences about putative effects of mining activities on the macroinvertebrate and crayfish communities when the sediment metal concentrations are not being monitored in situ, but at a site distant from where the organisms are collected.

Recommendation to augment FMC's macroinvertebrate monitoring program: *One of the two historic downstream sampling sites for macroinvertebrates and crayfish (Meadowbrook Creek) coincides with Site S-4 in the Flambeau River, where sediment was sampled as a one-time event in 2008 (See Sediments Report). It is recommended that sediments at Site S-4 continue to be sampled for at least ten years in conjunction with additional macroinvertebrate and crayfish studies as recommended under point # 8 below. Sediment sampling should also continue at Site S-1 (Blackberry Lane), which coincides with the upstream macroinvertebrate and crayfish sampling location, and Site S-3 at Sister's Farm.*

An additional five years sediment sampling beyond the ten years recommended above should be required if significant changes are detected in the continuing monitoring of the biota or the sediment. These changes could be triggered statistically (the precautionary principle suggests using p = 0.10) by the biotic or sediment monitoring results, or even if not exactly statistically significant, by apparent unexplained spikes in metal concentrations in biota or sediment or notable declines in biota toward the end of the ten-year monitoring period.

Recommendation for similar monitoring programs in the future: *In the future, choice of sampling sites should be done more carefully. In particular, sampling sites for macroinvertebrates and sediment need to be co-located physically and temporally whenever possible to reduce the influence of potentially confounding factors.*

4) Throughout most of the study at hand, FMC failed to appropriately co-locate its downstream macroinvertebrate sampling sites (Meadowbrook Creek and Port Arthur) with sites being utilized for surface water testing. With regard to the Meadowbrook Creek site, surface water was not tested there until 2007, sixteen years after the macroinvertebrate study commenced. Surface water has never been tested at the Port Arthur site.

An additional problem with FMC's surface water quality monitoring program is that the historic surface water sampling site utilized by FMC for "downstream" testing (SW-2) is actually upstream of the river's confluence with Stream C, which originates at the mine site and may be conveying potential toxins to the river. This problem was corrected in 2007 with the addition of a new surface water sampling site to the study regime (SW-3), located immediately below the mouth of Stream C. But it is not possible to determine if, historically, there was a causal relationship between metal levels in the river's surface water and the observed trends in macroinvertebrate populations in the Flambeau River.

The measured level of metal concentrations in biota and sediments during monitoring are to an important degree affected by surface water metal concentrations. The interplay of sediment and surface water toxins on the biotic community is complex and differs for particular metals, species, and ecotypes. In case continued monitoring of the biota and sediments discloses unforeseen changes in the community structure or metal concentrations, it would be useful in attempting to explain those changes to have as much information on hand as possible visavis all possible causal mechanisms. It would therefore be amiss to not continue surface water monitoring of the Flambeau River.

Recommendation to augment FMC's macroinvertebrate monitoring program: *Surface water monitoring of the Flambeau River should: (1) continue for as long as sediment and biota are being monitored in the river (at least ten years); and (2) due to concerns over spatial co-location, be expanded to include not only the surface water sampling sites identified in the December 2007 Stipulation Monitoring Plan (SW-1, SW-2 and SW-3), but also the Port Arthur biota sampling site. In addition, due to concerns over temporal co-location, surface water sampling should be timed so that samples are collected on the same days as biota are sampled.*

Recommendation for similar monitoring programs in the future: *In the future, choice of sampling sites should be done more carefully. In particular, sampling sites for macroinvertebrates and surface water need to be co-located physically and temporally whenever possible to reduce the influence of potentially confounding factors.*

5) Since number of individuals and taxa encountered in biotic sampling depends so intimately on sampling effort, it is critical that each year's and site's sampling be as identical as possible. The standard methodology of sampling utilized by FMC subsequent to 1991 is not clear. It is described (e.g. in the *FMC 2004 Annual Report: Appendix D*) as "using a net with an 8 by 18-inch opening and a 800 to 900 micron mesh size." To the present author this sounds like an aquatic kick-net. The methodology is further described as "Instream sampling methods consisted of kick-seining." But kick-seining, again to the present author, involves a much larger net than 8 by 18-inch opening – usually about 4 by 4 feet – and stirring up a meter square of river-bottom at each sampling effort. The area sampled by disturbing the river-bottom in front of each kick-net or kick-seine sampling, an important sampling parameter, is not described. Sampling effort for 2004 is described as: "At each of the three sites, instream sampling was conducted for approximately two man-hours." The *FMC 1992 Annual Report* says only that "Aquatic invertebrate collections were conducted using kick sampling techniques with both Surber sampler and D-frame nets."

These descriptions of sampling effort are inappropriately vague. On the one hand it's not clear exactly what the sampling methodology for any given year was – kick-net, Surber or kick-seining – and on the other it is not possible to verify that between sites and years, sampling effort was equivalent. "Approximately two-hours sampling effort" is quite vague, especially as the amount of sampling accomplished in two hours can vary depending on the individual. The purpose of benthic macroinvertebrate sampling is to gather information adequately reflecting the range of taxa and populations sizes of the macroinvertebrates in the river. The protocol used by FMC is a time-based protocol, which includes sorting of individual organisms from sediments. In addition to depending on the expertise, etc. of the individual doing the sampling another problem with time-based protocols is that they can underestimate large populations and over-estimate small populations. This is because the actual number of subsamples taken in the river is reduced when a large number of individual organisms needs to be sorted in a given time-frame, while when populations are low, more subsamples can be taken. The number (and total area sampled) of subsamples taken therefore more accurately represents the biota in the river than a time-based protocol.

A much more clearly-described and carefully-chosen sampling protocol would assure that data across sites and years is in fact comparable, and more reliably represents populations within the river. Such a protocol might include e.g. using the same number and size of subsamples (Surber, kick-net or kick-seine samples) for each site, and a description of the method used to locate subsamples – e.g. random within a site, equally or randomly spaced along a cross-river transect, etc. Collecting subsamples (e.g. kick-net samples) into separate containers, and identifying and recording them separately would also increase the statistical usefulness of the collection.

Recommendation for similar monitoring programs in the future: *A sampling protocol needs to be defined. The protocol should include number and size of subsamples for each site, and a description of the method used to locate subsamples.*

6) Consistency in sampling and data presentation is critical. Although it is not always feasible because of lack of taxonomic knowledge or expertise and due to time constraints, whenever possible specimens should be identified to the species level. This is especially important for the Ephemeroptera, Plecoptera, and Tricoptera, which are used in the calculation of the EPT index. As mentioned above, some species of these orders are much more tolerant of pollutants than others, and without knowing the community structure to the level of species it's difficult to make inferences about possible human impacts on the macroinvertebrates. In other words, without proper species-level identification for these taxa, these indices have considerably less usefulness.

I also found it necessary to not use the results from FMC's 2006 survey because identification of specimens was not done in the same manner as in previous years. Longitudinal (cross-year) sampling consistency is essential! As an example, if you are trying to determine trends in traffic on a highway, and for eight years you count all traffic, but discover that in the last year of the study, motorcycles & buses weren't counted, that makes that year's data useless for most analyses. If taxa are ID'd to species (or genus) level in one year, they should be in all years.

Recommendation for similar monitoring programs in the future: *Specimens should be identified to the species level. If this is not possible, then the reasons for foregoing species level identification should be clearly recorded. Once a particular level of taxa identification has been established (e.g., species vs. genus), that same level of identification should be maintained throughout the survey.*

7) Changing daylengths and water temperatures affect macroinvertebrate behavior in ways which might make them less susceptible to capture. It is therefore important that the principle of temporal co-location be applied to macroinvertebrate studies. This was not always done by FMC. For example, macroinvertebrate sampling was conducted in late October 1991, late September 1992 and mid-August 2004.

Recommendation for similar monitoring programs in the future: *Sampling protocol should specify that sampling be conducted at the same date (except for extenuating circumstances, within a 2- week window each year) and day-time (again, except for extenuating circumstances, within a 2-hour time window of the day.)*

8) It is important to continue macroinvertebrate monitoring at the Flambeau Mine site to determine if the apparent trends in decreased macroinvertebrate biodiversity downstream from the mine are real. Plecopterans (stoneflies), Tricopterans (caddisflies) and Gastropods (mollusks) show evidence of downstream declines over the course of sampling, although Ticopterans appear to have declined upstream as well. Ephemeropta (mayflies) showed an apparent decrease in taxa encountered in 2006, upstream and downstream. These trends are potentially important. Problems with the 2006 data for total taxa sampled (discussed above) make inferences about future trends especially difficult.

There appears to be no good explanation visavis human activities to explain the observed decline in some macroinvertebrate fauna downstream from the mine. The observed changes may or may not be completely unrelated to the mining activity. The greatest change in the macroinvertebrates, as noted above, seems to have been at the Port Arthur Dam site, far enough downstream from the mine that other, e.g. agriculture-related impacts may have caused those changes. However, the changes may in some causal way be connected to mining activities, as suggested by the observation of similar though perhaps not as profound changes at the Meadowbrook Creek site, near the mine.

To clarify these issues and because of the sensitivity of these organisms to metallic toxins, additional monitoring of macroinvertebrates in the Flambeau River is warranted.

Recommendation to augment FMC's macroinvertebrate monitoring program: *It is recommended that an additional six to ten years of macroinvertebrate sampling be done at the Blackberry Lane, Meadowbrook Creek and Port Arthur sampling sites, perhaps done every other year. If significant changes are detected in taxon richness or the EPT (or % EPT) index during the expanded monitoring period, an additional five years sampling beyond that already recommended should be required. These changes could be triggered either statistically (the precautionary principle suggests using $p = 0.10$) by* *the monitoring results or even if not exactly statistically significant, by apparent unexplained declines in either taxon richness or the EPT (or % EPT) index.*

9) Because of the ability of macroinvertebrates to bioaccumulate metals, regular analysis of a select set of macroinvertebrates (instead of only crayfish) for total body metal concentrations should be done, upstream and downstream from the potentially impacting activity. Copper or other metals in the macroinvertebrates will likely make their way into the higher food chain. In some streams near Yellowstone Park copper concentrations in macroinvertebrates reached levels which killed half of trout fed food with the same copper concentration.[25] Chemical analyses of macroinvertebrates in addition to crayfish were not done by FMC.

Recommendation for similar monitoring programs in the future: *Based on macroinvertebrate taxa present and their relative abundance, it is recommended that a select set of macroinvertebrates be identified for total body metal analysis.*

10) A number of endangered and threatened species were found in potentially-impacted reaches of the Flambeau River, previous to mining activity. As far as can be ascertained, no special effort was made to determine the location and numbers of these endangered populations either during the years of ore production or after mining ceased. Without such monitoring, it is not possible to make any reasonable statements visavis the effect of FMC's mining operation on these species of concern.

Recommendation to augment FMC's macroinvertebrate monitoring program: It is recommended that FMC conduct follow-up surveys to determine the fate of the following endangered or threatened species identified in the *Supplement to the Environmental Impact Statement for the Flambeau Mine Project, April 1992*: the purple wartyback mussel, the bullhead mussel, and three species of dragonflies (the pygmy snaketail, extra-striped snaketail, and St. Croix snaketail).

Recommendation for similar monitoring programs in the future: It is recommended that specific monitoring for endangered or threatened species be undertaken whenever a new mining operation is under consideration, and that additional monitoring specifically targeting any such species identified be required if the mine is permitted.

CONCLUSIONS

Due to a lack of baseline data, flaws in FMC's study design and inconsistencies in the reporting of data, it is not possible to ascertain with any degree of certainty whether or not the Flambeau Mine has had or may presently be having an impact on macroinvertebrate biota in the Flambeau River. In addition, the lack of follow-up studies on the fate of endangered and threatened species identified in and around the Flambeau River prior to mining is unacceptable.

There is enough evidence however to suggest that there were declines in some macroinvertebrate species downstream from the mine during the course of its operation, e.g. especially the Plecoptera and the Gastropoda. While it is not possible to identify the Flambeau Mine itself as *the* cause of these changes, or *a* significant cause of several, it is also not possible to say with any reasonable certainty that the Flambeau Mine did *not* play a part, however slight or however significant, in these observed changes.

Exactly what the changes in the macroinvertebrate communities have been, and how long they might last, is difficult to say unless the river continues to be carefully monitored and study design issues are resolved. To have a better understanding of possible effects visavis any future mining projects in Wisconsin, the biomonitoring protocols should be improved with consideration of the recommendations noted herein, including especially the reliability of the data as reported and the inclusion of studies to evaluate the fate of any threatened or endangered species identified at the project site.

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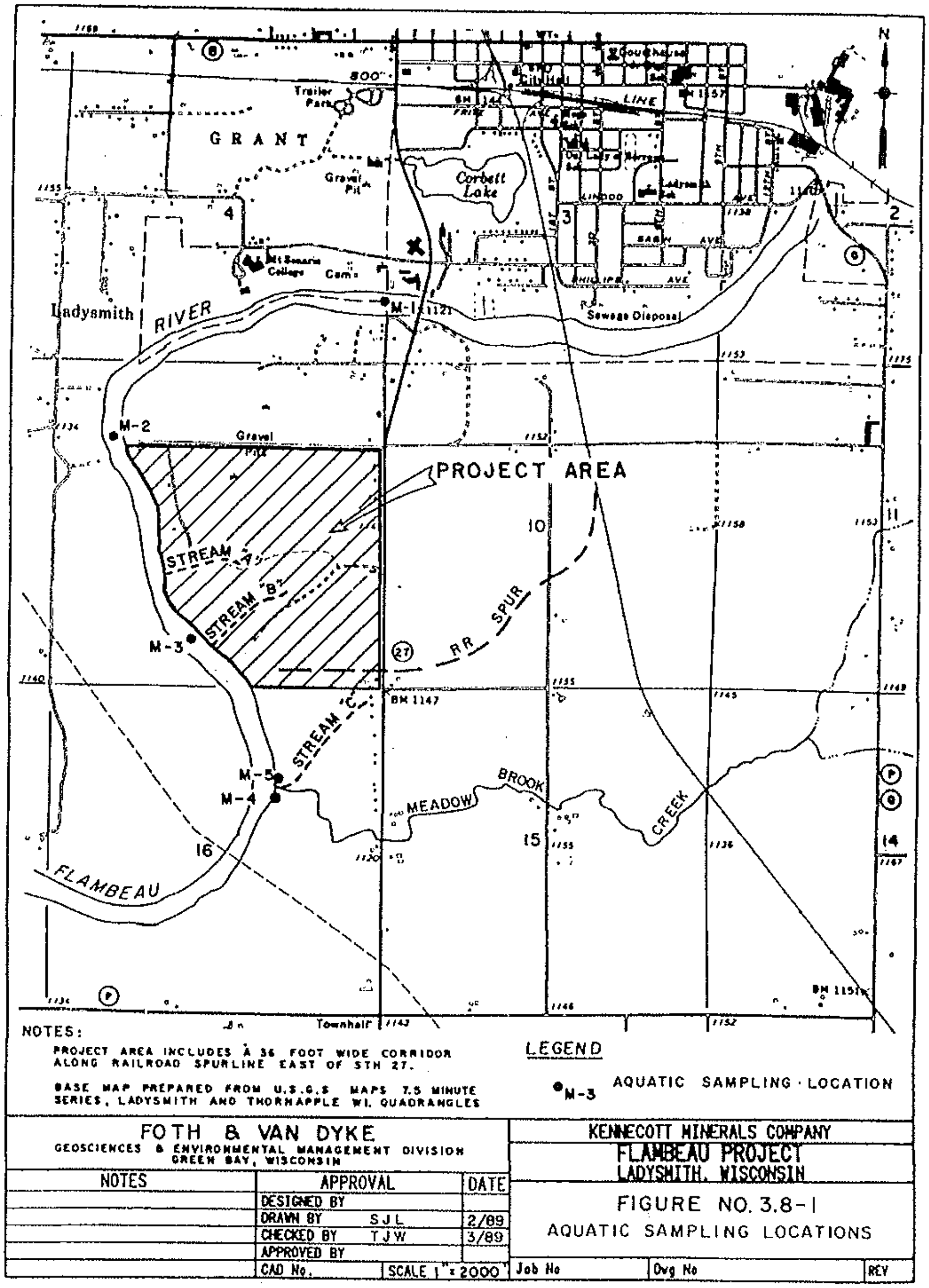
Appendix I

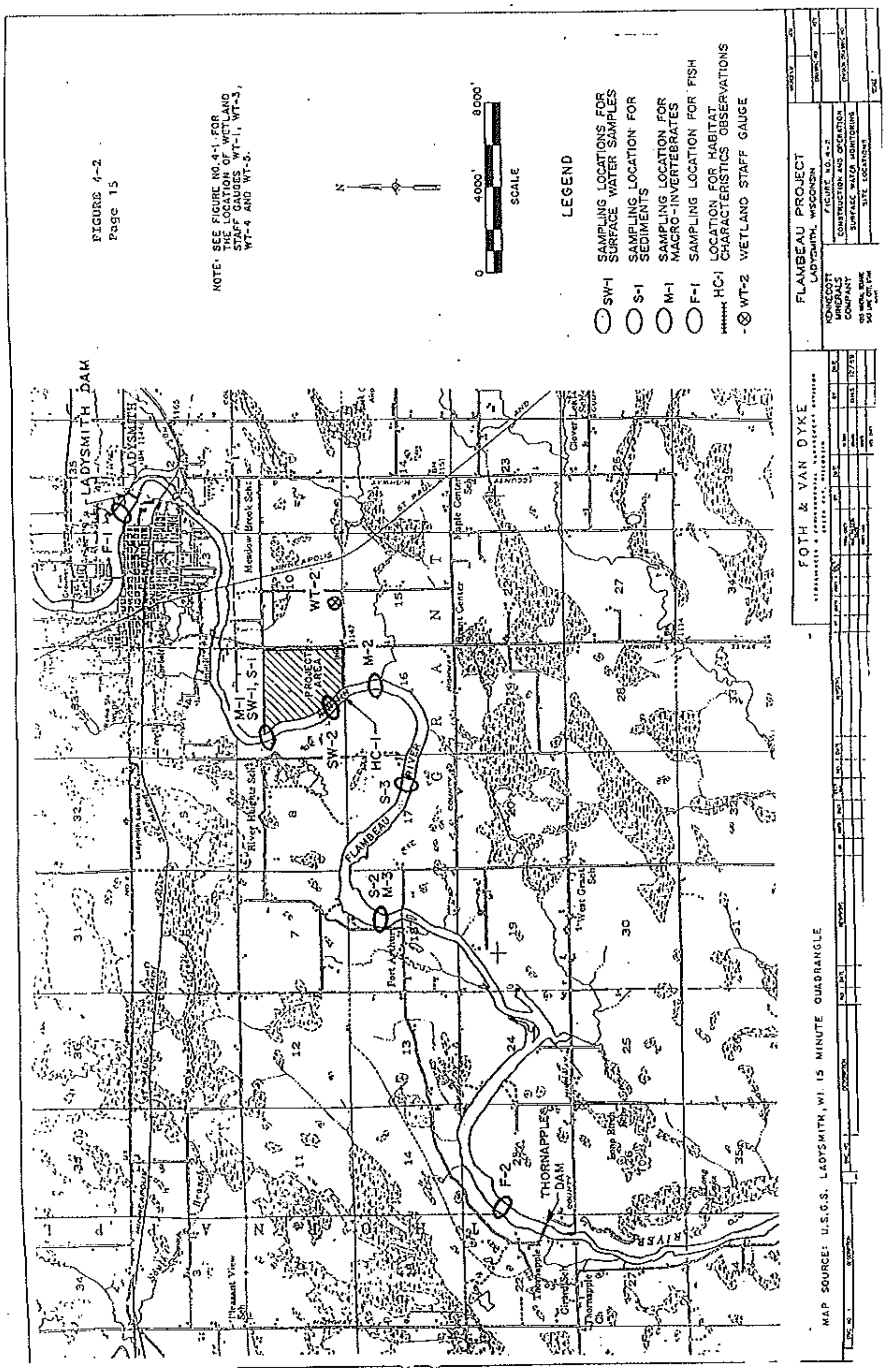
Flambeau River Macroinvertebrate Sampling Locations Utilized for Baseline Testing (1987-1988)

(Source: *Volume 2: Environmental Impact Report for the Kennecott Flambeau Project, 1989*)



Appendix II

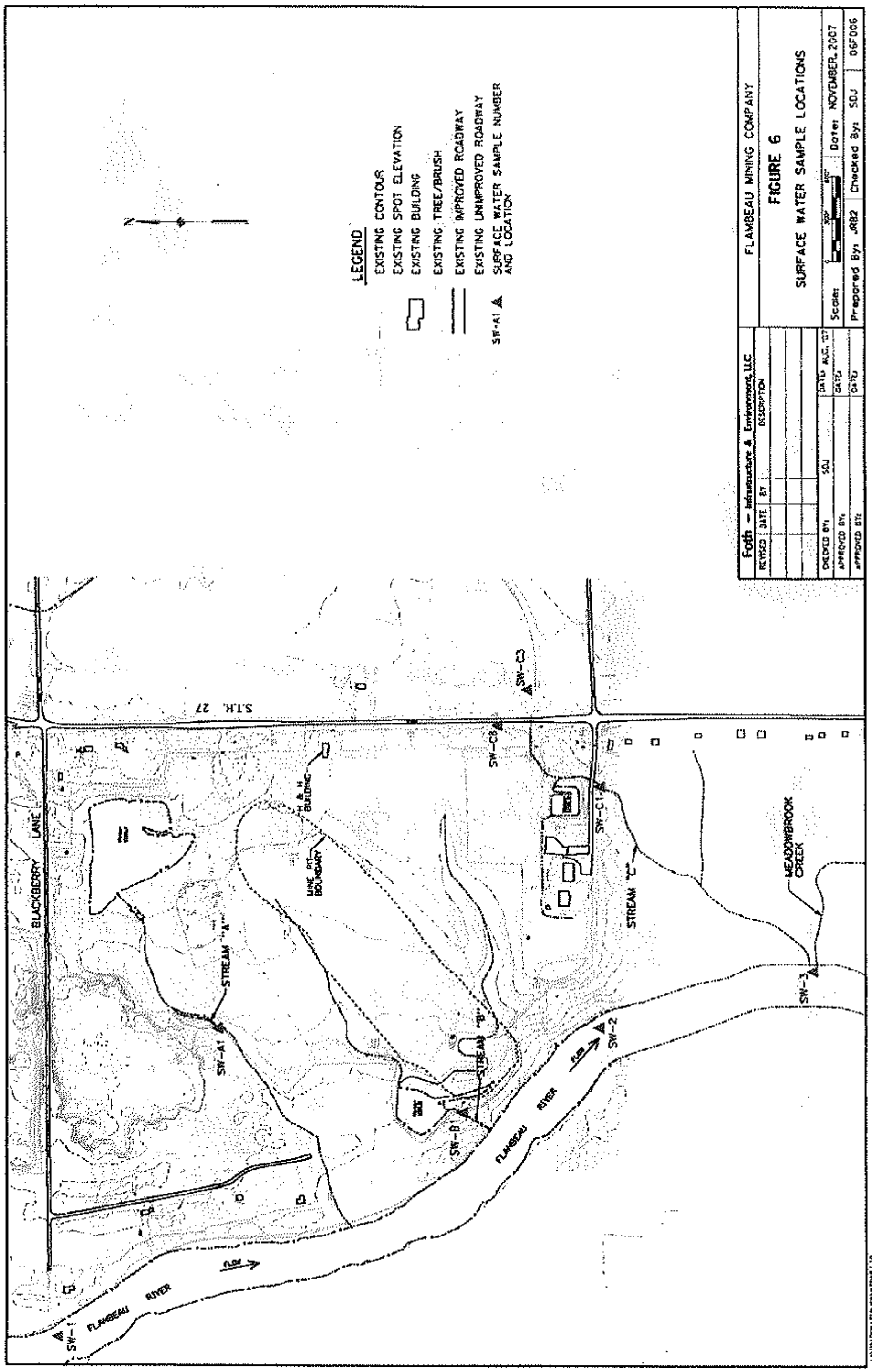
Flambeau River Surface Water, Sediment and Biota Sampling Locations Used at One Time or Another between 1991 and 2007 (Source: *Flambeau Mining Company 1993 Annual Report*)



Appendix III

Surface Water Sampling Locations at the Flambeau Mine Site (2008)

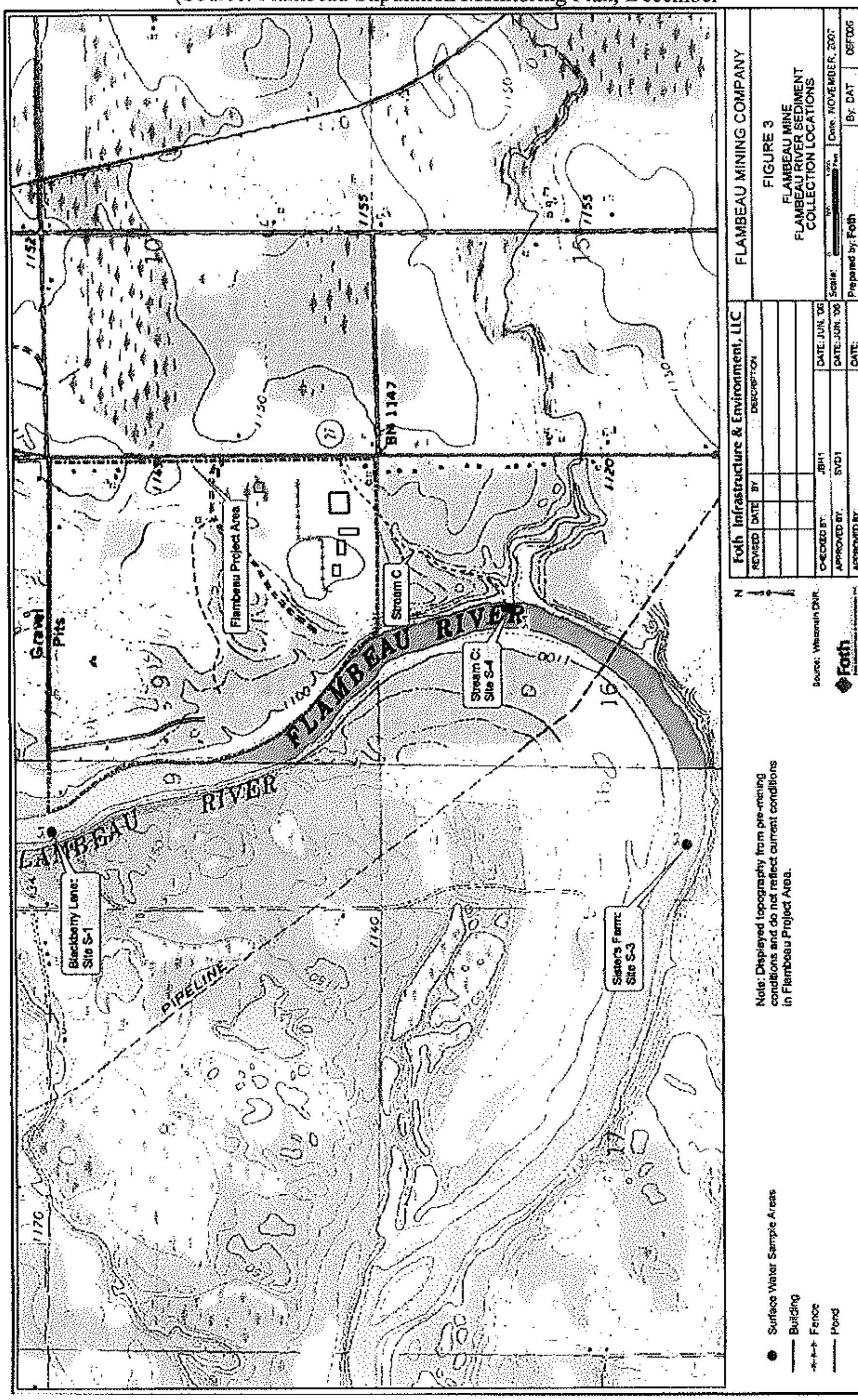
(Source: *Flambeau Stipulation Monitoring Plan, December 2007*)



Appendix IV

Sediment Sampling Locations in the Flambeau River (2008)

(Source: Flambeau Stipulation Monitoring Plan, December



Flambeau River Monitoring at the Flambeau Mine Rusk County, Wisconsin

3. CRAYFISH
Analysis, Comments and Recommendations

prepared for
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INTRODUCTION

Crayfish are crustacean decapods common in Wisconsin lakes and streams. Though they show some ability to manipulate bodily loads of some metals, they can be impacted by potential toxins in both sediments and the surface waters. Crayfish are also regularly eaten by vertebrates such as fish, birds, and mammals, and as such metals or other toxins in their bodies can make their way into those organisms. Because they are common and easily-captured invertebrate inhabitants of rivers such as the Flambeau River in northern Wisconsin, crayfish have been used in studies designed to measure the impact of human activities on the riverine community. One such activity is mining.

Flambeau Mining Company (FMC), a subsidiary of Kennecott Minerals of Salt Lake City, Utah, constructed an open pit copper sulfide mine alongside the Flambeau River in the mid 1990s. The river formed the western boundary of the project area, and the pit itself came to within 150 feet of the river. The Flambeau Mine was operational for four years. It ceased production in 1997 and has since been reclaimed. Due to the proximity of its mine to the Flambeau River, FMC was required to institute a Flambeau River monitoring program as a condition for approval of its Mine Permit.

In 1991-2001, 2004 and 2006-2008 FMC collected 25-30 crayfish (Cambaridae family) on an annual basis at each of three sampling sites in the Flambeau River. This was part of a broader monitoring program designed to ascertain any effects the company's Flambeau Mine might have on the biota in the river. These effects could occur during excavation of the mine, during its operation, and beyond the date of its operation if substances such as metals or other potential toxins or erosional runoff might be making their way through surface or groundwater into the river.

Locations chosen for crayfish analysis in the Flambeau River are shown in the map included in Appendix I. They included Blackberry Lane (Site M-1; about 0.7 mile upstream from the open pit site), Meadowbrook Creek (Site M-2; about 0.3 mile downstream of the project area, immediately above the creek's outfall) and Port Arthur (Site M-3; about 3.1 miles downstream). Crayfish were collected by kick-seining and pooled into a single composite whole-body sample which was chemically analyzed by companies under contract to FMC. The collection and analysis procedures appear to be appropriate in methodology and similar from year-to-year and site-to-site.

The composite samples were analyzed for a suite of trace elements (aluminum [Al], silver [Ag], arsenic [As], cadmium [Cd], chromium [Cr], copper [Cu], mercury [Hg], nickel [Ni], lead [Pb], selenium [Se], and zinc [Zn]) from 1991 to 2006. In 2007 and 2008 samples were only analyzed for copper, zinc, iron [Fe] and manganese [Mn].

Issues concerning the collection of baseline data, appropriate replication and co-location are discussed below.

SAMPLING & REPORTING ISSUES

1. Adequate baseline data for the present study is lacking. While Table 3.8-3 of *Volume 2, Environmental Impact Report for the Kennecott Flambeau Project, April 1989,* shows whole-body metal analyses of crayfish collected in August of 1988, the sampling locations are not recorded in the table. Without knowing which results are for upstream vs. downstream specimens, it is impossible to utilize the information with any degree of confidence. In addition, the report states that "There are no significant differences in the background metals from

the two sites." But since only two composite samples of approximately 12 crayfish each (later samples used 25-30 crayfish each) were tested, such a claim is anecdotal and not statistically defensible. It is also important to point out here that though considered "background" monitoring, results for 1991 and 1992 reported in later studies may have been affected by preliminary work on the mine site done in 1991 (see previous reports).

2. Iron and manganese were not added to the crayfish test panel until 2007. This appears to have been an oversight on the part of FMC, since both of these metals were tested in walleye and river sediment from the very beginning of the river monitoring program in 1991. Now that iron and manganese are being tested in crayfish, measureable levels have been detected. Interpretation of the data, however, is impeded by the lack of a reference point.

3. The availability of only one composite sample/site/year (1991-2008) limited the ability to do statistical analyses and draw meaningful conclusions regarding the level of potential risk to crayfish or organisms feeding on the crayfish. This is especially true for any given year's data. While it was possible, using data gathered over a number of years, to make statistical inferences concerning metal concentrations in crayfish, without in-year replication, this is not possible for any given year. E.g. in 1993 copper concentrations in crayfish collected upstream (at the Blackberry Lane site) were higher than in those collected at the Port Arthur site (15 mg/kg vs. 12 mg/kg.) But in 1994 those differences had reversed themselves (9.9 mg/kg vs. 18 mg/kg.) This nearly double copper concentration downstream vs. upstream is quite striking; but without replication we can't know anything about the statistical significance of that difference. In other words, without in-year replication, we have to wait for a number of years' data to make statistical inferences about the differences observed. An important goal of monitoring is to provide current information about the status of an ecosystem, so management decisions can be made in a timely fashion, based on reliable statistical analyses. As it is, without in-year replication, these decisions require waiting for multi-year sampling results which only allow statements such as "Yes, there *was* a difference in parameter X between sampling sites," rather than, "Yes there *is* a difference in parameter X between sampling sites."
   Additional in-year replication will naturally also increase the reliability of statistical inferences when comparing data over a number of years.

4. Yet another limitation imposed by the lack of in-year replication relates to toxicity assessment. As mentioned above, 25-30 crayfish/site/year were composited for analysis. As a result, variations among individual crayfish are not known. This makes it much harder to make reliable inferences, from a toxicological viewpoint, about the effects of the measured metal concentrations on individual crayfish, or the likelihood of a predator of the crayfish consuming prey abnormally or dangerously high in certain metals. The theory behind compositing is that the concentration in a composite of crayfish is roughly equal to the mean for those crayfish had individual samples been analyzed. Compositing is often done to save money and may sometimes be necessary if individual samples do not provide enough tissue for analysis. In the present instance where say 27 crayfish have been collected at an upstream site and 27 at

a downstream site, only 2 samples are chemically analyzed rather than 18 samples (assuming 3 crayfish are needed to provide enough tissue). What is lacking with a composite sample, however, is any idea of the variation that is present. For instance a mean of 20 can be arrived at with 2 different scenarios: (1) if the values for the 9 composite samples of 3 crayfish each are 35, 47, 42, 20, 5, 8, 10, 6 and 7 or (2) if the values for the 9 composite samples are 21, 19, 17, 22, 21, 20, 18, 19, and 23. Those 2 distributions tell us different things about the flowages they came from even though the means are identical in the two groups. There are more crayfish that have elevated concentrations in the first compared to the second scenario. If, for instance, there is a hazardous threshold of 25 then more of the crayfish (or their potential predators) are at risk in the first scenario than in the second. In general, the smaller the number of individuals in each composite sample, the less likely compositing will mask individuals exceeding potentially hazardous levels. It is difficult to adequately assess toxicological risk without having data from individual crayfish or relatively small composite samples rather than from a single large composite sample.

5. The upstream monitoring site employed for the crayfish study (Blackberry Lane) was the same as that used for surface water, sediment and macroinvertebrate sampling throughout the duration of the study at hand. Prior to 2007, however, there was no surface water or sediment testing at the downstream monitoring site at Meadowbrook Creek, and the second downstream site at Port Arthur had only limited sediment testing (1991-1993) and no surface water testing at all. When sites are not co-located, trends from individual sites may be due to differing confounding factors, which decreases the reliability of inferences visavis mining effects.

   The co-location problem at Flambeau was partially corrected in 2007 as a result of a negotiated agreement reached between opposing parties at a contested case hearing. As of 2007, crayfish and surface water are both being tested at the Meadowbrook Creek site, and this testing will continue on an annual basis (crayfish) and semi-annual basis (surface water) through 2011. The agreement also called for a one-time sediment study at the Meadowbrook Creek site which was conducted in 2008. The Port Arthur site, however, continues to only be monitored for crayfish.

RESULTS

Out of the eleven trace elements tested in crayfish samples, eight were below the level of detection or quantification in the majority of years (See Table 1, which also includes walleye data to be discussed in a separate report). The number of years in which the composite samples contained detectable concentrations was similar across locations (above, at, or below the mine). Even in the years when these eight elements were detected they tended to be at or near the detection or quantification limits, for example Cd. Although some of these elements can be toxic if concentrations are high enough, these low concentrations did not warrant further analysis. Data for these undetectable, non-quantifiable or very low concentration trace elements were not considered further.

Table 1. Number of years in which metals were below the detection limit in composite specimens, 1991-2006[1]
(n=13 years for crayfish and n=12 years for walleye)[2]

	Al	As	Ag	Cd	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Se	Zn
Walleye													
Ladysmith	3	11	10	2	9	0	0	4	0	8	11	7	0
Thornapple	3	11	10	7	10	0	0	4	0	8	11	8	0
Crayfish													
Blackberry Lane	0	10	11	9	8	0	NT	11	NT	9	11	11	0
Meadowbrook Creek	0	10	11	9	8	0	NT	11	NT	9	11	11	0
Port Arthur	0	10	11	9	7	0	NT	10	NT	8	11	11	0

NT = Not Tested

[1] Crayfish and walleye were also tested in 2007 and 2008, but for only copper, iron, zinc and manganese, all of which were above the detection limits.
[2] Excluding studies conducted in 2007 and 2008, crayfish were sampled in 1991-2001, 2004 and 2006; walleye were sampled in 1991-2000 and 2005-2006.

Two of the metals tested were consistently detected in whole body crayfish samples between 1991 and 2008. Those two elements were copper and zinc. In addition, aluminum was consistently detected between 1991 and 2006, although this metal is no longer being monitored.

In 2007 FMC reduced the number of metals being monitored in crayfish from 11 to 4. Copper and zinc remained on the test panel, the remaining metals originally monitored were eliminated, and two new metals (iron and manganese) were added. In 2007 and 2008, all four metals on the test panel were detected in measureable quantities.

Copper, aluminum and zinc concentrations in the composite samples were plotted by year with the vertical dashed lines indicating the period of mine operation (Fig. 1 - 3). In terms of baseline data, note that copper was found at 16 and 20 ug/gm dry wt. in crayfish whole-body samples taken in 1988, but which result is upstream, which downstream is not clear from Table 3.8-3 of *Volume 2, Environmental Impact Report for the Kennecott Flambeau Project, April 1989.* Zinc is recorded in that document as 23 and 29 ug/gm dry wt., again being unclear which value is upstream vs. downstream. Note however that these values for copper and zinc are similar to those found in 1991.

Iron and manganese graphs were not constructed due to the fact that only two data points were available (2007 and 2008), not enough to establish any sort of trend.

Fig. 1: Crayfish whole-body copper concentration, ug/g wet wt.

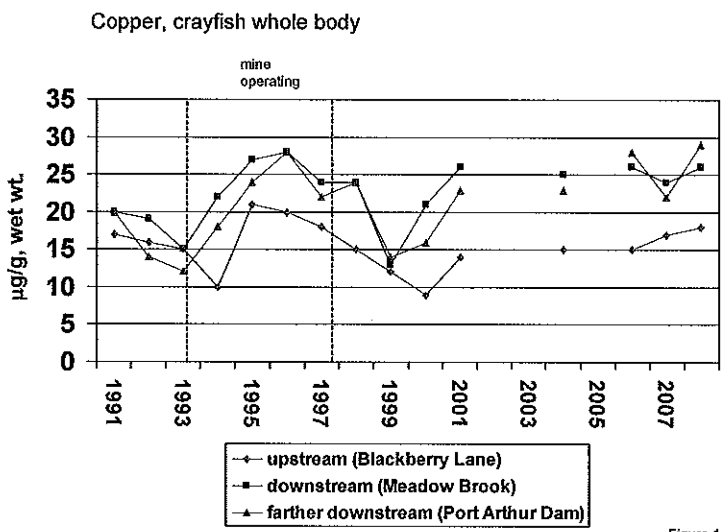


Figure 1.

Fig. 2: Crayfish whole-body aluminum concentration, ug/g wet wt.

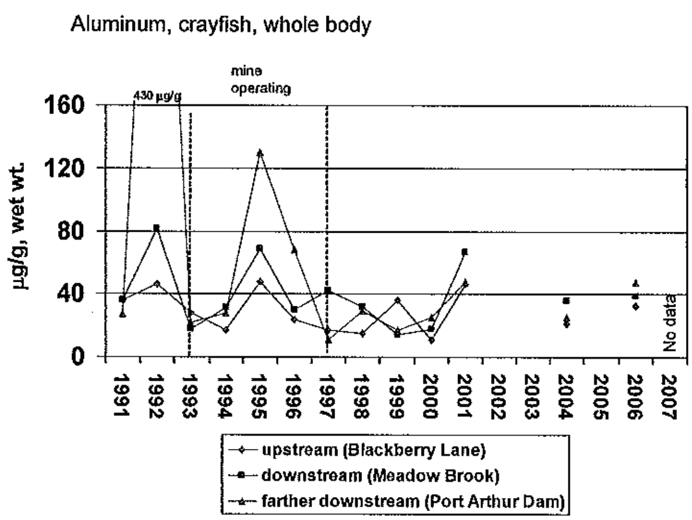
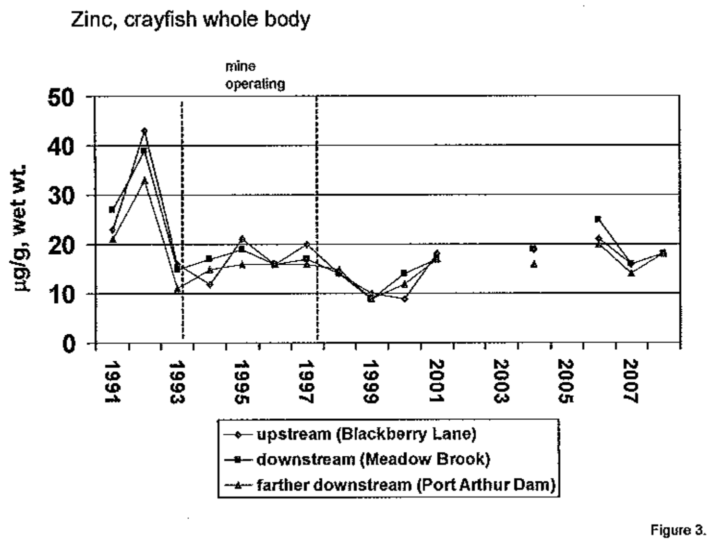


Figure 2.

Fig. 3: Crayfish whole-body zinc concentration, ug/g wet wt.



DISCUSSION OF RESULTS

Figures 1-3 suggest that there is considerable year-to-year variability in the elemental concentrations in the whole-body crayfish. That variability, however, seems to track across locations, i.e. if a year had higher or lower concentrations then those concentrations tended to be higher or lower at all three locations. Zinc, for instance, was elevated in 1992 compared to 1991 or 1993 and it was elevated at all three locations.

Crayfish whole-body copper appears to have been consistently higher at both downstream locations even prior to mining and to have risen at all three locations (including the upstream sampling site) during the mine operation. Concentrations fell off after the shutdown of the mine, but appear to have risen again, at all locations, around the year 2000. Due to a paucity of data it is difficult to make any statements about trends in these concentrations since 2005. Figure 1 seems to almost suggest a kind of cycle to copper concentrations. Though they are slightly higher downstream from the mine, the fact that crayfish sampled above the mine show a similar rising and falling pattern suggests some other factor is driving these cycles.

Table 2 shows the differences in the course of time between the upstream site and the two downstream sites, in crayfish copper concentrations. A one-sample t-test of the hypothesis that the differences between those sites (M-2 minus M-1 and M-3 minus M-1) are equal to zero resulted in $p < .001$ in both cases. In other words, there is less than a 0.1% chance that there was no difference between the sampling sites. Linear regression analysis of the differences (M-2 minus M-1 and M-3 minus M-1) resulted in positive slopes indicating increasing differences in crayfish copper levels, at $p = .07$ for Meadowbrook Creek (M-2) and $p = .02$ at the Port Arthur Site (M-3). This indicates that the gap between upstream and downstream copper concentrations appears to have increased during operation of the mine, and has been sustained in the post-mining years with significantly higher copper levels reported in the downstream crayfish. This suggests a possible mining effect.

Table 2: Differences in crayfish total body copper levels between upstream and downstream sites in the Flambeau River, 1991-2008

Year	Crayfish Total Body Copper Levels (mg/kg)[1]				
	Sampling Site			Difference between Downstream and Upstream Values	
	Upstream at Black-berry Lane (M-1)	Downstream at Meadow-brook Creek (M-2)	Downstream at Port Arthur (M-3)	(M-2) - (M-1)	(M-3) – (M-1)
1991 ("Baseline")	17	20	20	+3	+3
1992 ("Baseline")	16	19	14	+3	-2
1993	15	15	12	0	-3
1994	9.9	22	18	+12.1	+8.1
1995	21	27	24	+6	+3
1996	20	28	28	+8	+8
1997	18	24	22	+6	+4
1998	15	24	24	+9	+9
1999	12	13	14	+1	+2
2000	8.8	21	16	+12.2	+7.2
2001	14	26	23	+12	+9
2004	15	25	23	+10	+8
2006	15	26	28	+11	+13
2007	17	24	22	+7	+5
2008	18	26	29	+8	+11

[1] Data obtained from: *FMC 2006 Annual Report - Appendix C; FMC 2007 Annual Report - Appendix D; and FMC 2008 Annual Report - Appendix C.*

The 1992 crayfish aluminum result at Port Arthur (430 ug/gm) appears to be an outlier. Since aluminum is used as a biomarker of sediment ingestion when GI tracts of animals are analyzed, the highly variable aluminum concentrations in crayfish may result from more or less sediment being collected and analyzed with the crayfish whole bodies. There is no clear pattern to the crayfish whole-body aluminum analyses, other than that they do seem to rise and fall together at the three sites, with generally somewhat higher concentrations downstream from the mine. These higher downstream concentrations, however, appear to also occur before the mine began operating.

Crayfish zinc concentrations at upstream and downstream sampling sites appear to be highest before the period of mine operation, and track one another closely across the three sites.

Statistical analyses done on the crayfish copper, aluminum and zinc data, using Minitab – Release 15, are summarized in Table 3.

Table 3: Results of statistical tests for crayfish elemental analyses for years in which there is data, 1991-2008.

Metal	Test	Significance
Copper	Two-Way Anova*	Site & Year p<.001
	Two-sample t-test, Blackb.L. vs. Meadow.Cr.	p<.001; Mean(Bl.) = 15.45 mg/kg Mean(MbCr.) = 22.67 mg/kg
	Two-sample t-test, Blackb. L. vs. Port Arthur	p=.002; Mean (Bl.) = 15.45 mg/kg Mean (PA) = 21.13 mg/kg
Zinc	Two-way Anova**	Site p = 0.567, Year p <.001
	Two-sample t-test** Blackb.L.vs. Meadow.Cr.	p = 0.772
	Two-sample t-test** Blackb.L.vs. Port Arthur	p = 0.749
Aluminum	Two-way Anova**; value of 430 for PA dam left in.	Site p=0.149, Year p=.001
	Two-sample t-test* Blackb. Ln. vs. Meadow. Cr.	p = 0.140
	Two-way Anova**, value of 430 changed to 40 = mean of Port Arthur w/o that value	Site p <0.001, Year p = 0.026
	Two-sample t-test**, Blackb.L. vs. PA dam, value of 430 left or changed to 40	p<.001; Mean(Bl) = 29.08 mg/kg, Mean(PA) = 39.85 mg/kg

* Untransformed data considered normal by Minitab
** Non-normal data normalized by Johnson Transformation

Table 3 indicates that zinc concentrations changed significantly over the years, but inter-site difference was not significant at p = .05.

Aluminum concentrations also varied significantly from year to year. Mean aluminum in crayfish collected at Port Arthur was significantly greater than Blackberry Lane when considering the entire period of sampling, whether the apparent outlier of 430 mg/kg was left in, or changed to the mean value for that site, when the 430 value is removed.

Table 3 also indicates that copper concentrations in the crayfish changed significantly over the years of testing, and specimens collected at the two sampling sites located downstream from the mine had significantly higher levels of copper than the upstream crayfish (also see Table 2, above). While it is not possible to prove a mining effect on crayfish copper concentrations, the FMC 2006 annual report statement that: "Based on all data collected, including that which was collected in 2006, there are no impacts to crayfish relative to metal uptake whether we are looking at upstream/downstream effects or effects due to time (active mining phase, mine site reclamation, or post-reclamation" should be considered over-reaching.

A brief survey of the literature suggests that absorption and release of metal ions by crayfish and related organisms is both metal and species-specific. Whole-body metal concentrations in crayfish and other aquatic species often do track ambient (sediment or water-column) concentrations, but there is also evidence the individual organism can regulate some metal ions under broad ranges of exposure.[1, 2, 3, 4] Toxicity caused by the metals monitored by FMC is complicated by water hardness, disturbance of the sediments, the sensitivity of individual organisms and their varying ability to dump (depurate) excess ions, etc. Though it is unlikely metal concentrations found in the bodies of crayfish in the Flambeau River reached toxic or physiologically stressful levels, or levels which might endanger predators consuming the crayfish, the use of composite samples without proper replication prevents us from making that conclusion with a statistical level of confidence otherwise attainable.

RECOMMENDATIONS

Because some of the suggested improvements to FMC's Flambeau River crayfish monitoring program that were mentioned earlier cannot be implemented retroactively but could be useful in the design of monitoring programs in the case of future mining activity, recommendations are listed in two different categories: (1) General recommendations, based on perceived shortcomings of monitoring in the present case, to improve the utility of similar monitoring programs undertaken by others in the future; and (2) Recommendations for how to continue and augment the present study to better track potential impacts of the Flambeau Mine on the associated ecosystem.

1. Though some preliminary crayfish monitoring was undertaken by FMC in1988, ambiguous recording made the results uninterpretable. In addition, "background" data from 1991 and 1992 may have been affected by preliminary work at the mine site already underway in 1991 (see previous reports).

Recommendation for similar monitoring programs in the future: *It is recommended that several years' true background monitoring be gathered before initiating pre-mining or mining activity and that care be taken to avoid ambiguous recording of data. It is also recommended that the protocols used for these baseline studies, including sampling locations, remain constant during the pre-mining, mining and post-mining period.*

2. Iron and manganese were not added to the crayfish test panel until 2007. As a result, interpretation of current test results showing measureable concentrations of these metals in crayfish specimens has been impeded.

Recommendation for similar monitoring programs in the future: *Test panels should be thoroughly reviewed at the onset of any monitoring program such as that undertaken by FMC so that important data sets are not overlooked.*

3. The availability of only one composite sample/site/year limited the ability to do statistical analysis and draw meaningful conclusions on a timely basis for a given year. It was only after a number of years' data was collected that it became possible to make statistically-significant inferences visavis metal concentrations in the crayfish.

An additional problem with composite samples is that they mask any individual organisms which might, because of their particular physiology, microhabitats, or diet have accumulated metals to potentially toxic or otherwise harmful levels. The uncertainties around potential hazards to individual crayfish from copper in the Flambeau River are succinctly summarized in a December 12, 2001 memo written by Elisabeth Harrahy, an environmental toxicologist with the Wisconsin Department of Natural Resources (DNR). In that memo Ms. Harrahy, in an analysis of metals in Flambeau River crayfish reported by FMC up to that date, states that "Without more in-depth monitoring, it is difficult to draw any conclusions on the effects of this Cu on these crayfish."

Recommendation to augment FMC's crayfish monitoring program: *To allow more timely management decisions to be made, it is recommended that the total composite crayfish sample be divided into replicate subsamples of say 5 each, and analyses done on these subsamples. If only 2 or 3 crayfish provide enough tissue for the analyses, then smaller composites should be used, the principle being to provide as many subsamples per site/year as possible, to improve the ability to do statistical analyses comparing sites and years. In addition, FMC should include in its report a current literature assessment of toxicological thresholds for the metals being monitored in order to facilitate interpretation of the data.*

Recommendation for similar monitoring programs in the future: *Crayfish or other chosen macroinvertebrates sampled for metal analyses should be done in such a way as to provide as many subsamples per site as possible, and include a current literature assessment of toxicological thresholds for the metals being monitored.*

4. To strengthen inferences about the possible effect of mining on the metal concentrations in Flambeau River invertebrates, it is recommended the monitoring of crayfish metals continue on a regular basis for at least 10 years. These analyses could be limited to only the five elements historically present at regularly detectable levels, i.e. zinc, aluminum, manganese, iron and copper.

The need for continued monitoring of the crayfish receives further support from a statement in the memo mentioned in #3 above, written by the Wisconsin DNR's Elisabeth Harrahy. In that letter Ms. Harrahy states: "However, because metals are expected to continue moving from the mine pit to the river, and because metals can build up in sediments over time and bioaccumulate in organisms (with potential for cascading up the food chain), continued monitoring could yield much important information."

Recommendation to augment FMC's crayfish monitoring program: *It is recommended that crayfish analysis, using protocols discussed above, continue for an additional 10 years. If significant changes are detected during the expanded monitoring period, an additional five years sampling beyond the ten years recommended should be required. These changes could be triggered statistically (the precautionary principle suggests using $p = 0.10$) by the biotic monitoring results, or even if not exactly statistically significant, by apparent unexplained spikes in metal concentrations in the crayfish.*

5. Chemical analyses of macroinvertebrates in addition to crayfish were not done by FMC. As mentioned in the macroinvertebrate report, because of the ability of macroinvertebrates to bioaccumulate metals, regular analysis of a select set of macroinvertebrates (in addition to crayfish) for total body metal concentrations could

provide much useful information with regard to tracking potential toxins that might be making their way into the higher food chain.

Recommendation for similar monitoring programs in the future: *It is recommended that monitoring programs such as those undertaken by FMC include whole-body elemental analyses of invertebrates in addition to crayfish – e.g. mayflies, stoneflies, mussels, etc.*

6. Inferences regarding the possible effects of human activities on river or stream ecosystems are strengthened when sampling sites for specimens such as crayfish, macroinvertebrates, sediment and surface water are spatially and temporally co-located. In particular, the measured level of metal concentrations in biota and sediments during monitoring is to an important degree affected by surface water metal concentrations. In case continued monitoring of crayfish by FMC discloses unforeseen changes in metal concentrations, it would be useful in attempting to explain those changes to have as much information on hand as possible visavis all possible causal mechanisms. It would therefore be amiss to not continue surface water monitoring of the Flambeau River per existing protocols.

Recommendation to augment FMC's crayfish monitoring program: *Surface water monitoring of the Flambeau River should: (1) continue for as long as crayfish are being monitored in the river (at least ten years); and (2) due to concerns over spatial co-location, be expanded to include not only the surface water sampling sites identified in the December 2007 Stipulation Monitoring Plan (SW-1, SW-2 and SW-3), but the crayfish sampling site at Port Arthur. Due to concerns over temporal co-location, surface water sampling should be timed so that samples are collected on the same days as crayfish are sampled, in addition to other scheduled dates.*

Recommendation for similar monitoring programs in the future: *Whenever possible, the various studies (e.g., metals analyses of crayfish, walleye, sediment and surface waters and/or biota surveys) implemented by an industry or agency to assess potential impacts of human activity on the riverine community should be spatially and temporally co-located.*

CONCLUSIONS

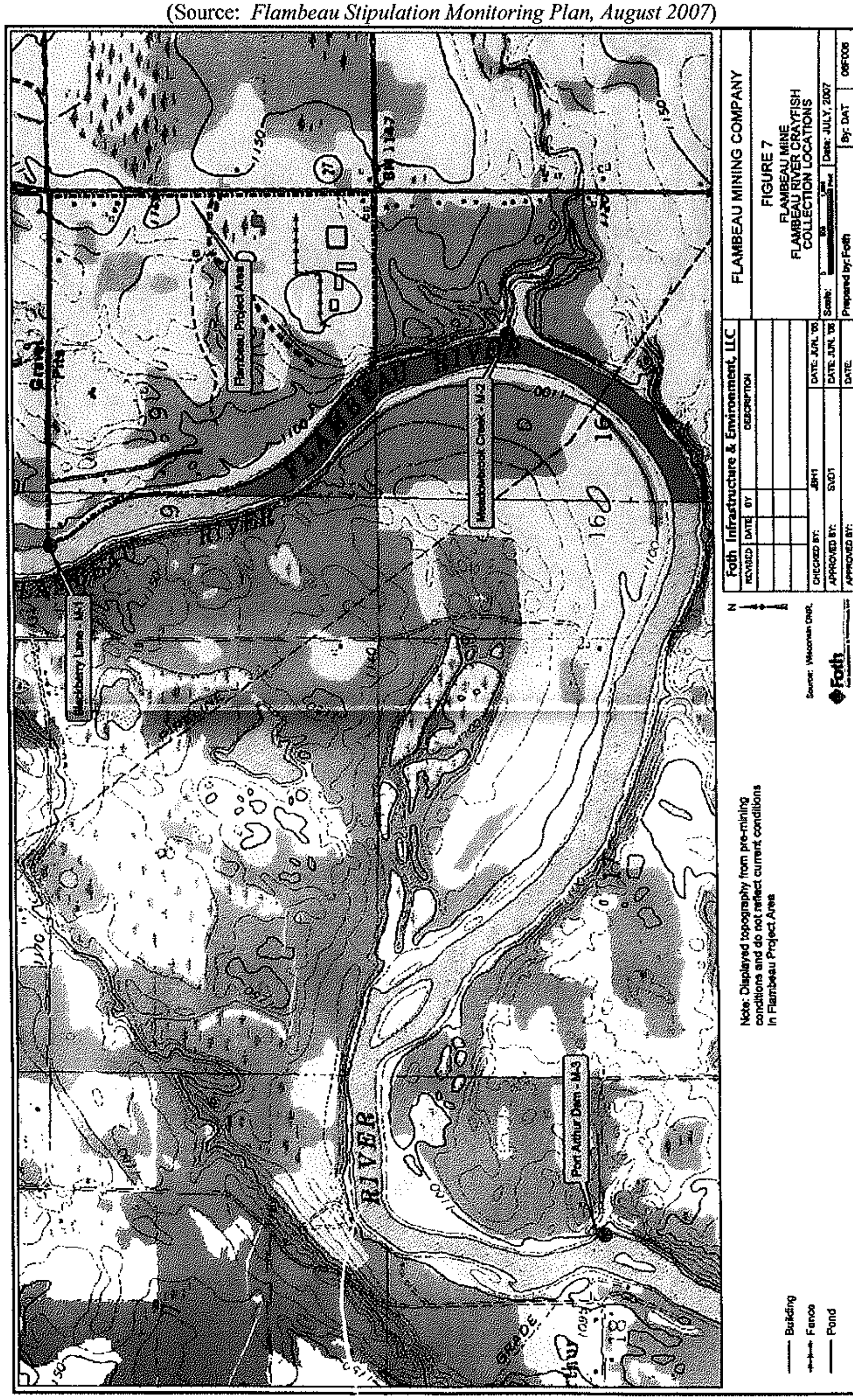
Copper was the element of interest that showed the clearest pattern during the period of monitoring crayfish whole-body metal concentrations. While levels of copper in the crayfish showed an overall increase both upstream and downstream from the mining activity, it was significantly higher at both downstream sites than upstream, and the gap between downstream and upstream sites widened over time, suggesting a possible mine effect. Copper levels did not appear to reach toxic or otherwise harmful levels in this organism during the time period in question (1991-2008), although one's confidence in that inference is lessened by the monitoring protocols used. Monitoring should continue and procedures be improved to strengthen any inferences made regarding the effect, if any, of mining activities on the benthic invertebrates such as crayfish.

[1] Bryan, G.W. (1967) J. Exptl. Biol ;46(2):281-96
[2] Guner, U. (2007) Environ Monit Assess 133:365–369
[3] López FJ, et al (2004) Environ Monit Assess. Apr-May;93 (1-3):17-29.
[4] Bagatto, G. and Alikhan, M.A. (1987), Bull. Environ. Contain. Toxicol. 38:1076-1081.

Appendix I

Crayfish Sampling Locations in the Flambeau River (1991-2008)

(Source: *Flambeau Stipulation Monitoring Plan, August 2007*)



Flambeau River Monitoring at the Flambeau Mine Rusk County, Wisconsin

4. WALLEYE TISSUE MONITORING
Analysis, Comments and Recommendations

prepared for
Wisconsin Resources Protection Council

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INTRODUCTION

Potentially toxic substances including various metals found in the surface waters and sediments of lakes and rivers can make their way into the vertebrate community inhabiting or making use of the aquatic ecosystem. This vertebrate community includes a variety of fish species, and of especial interest to humans, the edible or recreationally-important fish such as walleye. Most of us are familiar with warnings about consuming fish due to mercury accumulation in their bodies. Other metals can accumulate in fish as well due to natural or anthropogenic causes.

Because of the importance of fish to the riverine community and human populations, and because fish sampling is one way to measure human impacts on river ecosystems, industries located along riverways are sometimes required to monitor fish for bioaccumulation of potential toxins. Such was the case with Flambeau Mining Company (FMC), a subsidiary of Kennecott Minerals of Salt Lake City, Utah that constructed an open pit copper sulfide mine alongside the Flambeau River in the mid 1990s. The river formed the western boundary of the project area, and the pit itself was constructed to within 150 feet of the river. The Flambeau Mine was operational for four years. It ceased production in 1997 and has since been reclaimed.

In 1991-2000 and 2005-2008 FMC sampled walleye (*Sander vitreus*) on an annual basis at two different sampling sites in the Flambeau River. This was part of a broader monitoring program designed to ascertain any effects the company's Flambeau Mine might have on the biota in the river. These effects could occur during excavation of the mine, during its operation, and beyond the date of its operation if substances such as metals or other potential toxins or erosional runoff might be making their way through surface or groundwater into the river.

Locations chosen for walleye analysis in the Flambeau River are shown in the map included in Appendix I. They included the Ladysmith flowage (Site F-1; about 3.8 miles upstream of the mine) and the Thornapple flowage (Site F-2; about 7.6 miles downstream of the mine). Electroshocking was utilized to collect nine walleye specimens annually at each location. Walleye in specified size ranges, with the smallest being 10-12 inches in length and the largest 22 inches or greater, were targeted for collection. Specimens were handled, processed and analyzed as follows, as described in FMC's 1991 Annual Report:

> *Fillets (with skin left on) are to be tested for total mercury. The livers of the fish collected at each of the two sampling stations are to be composited into one upstream and one downstream sample. Each is to be analyzed for the metal parameters included on the list of analytical parameters for sediments. Each organism is to be measured for total length, sexed, and the stomach contents noted. The age of each individual fish is to be determined using commonly-accepted techniques.*

The focus of the present report is on the results of the liver analyses, and to a lesser degree, the fillet analyses.

In terms of the parameters tested, the composite walleye liver samples collected between 1991 and 2006 were analyzed for a suite of trace elements including aluminum [Al], silver [Ag], arsenic [As], cadmium [Cd], chromium [Cr], copper [Cu], iron [Fe], manganese [Mn], mercury [Hg], nickel [Ni], lead [Pb], selenium [Se], and zinc [Zn]. Beginning in 2007 samples were analyzed only for Cu, Fe, Mn, and Zn. The individual walleye fillets were only analyzed for total mercury (1991 – 2006). All trace element data are presented on a wet wt. basis.

Issues concerning the collection of baseline data, the selection of sampling sites, appropriate replication and toxicity assessment are discussed below.

SAMPLING AND REPORTING ISSUES

1. Adequate baseline data for the present study is lacking. According to Table 3.8-3 of *Volume 2, Environmental Impact Report for the Kennecott Flambeau Project, April 1989*, only two walleye specimens were collected for background analysis, a 20-inch fish caught at Thornapple Dam on 8/24/88 and a 14-inch specimen caught "north of Meadowbrook" on 6/20/88. This is problematic for several reasons:
    a. Two fish cannot be considered representative of the general walleye population in the Flambeau River upstream and downstream from the mine site. To establish reliable baseline conditions, several years of background monitoring data involving larger sample sizes should have been gathered.
    b. Since both Thornapple Dam and Meadowbrook Creek are downstream from the mine site, it appears that no upstream walleye specimen was collected as part of the baseline study. In addition, "north of Meadowbrook" is not a specific enough term to truly determine the site where the second fish was caught.
    c. Metal analysis performed on the two walleye specimens did not include aluminum, iron or manganese, three metals present in measurable quantities in walleye collected in later studies.
    d. Even though a more comprehensive monitoring program for walleye was put in place in 1991-1992, by that time significant pre-mining activity had already commenced at the site (see previous reports).

2. The upstream sampling site selected for the walleye study, effective 1991, was the Ladysmith Flowage, located about 3.8 miles upstream from the mine site. The downstream sampling site at Thornapple Dam is about 7.6 miles downstream from the project area. Fish collected as far upstream and downstream as this are subject to environmental variability which may readily not be related to the mining activity.

3. Individual walleye fillets from the 18 fish collected each year were analyzed for mercury content, allowing variations among individual fish to be assessed. The same procedure, however, was not followed for walleye liver analysis, for which composited samples were used. The availability of only one composite liver sample/site/year (1991-2008) limited the ability to do statistical analyses and draw meaningful conclusions regarding the level of potential risk to walleye. This is especially true for any given year's data. While it was possible, using data gathered over a number of years, to make statistical inferences concerning metal concentrations in walleye livers, without in-year replication, this is not possible

for any given year. E.g. in 1995 copper concentrations in liver tissue from walleyes collected upstream (Ladysmith flowage) were higher than in those from fish collected downstream at the Thornapple flowage (13 mg/kg vs. 3.6 mg/kg.) But in 1996 those differences had reversed themselves (26 mg/kg vs. 45 mg/kg.) This nearly double copper concentration downstream vs. upstream is quite striking; but without replication we can't know anything about the statistical significance of that difference. In other words, without in-year replication, we have to wait for a number of years' data to make statistical inferences about the differences observed. In the above example, copper levels measured annually in composite liver samples from downstream walleye were higher than in the upstream fish not only in 1996, but remained so for the next six years, thereby allowing one to make reliable statistical inferences *in retrospect*.

An important goal of monitoring is to provide current information about the status of an ecosystem, so management decisions can be made in a timely fashion, based on reliable statistical analyses. As it is, without in-year replication, these decisions require waiting for multi-year sampling results which only allow statements such as "Yes, there *was* a difference in parameter X between sampling sites," rather than, Yes there *is* a difference in parameter X between sampling sites."

Additional in-year replication will naturally also increase the reliability of statistical inferences when comparing data over a number of years.

4. Yet another limitation imposed by the lack of in-year replication in the FMC study design relates to toxicity assessment. As mentioned above, 9 walleye livers/site/year were composited for analysis. As a result, the variation in walleye livers among individual fish is not known. This makes it much harder to make reliable inferences, from a toxicological viewpoint, about the effects of the measured metal concentrations on individual fish. The theory behind compositing is that the concentration in a composite of fish is roughly equal to the mean for those fish had individual samples been analyzed. Compositing is often done to save money. In the present instance where 9 walleye have been collected at an upstream site and 9 at a downstream site, only 2 samples are chemically analyzed rather than 18 samples. What is lacking with a composite sample, however, is any idea of the variation that is present. For instance a mean of 20 can be arrived at with 2 different scenarios: (1) if the values for the 9 individual fish are 35, 47, 42, 20, 5, 8, 10, 6 and 7 or (2) if the values for 9 individual fish are 21, 19, 17, 22, 21, 20, 18, 19, and 23. Those 2 distributions tell us different things about the flowages they came from even though the means are identical in the two groups. There are more fish that have elevated concentrations in the first compared to the second scenario. If, for instance, there is a hazardous threshold of 25 then 1/3 of the fish are at risk in the first scenario whereas none are at risk in the second scenario. There is no way to adequately assess the toxicological risk without having data from individual fish rather than from a single composite sample.

5. The measured levels of metal concentrations in biota and sediments during monitoring are to an important degree affected by surface water metal concentrations. FMC, however, did not include surface water testing at either of the two walleye sampling sites as part of the study protocol.

6. It appears, from information provided by FMC, that the sampling sites for walleyes for 2007 were moved somewhat upstream from sampling sites used for previous years (see Appendix I and II.) Whether the sites were intentionally changed or if the labeling on the maps provided by FMC was simply not accurately done is unclear. Again, it is important to maintain across-year consistency in both sampling and reporting.

RESULTS

Table 1 shows that for walleyes, as for crayfish, for most years most metals were below detection limit. For that reason the further discussion of walleye liver metals involves only copper, zinc, iron, manganese, and aluminum which showed measurable levels.

Table 1. Number of years in which metals were below the detection limit in composite specimens, 1991-2006[1]
(n=13 years for crayfish and n=12 years for walleye)[2]

	Al	As	Ag	Cd	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Se	Zn
Walleye													
Ladysmith	3	11	10	2	9	0	0	4	0	8	11	7	0
Thornapple	3	11	10	7	10	0	0	4	0	8	11	8	0
Crayfish													
Blackberry Lane	0	10	11	9	8	0	NT	11	NT	9	11	11	0
Meadowbrook Creek	0	10	11	9	8	0	NT	11	NT	9	11	11	0
Port Arthur Dam	0	10	11	9	7	0	NT	10	NT	8	11	11	0

NT = Not Tested

[1] Crayfish and walleye were also tested in 2007 and 2008, but for only copper, iron, zinc and manganese, all of which were above the detection limits.
[2] Excluding studies conducted in 2007 and 2008, crayfish were sampled in 1991-2001, 2004 and 2006; walleye were sampled in 1991-2000 and 2005-2006.

Concentrations of copper, zinc, iron, manganese and aluminum in composite liver samples from walleye collected upstream and downstream from the mine site were plotted by year with the vertical dashed lines indicating the period of mine operation (Fig. 1-5, below). Figures 6 and 7 show mercury concentrations in individual (not composite) fillets.

Fig. 1: Walleye liver copper concentrations, ug/g, wet weight (one composite sample/site/year)

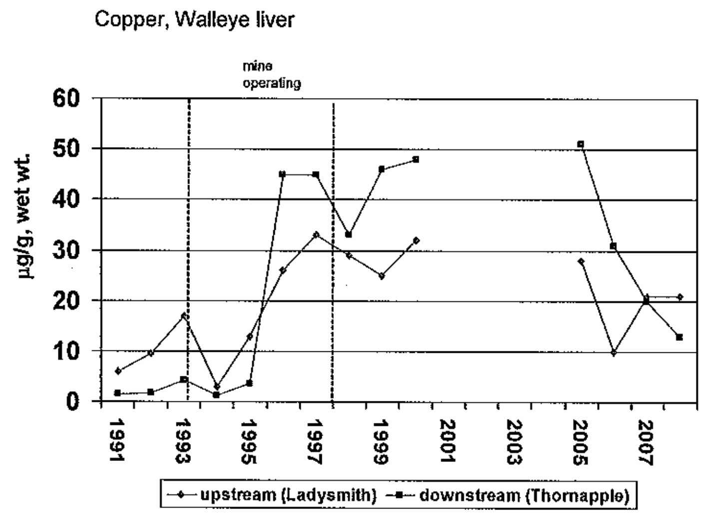


Figure 1.

Fig. 2: Walleye liver zinc concentrations, ug/g, wet weight (one composite sample/site/year)

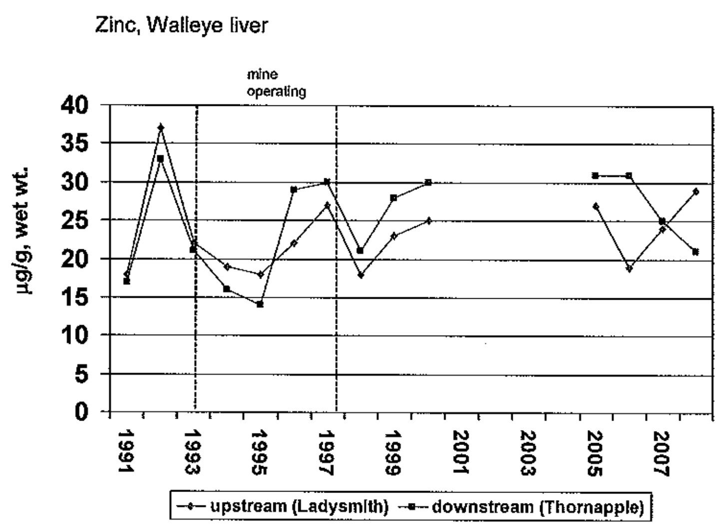


Figure 2.

Fig. 3: Walleye liver iron concentrations, ug/g, wet weight (one composite sample/site/year)

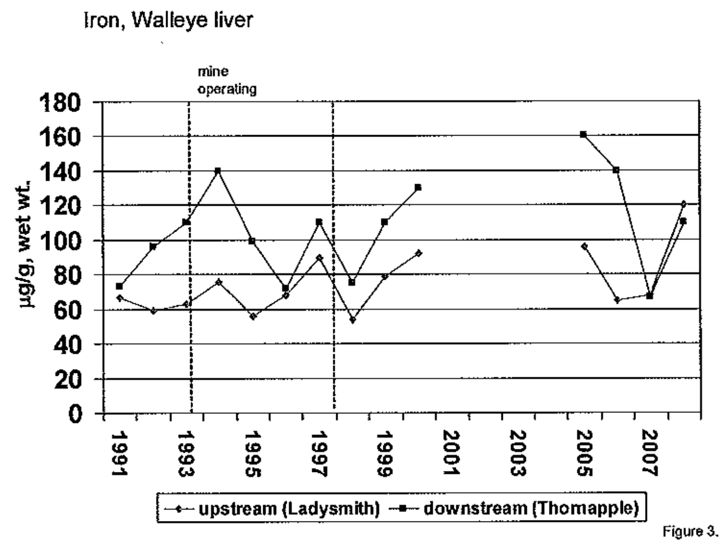


Fig.4: Walleye liver manganese concentrations, ug/g, wet weight (one composite sample/site/year)

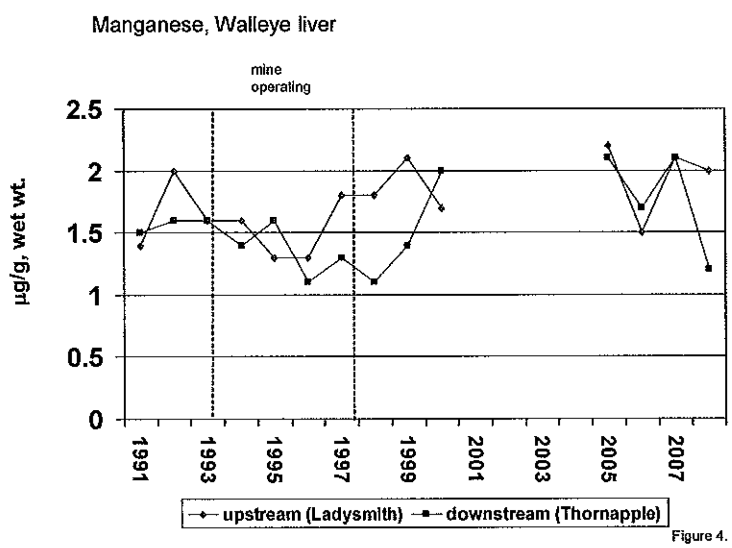


Fig. 5: Walleye liver aluminum concentrations, ug/g, wet weight (one composite sample/site/year)

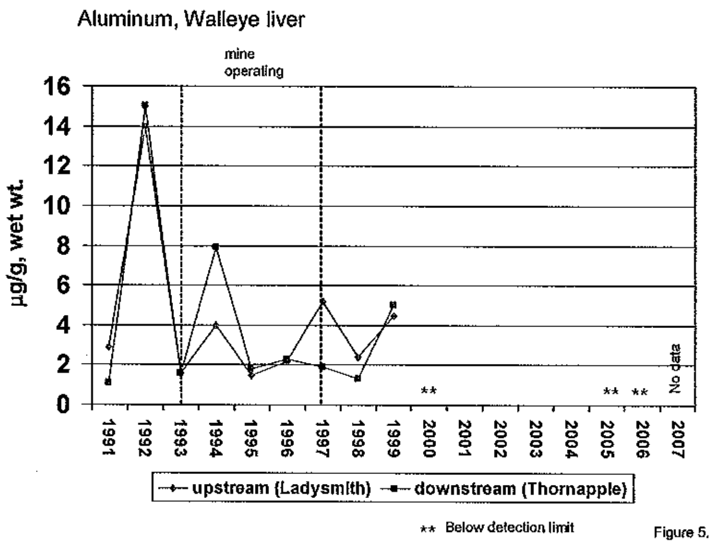


Figure 5.

Fig. 6: Individual walleye fillet geometric mean mercury concentrations, ug/g wet wt.

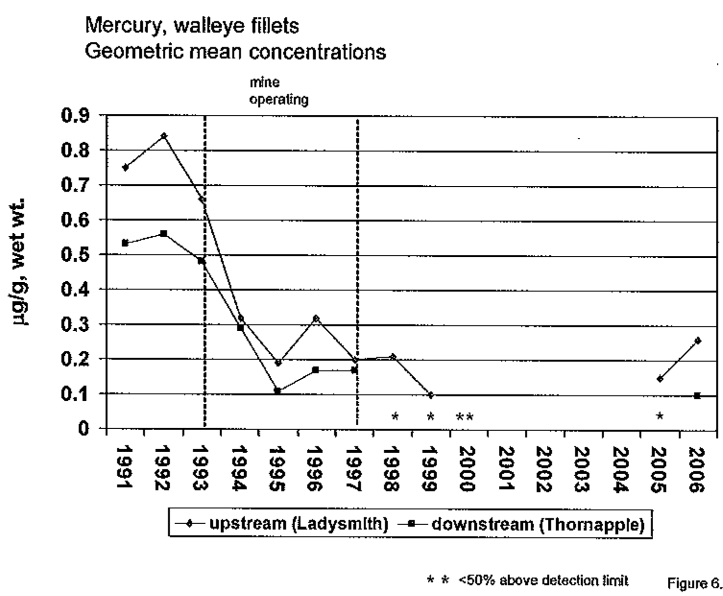
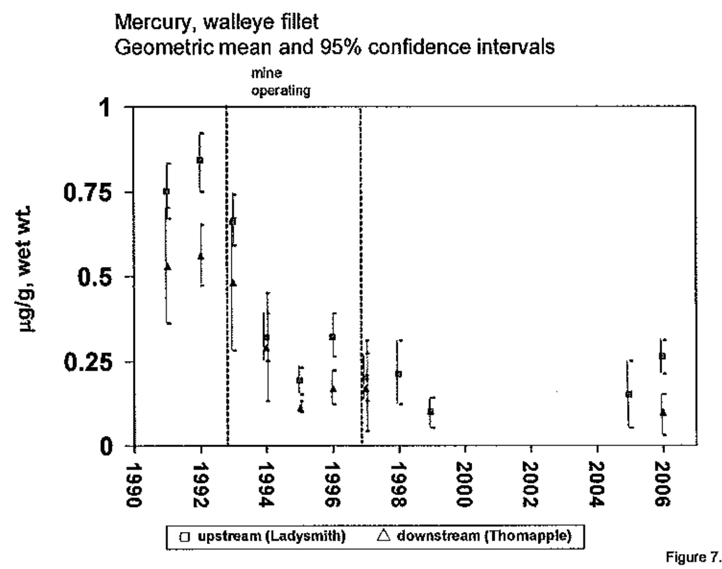


Figure 6.

Fig. 7: Individual walleye fillet geometric mean mercury concentrations with 95% confidence intervals, ug/g wet wt.



DISCUSSION OF RESULTS

Based on visual inspections of the data, it appears that prior to the commencement of ore production at the Flambeau Mine in 1993 (Figure 1), copper concentrations in liver samples from walleye caught upstream from the mine site were higher than in downstream fish. A similar view was expressed by FMC's consultant in its 1996 fish sampling report: "A review of historical information (data from 1991 to 1995) suggests that relative values for copper in walleye liver from the Thornapple Flowage are fairly consistent. Walleye liver values from the Ladysmith Flowage are more variable and, in general, much higher than in the Thornapple Flowage." This trend, however, appeared to reverse during the operational phase of the Flambeau Mine, when higher copper levels began to be measured in downstream fish. This shift, first detected in walleye tested in 1996, prompted FMC's consultant to repeat the copper test done on the 1996 liver samples in an effort to confirm the results, shown in Table 2 (see *Report on Activities Associated with 1996 Fish Sampling, Appendix J, FMC 1996 Annual Report*). Similar results prompted a repeat of the same tests for 1997 (see discussion below.)

Table 2: Copper concentrations in composite walleye liver samples, ug/gm, wet weight, 1995-1997

Sampling Site	Copper Concentration in Walleye Liver (ug/gm)				
	1995	1996		1997	
	Single analysis	Original analysis (9/19/96)	Repeat analysis (10/24/96)	Original analysis (9/16/97)	Repeat analysis (12/11/97)
Upstream (Ladysmith Fl.)	13	26	45	33	33
Downstream (Thornapple Fl.)	3.6	45	40	45	43

As shown in Table 2, the increased copper levels between 1995 and 1996 were indeed confirmed. From 1995 to 1996 walleye liver copper concentrations upstream from the mine increased on the order of 2 to 3-fold. Downstream, however that increase was on the order of 11 to 12-fold. (Also see Figure 1, in which the original analyses were used). Upon reviewing this and related data, FMC's consultant suggested in its 1996 fish sampling report that the 1996 copper results "be flagged as suspicious and that monitoring data for the 1997 field season be used to evaluate possible trends and/or further explain the 1996 data set."

In 1997 the upstream composite liver sample registered a copper level of 33 mg/kg, and the downstream sample registered 45 mg/kg – both similar to the 1996 results (see *Report on Activities Associated with 1997 Fish Sampling, Appendix E, FMC 1997 Annual Report*). About three months later the company re-ran the test, and the resultant values were similar to the original ones (upstream came back at 33 mg/kg and downstream 43 mg/kg). Upon reviewing the data, FMC's consultant concluded the following in its 1997 fish sampling report:

> *"A review of the historical information (data from 1991-1997) suggests that relative values for copper in walleye liver from the Thornapple Flowage and from the Ladysmith Flowage are consistent. Moreover, it is observed that year-to-year increases and decreases in concentrations of copper in the liver of walleye are comparable from the upstream flowage to the downstream flowage. [We have] reviewed other data for the Flambeau River for this time period including crayfish tissue analysis, surface water data and sediment deposition data. None of these data sets show other than consistent copper or other metals concentrations in the ecosystem for the time period of 1991 to 1997. It is concluded that the operation of the mine has had no impact on the concentrations of metals which are observed in the liver of walleye."*

In light of the data presented above, one is naturally led to question the company's conclusion that "*None of these data sets show other than consistent copper or other metals concentrations in the ecosystem for the time period of 1991 to 1997.*" And while the observed trends in metal concentrations do not prove causation, neither do the data provide support for FMC's further statement that "*...the operation of the mine has* *had no impact on the concentrations of metals which are observed in the liver of walleye."*

All walleye liver studies conducted between 1996 and 2006 showed higher copper concentrations in the livers of downstream fish compared to upstream fish (see discussion following Table 3.) In 2006, copper levels in the livers of both upstream and downstream fish began to decrease toward pre-mine levels, with the latest data (2008) showing higher copper levels in the upstream fish, as was reported prior to mining.

There is no obvious trend in zinc in walleye livers, other than perhaps somewhat of an increase during mining activities, though never to concentrations exceeding values previous to mining. Iron likewise shows no clear trend, though downstream concentrations were always at or above upstream concentrations. There were no clear trends in manganese levels. For this metal, upstream concentrations tended to be higher than downstream. Aluminum concentrations varied greatly over time, and seem in general to have been decreasing.

Mercury in walleye fillets decreased over the period of testing, with some evidence of an increase between 2006 and 2007. (Analyses on walleye fillets collected in August of 1988 gave 0.24-0.26 ug/gm wet weight, somewhat below the 1991 values. Additional background data would likely help very much in explaining the trends in mercury noted.) Figure 7, showing the 95% confidence intervals for the mercury determinations of individual fish, indicates a sizable between-individual variance for the walleyes analyzed for mercury. The amount of variation also changed greatly from year to year, without any definite pattern. The fact that upstream and downstream walleye fillet mercury levels vary widely, together, suggests some non-mining-related cause.

Statistical analyses done on the walleye copper, zinc, iron, manganese, aluminum and mercury data, using Minitab – Release 15, are summarized in Table 3.

Table 3: Results of Statistical Tests for Metal Concentrations in Walleye Livers (1991-2008)

Metal	Test	Significant? (p)
Copper	Two-Way ANOVA Upstream*, Downstream**	Year p = 0.284 Site p < .001; Mean(Up) = 19.52 mg/kg, Mean(Down) = 24.59 mg/kg
Zinc	Two-Way ANOVA Upstream* vs. Downstream*	Year p = .009 Site p = .352
Iron	Two-Way ANOVA Upstream*, Downstream*	Year p = .062 Site p <.001; Mean(Up) = 75.2 mg/kg Mean(Down) = 106.6
Manganese	Two-Way ANOVA Upstream*, Downstream*	Year p = 0.147 Site p = 0.128
Aluminum (1991-2006)	Two-Way ANOVA Upstream**, Downstream**	Year p = 0.045 Site p = 0.81
Walleye fillet Mercury (1991-1997)	Two-Way ANOVA Upstream*, Downstream*	Year p = 0.001 Site p = 0.011; Mean(Up) = 0.47 ug/g, Mean(Down) = 0.33 ug/g

* Untransformed data considered normal by Minitab
** Data flagged as non-normal, normalized by Johnson Transformation

Table 3 indicates that there is a statistically significant difference ($p<.05$) in walleye liver metal concentrations upstream vs. downstream for copper and iron, with the downstream sites showing higher concentrations. Aluminum concentrations show a barely significant difference over years, but not between sites. ANOVA results suggest mercury in walleye fillets varied significantly from year to year, and were higher upstream than downstream.

Comparing the figures showing these elemental compositions in crayfish with those in walleye livers suggests similar year-to-year patterns. In particular, copper concentrations increased in both crayfish and walleye tissue compared to pre-mining levels beginning in the mid-1990s. The increase was more noticeable in walleye compared to crayfish. That is not surprising, since the walleye are likely eating some crayfish. It is also likely their other prey would mimic these swings in metal composition. These similar trends in elemental composition between crayfish and walleye suggests that the walleye sampled farther upstream represented to a degree, at least, what the biota was doing closer to the mine.

Copper, and to a lesser degree iron, seemed to be the only elements that may have been elevated because of mining, but other unknown factors common to the entire drainage were also operating. It is difficult, however, to infer true background levels of these metals in biological tissue, since there was some pre-mining activity at the mine site beginning in 1991 (see previous reports). Walleye liver analyses were done on two fish collected in 1988, both apparently downstream from the mine site. Copper concentrations in these analyses varied from 2-5 ug/gm, and zinc 6-13 ug/gm, similar to results from 1991, but iron was not tested at all. With such a limited sample size, no upstream specimens, and a limited test panel, reliable conclusions cannot be drawn with regard to baseline concentrations. Additional pre-activity background data would be very useful.

A limited literature search was made to compare copper concentrations in Flambeau River walleye with those found in other ecosystems. In an Ontario study involving northern pike, a close relative of the walleye, copper concentrations in liver tissues were approximately 11 µg/g wet wt.[1] Beginning in 1996, and continuing through 2005, Flambeau River walleye liver tissues consistently exceeded this value, in both upstream and downstream fish. Downstream concentrations, however, appeared to have increased more than the upstream concentrations. The analysis of individual rather than composite walleye liver samples would increase one's ability to infer differences, or the lack thereof, between upstream and downstream locations.

Concentrations of copper in walleye liver tissue appear to be moving downward, but in 2008 were still approximately nine times the 1991 "baseline" level in downstream fish (13 mg/kg vs. 1.5 mg) and three and a half times the "baseline" in upstream fish (21 mg/kg vs. 6.0 mg/kg.). The 2007-2008 results also, for the first time in more than ten years, provide downstream walleye liver copper concentrations which are less than those upstream. The sampling which will be done over the next few years will help determine whether this declining trend is real or not. While the wide variation and differing patterns of metal concentrations in walleye liver – and fillets – suggests that other environmental factors in the river other than those connected with mining had an important influence on these values, the data presented and the lack of replication make it impossible to conclude that FMC's activities had no effect on metal concentrations in walleye. Therefore the conclusion FMC drew in their 2006 annual report that "Based on review of the data, it is concluded that the operation of the mine, including the time window when reclamation and habitat restoration activities are being conducted, has had no impact on the concentrations of metals which are observed in the liver or tissue of walleye" is not warranted.

RECOMMENDATIONS

Because some of the suggested improvements to FMC's Flambeau River walleye monitoring program that were mentioned earlier cannot be implemented retroactively but could be useful in the design of monitoring programs in the case of future mining activity, recommendations are listed in two different categories: (1) General recommendations, based on perceived shortcomings of monitoring in the present case, to improve the utility of similar monitoring programs undertaken by others in the future; and (2) Recommendations for how to continue and augment the present study to better track potential impacts of the Flambeau Mine on the associated ecosystem.

1. Though some preliminary walleye monitoring was undertaken in 1988, data collection was insufficient to draw meaningful conclusions regarding baseline metal levels in walleye tissue. "Background" data from 1991 and 1992 may have been affected by preliminary work at the mine-site already underway in 1991. Several years' true background monitoring – before any on-site human disturbance – should always be gathered, and the procedures and protocols of that background sampling should be the same as subsequent procedures.

Recommendation for similar monitoring programs in the future: *It is recommended that adequate baseline studies be completed before initiating pre-mining or mining activity, and the protocols used for these baseline studies, including sampling locations, should be continued into the period of monitoring during pre-mining, mining or post-mining activity.*

2. It may not physically be realistic to require fish sampling directly above and directly below activities such as those undertaken by the FMC along the Flambeau River. However, fish collected as far upstream as the Ladysmith Flowage (3.8 miles) and downstream as the Thornapple Flowage (7.6 miles) are subject to environmental variability which may readily not be related to the mining activity. Whether walleyes collected nearer the mine, upstream or downstream, would have elemental compositions regularly differing from those collected farther afield is difficult to say. They might, depending on random, sporadic or regular events, or they might not. However, whenever possible – and this might require choosing a different species of fish as biomonitor – samples should be collected as near to upstream and as near to downstream of the potentially impacting human activity as possible.

Recommendation for similar monitoring programs in the future: *It is recommended that sampling locations for fish species being monitored be located as near to upstream and downstream of the potentially-impacting human activity as possible.*

3. Because the majority of the data were from composited samples (one composite sample/year/location), there was no measure of variability. This lack of replication and data on variability among individual samples makes it difficult to interpret what the metal concentrations measured in liver tissue mean from a toxicological viewpoint. Although earlier sampling can not be redone at this location, having information on current levels of variability for each of the trace elements would allow for a fuller assessment of potential risk to fish. Therefore it is recommended that walleye livers be analyzed individually, especially for copper but for the other elements as well, for some portion of the monitoring period. That will provide approximately 9 replicates per location upon which to calculate variability. It would be desirable to have a measure of variability for two or more years of data given the level of inter-annual variation seen in the Hg fillet data set. All of the other caveats for sampling would need to be considered, such as collecting the same species, same size or range of sizes, same timeframe, same habitat, etc. In addition, it would be helpful for FMC to include in its reporting a current literature assessment of toxicological thresholds for metals of concern (copper, iron, zinc, manganese and aluminum), in order to facilitate interpretation of the data.

Statistical reliability of comparisons of upstream and downstream walleye liver metal concentrations would be greatly enhanced if samples were tested individually. This is yet one more reason that individual as opposed to composite testing of walleye liver specimens is recommended for at least two years of the monitoring period.

Recommendation to augment FMC's walleye monitoring program: *It is recommended that walleye livers be analyzed individually, especially for copper but for the other elements as well, for two or more years of the monitoring period. FMC should also include a current assessment of toxicological thresholds for metals of concern in its report.*

Recommendation for similar monitoring programs in the future: *It is recommended that all specimen tissues extracted for metals analysis – fillet, liver or other – be analyzed on an individual rather than composite basis, for at least some portion (two or more years) of the monitoring period, in order to establish an estimate of variation among individuals. The entity initiating mining activity should include a current assessment of toxicological thresholds for metals of concern in its report.*

4. To strengthen inferences about the possible effect of mining on the metal concentrations in Flambeau River walleye, and to clarify if the recent declining trend in copper levels in downstream fish is real or not, it is recommended the monitoring of metals in walleye liver tissue continue on a regular basis for at least 10 years. These analyses could be limited to the five elements historically present at regularly detectable levels, i.e. copper, zinc, iron, manganese and aluminum.

Recommendation to augment FMC's walleye monitoring program: *It is recommended that walleye liver tissue analysis, using protocols discussed above, continue for an additional 10 years. If significant changes are detected during the expanded monitoring period, an additional five years sampling beyond the ten years recommended should be required. These changes could be triggered statistically (the precautionary principle suggests using* $p = 0.10$*) by the biotic monitoring results, or even if not exactly statistically significant, by apparent unexplained spikes in metal concentrations in the walleye liver tissue.*

5. The measured level of metal concentrations in biota and sediments during monitoring is to an important degree affected by surface water metal concentrations. In case continued monitoring of walleye discloses unforeseen changes in metal concentrations, it would be useful in attempting to explain those changes to have as much information on hand as possible visavis all possible causal mechanisms. It would therefore be amiss to not continue surface water monitoring of the Flambeau River per existing protocols.

Recommendation to augment FMC's walleye monitoring program: *Surface water monitoring of the Flambeau River should: (1) continue for as long as walleye are being monitored in the river (at least ten years); and (2) due to concerns over spatial co-location, be expanded to include not only the surface water sampling sites identified in the December 2007 Stipulation Monitoring Plan (SW-1, SW-2 and SW-3), but the walleye sampling sites at the Ladysmith Flowage and Thornapple Flowage. Due to concerns over* *temporal co-location, surface water sampling should be timed so that samples are collected on the same days as walleye are sampled, in addition to other scheduled dates.*

CONCLUSIONS

There was considerable among-year variation in metal concentrations in the walleye livers and fillets, which is typical for trace element concentrations in aquatic biota. Based on both visual inspection of the data and statistical analyses, there appears to have been an increase in walleye liver copper concentrations subsequent to mining, with downstream concentrations being significantly higher than upstream concentrations. This suggests a possible mining effect. The same can be said for crayfish whole-body specimens, as discussed in a separate report, although the elevation in copper levels appeared to be less pronounced in crayfish.

Iron concentrations in walleye livers were higher downstream than upstream, though this was true before mining activity began, and the trend in concentrations subsequent to the start of mining activities is not clear. Zinc, manganese, and aluminum concentrations in walleye livers do not show clear trends or between-site differences. Had the study protocol included within-year replication of liver samples instead of only one composite sample per site per year, one's ability to draw statistically defensible conclusions from the study at hand would have been significantly enhanced. Walleye fillets, which were tested individually, showed highly variable within-year mercury levels. These levels were significantly higher upstream than downstream, and declined significantly over the course of the study.

Suggested improvements in monitoring procedures would allow making stronger inferences about the effects of mining activity, if any, on walleye metal loads.

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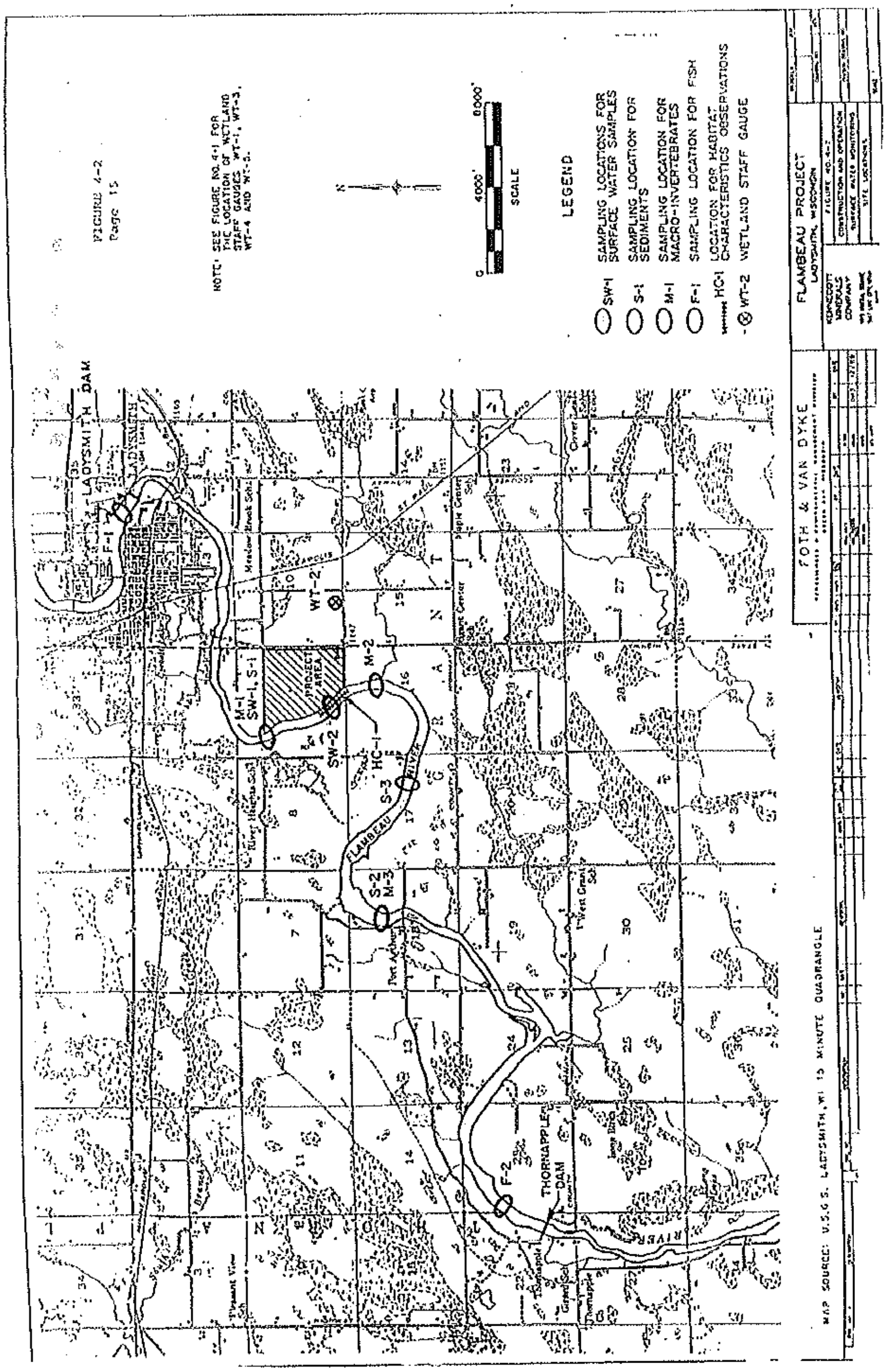
[1] Eisler, R. 1998. C Biol. Sci. Report USGS/BRD/BSR 1997-0002, Contaminant Hazard Reviews Report No. 33. 120 pg. Available online at http://www.pwrc.usgs.gov/

Appendix I

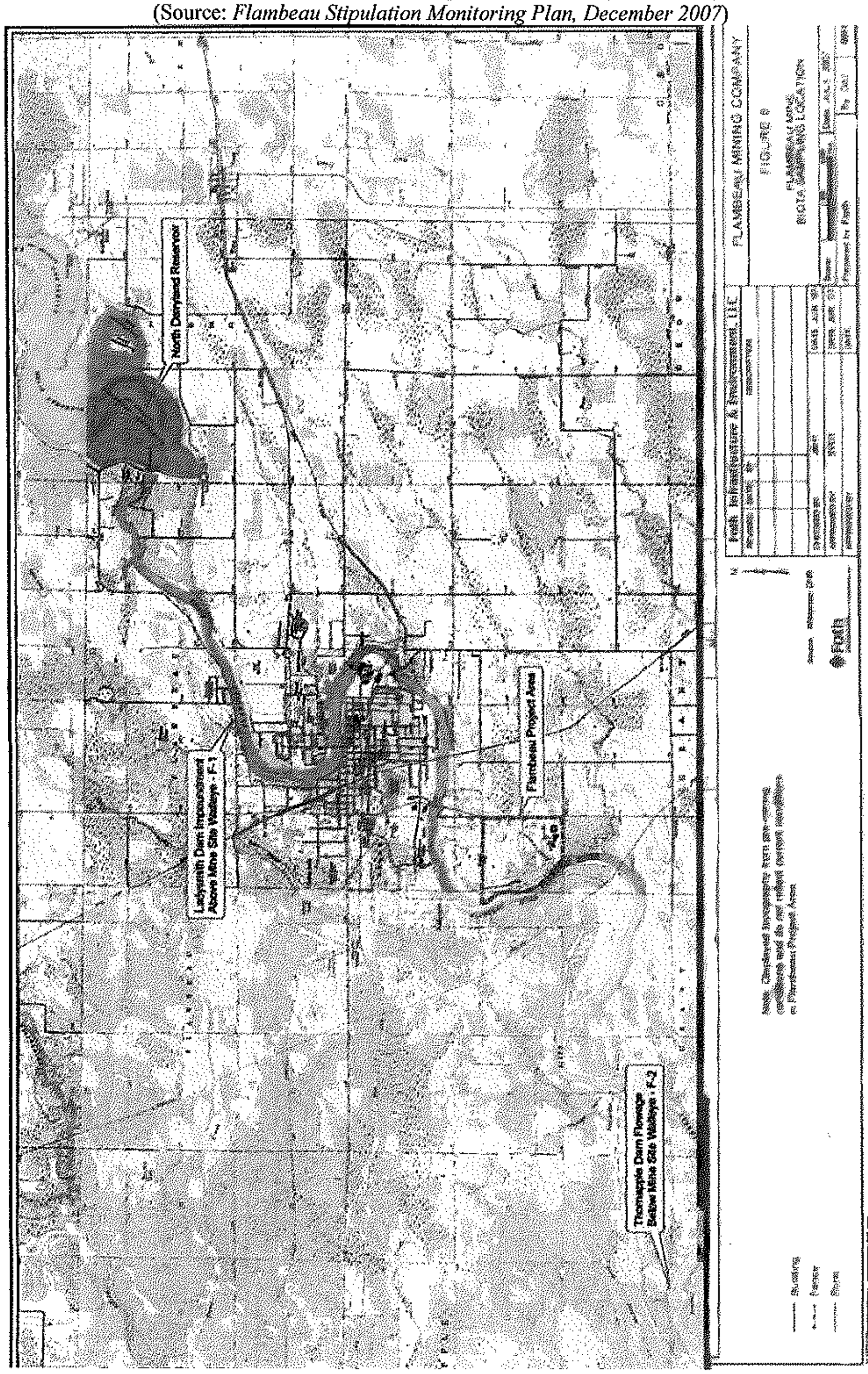
Flambeau River Surface Water, Sediment and Biota Sampling Locations Used at One Time or Another between 1991 and 2007 (Source: *Flambeau Mining Company 1993 Annual Report*)



Appendix II

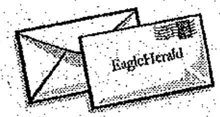
Flambeau River Walleye Sampling Locations (2007-2008)

(Source: *Flambeau Stipulation Monitoring Plan, December 2007*)



LETTERS

Editor's note: *Please include your name, address and telephone number on all letters to the editor.*



Writer shares information about Back Forty Mine

Dear Editor,

Following is a piece of information that residents of this area seem to be overlooking but should instead be paying very close attention to.

The American Heritage Dictionary of the English Language defines:

- Cyanide: Any of various salts or esters of hydrogen cyanide containing a CN group, especially the extremely poisonous compounds of potassium cyanide and sodium cyanide.
- Potassium cyanide: An extremely poisonous white compound KCN, used in the extraction of gold and silver from ores.
- Sodium cyanide: A poisonous white crystalline compound NACN, used in extracting gold and silver from ores.

It has already been determined that these poisons will be used in the mining process at the Back Forty Mine site.

According to the American Medical Association Medical Guide:

- Lead poisoning: Lead is a powerful poison, and workers exposed to high concentrations of the metal may develop damage to their kidneys or nervous systems. There is a public health problem of lead poisoning, especially of children, from lead-based paint found in older homes and buildings, and from water pipes into tap water.

Check out PBS's NOVA "Water Crisis in Flint, Michigan" documentary, produced by Kevin Lavery.

On a side note, pulverized rock can contain lead which would be taken out along with other minerals in the mining process.

There are more, many more, health problems that could arise as the result of mining. Check it out yourself online or at our local libraries. You should not want this for your children, the elderly or even yourself. Educate yourself and then stand up for what is good and right.

Carole J. Boerner
Marinette/Menominee

Eagle Herald
7-29-17

Wisconsin Wildlife Federation

Senator Tiffany and members of the Senate Sporting Heritage, Forestry and Mining Committee, the Wisconsin Wildlife Federation is appearing "For informational purposes" on Senate Bill 395 which revises certain nonferrous mining regulations. The Federation has been significantly involved in past mining regulation changes and in several mining permit processes, the most recent ones being the Federation strongly opposing the ferrous mining bills related to the Penokee mine and opposes the Back Forty mine in Michigan because of its potential severe negative impact on the important sturgeon and small mouth bass fishery of the Menominee River.

I personally had extensive mining regulation experience during my tenure at the Department of Natural Resources, having various roles in the regulation of four separate metallic mines. Also on behalf of the Wildlife Federation and at the request of former Senators Tim Cullen and Dale Schultz, I was involved in negotiating with mining industry representatives a compromise alternative draft of the aforementioned ferrous mining bill, portions of which were introduced as legislation by Senators Cullen and Schulz.

SB 395 contains several provisions of that negotiated alternative iron mining bill and the Federation remains in agreement with those provisions. However there are three portions of the SB 395 that we believe need changing in order to assure that the environment and neighboring landowners are protected and that State of Wisconsin taxpayers are not holding the bag for substantial pollution cleanup costs from a future sulfide in Wisconsin.

The three sections of the bill that need amendment are:

1. The replacement of the current "Mining Moratorium" provision of current law. While the current "mining moratorium" language is flawed and ineffectual in providing valuable information insuring that future sulfide mines in Wisconsin are environmentally sound, the principle behind the mining moratorium law remains very important. The mining moratorium section of current law should not just be deleted but rather should be replaced by a requirement that nonferrous mining applicants submit pollution abatement technology for the mining project that has been proven to be effectual and reliable in meeting environmental standards. That would be far more beneficial to mining regulators than the current mining moratorium law provisions.
2. Secondly, the bill should be modified to require that if the mining company makes significant changes to its initial bulk sampling plan after it is submitted to the DNR for review, the applicant must submit an amendment to the plan documenting those changes and including a revised reclamation plan.
3. Thirdly and **most importantly**, the current perpetual irrevocable trust should not be completely removed. The irrevocable trust financial assurance in NR 132 provides financial protection broader in scope than the chapter 293 mine reclamation bond and the chapter 281 long term assurance bond for the mine waste site. In addition, in light of the pollution history of sulfide mining, there needs to be assured financial assurance for a substantially longer period of time than the 40 years required by the long term assurance bond for the mine waste site. Future generations of Wisconsin taxpayers should not be left holding the bag of substantial mining cleanup costs.

Please find attached written testimony providing more detailed information supporting the need for these three amendments to SB 395. The Federation will be very willing to work with the bill authors and representatives of the mining industry on bill amendment language to address the aforementioned three concerns.

Submitted by George Meyer
Executive Director
Wisconsin Wildlife Federation
September 6, 2017

1. Mining Moratorium Language Replacement

Section 293.50, Wisconsin Statutes, also known as the mining moratorium law, was enacted by the Legislature in 1998 during the permitting process for the proposed Crandon mine in Forest County. The law basically required an applicant for a sulfide mine to submit proof that a Canadian or U.S. sulfide mine had operated for 10 years and another mine that had been closed for 10 years without an environmental violation or causing environmental pollution.

The Department of Natural Resources, based on the recommendations of experienced mining regulatory staff, opposed the mining moratorium bill for several reasons. It was the Department's conclusion that the law would not provide any significant information that would help assure that any future sulfide mine proposed in Wisconsin would not cause pollution. All mines are unique in their geological and hydrogeological characteristics and mines in other states or provinces would not necessarily translate to a Wisconsin mining location. In addition, since the sample mines would have had to be in existence for a lengthy period of time and necessarily been planned and designed well before their opening or closure, the technology associated with those mines would have been old and likely outdated technology.

After the mining moratorium law was enacted, the Crandon mine applicant did submit three sample mines, one had been in existence for over 10 years and was still operating, another had been closed for 10 years and one that had been open for more than 10 years and closed for 10 years. One was in the desert of Arizona, one was in the permafrost of the Northwest Territories and the third was in the foothills of a mountain range in California. None bore any resemblance to the topographical and hydrogeological conditions of the Crandon mine. A great amount of staff time was spent sending staff to those sites to inspect the mines and conferring with the proper state and provincial mining regulatory staff. This cost was then passed onto the mining company. None of the resulting information was helpful to the Crandon mine regulatory process. In addition the Department reviewed the information from those three mines and the preliminary staff judgement was that the sample mines met the standards of the mining moratorium law. The information on those three mines is available to being used by future sulfide mining companies to show compliance with the current mining moratorium law.

The Department while opposing the bill creating the mining moratorium law testified the bill should be amended to require the sulfide mining applicant provide information that the technology that they were proposing for the mine had previously been used and proven to meet environmental standards. The Wisconsin Wildlife Federation is requesting that the bill be amended to include such language. In fact it would be a true "Prove it First" provision.

2. Bulk Sampling Plan Amendment Language

SB 395 make changes to the current statutory bulk sampling plan review process. One deficiency in the new bill language is that it does not address the situation where, after there has been a thorough DNR review of all the components required for a bulk sampling plan including the reclamation plan, the company makes significant changes in its bulk sampling process. The bill should be modified to require that if there are significant changes, the applicant shall submit to DNR an amendment to the plan including an amended reclamation plan if necessary.

3. Retention of Greater Long Term Care Financial Responsibility

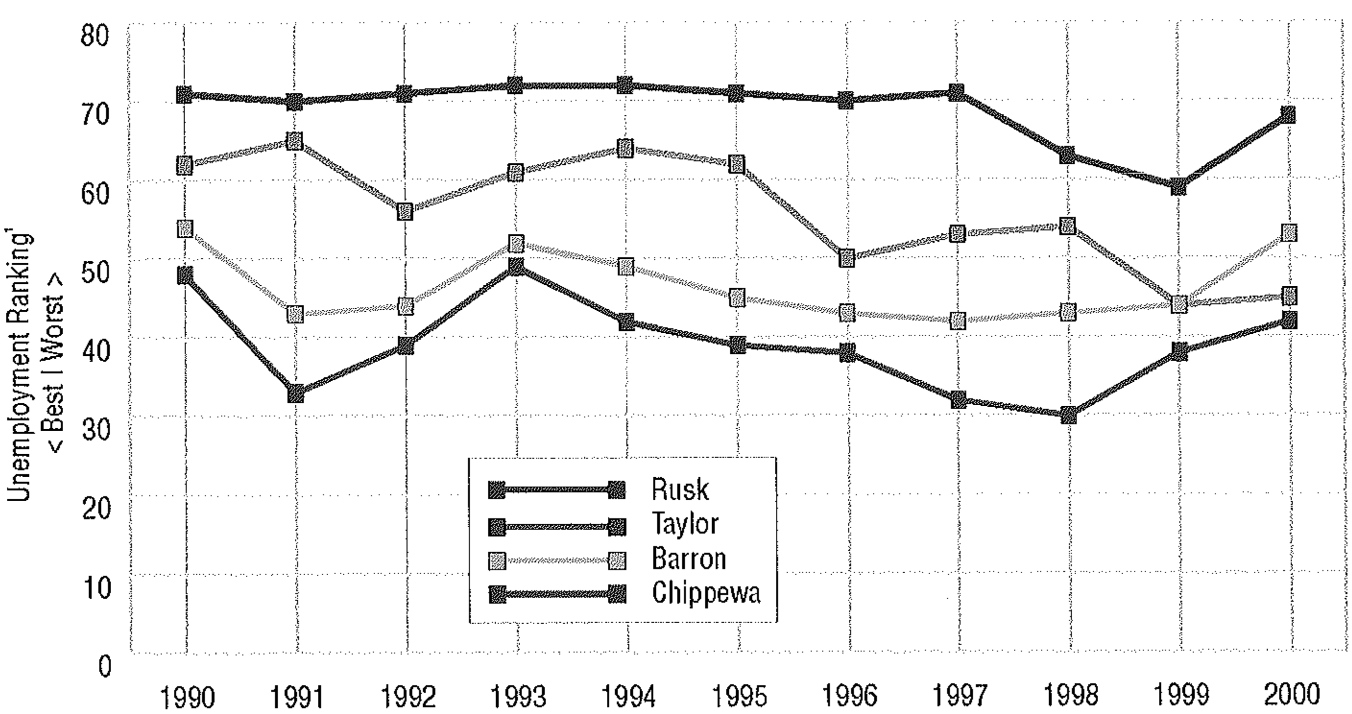
Under chapters 293 and 281, Wisconsin Statutes, DNR requires mining applicants to furnish bonds for reclamation of a completed or abandoned mine site and a long term care bond for the mining waste site. These two bonds do not cover all of the pollution potential that may result from sulfide mines. In addition, the longer of the two bonds, the long term care bond for the mining waste site only lasts for forty years.

During the Crandon mine regulatory process, it became evident that the complexities of mining sites and the historical substantial pollution problems associated with sulfide mining required a long term financial assurance instrument covering all of the potential sources of pollution from a sulfide mining site and that the assurance instrument would need to last for more than forty years.. As a result, section NR 132.085, Wisconsin Administrative Code, was adopted to assure that Wisconsin taxpayers and affected neighboring landowners would not have to bear the potential substantial cost of long term failure of a mining site. That section requires a sulfide mining applicant to enter into a perpetual irrevocable trust agreement with sufficient financial backing to assure that there would be sufficient finances available perpetually to cover any preventative and remedial costs associated with a sulfide mine. The risk of long term pollution from a future sulfide mine in Wisconsin still exists. While mining companies may feel that the current perpetual irrevocable trust fund requirement of NR 132 is unreasonable and onerous, the alternative to falling back on the 40 years long term care financial assurance provisions of section 289.41 (1m) (g) is not considered adequate by former experienced mining regulators to protect the citizens of Wisconsin.

Economic Indicators for Rusk County and Its Neighboring Counties, Before, During and After the Mining Years:

-Annual Unemployment Rate
-Percentage of Total Population Living in Poverty
-Percentage of Children Living in Poverty
-Annual Per Capita Income

The Non-Effect of the Flambeau Mine on Rusk County's Annual Unemployment Rate



The Flambeau Mine operated between 1993 and 1997.

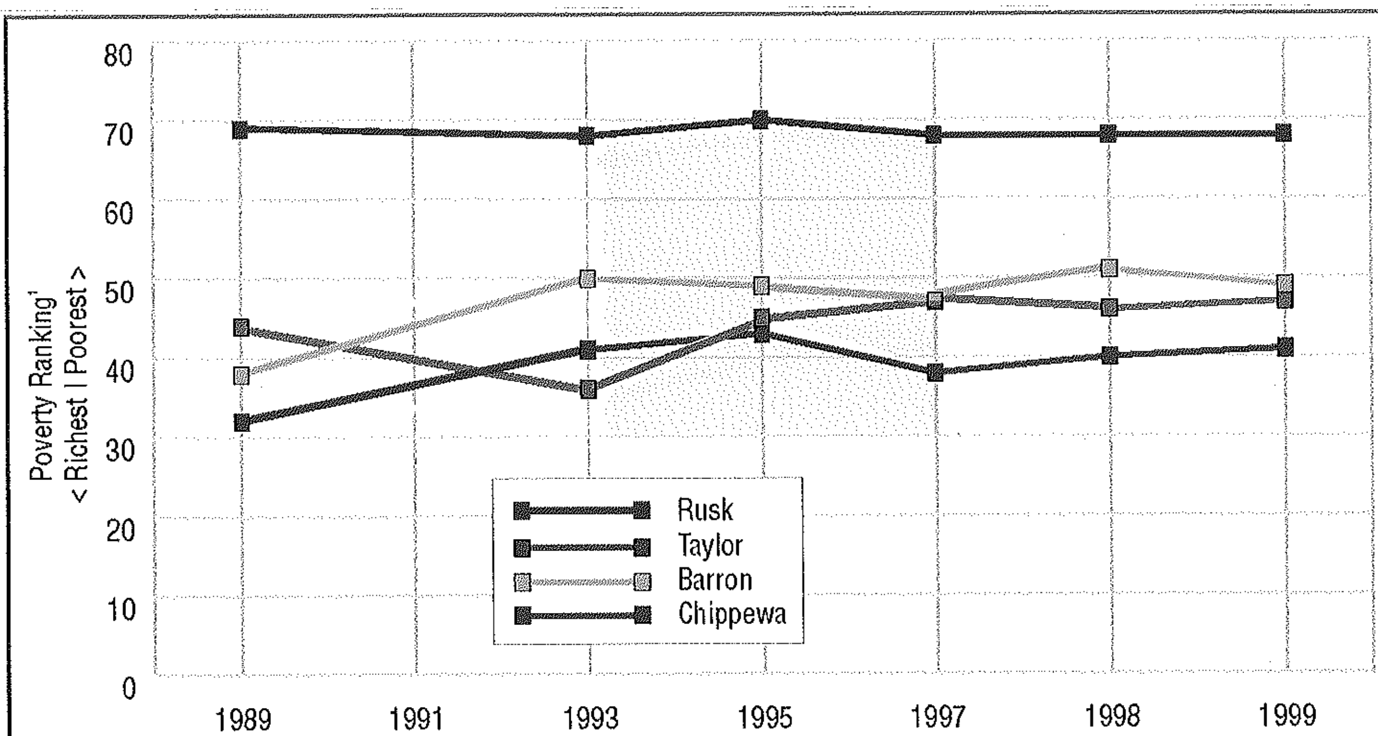
Since there are 72 counties in the State of Wisconsin, a rank of 72 means the county had the highest unemployment rate in the state.

Year	County								State of Wisconsin
	Rusk		Chippewa		Taylor		Barron		
	Unemployment Rate [1]	County Rank [2]	Unemployment Rate [1]	County Rank [2]	Unemployment Rate [1]	County Rank [2]	Unemployment Rate [1]	County Rank [2]	Unemployment Rate [1]
1990	8.2%	71	5.8%	48	6.7%	62	6.2%	54	4.4%
1991	10.6%	70	6.2%	33	8.6%	65	6.8%	43	5.5%
1992	10.2%	71	6.4%	39	7.7%	56	6.7%	44	5.2%
1993	11.0%	72	6.5%	49	7.6%	61	7.0%	52	4.7%
1994	9.8%	72	6.1%	42	7.6%	64	6.4%	49	4.7%
1995	7.6%	71	4.6%	39	6.4%	62	4.8%	45	3.7%
1996	7.0%	70	4.4%	38	4.9%	50	4.5%	43	3.5%
1997	7.9%	71	4.2%	32	5.3%	53	4.8%	42	3.7%
1998	6.0%	63	3.8%	30	5.0%	54	4.3%	43	3.4%
1999	4.6%	59	3.7%	38	3.9%	44	3.9%	44	3.0%
2000	6.8%	68	4.4%	42	4.5%	45	4.8%	53	3.5%
2010	12.3%	70	8.4%	27	10.3%	51	9.3%	39	8.7%
2016	5.3%	60	4.4%	38	4.3%	36	4.7%	47	4.1%

1. Unemployment rates were obtained from the web page of the Wisconsin Department of Workforce Development, January 2002 (www.dwd.state.wi.us/lmi) and August 2017 (https://dwd.wisconsin.gov/).

2. County rank indicates the number of counties in the state with *equal or lower* unemployment rates. Since there are 72 counties in the State of Wisconsin, a rank of 72 means the county had the *highest* unemployment rate in the state.

The Non-Effect of the Flambeau Mine on the Percentage of Rusk County's Total Population Living in Poverty



The Flambeau Mine operated between 1993 and 1997.

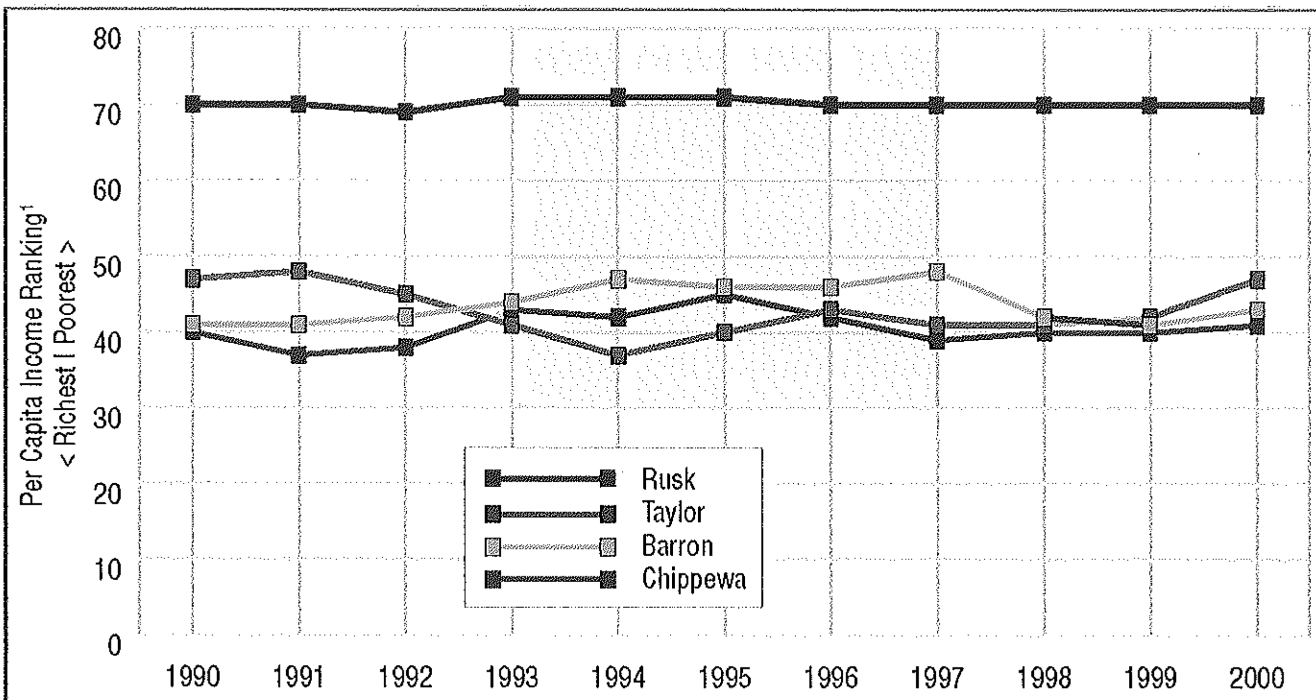
Since there are 72 counties in the State of Wisconsin, a rank of 72 means the county had the highest percentage of people living in poverty in the state.

Year	County								State of Wisconsin
	Rusk		Chippewa		Taylor		Barron		
	Percent Living in Poverty [1]	County Rank [2]	Percent Living in Poverty [1]	County Rank [2]	Percent Living in Poverty [1]	County Rank [2]	Percent Living in Poverty [1]	County Rank [2]	Percent Living in Poverty [1]
1989	16.6	69	10.5	32	12.7	44	11.6	38	10.7
1993	16.6	68	11.3	41	11.1	36	12.6	50	10.9
1995	14.9	70	9.7	43	9.8	45	10.4	49	8.9
1997	14.6	68	9.6	38	10.6	47	10.6	47	9.2
1998	13.6	68	9.4	40	9.8	46	10.7	51	8.9
1999	11.9	68	8.5	41	9.1	47	9.5	49	8.4
2015	14.0	59	10.8	29	12.4	45	10.5	26	12.1

1. Percentages were obtained from the web page of the United States Census Bureau, September 2003 (www.census.gov/hhes/www/) and August 2017 (https://www.census.gov/did/www/saipe/index.html).

2. County rank indicates the number of counties in the state with *equal or lower* percentages of people living in poverty. Since there are 72 counties in the State of Wisconsin, a rank of 72 means the county had the *highest* percentage of people living in poverty in the state.

The Non-Effect of the Flambeau Mine on Rusk County's Annual Per Capita Income



The Flambeau Mine operated between 1993 and 1997.

Since there are 72 counties in the State of Wisconsin, a rank of 72 means the county had the lowest per capita income in the state.

Year	County								State of Wisconsin
	Rusk		Chippewa		Taylor		Barron		
	Per Capita Income [1]	County Rank [2]	Per Capita Income [1]	County Rank [2]	Per Capita Income [1]	County Rank [2]	Per Capita Income [1]	County Rank [2]	Per Capita Income [1]
1990	$7,161	70	$9,186	40	$8,934	47	$9,167	41	$12,686
1991	$7,542	70	$10,002	37	$9,246	48	$9,698	41	$13,043
1992	$7,849	69	$10,240	38	$9,514	45	$9,972	42	$13,287
1993	$8,003	71	$10,349	43	$10,367	41	$10,250	44	$13,840
1994	$8,474	71	$10,906	42	$11,350	37	$10,755	47	$14,534
1995	$8,991	71	$11,581	45	$11,841	40	$11,440	46	$15,324
1996	$9,490	70	$12,299	42	$12,297	43	$11,810	46	$16,118
1997	$10,074	70	$13,156	39	$12,993	41	$12,525	48	$17,437
1998	$11,258	70	$14,263	40	$13,893	41	$13,825	42	$18,655
1999	$11,879	70	$15,461	40	$15,248	42	$15,359	41	$20,116
2000	$12,377	70	$16,178	41	$15,409	47	$15,823	43	$20,503

1. Annual per capita adjusted gross incomes were obtained from the 1995-1996, 1997-1998, 1999-2000 and 2001-2002 volumes of the Wisconsin Blue Book. Values for 2000 were obtained from the Wisconsin Department of Revenue.

2. County rank indicates the number of counties in the state with *equal or higher* per capita incomes. Since there are 72 counties in the State of Wisconsin, a rank of 72 means the county had the *lowest* per capita income in the state.

LAURA GAUGER: IN RESPONSE: FLAMBEAU MINE PROVES NEED TO PRESERVE WISCONSIN'S MINING MORATORIUM LAW

August 17, 2017

The column below reflects the views of the author, and these opinions are neither endorsed nor supported by WisOpinion.com.

I was a plaintiff in a 2012 Clean Water Act lawsuit against Rio Tinto of London, owner of the Flambeau Mine near Ladysmith, Wis. My three-year legal battle was quite contrary to statements made by Ladysmith City Administrator Al Christianson in his August 15 commentary in WisPolitics.com: "The Real Flambeau Mine Story."

Christianson, in an effort to advocate for repeal of Wisconsin's Mining Moratorium Law, described the Flambeau Mine as "environmentally sound" and stated that "mining related problems…didn't happen." He then suggested our Clean Water Act lawsuit was a waste of time that amounted to no more than trying to prove that "some runoff from a parking lot…picked up trace amounts of mineral."

Christianson also chided, "Before you draw conclusions about the Flambeau Mine, look to see where the information came from." On that point I agree. So please let me set the record straight, using court records, actions taken by the Environmental Protection Agency at the Flambeau Mine, and an April 2017 report documenting surface and ground

water contamination at Flambeau authored by Dr. Robert E. Moran, a world-renowned hydrogeologist (https://remwater.org/).

"Flambeau ground and surface water quality is being and has been degraded—despite years of industry public relations statements touting the success of the…operation. Rio Tinto said in a 2013 public relations (PR) release regarding the Flambeau Mine: "Testing shows conclusively that ground water quality surrounding the site is as good as it was before mining." In efforts to encourage development of the other metal-sulfide deposits in northern Wisconsin and the Great Lakes region, the industry approach has been to simply repeat this false statement over and over, assuming that repetition will make it believed. Unfortunately, the…data show otherwise."

Dr. Moran added: "I know of no metal-sulfide mines anywhere in the world that have met the criteria of Wisconsin's 1998 moratorium on issuance of permits for mining of sulfide ore bodies without degrading the original water quality, long-term."

Dr. Moran's findings in 2017 were consistent with the findings of my legal team in 2012, when we sued Rio Tinto in federal court over surface water contamination at the Flambeau Mine. I was cautiously optimistic going into court

because the tributary of the Flambeau River at the heart of our lawsuit recently had been added, on the recommendation of the Wisconsin DNR, to the EPA's list of "impaired waters" due to high copper concentrations linked to the Flambeau Mine. The levels were out of control because Rio Tinto never obtained an important permit *required* by the Clean Water Act that would have regulated the amount of pollutants getting into the stream.

Christianson branded the lawsuit a "scare tactic." But, at trial, the U.S. District Court agreed with us and found Flambeau Mining Company (FMC), a subsidiary of Rio Tinto, to be in violation of the Clean Water Act on numerous counts.

My excitement at winning quickly came to an end, however. The decision was challenged and, in a controversial move, the U.S. Court of Appeals let the mining company off the hook. In its ruling, the appellate court did not dispute the tributary was impaired. Rather, it focused on a very narrow issue regarding whether Rio Tinto could be held accountable for the company's failure to have the federally mandated Clean Water Act permit. The court ruled in the company's favor because the Wisconsin DNR had never required the permit.

"these waters would require expensive, active water treatment to be made suitable for most foreseeable uses. Historically, most such costs are paid by the taxpayers."

Mind you, these levels of pollution are from a tiny, state-of-the-art sulfide mine that operated for only four years. Compare that to the much larger projects coming down the pike for northern Wisconsin if the Mining Moratorium Law is repealed!

Dr. Moran summed it up best in a January 2017 statement: "Wisconsin's 'Prove it First' law is the most intelligent and pragmatic legislation intended to protect water quality that I have encountered ANYWHERE in the world, and I have been involved in such activities for more than 45 years in many countries."

As Al Christianson suggested, "Before you draw conclusions about the Flambeau Mine, look to see where the information came from." That's why I am siding with those who are fighting to preserve Wisconsin's Mining Moratorium Law.

* * *

--Laura Gauger, of Duluth, was living in northwestern Wisconsin in the 1990s when the Flambeau Mine was built near Ladysmith, Wis. In 2007 she co-authored, with Roscoe Churchill of Ladysmith, a book about the mine that is available at many public libraries and schools throughout

the state ("The Buzzards Have Landed! The Real Story of the Flambeau Mine") Gauger also was a plaintiff in a 2012 Clean Water Act case against the mine's owner.

For questions or assistance, please contact: Colin Schmies at schmies@wispolitics.com or 608-206-0476.

PUBLIC HEARING
Ladysmith, Wisconsin
September 7, 2017

My name is Lea Jane Burie. I live 228 feet from the Menominee River in McAllister, Wisconsin, and I am a concerned citizen.

Thank you for the opportunity to speak with you about this critical issue regarding Wisconsin's current "Prove It First" Mining Moratorium law, and how necessary it is to preserve this law as it stands.

First, there has NEVER been a successful metallic sulfide mine. With regard to the Flambeau Mine, Dr. Robert Moran, an internationally respected hydrologist for 45 years, has revealed in his recent report that ground and surface water quality is being, and has been, degraded at the Flambeau mine site. The Flambeau mine is an example of a deeply flawed permitting and government oversight process. The opposite of a clean mining operation, groundwater quality data shows contaminants that greatly exceed baseline data, water quality, and aquatic life criteria. Flambeau has ongoing water contamination issues and cannot be an example to satisfy the Moratorium law. I will give you a copy of Dr. Moran's report from April, 2017.

In addition, the Wisconsin DNR completed an investigation of water quality at the Flambeau mine site and placed

Stream C on its list of impaired waters for "acute aquatic toxicity" caused by copper and zinc contamination. The EPA agreed and also listed the stream as "impaired" in 2014.

The concept that the unsuccessful Flambeau Mine would in ANY WAY be comparable to the proposed Back Forty project in Michigan is mistaken.

Flambeau and the proposed Back Forty project are both metallic sulfide mines near a river. That is where the similarity ends. Flambeau was 220 feet deep, Back Forty 750 deep. Flambeau's open pit: 32 acres; Back Forty: 83 acres—3 times as large. Flambeau produced 1.9 million tons of ore; Back Forty estimates 12.5 million tons. Waste rock at Flambeau: 9 million tons, as compared with an estimated 54 million tons at Back Forty. Back Forty tailings are projected as 11.8 million tons. There was NO tailings storage at Flambeau, because there was NO on-site processing at Flambeau. It was all shipped by rail to Canada for smelting, so THAT is where the tailings dam with the slurry of fine-ground toxic material is located. Flambeau's environmental footprint was 181 acres, compared to 865 acres at Back Fort—4-1/2 times the size of Flambeau.

If Flambeau's mine contractor could not protect the water at the much smaller Flambeau Mine, where there were NO tailings dams to worry about, there is NO reason to expect that the Menominee River watershed will be protected from Acid Mine Drainage and catastrophic mine failures.

Is it fair to use the contaminated Flambeau Mine as justification for repealing Wisconsin's Mining Moratorium Law, when you SEE the kinds of new ill-fated projects being promoted in the region, and which could very well happen in Wisconsin as well?

According to the Great Lakes Indian Fish & Wildlife Commission, a mine can generate Acid Mine Drainage for hundreds or even thousands of years.

The Menominee River is the largest river system in the U.P., with a 4,000-square-mile area that drains into Lake Michigan. More than 40 million people depend on the Great Lakes for drinking water.

Are you willing to risk the lives of these people in order to build a cell phone?

Please protect our water & air quality, property values, tax revenues, tourism income, wildlife, aquatic life, and our health. Keep the Mining Moratorium and "Prove It First" law in place. If metallic sulfide mining were safe, and the Flambeau Mine were perfect, you wouldn't be trying to change the Law.

Of All The Sulfide Mines In The U.S. And Canada, Here's just a couple examples of what can happen.

Summitville Gold Mine, Colorado… Killed 18 miles of the Alamosa River. And by the way, Colorado currently has 230 Sulfide Mines leaking AMD into their state rivers.

Zortman-Landuski Mine, Montana… This mine generated AMD that is predicted to last for thousands of years. Nearly every drainage in the Little Rock Mountains has been contaminated by this mine.

Red Dog Mine, Alaska… Studies found Cadmium, Lead, and Zinc along a 24 mile stretch of the haul Rd. Also The Green Creek Mine in Juno Alaska was sited with violations 391 times.

Pinto Valley Mine, Arizona… In 1997 a tailings dam failed and 3.4 million gallons of heavy metal tainted water was released into Pinto Creek, which flows into Roosevelt Lake, one of the area's largest sources of drinking water.

Chinco Mine, New Mexico… Between 1991-1996 - 250,000 gallons of tailings were released into White Water Creek when the mine experienced a series of pipe line ruptures, which killed a variety of wildlife including birds protected by the Migratory Treaty Act.

Gilt Eagle Mine, South Dakoda… Began generating AMD in 1992 contaminating nearby bodies of water and destroying fish populations.

Grouse Creek Mine, South Dekoda… In 1994 it was heralded as a "State of the Art" mine. Three years later the mine closed, leaving no profits and leaking tailing impoundments. In 2003 the EPA and The Forest Service declared the mine site to be an Imminent Endangerment.

Flambeau Mine, Wisconsin… Although there was no processing on the site, after the mine closed the Flambeau River was found to be virtually devoid of all life. Through the freedom of information act the Wisconsin DNR learned that in 1987 Kennocott Mining Co. and Steve Donahue of consulting firm Foth Engineering of Green Bay, WI knew there was a fracture in the bedrock that ran from the mine pit to the river bed but they said "Nothing".. Copper levels were found to be ten times the Acute standard and Zinc was twice the Acute standard. There self conducted water sampling tests that were submitted to the DNR were found to be falsified. The Flambeau Mine was cited for "Eleven" Clean Water Act Violations. Surface waters were also added to the "Impaired Waters" list with the E.P.A. due to toxic heavy metals, and it also polluted the ground water.

It is important to note that Steve Donahue of Foth Engineering is also the consultant for Aquilas Back Forty Project, and they too, will be allowed to do self-conducted water sampling tests.

Eagle Mine... Marquette Co. Michigan… This is operated by Lundin Mining Company and is the only mine they operate in the U.S. They also mine in Spain and the Democratic Republic of the Congo. In Spain the mining regulations are lax… and in the Congo, they are virtually "Nonexistent" as the photos reflect. When Lundin was trying to get there permits for the Eagle Mine, they promised the people that every precaution would be used to protect the environment. In the original permit it states that they would be installing **"Bag House Filters"** on the exhaust stack, this is also what they told the people. Almost immediately after being granted there permit they rewrote part of the original permit and asked the MDEQ if they could remove these filters… and it was granted.. They lied to the people!! Twice a day they blast the tunnel which can be felt for a radius of two miles, soon after they do a "High Velocity Air Blast" to clear the mine shaft. What now comes out of the stack (WO) filters looks like charcoal dust blasting out of the stack and into the environment, which will become AMD as soon as it hits the ground. Just last year they had a cave-in they down played till it was learned to be a large block fracture due to "Inadequate Shoring".. Again they cheated and lied to cover it up.. They all cheat, they all lie.. **"All Of Them"..**

Mount Polly Mine, Central British Columbia… This mine caused the greatest disaster in Canadian History by over filling it's tailings pond. This caused a berm to break and released Four Billion Gallons of raw tailings into Hazel Creek, which flows into Polly lake.. Literally mowed down the forest till it got to Quenel Lake, which is the Cleanest Deep Water Lake on Earth and proceeded to the Cariboo River. Although it took four days for this pond to empty itself they were issued a continuance permit the next day.

There are well over 100,000 Sulfide Mines in the U.S. and Canada, there has "never" been a Sulfide mine that has "Not"… contaminated the waterways they operate on.

JAMES W. EDMING

STATE REPRESENTATIVE • 87TH ASSEMBLY DISTRICT

Testimony in Support of Senate Bill 395

Senate Committee on Sporting Heritage, Mining and Forestry

Thursday September 7, 2017

Mr. Chairman and committee members, I would like to welcome you to the 87th Assembly District and thank you for holding this public hearing today on Senate Bill 395. I appreciate having the opportunity to speak with you in support of this important legislation.

Mining is an important part of the history of our state. The miner on our state flag and our state nickname the "Badger State" both honor mining's importance to the history of Wisconsin. I believe that mining can also be an important part of Wisconsin's future. If done right, reforming our state's nonferrous mining laws could provide a major boost to the economy of rural Wisconsin.

I am a lifelong resident of Rusk County and have seen first-hand the positive impacts a successful mining operation can have on a community. Not far from here is the site of the Flambeau Mine that operated during the 1990s. While this mine is now closed, its economic impact can still be felt in this area today. Local governments used revenue from the mine for various economic development projects. Through these projects, new businesses were attracted to the area and existing businesses were provided the resources they needed to expand. Many of these businesses continue to provide careers to people of this area today. In addition, the operator of the mine, the Flambeau Mining Company gave back to the community. The biggest example of this generosity is the Rusk County Public Library here in Ladysmith that was made possible by a $500,000 donation from the company.

Currently, many young people are leaving northern Wisconsin for better economic opportunities. I support SB 359 because it makes needed reforms to our state's mining laws that will make it possible for good paying mining jobs to again come to northern Wisconsin. These jobs, as well as the other economic development that will occur surrounding any mining operation, will provide opportunities that incentivize our youth to stay and start their families here.

Mr. Chairman and members, I urge you to support SB 395 and thank you again for the opportunity to testify before you today.

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Rob Hutton

STATE REPRESENTATIVE • 13TH ASSEMBLY DISTRICT

Rep. Rob Hutton
Re: SB 395
9/7/2017

Thank you chairman and members of the Committee on Sporting Heritage, Mining and Forestry for the opportunity to testify on SB 395. SB 395 is an important piece of legislation that has the potential to transform Northern Wisconsin's economy. This bill would repeal Wisconsin's mining moratorium allowing for safe extraction of Wisconsin's great natural resources. The legislation strikes the needed balance to promote jobs and development while continuing to protect Wisconsin's environment.

The site of the Flambeau Mine, which I had the privilege of touring last night, located less than five miles from here is a great demonstration that mining can be done in a safe environmentally friendly manner. This legislation seeks to set up guidelines that will duplicate the success found at this mine.

This legislation would repeal the mining moratorium in Wisconsin. The mining moratorium, put into place in 1998, banned any future nonferrous mines unless it could be proven that a mine was operational for ten years and then closed for ten years with no long term detriment to the environment. The Flambeau mine site fulfills the spirit of this moratorium as it has been beautifully restored over ten years ago with no long term environmental consequences.

There will be many speakers today that will speak to the technical aspects of this bill. I wanted to offer some perspective on the community and family impact of this bill. In recent history we have seen significant private sector investments made in Southern Wisconsin, most recently with the Foxconn announcement. The prospect of adding 13,000 family supporting jobs in the southeast corner of the state is something we all should be excited about. While I strongly support this transformation development near my district, I see the need for the same transformational development several hours north of my district. That is why I was honored to co-author, along with several of my Assembly colleagues, this legislation with Senator Tiffany.

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Karl A. Fate

If I am considering buying a product, I would want a preponderance of evidence that the product would not damage the waters of our State. The Moratorium Law does not ask for a preponderance of evidence, it only asks for a single example. For Senator Tiffany and his clients, a single example of success is asking too much.

Apparently, Senator Tiffany hasn't learned anything from his failed Iron Mining Law. Trying to force an arbitrary timeline on reviewing any mining proposal, especially in a complex and sensitive environment, just plain does not work. I have reviewed every sulfide mining proposal in our area of Wisconsin since 1980. The review periods lasted for a long time for a reason. These were mines being proposed in extremely difficult, complex, and sensitive areas that lie below the vast bed of gravel left behind by the glaciers and that involve the disruption of the massive column of water that is the foundation for our lakes, streams, and wetlands. The Flambeau Mine was somewhat of an anomaly in this regard, but even at Flambeau there are water quality issues.

Trying to subsidize any mining interest by weakening the laws, just plain does not work. It is especially foolhardy in an area were the water is so special and so important to so many people. You cannot change the physical realities of where we live by weakening the law.

At the same time that we are seeing this proposal to weaken the law regarding sulfide mining in Wisconsin, we are seeing growing opposition in our State and in Michigan to an actual massive sulfide mining proposal. In addition to being opposed by most every Indian Band, Tribe, and Nation in the region, as well as several sport fishing and environmental groups, the Back Forty Mine is also being opposed by Marinette County, Wisconsin, Menominee County, Michigan, City of Marinette, Wisconsin, Brown County, Wisconsin, Menominee County, Wisconsin, Shawano County, Wisconsin, Door County, Wisconsin, Oconto County, Wisconsin, City of Peshtigo, Wisconsin, Town of Wagner, Wisconsin, and Town of Porterfield, Wisconsin.

On the State level, both the Assembly and Senate are proposing bipartisan Joint Resolutions opposing the Back Forty Massive Sulfide Mine.

Whereas, the Menominee River provides a unique habitat for species of special concern such as lake sturgeon and freshwater mussels, which would be negatively impacted by discharges into the river; and

Whereas, the potential impacts of the mine include long term leaching of acid-producing wastes into the groundwater and the river; and

Whereas, the hazardous wastes generated by the mine would degrade water quality and present risks to human health and the environment in Wisconsin and Michigan; and

Whereas, potential economic losses including reduction in property values and loss of tourism revenue are not factored into the permitting review process; and

Whereas, the approval of this mine will result in the loss of significant cultural resources of the Menominee Indian tribes of Wisconsin including Native American gravesites and other areas of historical significance; now, therefore, be it

Resolved by the assembly, the senate concurring, That the legislature opposes the development of Aquila Resources' Back Forty Project, a proposed open pit metallic sulfide mine in the Upper Peninsula of Michigan, due to its potential negative impacts on the natural resources, public health, and economy of Northern Wisconsin, and urges the Michigan Department of Environmental Quality to deny a mining permit for the project; and, be it further

Resolved, That the assembly chief clerk shall send a copy of this resolution to Governor Scott Walker, Department of Natural Resources Secretary Cathy Stepp, the county board chairs of Florence, Oconto, Brown, Marinette, Kewaunee, and Door counties, the governor of Michigan, and the Michigan Department of Environmental Quality.

Testimony at the public hearing in Ladysmith on a proposed mining law – 9/7/17

My name is Al Manson. I was born and raised in Wisconsin. Along with 8 of my relatives, I own a 180 acre farm on the Chippewa River in northern Rusk County. We have been here for nearly 50 years.

We are all strongly opposed to Senate Bill 385.

On our farm, which borders the Chippewa River for over half a mile, we have wetlands, ponds, and a stream. We have a dug well from which we get the water we drink.

We are very aware of the potential for pollution. We look to our neighbors to see what chemicals, pesticides, and manure may be used on nearby land, and how it might now or in the future affect our water.

When I think of how we feel about the land, and its water, and how we live on it and depend on it, it occurs to me that my concern for a particular piece of land and its surroundings is exactly why I am here.

My concern is not just for my property, and that of my neighbors. It is for all of us in this state, and even in neighboring states that share our water resources.

I do not want this bill to be passed because it will greatly increase the chances of water pollution in many areas of our state. It relaxes or eliminates many protections for our groundwater.

You have probably been presented with what are now called "alternative facts" concerning this issue, including information on the Flambeau mine.

Here is one fact that is clear and that can be recorded. I am opposed to Senate Bill 385 due to its threat to our water.

Thank you.

Al Manson

Al Manson

509 E 3rd Street N, Ladysmith, WI tel: 715 403-1941

HARDROCK MINE RECLAMATION AND REGULATION

<u>HOW CHANGING VALUES and CHANGING LAW CAUSED HARDROCK MINES to DESIGN, BUILD, and OPERATE for LONG-TERM CLOSURE and RECLAMATION: A FEDERAL and STATE REGULATORY SUCCESS STORY</u>

prepared for the

AMERICAN EXPLORATION & MINING ASSOCIATION

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July 2017

TABLE OF CONTENTS

1.0 Executive Summary 1

2.0 Hardrock Mine Regulation Effectiveness – EPA has never determined that any hardrock mine approved by a federal or a Western State agency after 1990 to be among the "top priority among known response targets" 3

2.1 EPA's National Priorities List for CERCLA Cleanup 3

2.2 A specific hardrock mine clean-up case study cannot be used to evaluate the effectiveness of current hardrock mine regulation if that specific hardrock mine had not been subjected to regulation prior to its design and construction 4

2.3 Hardrock mines on the National Priorities List must be rationally classified into three (3) major eras based upon applicable regulation or the lack thereof: (1) Pre-Regulatory Era (prior to 1970); (2) Transition Regulatory Era (1970 through 1990); and, (3) the Regulated Hardrock Mine Era (post-1990).. 5

2.4 Northwest Mining Association June 30, 2013 Comments on EPA's Bristol Bay Watershed Assessment determined that current hardrock mining regulations were protective of the environment, citing to specific federal and state government studies that explicitly support this conclusion.......... 7

2.5 The 2015 Enviroscientists Report confirms the NWMA/(AEMA) Comments on EPA's Bristol Bay Watershed Assessment in June 2013 that determined that no Western hardrock mine has been placed on the CERCLA NPL since 1990 8

3.0 Current hardrock mine regulation is protective of the environment, as determined by: (1) the United States National Academy of Sciences; (2) the Western Governors Association; and, (3) Senator Murkowski's 2011 Investigation 10

3.1 The National Academy of Sciences/National Research Council has determined that existing hardrock mine regulation on federal land is "complicated but generally effective" in protecting the environment.......10

3.1.1 The NAS/NRC Report determined that "[s]imple 'one-size-fits-all' solutions are impractical because mining confronts too great an assortment of site-specific technical, environmental, and social conditions." 10

3.1.2 The NAC/NRC Report correctly characterizes the current hardrock mining industry as having minimal impact on public lands and the NAC/NRC Report also correctly characterizes the importance of the hardrock mining to the US economy and to US manufacturing 11

3.2 Current hardrock mine regulation continues to be protective of the environment on federal lands as further evidenced by the United States Forest Service and United States Bureau of Land Management Responses to Senator Murkowski's 2011 Investigation.....11

3.3 The Bi-Partisan Western Governors' Association confirms that the Western States "have a proven track record in regulating mine reclamation in the modern era, having developed appropriate statutory and regulatory controls" that are "protective of human health and the environment" as well as being protective of public treasuries.....11

3.4 Current hardrock mine regulation is protective of the environment on all federal and state Western lands - A Summary.....14

4.0 Changing Societal Values – The Great Depression, World War II, the Cold War, and the Modern Environmental Movement.....125

4.1 Prior to 1970, there was virtually no direct regulation of municipal sewage, industrial wastes or hardrock mines.....15

4.2 Societal Values of "The Greatest Generation".....15

4.3 Cultural Balance.....18

4.4 The Modern Environmental Movement.....18

4.5 Cultural and Legal Changes Incorporating Environmental Values.....18

5.0 Development of Legally-Applicable Hardrock Mine Regulation.....19

5.1 Regulation of the Natural Media Receptors – An Overview.....19

5.2 Surface Water.....20

5.3 Groundwater Protection at Hardrock Mines.....21

5.3.1 State Protection of Groundwater at Hardrock Mines.....21

5.3.2 Federal Protection of Groundwater at Hardrock Mines.....21

5.4 Hardrock Mine Reclamation, Fincial Assurances and Water Quality Protection..22

5.5 The National Environmental Policy Act of 1970.....24

5.6 Evaluation of the Effectiveness of Hardrock Mine Regulation based upon the Timing of Regulatory Developments.....25

6.0 Conclusion 27

1.0 Executive Summary

The federal and state regulation of hardrock mining and milling facilities (collectively, "hardrock mines")[1] is a success story of environmental protection that is well-illustrated by the fact that of the **none** of the Western hardrock mines that were designed, built and/or approved in the last 26 years are on the United States Environmental Protection Agency ("EPA") National Priorities List of environmental cleanup sites. To characterize this another way, there has never been an environmental problem at a hardrock mine approved by a federal or state agency in the West after 1990 that required EPA to make any such hardrock mine a Superfund "top priority among known response targets." Finally, and most succinctly, no hardrock mine permitted/approved in the West after 1990 has ever been placed on EPA's Superfund National Priorities List. This is in stark contrast to Western hardrock mines designed and built prior to 1970 when there were no regulatory approvals for such facilities and no cultural guidelines.

The reasons for this are straightforward and summarized below.

Current hardrock federal and state mine regulation is protecting the environment. This is not just the opinion of the relevant agencies or the hardrock mining industry. It is also the opinion of the federal government's National Academy of Sciences/National Research Council and the bi-partisan Western Governors' Association.

In 1999, the federal government's independent National Academy of Sciences/National Research Council produced a comprehensive report entitled "Hardrock Mining on Federal Lands" regarding then-current hardrock mine regulation on lands managed by the federal government and states agencies and determined:

> The overall structure of the federal and state laws and regulations that provide mining-related environmental protection is complicated but generally effective.
>
> ...
>
> Simple "one-size-fits-all" solutions are impractical because mining confronts too great an assortment of site-specific technical, environmental, and social conditions. Each proposed mining operation should be examined on its own merits. ... **Recommendation: BLM and the Forest Service should continue to base their permitting decisions on the site-specific evaluation process provided by NEPA [National Environmental Policy Act].** ...

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[1] For the purposes of this study, "hardrock mine" includes any facilities deemed to be a "mining" or "beneficiation" facility by the EPA. EPA has defined "mining and beneficiation" to include, generally, all metal mines, but EPA's use of the term "hardrock mine" also includes many non-metallic industrial mineral mines, such as phosphate rock, trona, fluorospar, and mica, as well as the mills required to concentrate the target minerals of these ores. See generally 40 C.F.R. 261.4(b)(7)(July 15, 2016). In common usage, EPA's "mining and beneficiation" is more typically referred to as "hardrock mining and milling" or just for the purposes of this Report sometimes "hardrock mine."

"Hardrock Mining on Federal Lands," National Academy of Sciences/National Research Council, Executive Summary, p. 5. Importantly, the bi-partisan Western Governors Association has determined that the Western States, which regulate hardrock mining on state and private lands within their borders, "… impose permit conditions and stringent design and operating standards, to ensure that hardrock mining operations are conducted in a manner that is protective of human health and the environment." WGA, Policy Resolution 10-16, Background (A)(8) ("National Minerals Policy"). Moreover, the states and federal agencies have continued to strengthen their reclamation and financial assurances requirements on an ongoing basis.

The correctness of the 1999 National Academy of Sciences determinations were revalidated and confirmed by Senator Murkowski's 2011 Investigation, when the United States Forest Service ("Forest Service") and the United States Bureau of Land Management ("BLM") reported to the Senator that out of 3,344 mining plans of operations approved by these two agencies since 1990, **none of these 3,344 federal mine plan approvals created an environmental problem that caused EPA to place any of these hardrock mines on EPA's highest priority environmental clean-up sites.** Therefore, Senator Murkowski's study objectively demonstrates the continued correctness of the National Academy/National Resources Council's 1999 determinations.

The development of the effective hardrock mine regulation and reclamation of the Forest Service, the BLM and Western States did not occur overnight. There was a "learning curve" that took a couple of decades. But the single most important factor creating effective hardrock mine regulation has been an American cultural shift since about 1970 with the advent of the modern environmental movement. Prior to 1970, municipal waste, industrial waste and hardrock mines were not regulated to protect the environment. Protecting the environment was not a major societal priority. The US hardrock has incorporated these environmental values into the cultural fabric of the industry.

The absence of environmental protections prior to 1970 was, in significant part, a legacy of the then-dominant American cultural focus from the Great Depression on jobs and the economy, followed immediately by World War II, the Cold War and the Korean War. All of these nation-threatening events caused the federal government to force dramatic and environmentally-harmful national efforts to quickly and heroically increase the chain of industrial and manufacturing production to historic heights. Hardrock mining was (and remains) the first and primary link in much of the manufacturing chain. Much of the CERCLA hardrock mine negative environmental legacy arose during this period or long before. Even in the late 1950s, President Eisenhower's forward-looking "Blueprint for America" did not even mention the environment.

The modern environmental movement, symbolized by the first Earth Day and by the enactment of the National Environmental Policy Act in 1970, evidenced a shift of our society from one that had been almost wholly-focused on industrial and manufacturing production values to a society where environmental values had a role, too. This shift in values was implemented by changes in law and regulation over the next twenty years as the United States adjusted to this more balanced approach to hardrock mining. As

discussed below, these laws, regulations and the collective experience of federal and states agencies, as well as the hardrock mine industry (learning from regulatory omissions along the way) have created a regulatory climate and an operating culture in which current hardrock mine regulation is an effective protector of the environment.

Hardrock mines designed and built prior to 1970 were developed to maximize production and minimize cost with little or no regard for environmental values. Importantly, however, after 1990, all new hardrock mines have been designed, built and operated to integrate long-term environmental closure and reclamation as a primary design standard. This is required by current law, but it is also required by the U.S. culture, generally, and by the U.S. hardrock mining industry, specifically.

Therefore, the EPA cannot rationally use information about environmental closure and reclamation costs from hardrock mines designed and approved prior to 1970 to assess the degree and duration of environmental risk associated with hardrock mines in 2017. Doing so would be as absurd as assuming that the design flaws of the 1964 Chevrolet Corvair, made infamous by Ralph Nader's 1966 book "Unsafe at Any Speed," should be used to assess whether any new National Highway Traffic Safety rules are needed in 2017. In both the hardrock mine and the NHTSA examples, the result of such assessments would be equally hopeless and comically out of date.

The Forest Service, the BLM, and the Western States reclamation agencies, in concert with the hardrock mining industry environmental management, have prevented any hardrock mine, designed and approved after 1990, from being deemed by EPA to be a "top priority" cleanup site.

This achievement is a genuine "success story."

2.0 Hardrock Mining Regulation Effectiveness – EPA has never determined that any hardrock mine approved by a federal or a Western State agency after 1990 to be among the "top priority among known response targets"

2.1 EPA's National Priorities List for CERCLA Cleanup

The federal "Comprehensive Environmental Response Compensation and Liability Act of 1980, as amended (commonly referred to as "CERCLA" or "Superfund"), requires EPA to publish the National Priorities List annually to identify the "national priorities among known releases or threatened releases [of hazardous substances] throughout the United States ...."[2] The National Priorities List identifies "[t]o the extent practicable, ... [EPA's] 'top priority among known response targets'...."[3] The National Priorities List ("NPL") includes over 1100 sites, which includes only about 50 hardrock mining sites, which, in turn are almost all pre-1970 facilities.[4]

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[2] 42 U.S.C. Section 9605(a)(8)(B).

[3] Id.

[4] http://www.epa.gov/superfund/sites/npl (March 30, 2012). Unfortunately, EPA had prepared and electronically-published a Table designated "Summary – Mining Sites on the National Priorities List"

EPA has specifically determined that hardrock mining wastes pose significantly lower environmental risk than "mineral processing" wastes, and so EPA has determined that "high volume" "low hazard" wastes should not be regulated as if they were "hazardous wastes."[5] Therefore, information about environmental problems with inorganic chemical plants and mineral processing facilities that generate actual "hazardous waste" does not provide any useful information to assess the environmental issues associated with hardrock mines. Accordingly, even more importantly, environmental regulatory issues associated with mineral processing facilities and inorganic chemical plants provide no information about the current regulation of hardrock mining. Mineral processing and inorganic chemical plants are subject to substantially different regulatory programs, standards and procedures than hardrock mines. In short, to have an intelligent discussion about the effectiveness of hardrock mine regulation one must evaluate hardrock mining and milling facilities that were actually subject to regulation since 1990. EPA's now-defunct NPL Mining Sites List failed to do this, since almost one-half of the EPA's so-called "Mining Sites" were in fact mineral processing or inorganic chemical plants.

2.2 A specific hardrock mine clean-up case study cannot be used to evaluate the effectiveness of *current* hardrock mine regulation if that specific hardrock mine had not been subjected to regulation prior to its design and construction

One cannot evaluate the effectiveness of hardrock mine regulation if one does not first consider whether or not a case study hardrock mine had been subject to regulation, and then second, if applicable, one must consider the nature of the specific regulation to which a hardrock mine had been subject to regulation *prior to its design and construction*. Obviously, it is utterly pointless, absurd, and deliberately misleading, to pretend to "evaluate" the effectiveness of hardrock mine regulation with reference to any hardrock mine that has never been subject to regulation! Nevertheless, nongovernmental organizations (NGO's) that seek their funding by opposing hardrock mines inevitably use

("EPA's Mining Site List," May 2013, www.epa.gov/aml), but EPA's Mining Site List was highly misleading because it did not include only hardrock mines, nor even just "hardrock mining and milling sites." Unfortunately, EPA's "Mining Sites List" included large numbers of downstream inorganic chemical plants and "mineral processing" sites that are not hardrock mines. This critical substantive distinction seems to have given rise to multiple legal actions filed by non-governmental organizations ("NGO") against the hardrock mining industry and against EPA speciously seeking regulation of hardrock pursuant CERCLA 108(b). Fortunately, after the NWMA/AEMA provided its public comments regarding EPA's fatally-flawed "Summary – Mining Sites on the National Priorities List" and other closely-related issues in EPA's "Bristol Bay" public docket (see discussion in Section 2.4 below), EPA terminated its dissemination of this particular grossly misleading information by removing it from EPA's website. Nonetheless, the NGO legal challenges against the mining industry that were apparently supported, in part, by EPA's years of misinformation regarding the hardrock mining industry, continue to this day.

[5] See 50 Fed. Reg. 40,292 (Oct. 2, 1985); EPA, "Report to Congress, Wastes from the Extraction and Beneficiation of Metallic Ores, Phosphate Rock, Asbestos, Overburden from Uranium Mining, and Oil Shale," (Dec. 31, 1985); 55 Fed. Reg. 32,135 (Aug. 7, 1990); and EPA, "Report to Congress on Special Wastes from Mineral Processing" (July 1990).

historical and factually irrelevant examples to suggest there are current problems with hardrock mines in both regulatory and litigation settings.[6]

Hardrock mines designed and built prior to 1970 were developed to maximize production and minimize cost, but after 1990, all new hardrock mines have been designed, built and operated to integrate long-term environmental closure and reclamation as a primary design standard, as required by current law and culture. Therefore, the success of hardrock mining regulation must be evaluated by using reasonably current applicable rules.

No one would suggest that General Motors (GM) should be prohibited from producing cars in 2017 or subject to new regulation because, in 1965, GM produced the Corvair (deemed "unsafe at any speed" by Ralph Nader[7]) which does not meet 2017 standards. Yet, critics of the hardrock mining industry repeatedly and constantly describe environmental problems at hardrock mines that were designed and operated prior to 1970 as illustrative of current hardrock mine.[8] This is absurd.

Hardrock mines designed and operated prior to 1970 were in place long before hardrock mines were subject to any regulation whatsoever. Thus, it is critical to determine, even if only generally, the extent to which any hardrock mine used as an example or case study to evaluate the effectiveness of hardrock mine regulatory programs has actually been subject to relevant regulatory programs.

2.3 Hardrock mines on the National Priorities List must be rationally classified into three (3) major eras based upon applicable regulation or the lack thereof: (1) Pre-Regulatory Era (prior to 1970); (2) Transition Regulatory Era (1970 through 1990); and, (3) the Regulated Hardrock Mine Era (post-1990).

Hardrock mine regulation must be classified into 3 major eras based upon the extent of applicable regulation or the lack thereof: (1) Pre-Regulatory Era (prior to 1970); (2) Transition Regulatory Era (1970 through 1990); and, (3) Regulated Hardrock Mine Era (Post-1990). Below, Section 4.0 ("Changing Societal Values – The Great Depression, World War II, the Cold War, and the Advent of the Modern Environmental Movement") provides some of the policy history supporting use of these three temporal classifications. Further below, Section 5.0 ("Development of Legally-Applicable Hardrock Mine

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[6] Maest, A.S., Kuipers, J.R., Travers, C.L. and Atkins, D.A., 2005, "Predicting Water Quality at Hardrock Mines: Methods and Models, Uncertainties, and State-of-the Art." But importantly also see, Schlumberger Water Services, 2013, "Technical Review of the Kuipers Maest, 2006, 'Comparison of predicted and actual water quality at hardrock mines: The reliability of predictions in Environmental Impact Statements,'" p. 1, that determined *inter alia* that "The conclusions contained in the [Maest Kuipers, 2006] report are not relevant to any current mines that are being permitted, or to any future mines ...[because] [m]odern-day characterization and analysis techniques have changed so radically from virtually all of the studies cited by the report that it is meaningless to draw any comparison to modern-day conditions." Emphasis added.

[7] Nader, Ralph, Unsafe at any speed: The Designed in Dangers of the American Automobile, Grossman Publishers, 1965.

[8] See footnote 6, supra.

Regulation") provides a summary of the primary legal support for using these three (3) temporal classifications.

Facilities designed and constructed in the Pre-Regulatory Era (prior to 1970) provide no useful information about the effectiveness of current hardrock mine regulation "predictions" since Pre-Regulatory Era Hardrock Mines were designed, constructed and operated to maximize production and minimize cost. Pre-Regulatory Era Hardrock mines did not even consider long-term environmental closure and reclamation. In stark contrast, long-term environmental closure and reclamation are required by current federal and state law, while Pre-1970 hardrock mines were never subject to any regulation whatsoever. Even worse, Pre-Regulatory Era facilities were conceived, designed and operated even before environmental values were imbedded in the American culture. Thus, when subsequently enacted laws and regulations were applied to these facilities after-the-fact, such regulatory efforts could not influence the facility design and construction. Thus, such regulation could never hope to prevent *all* releases to the environment from facilities. For example, tailings facilities from the Pre-Regulatory Era were often designed to release to the ground water for reasons of structural safety, while even simple release-reporting to ground water was only required starting in the 1980s, and even then, only under certain limited circumstances. In short, pre-1970 Pre-Regulatory Era facilities were not conceived, designed or operated with significant concern for the environment.

Importantly, even hardrock mines designed and constructed during the Transition Regulatory Era were often not subject to direct regulatory approvals. But at least there was an increasing cultural awareness of the regulated community and the government that environmental values needed to be considered, even if imperfectly. However, *those Transition Regulatory Era Mines that were actually subject to regulation* were never subject to full control of surface and ground water regulation and geochemical predictive modeling that characterizes current hardrock mine permitting.

For example, in 1985, it was EPA's assessment was that "EPA data on management methods at mining facilities indicate that only a small percentage of mines currently [i.e., 1985] monitor their ground water, use run-on/run-off controls or liner, or employ leachate collection, detection, and removal systems." 50 Fed. Reg. 40,292 (Oct. 2, 1985); EPA, "Report to Congress, Wastes from the Extraction and Beneficiation of Metallic Ores, Phosphate Rock, Asbestos, Overburden from Uranium Mining, and Oil Shale," (Dec. 31, 1985) ("RTC I," p. ES-10.) Therefore, as a practical matter, according to EPA, any discussion of the effectiveness of "environmental predictions" at facilities designed and approved prior to 1985 is utterly meaningless. To restate this point, hardrock mining facilities designed and approved prior to 1985 do not provide any useful information about current regulation of hardrock mines because pre-1985 hardrock mines were not designed, built and operated to integrate long-term environmental closure and reclamation. This is in sharp contrast to current law and regulation.

Therefore, per EPA, there was almost no comprehensive regulation of ground water discharges prior to 1985. Of course, such programs were not created overnight. Even in

1990, programs specifically designed to preclude groundwater releases from mining facilities were in their infancy and geochemical "predictive" modeling was largely conceptual at that time. Modern geochemical predictive modeling really did not begin practical application as a regulatory tool in the mid-1990s. For example, Earthworks, a group that opposes the hardrock mining industry, contracted for a report "Predicting Water Quality at Hardrock Mines: Methods and Models, Uncertainties, and State-of-the Art" in which of 202 references cited to, only 28 dated from before 1990, and most of the directly pertinent geochemical references have been published since 2000.[9] Nevertheless, if one evaluates and then assigns each hardrock mine that EPA has deemed to be among its "top priority among known response targets" (i.e., the NPL) to the major regulatory era when it was designed, constructed and approved, then a very clear and incontestable picture develops, as discussed immediately below.

2.4 Northwest Mining Association June 30, 2013 Comments on EPA's Bristol Bay Watershed Assessment determined that current hardrock mining regulations were protective of the environment, citing to specific federal and state government studies that explicitly support this conclusion.

The American Exploration & Mining Association (AEMA) (formerly Northwest Mining Association or "NWMA") provided comments to EPA's Bristol Bay Watershed Assessment concerning the Alaskan Pebble Project on June 30, 2013 regarding the effectiveness of existing hardrock mine regulation. Baird, 2013, "Hardrock Mining Reclamation and Reclamation – Developing Sustainable Environmental Protection through Changing Values, Changing Laws and Experience: A Federal State Success Story" (the "NWMA 2013 Study"). The NWMA 2013 Study provides detailed support to arrive at its conclusions that:

> Current Hardrock Mining regulation is protecting the environment. However, this is not just the opinion of the relevant agencies or the Hardrock Mining industry; it is the opinion of the National Academy of Sciences and the bi-partisan Western Governors' Association.

Unfortunately, EPA apparently wholly-ignored the NWMA 2013 Study with regard to the "Bristol Bay Watershed Assessment," except that the NWMA 2013 Study may have caused EPA's to terminate use of its so-called "NPL Mining Site List." Nevertheless, to date, EPA has never referenced the NWMA/AEMA's 2013 Study.

AEMA must assume EPA's failure to acknowledge the relevant indisputable facts described in NWMA's 2013 Report has something to do with the bias that occurred within EPA regarding the "Bristol Bay Watershed Assessment." More specifically, the respected Cato Institute "think tank" has stated:

> Because there was never a mining permit application [submitted for the Pebble Project], EPA charged a senior biologist (not a mining engineer)

[9] See footnote 6, supra.

> named Phillip North to design a worst case scenario open-pit 'hypothetical mine' that could never be approved. … North then proceeded to 'model' the maximum deleterious impact of the nonexistent, unplanned, and imaginary mine …
>
> EPA and North simply ignored … [a $150,000,000 in scientific study of the] biology, ecology, and dynamics of the Bristol Bay watershed. EPA and North simply ignored this remarkable repository of information before admitting, during the entire time that the Bristol Bay Watershed Assessment was written (2011-2014), that it was never really intended to provide a scientific foundation for regulatory decision-making, after all.
>
> …
>
> While he was creating his hypothetical mine, Mr. North also coached anti-Pebble activists on how to petition his own Agency to stop the real permit application. It appears he even wrote petitions. …

Mamula, Ned and Michaels, Patrick J., 2016, "A Green Mess: Is EPA in Hot Water over Alaska's Bristol Bay?" http://www.cato.org/publications/commentary/green-mess-epa-hot-water. Importantly, when the House Oversight Committee sought to bring Mr. North before a Committee Hearing in 2013:

> … he delayed, bobbed and weave, and suddenly pulled his children out of school and fled the country.

Id. Therefore, the AEMA/NWMA must assume that the important information that it has previously presented to EPA regarding the adequacy of existing hardrock mine reclamation has been lost to EPA's unethical Bristol Bay Watershed Assessment sideshow.

Accordingly, the AEMA has developed this document in 2017 to further support its and refine the NWMA's original demonstration that currently, federal and state hardrock mine reclamation programs and financial assurance mechanism are protective of the environment. Therefore, the AEMA commissioned the independent expertise of Enviroscientists, Inc. to review and assess NWMA's 2013 Report to be sure that its information is fully considered by future EPA actions.

2.5 The 2015 Enviroscientists Report confirms the AEMA/NWMA Comments on the Bristol Bay Watershed Assessment in June 2013 that determined that no Western hardrock mine has been placed on the CERCLA NPL since 1990

Dr. Richard DeLong of Enviroscientists, Reno, Nevada, has completed an assessment of U.S. Environmental Protection Agency's National Priorities List ("NPL") for Mining and Milling Sites. Please see attached "Memorandum" from Richard DeLong to Joe Baird,

Baird Hanson LLP, dated, May 15, 2015, "Assessment of Mining and Milling Sites on the National Priorities List" ("Enviroscientists Memo"). Dr. DeLong's analysis states:

> There are over 1,100 sites on the NPL. Of those, there are 100 that the EPA has classified as MMS [i.e., "Mining and Milling Sites"]. However, only 55 of those sites are actual mining operations where mineral resources were extracted from the earth. The other 45 are mineral processing facilities where a mineral product is delivered to the operation for further processing. The 55 "hardrock" MMS on the NPL fall into the following temporal classifications: 49 are prior to 1970; five are from 1970 through 1990; and one is post-1990 and it is the Barite Hill property in South Carolina.

Therefore, per the Enviroscientists' Memorandum, the 55 Mining and Milling sites on the NPL fall into the following temporal classifications:

Pre-Regulatory Era (prior to 1970)	49
Transition Regulatory Era (1970 through 1990)	5
Regulated Hardrock Mine Era (post-1990)	1[10]

By eliminating the "red herring" mineral processing and inorganic chemical plants from the EPA's so-called "Mining" Sites List of 100 sites, the EPA List can be corrected to include about 55 sites that are hardrock mining sites, but **<u>only if</u>** one includes hardrock mining sites from ***all*** eras, including many historic facilities dating back to the 1800s, which obviously provided no information about 20th century mine design, construction, operation and reclamation/closure practices, let alone 21st century practices.

Obviously, and most importantly from the perspective of evaluating the success of current hardrock mine regulation, *none* of the hardrock mines on the National Priorities List were approved after 1990 in the West.[11] Moreover, this is validated and updated regarding federal lands by the Forest Service and the BLM, as discussed immediately below.

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[10] Barite Hill, McCormick County, South Carolina, EPA Facility ID SCN000407714. According to EPA, from 1991 to 1995, gold and silver mining was conducted at the site.

[11] It is important to note that eliminating mineral processing and inorganic chemical plant sites almost certainly does not affect the number of regulated facilities from EPA's so-called Mining Site List that would be deemed to be located on the NPL since 1990. In fact, there have been very few new mineral processing facilities constructed since 1990, other than updating of existing facilities (e.g., Rio Tinto's Utah Copper Division) or use of small "mineral processing" facilities such as the dore furnaces commonly located at gold mines. Very few, if any, new large regional mineral processing facilities have been constructed since 1990. Nevertheless, one cannot have an intelligent discussion about the efficacy of or even enumerate the issues related to regulating hardrock mines and mills if the data includes information about mineral processing and inorganic chemical plants.

3.0 Current hardrock mine regulation is protective of the environment, as determined by: (1) the United States National Academy of Sciences; (2) the Western Governors Association; and, (3) Senator Murkowski's 2011 Investigation.

3.1 The National Academy of Sciences/National Research Council has determined that existing hardrock mine regulation on federal land is "complicated but generally effective" in protecting the environment.

In 1999, the federal government's independent National Academy of Sciences/National Research Council ("NAS/NRC"), including several-related organizations,[12] produced a comprehensive report entitled "Hardrock Mining on Federal Lands" regarding then-current hardrock mine regulation on lands managed by the Forest Service and the Bureau of Land Management and determined:

> The overall structure of the federal and state laws and regulations that provide mining-related environmental protection is complicated but generally effective.
>
> ...

NAS/NRC, 1999, "Hardrock Mining on Federal Lands," p.5. Importantly, the NAS/NRC also identified a number of areas where implementation of existing laws could be improved, Id., pp. 6 – 9, and all of the NAS/NRC recommendations that increased the protection of the environment have since been adopted into current federal law.

Importantly, the Forest Service and the BLM continue to improve their programs. Since the 1999 NAS/NRS determination, for example, the Forest Service developed a new "Training Guide for Reclamation Bond Estimation and Administration – For Mineral Plans of Operation authorized and administered under 36 CFR 228A" in 2004, which considered the decades of experience that had developed concerning creating financial assurances and distilled much of this practical knowledge into the Forest Service manual. Additionally, in 2001, the BLM expanded its program to provide for financial assurances on all surface disturbing activities, including notice-level exploration projects affecting fewer than five acres. Thus, the hardrock mining regulation protecting federal land is continually improving and adjusting to take into account the lessons learned from experience, as is required pursuant to NEPA "adaptive management" strictures. These existing regulatory programs already substantially limit or eliminate the degree and duration of environmental risk associated with the current hardrock mining industry.

3.1.1 The NAS/NRC Report determined that "[s]imple 'one-size-fits-all' solutions are impractical because mining confronts too great an assortment of site-specific technical, environmental, and social conditions."

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[12] "Committee on Hardrock Mining on Federal Lands," "Committee on Earth Resources," "Board on Earth Sciences and Resources," "Commission on Geosciences, Environment, and Resources."

Over the last 40 years, the Forest Service and the BLM have developed complicated, but nonetheless workable and environmentally protective programs under the auspices of their own authorities comprehensively coordinated by the National Environmental Policy Act ("NEPA") to properly evaluate and take into account site-specific conditions. The NAS/NRC properly characterizes the situation.

> Conclusion: Federal land management agencies' regulatory standards for mining should continue to focus on the clear statement of management goals rather than on defining inflexible, technically prescriptive standards. Simple 'one-size-fits-all' solutions are impractical because mining confronts too great an assortment of site-specific technical, environmental, and social conditions. Each proposed mining operation should be examined on its own merits. ... Recommendation: BLM and the Forest Service should continue to base their permitting decisions on the **site-specific evaluation** [emphasis added] process provided by NEPA. The two land management agencies should continue to use comprehensive performance-based standards rather than rigid, technically prescriptive standards. ...

"Hardrock Mining on Federal Lands," Executive Summary, p.5. The NAC/NRC emphasis on the criticality of site-specific evaluation is emphasized by NEPA, CERCLA's ARARs process and state permitting for determining rational standards that are protective of the environment and create realistic mechanism for reclamation guarantees.

3.1.2 The NAC/NRC Report correctly characterizes current hardrock mining industry as having minimal impact on public lands and NAC/NRC Report also correctly characterizes the importance of hardrock mining to the US economy and to US manufacturing

The NAC/NRC Report "... respond[ed] to a request by Congress that the National Research Council assess the adequacy of the regulatory framework for hardrock mining on federal lands." "Hardrock Mining on Federal Lands," Executive Summary, p. 1. Importantly, the Report states that "[t]he area of federal land available to hardrock mining in the Western states is enormous, but the surface area actually physically disturbed by active mining is small in comparison ... [a]pproximately 0.06% of BLM lands are affected by active mining and mineral exploration operations." Id. And, "while society requires a healthy environment, it also requires sources of materials, many of which can be supplied only by mining." Id. Importantly:

> Regulations intended to control and manage the alteration of the landscape and the environment in an acceptable way are generally in place and are updated as new technologies are developed to improve mineral extraction, to reclaim mined lands, and to limit environmental impacts.

Thus, the NAC/NRC Hardrock Mining Report correctly notes that hardrock mining has a minor surface area "footprint" relative to total federal lands, and that society requires mining for survival.

3.2 Current hardrock mine regulation continues to be protective of the environment on federal lands as further evidenced by the United States Forest Service and the United States Bureau of Land Management Responses to Senator Murkowski's 2011 Investigation

By letter dated, March 8, 2011, Senator Murkowski's (R-AK) asked the Forest Service and the BLM how many mine plans of operations ("MPOs") the agencies had approved since 1990 and asked how many of those approved MPO facilities subsequently were listed by EPA on the NPL? The Forest Service responded to Senator Murkowski by stating that they had approved 2,685 MPOs since 1990 and stated that none of these required EPA to place them on the NPL. The BLM responded to Senator Murkowski by stating that they had approved 659 MPOs after 1990 and stated that none of these required EPA to place them on the NPL.

Thus, the 1999 NAS/NRC determination that current hardrock mine regulation was protective of federal lands was additionally confirmed and updated by Senator Murkowski's 2011 Investigation.

3.3 The Bi-Partisan Western Governors' Association confirms that the Western States "have a proven track record in regulating mine reclamation in the modern era, having developed appropriate statutory and regulatory controls" that are "protective of human health and the environment" as well as being protective of public treasuries

The Western Governors' Association has repeatedly determined that current Western States' hardrock mine regulation is protective of human health and the environment. The Western States have agencies and staffs that have been exclusively dedicated to prospective mine regulation and to prospectively requiring mine operating and mine reclamation plans. Additionally, good regulatory work and correct mine financial assurances have not only protected public health and the environment, but these regulatory programs have also protected state and federal public treasuries. Importantly, these WGA determinations have been Bi-Partisan. Even more importantly, these determinations regarding the quality of Western states mine regulation and reclamation have been on-going, made year-after-year, by an ever-changing group of Bi-Partisan Western Governors. Please note that WGA policy statements are either, renewed, updated or "sun-setted" every three (3) years, but it is also important to see the evolution of these policy statements.

In 2010, the Western Governors' Association ("WGA") stated:

> The Western States … extensively regulate hardrock mining operations on both public and private lands, and uniformly impose permit conditions and

> stringent design and operating standards, to ensure that hardrock mining operations are conducted in a manner that is protective of human health and the environment, and that, at closure, the mined lands are returned to a safe, stable condition for productive post-mining use.

WGA, Policy Resolution 2010-16, Background (A)(8) ("National Minerals Policy"). More recently, in 2011, the Western Governors Association "Policy Statement" further emphasized the above points stating simply:

> The member states have a proven track record in regulating mine reclamation in the modern era, having developed appropriate statutory and regulatory controls, and are dedicating resources and staff to ensure responsible industry oversight.

WGA, Policy Resolution 2011-4 ("Bonding for Mine Reclamation"). Previous WGA policy determinations provided foundation for the correctness of the above determinations, stating that:

> All Western states ... have staff dedicated to ensuring that ongoing mine operations develop and follow appropriate reclamation plans.
>
> ...
>
> Western states have a proven track record in regulating mine reclamation in the modern era – including for hard rock mines – having developed appropriate statutory and regulatory controls, and are dedicating resources and staff to ensure responsible industry oversight.

WGA, Policy Resolution 2014-07 ("Bonding for Mine Reclamation"). Thus, while the National Academy of Science/NRC confirms that hardrock mine regulation on federal lands is "generally effective," the Western Governors' Association confirms that the Western States' hardrock mine regulation is also "protective of human health and the environment." Collectively, this means that all Western lands, federal and state (including private) lands are covered by adequate regulations regarding hard rock mining.

Thus, since it has been well-established that state regulatory and policy regulation of hardrock mining protects human health and the environment, it is important to also ensure that such regulation is protective of the state public finances, as well.

In 2014, the WGA correctly determined regarding the Western mining states that:

> An important component of a state's oversight of mine reclamation is the requirement that mining companies provide financial assurances in a form and sufficient to fund required reclamation if, for some reason, the company itself fails to do so [often referred to generically as "Bonding"].
>
> ...

> All Western states have developed regulatory bonding programs to evaluate and approve the financial assurances required of mining companies. The states have developed the staff and expertise necessary to calculate the appropriate amount of the bonds, based upon the unique circumstances of each mining operation, as well as to make informed predictions of how the real value of current financial assurance may change over the life of mine, even post-closure.

WGA, Policy Resolution 2014-07 ("Bonding for Mine Reclamation"). These are powerful Bi-Partisan collective gubernatorial determinations made over a period of recent years. Importantly, these statements by Western State political leaders are well-supported by the independent factual record.

3.4 Current hardrock mine regulation is protective of the environment on all federal and state Western lands – A Summary

In 1999, federal hardrock mine regulation programs of the USFS and the BLM were deemed to be "generally effective" in protecting the environment by the National Academy of Science/National Research Council. In 2011, Senator Murkowski's investigation of the BLM and Forest Service mine regulation experience verified and updated the 1999 NAS/NRC determination. And the Bipartisan Western Governors' Association has determined that the state hardrock mine regulatory programs were both "protective of human health and the environment" and protective of public treasuries.

Importantly, such regulatory "treasury protection" does not even consider the major additional public benefit of mining revenue from state revenue from taxes, severances taxes, and employee income taxes, among other sources, which are substantial since mining jobs (i) are traditionally some of the highest paying hourly wages in any state (ii) like any industrial enterprise, have substantial job multiplier effects on supporting business and employment and (iii) typically produce products that are the necessary in-puts for US manufacturing.

Nevertheless, it is reasonable to ask, "Why is hardrock mine regulation so effective now, when historic operations created significant problems?" Obviously, as discussed above, part of the answer is simply that prior to 1970 (i.e., the Pre-Regulatory Era) there was no significant environmental regulation of hardrock mines. However, it is also important to recognize that prior to 1970 there was also no significant environmental regulation of municipal waste or municipal sewage, nor was there any significant regulation of manufacturing environmental impacts. The "bottom line" is that the American culture has now made environmental protection a priority value – not only for the hardrock mining industry, but also for local communities, industry, the regulatory community, and the public. Therefore, unlike in decades gone-by, public, private and NGO managers are now paying close attention to hardrock mining environmental issues that did not even show up on the policy "radar screen" prior to 1970.

4.0 Changing Societal Values – The Great Depression, World War II, the Cold War, and the the Modern Environmental Movement

4.1 Prior to 1970, there was virtually no direct regulation of municipal sewage, industrial wastes or hardrock mines.

Prior to 1970, there was no significant regulation of hardrock mines at either the federal or state level. Mining was not an exceptional activity in this regard. Prior to 1970 there was very little direct regulation of municipal sewage or industrial waste discharges. The early federal water pollution control laws were primarily construction grants programs that were public works projects subsidizing certain activities, but these were not regulatory prohibitions. Rivers, lakes and other water bodies were deliberately used to dispose of all types of septic, chemical and industrial wastes.

Prior to 1970, government and industrial managers did not "see" environmental pollution as a problem or they simply did not know what to do about it. In 2017, this may seem incomprehensible. However, if one briefly reviews our history leading up to this point, one can quickly understand how the culture reached this point. More importantly, for the purpose of this report, in part, it explains why the regulatory omissions of the past will not be repeated, even without specific regulatory prohibitions.

4.2 Societal Values of "The Greatest Generation"

Tom Brokaw's iconic 1998 book *The Greatest Generation*[13] describes the generation of American who came of age in the poverty of the Great Depression and went on to fight World War II, the Korean War, the Cold War, and then participated in generating an era of comparative affluence in the 1950s and 1960s. The deprivation of the Great Depression created a culture in which jobs and manufacturing production were the primary concerns. Belching industrial smokestacks symbolized prosperity in one town, while clean air in the next town symbolized factory closure and unemployment. For example, in 2016, it is now ironic to note with regard to a historic smokestack at a Hoover vacuum manufacturing facility that:

> … the Hoover Co. understood the value of the tall chimney promoting the burgeoning company at a time when companies took pride in the height of their smokestacks. While today they may represent industrial pollution, in that era, the image of the black billowing smoke from a tall chimney stack represented prosperity. 'They wanted it to be a symbol of their company by putting their name on it,' Fernandez said. 'Every time somebody would take a picture of North Canton [Ohio], that chimney is in the picture.' 'It's certainly symbolic.'

"Iconic Hoover Smoke Stack to be Restacked," Robert, Wang, The Canton Repository, December 4, 2014. Obviously, this describes a very different set of values from the environmental values that are foundational to the US in 2017.

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[13] Brokaw, Thomas, The Greatest Generation, Random House, New York, 1998.

The economic desperation of the Great Depression focused both public and private values upon the primary mission of finding ways to generate employment, manufacturing production and material prosperity to the exclusion of almost all other societal values. Thus, for example, when President Roosevelt's New Deal promoted multiple massive government dams on the Columbia River and Tennessee River systems progressive folk hero Woody Guthrie celebrated these achievements with songs like "Roll On, Columbia, Roll On" and "Grand Coulee Dam" unabashedly supporting such projects without any apparent concern about the associated major environmental, social or First Nation impacts. "Environmental concerns," as we now understand them were not part of the mainstream culture. The American culture of the Great Depression was one that necessarily worshiped jobs, production and material prosperity above all other values. These traits became even more deeply embedded into the American cultural fabric by the advent of World War II ("WWII") and its precursor events.

Strategically, WWII was to be won or lost based not just upon the bravery and sacrifice of soldiers, sailors and airmen, but also by delivering a crushing weight of one nation's gross national product ("GNP") onto the enemy nation. At the time, the United States excelled at this form of industrial warfare. At the time, the US could generate GNP quickly and in vast quantities of material, and the US did exactly that. Idled factories were brought back to smoking productively, while liquid (and solid) industrial wastes were conveniently disposed in the waterways behind these same plants.[14] Massive new industrial production facilities were conceived of and brought into production within months, not years. Enormous new manufacturing plants were constructed to build aircraft, ships, tanks, trucks, weapons and munitions, to name just a very few of the critical implements of war. Whole new cities were constructed, seemingly overnight, to meet various production goals, and indeed, the "Manhattan Project" developing atomic weapons built new towns and industrial facilities like Oak Ridge, Tennessee and Los Alamos, New Mexico in secret, without any oversight other than that that ensured production was achieve ASAP. There was no "permitting" of any of these great public works, and little or no consideration of environmental values.

Critically, all manufacturing requires mineral inputs as primary material ingredients and the wartime plants consumed the products of hardrock mines voraciously, demanding immediate expansion of the hardrock mining industry during WWII without regard to environmental impacts.

The federal government's direct orders and subsidies spurred the hardrock mining industry into what was the greatest periods of the industry's expansion in the shortest possible time. Providing immediate production, and lots of it, was the driving societal value. Generating GNP to deliver its brutal impact upon enemy nations was imperative. Indeed, *everyone* knew that American lives depended upon this industrial production, including the primary contribution of the hardrock mining industry. (Mining is referred to as being a "primary industry" for good reason!) Environmental values, as we now

[14] Obviously, the US could not duplicate these same achievements at this time.

understand them, were pushed to an obscure corner, or more typically, such values simply did not influence federal decision-making whatsoever.

Perhaps, no single visual image captures the difference in attitudes between this period and the present than the 1943 Pennsylvania Railroad calendar art by Dean Cornwell showing a PRR steam locomotive highballing past a massive steel mill belching fire and smoke, a munitions train on the foreground track, full coal hopper cars in the background and a pile of iron ore set to be charged into the steel production furnaces. Uncle Sam looms huge in the background, rolling up his sleeve to get down to work. There is no mistaking the message, even in 2017. In 1943, the Pennsylvania Railroad was proudly displaying the pollution it generated to help win World War II.

Nor did the post-WWII culture quickly change from its intense wartime focus on material production to the exclusion of other values. The Union of Soviet Socialist Republics (USSR), a World War II ally, immediately became the new "Cold War" enemy. Additionally, Communist China, also a then-recent WW II ally became a frightening new enemy in very real "hot" war in Korea in 1950. The Soviet Union's surprisingly swift development of nuclear weapons only exacerbated US concerns. Not only were many WWII attitudes of the USA about the production ethos maintained, but indeed many of the WWII industrial and mineral production subsidies were maintained through the Korean War, and for some time thereafter. Indeed, the most far-reaching federal statute explicitly supporting U.S. mineral production was passed during this period, i.e., the U.S. Defense Production Act of 1950.

If a town was in the way of the growth of mine production, then the town had to move, in whole or in part, as witnessed, e.g., at Butte, Montana or at Bingham Canyon Utah. Other values, be they cultural or environmental, were secondary to overall societal production needs. And, indeed, the core values of production, employment and prosperity continued well into the 1960s.

> In the 1960s, before the crises of energy shortages, sprawl, air and water pollution, and post-industrial economic restructuring gripped urban and rural places across America, unlimited growth was a primary goal of many communities. Growth, both economic and demographic, was a mark of progress, a source of pride, and a centerpiece of many communities' identifies.

Greenow, Linda, 2004, "When Growth was Good: Images of Prosperity in Mid-Twentieth Century America, Middle States Geographer, 2004, 37:pp. 53-61, p. 53.

In short, the current culture of the USA has embedded environmental values into all aspects of policy-making. In contrast, "The Greatest Generation" had no such luxury in the 1930s, 1940s or 1950s. The 1960s reaction to such attitudes is understandable. However, it is not only the hardrock mining industry that had to change and incorporate such values, it was society as a whole that had to make these changes. And, such

changes, did in fact occur, in the public, the government, and the hardrock mining industry.

4.3 Cultural Balance

Fear of unemployment, fear of war, and fear of losing wars were all factors that pushed the United States far into the public policy mode of production-at-all-costs during most of the Twentieth Century. Environmental values were almost entirely ignored regarding industrial production until 1970. Indeed, such values were rarely even articulated. At the time, the pendulum had swung too far in the direction of industrial production at all cost, which led to unnecessarily high costs to natural and environmental values. However, times *were* changing in the 1960s and 1970s. With the prosperity of the 1950's and 1960's, other values could and did enter or re-enter the American culture ... including environmental values.

4.4 The Modern Environmental Movement

There is no single event that marks the beginning of the environmental movement, but there are a series of events that collectively altered the mix of cultural norms regarding jobs, production, pollution, and the environment. Concerns about nuclear arms and the effects from nuclear fallout (e.g., strontium 90) from bomb testing raised consciousness about the "environment" in the 1950s. The controversy surrounding the proposal of several major dams on the Colorado River system provided a focus for environmental values in the late 1950s, perhaps most notably the work of the Sierra Club and David Brower to help thwart the building of the Echo Park Dam in Dinosaur National Monument. The 1962 publication of Rachel Carson's controversial book *Silent Spring* provided a counterpoint to the widespread use of chemicals in the U.S. and Dupont's "better living through chemistry" message. Shortly thereafter, changing values and changing politics allowed the passage of the landmark Wilderness Act of 1964. All of these and many other factors brought changes to America's culture and values.

America reached a symbolic turning-point on April 22, 1970, celebrated by the first Earth Day. The advent of the modern environmental movement was to generate major changes for the U.S. hardrock mining industry, and indeed, all of US industry, manufacturing, state and municipal government pollution. However, these changes were certainly not immediate, and many of the changes most applicable to hardrock mining, reclamation, environmental protection and financial assurances would take decades to develop and implement.

4.5 Cultural and Legal Changes Incorporating Environmental Values

The above discussion is provided to emphasize the extent and rapidity of the change in societal values that caught both government and industry off-guard in the 1970s. Prior to 1970, there was very little regulation of government or industrial pollution. Often, there was no regulation of pollution whatsoever. Even worse, the USA's pre-1970 values and norms were such that environmental values were not significantly impacting societal

decision-making in any way, because much of society did not even understand there was another way of conceiving of the world. In fact, it was only late in 1969 that the US enacted the National Environmental Policy Act of 1969 (NEPA), which was the forerunner of most modern federal environmental statutes.

Accordingly, there is nothing that can be learned about the effectiveness of current hardrock mine regulation by studying facilities that were designed or constructed prior to 1970. These facilities were designed, built and operated to maximize production and minimize cost, but hardrock mines permitted/approved after 1990 have been designed, built and operated to integrate long-term environmental closure and reclamation as a primary design standard, as required by current law and mining industry attitudes.

Importantly, as discussed immediately below, even though laws and attitudes were changing rapidly starting in the 1970s, there was certainly a very steep "learning curve" as both government and industry tried to cope with challenges of a sort that never had had to be addressed previously. This transition was hard for all concerned, and mistakes were made. For example, the infamous "Syringe Tide" of raw garbage and medical waste washed up onto New Jersey and Long Island beaches as late as 1988-1989 highlighted on-going municipal waste disposal practices, and indeed, well into the 1990s, New York City and various New Jersey communities were still ocean-dumping sewage sludge in the New York Bight and raw sewage via storm water overflow.

Fortunately, the Hardrock Mining Industry's transition problems was largely complete by 1990, and since 1990 environmental problems associated Hardrock Mining have been generally modest and manageable, as benchmarked, in part, by the lack of any new Western hardrock mines appearing on the CERCLA National Priorities List in the last 26 years.

Section 5.0, immediately below, provides a summary of the major environmental regulatory programs that have created the regulated hardrock mine era.

5.0 Development of Legally-Applicable Hardrock Mine Regulation

5.1 Regulation of the Natural Media Receptors – An Overview

Fundamentally, there are four major categories natural media that the environmental laws protect: (1) air; (2) surface water; (3) groundwater, and (4) land. As a practical matter, hardrock mining has not typically triggered significant scientific, policy or regulatory questions regarding air quality; therefore, this study does not evaluate hardrock mine regulation regarding protection of air quality.[16] Surface water quality protection has been

[16] For example, the only significant air quality policy issue that has arisen from hardrock mining concerns the emissions of mercury from gold mining operations in Nevada impacting Idaho dam-impounded reservoirs. However, these allegations were effectively discredited by the White Paper developed by the Idaho Association of Commerce and Industry/Idaho Council for Industry and the Environment Report "Sources and Receptors of Mercury in Idaho," January 28, 2009 ("Idaho Mercury Report"). Mercury in Idaho's waterways is primarily a result of geologic source mercury or legacy mining (i.e., historic mining

dominated by promulgation of federal statutory and regulatory programs, which then have typically been implemented by state agencies. On the other hand, ground water quality protection has been the province of State government with some specific notable exceptions.

Regulation of direct impacts to land (i.e., "reclamation") has been almost exclusively the province of the relevant land management authorities. The regulation of hardrock mine reclamation on National Forest System lands has been administered by the USFS since 1974, the regulation of hardrock mining on Department of Interior managed public domain lands has been administered by the BLM since 1981, and the regulation of state and private lands within a state are administered by the relevant state agency. Additionally, the integration of post-mining land use, continued protection of water quality and post-mining land uses following hardrock mine closure and reclamation, as well as bonding for these purposes, has been the unique province and expertise of the State and Federal Land management agencies. A brief history of these programs is provided below.

5.2 Surface Water

The Clean Water Act[17] was passed in 1972 and, among other things, created a requirement for a discharger of a "pollutant" to "navigable waters" (which later came to be more broadly defined as "waters of the United States") from a "point source" to obtain an NPDES permit.[18] In theory, the Clean Water Act, most particularly the NPDES permit system was one of the first federal laws potentially directly implementing regulation of hardrock mines. However, implementation was slow as EPA and the mining industry grappled with new concepts, new operational issues, and new regulatory concepts, including but not limited to programmatic litigation (see e.g., *U.S. Steel Corp. v. Train*, 556 F. 2d. 822 (7th Cir. 1977), and major statutory amendments[19] to address these issues. Thus, EPA did not promulgate 40 C.F.R. 440, Subpart J, concerning "Copper, Lead, Zinc, Gold, Silver, and Molybdenum Ores Subcategory," some of the most common Hardrock Mines, until December 1982. 47 FR 54609, Dec. 3, 1982.

Therefore, prior to 1982, EPA and delegated State programs had attempted to enforce on a case-by-case basis an inflexible and absolute "no discharge" requirement that did not take into account net contributions of rain and snow which contributed to unrealistic environmental evaluations that significantly contributed to environmental problems at early Transition Era hardrock mines. Thus, the very first practical federal regulatory scheme specifically regulating hardrock mine surface discharges did not even exist until the very end of 1982. Not surprisingly, sorting out the implementation of the NPDES program did not occur overnight.

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using historic mineral extraction technologies and practices long abandoned). Neither the EPA, nor the NGO's, have ever responded to the Idaho Mercury Report in writing.

[17] Technically, the Clean Water Act is the Federal Water Pollution Control Act Amendments of 1972, Pub. L. No. 92-500 (codified as amended at 33 U.S.C. Section 1251-1387.

[18] 33 U.S.C. Sections 1311(a), 1362(6), (7), (12), (14).

[19] 1977 Clean Water Act Amendments, Pub. L. No. 95-217, 91 Stat. 1581 (codified as amended in scattered sections of 33 U.S.C.)

5.3 Groundwater Protection at Hardrock Mines

5.3.1 State Protection of Groundwater at Hardrock Mines

Groundwater regulation is generally held to be the unique province of state government. Groundwater, unlike surface water, does not readily migrate across State borders. Thus, while the federal definition of "waters of the United States" has been construed broadly, it has not generally been construed to regulate groundwater. As the American Law of Mining states, "[t]he Clean Water Act makes a clear distinction between navigable waters on the one hand and groundwater on the other."[25]

Therefore, state hardrock mine regulation has emerged as the primary regulatory tool for preventing or otherwise regulating potential hardrock mining impacts to groundwater. However, these programs have been relatively recent developments (i.e., since 1990). For example, the Nevada "Mining Facilities" regulation explicitly protects against and regulates discharges to groundwater from mining facilities were promulgated on September 1, 1990.[26] And although Idaho's Ground Water Quality Plan became law in 1992,[27] it was not until 1997 that a detailed and comprehensive enforcement mechanism was promulgated. See IDAPA 58.01.11, 3-20-1997 ("Ground Water Quality Rule"). Alaska's Hardrock mine reclamation was codified and promulgated in 1991. Washington's Metal Mining and Milling Act protects against potential discharges to groundwater and was passed in 1994.[28]

Thus, comprehensive direct preventative regulation of potential groundwater impacts of hardrock mine regulation was only initiated in the 1990s.

5.3.2 Federal Protection of Groundwater at Hardrock Mines

The Clean Water Act regulates discharges from hardrock mines, to "waters of the United States," and as discussed above, this is generally limited exclusively to surface water discharges. Certain Federal programs, including the Safe Drinking Water Act,[29] the federal Resource Conservation and Recovery Act[30] and Uranium Mill Tailings Radiation Control Act of 1978[31] regulate specific, narrowly defined activities potentially relevant to hardrock mines. The federal public lands agencies (i.e., the Forest Service and the BLM) incorporate state groundwater standards into NEPA compliance and mitigation. Nevertheless, as discussed below, since these state programs were devised in the 1990s, even explicit federal incorporation of state groundwater standards did not provide significant preventative groundwater regulation until, at least 1990. EPA has confirmed this to be true.

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[25] 5 Am. L. of Mining Section 169.02[2][c] (2d ed.)
[26] NAC 445A.350 et seq.
[27] See Idaho Groundwater Plan, Section II-C, Senate Bill 1321 (1992).
[28] Wash.Rev.Code 43.21.
[29] Safe Drinking Water Act, 42 U.S.C Sections 300 et seq.
[30] Resource Conservation and Recovery Act, 42 U.S.C. Sections 6901 et seq.
[31] Uranium Mill Tailings Radiation Control Act of 1978, 42 U.S.C. Section 7901 et seq.

EPA's assessment of groundwater protection at hardrock mine in 1985 was as follows:

> Ground-water monitoring is difficult, expensive, and has seldom been conducted at mine sites on a comprehensive basis. Because of complex geologic strata (presence of an ore body) and the extensive size of many mine properties, proper ground-water monitoring is technically difficult and costly. Historical practice in the mining industry has not required such monitoring. As a result, there is very little available information in the literature, and almost none on a complete or comprehensive basis. Most mines have no historical or contemporary ground-water monitoring information.

RTC I, p. 6-7 (emphasis in original). In short, as late as 1985 EPA asserts that groundwater protection at hardrock mine sites was virtually nonexistent. Thus, per EPA's own study of the hardrock mining industry, one cannot rationally gauge the current effectiveness of hardrock mine regulation regarding groundwater protection with reference to sites designed and approved before 1985.

Accordingly, in the 1980s, federal regulation hardrock mining for protection of groundwater was limited, and virtually non-existent. This left the subject of groundwater regulation at hardrock mines to the state governments. The Western States stepped-up to manage this area in the 1990s, generally as part of mining specific statutes or regulations, and eventually tied directly to hardrock mine reclamation programs and financial assurance requirements.

5.4 Hardrock Mine Reclamation, Financial Assurances and Water Quality Protection

In 1974, the Forest Service promulgated regulations governing reclamation and performance bonding of hardrock mines on National Forest System Lands.[32] These were some of the first regulations governing Hardrock Mine reclamation promulgated by any agency, federal or state. In 1981, the BLM promulgated the surface management regulations applicable to Mine Plans of Operations ("MPOs") similar in concept to those of the Forest Service. The history of the impact and evolution of these programs is described in greater detail by Northwest Mining Association's "The Evolution of Federal and Nevada State Reclamation Bonding Requirements from Hardrock Exploration and Mining Projects: A Case History Documenting How Federal and State Regulators Used Existing Regulatory Authorities to Respond to Shortcomings in the Reclamation Bonding Program," prepared by Jeffrey V. Parshley and Debra W. Struhsacker, January 2008. That study documents federal and state interagency and industry cooperation by which hardrock mine regulation worked to create the currently effective hardrock mine regulation in Nevada; however, a similar history is reflected in most of the western mining states, as discussed above.

[32] 36 CFR Part 228 (2016).

However, hardrock mine regulation is certainly not only about the Forest Service and the BLM. The Western States have regulated hardrock mining for decades. For example, both Idaho and Colorado had mined land reclamation programs that dated back to the 1970s. Initially these programs, like those of the Forest Service and the BLM focused on regrading and revegetation of mined lands, and not on surface water quality and certainly not ground water protection. Indeed, initially, the Forest Service deferred protection of surface water to EPA enforcement of the Clean Water Act and EPA oversight of delegated state Clean Water Act programs, which gave rise to two of the most notorious hardrock mine regulatory failures during the Transition Era (1970-1990), specifically Summitville, Colorado and Zortman, Montana. Thus, it became clear to the BLM, the Forest Service and the Western States that closure, reclamation, post-mining land uses and water quality had to be integrally-related and "bonds" posted.

Accordingly, the current reclamation bonding programs are working very well. Not only are Regulated Hardrock Mines (i.e., post-1990) avoiding EPA CERCLA National Priorities List, but even more importantly, existing financial assurances (federal and state) are avoiding public liability, even when defaults have occurred. For example, in the co-authors' home states of Idaho and Nevada, there has never been a Hardrock Mine that was approved and for which financial assurances were posted that defaulted on the financial assurances such that the Mine was not closed and reclaimed in accordance with: (1) the reclamation/closure plan approved by the relevant federal and/or state agencies; and (2) the financial assurances retained by the agencies. This is discussed in greater detail below.

In Idaho, two relatively large hardrock mines in Idaho defaulted on their bonds in the 1990s such that the public agencies had to rely on financial assurance monies to close and reclaim the properties. Even though both mines dated from the Transition Era (i.e., pre-1990), in both situations (specifically, Dakota Mines-Stibnite and Black Pine), the bond amounts proved to be adequate. Interestingly, these two mines had been identified by Earthworks' (one of the CERCLA 108(b) plaintiffs) as being insufficiently bonded.[33] Earthworks was wrong, by a factor of ten. More specifically, Earthworks' stated that adequate bonding for each of these mines would be about $50,000 per acre; in fact, Dakota Stibnite and Black Pine were closed and reclaimed for $2,710 per acre and $7,383 per acre respectively.[34] In short, it is objectively demonstrable that any factual assertions by Earthworks are insufficiently grounded to be given serious consideration in any EPA rulemaking.

Nevada has the nation's largest and arguably the most successful state hardrock mine environmental closure and reclamation program. In part because it started later, Nevada developed water quality protection and land reclamation into an integrated and "bonded" hardrock mine program, essentially from the beginning. Nevada's "Mining Facilities" regulations protecting waters of the state (surface and groundwater) were promulgated in 1989, and then in 1990 the Nevada legislature passed the Nevada Reclamation Act. In

[33] Letter, Baird Hanson William LLP to USFS Salmon-Challis Nation Forest, May 24, 2007

[34] Thus, Earthworks and their NGO colleagues have been are fully informed of the adequacy of existing hardrock mine financial assurances for 20 years.

the mid-to-late 1990s, two permitted mines (Goldfields and Mt. Hamilton) defaulted on their "bonds," which were adequate but not immediately available for necessary water system management. This prompted voluntary efforts on the part of the Nevada mining industry to act to prevent any interim spills and this caused the Nevada Mining Association to seek a change in Nevada law to allow for immediate NDEP access to "fluid management bonding." This problem has never recurred.

Thus, every Idaho and Nevada hardrock mine (including those that have been in default) that was approved and subject to financial assurances has been closed and reclaimed in accordance with: (1) the reclamation/closure plan approved by the relevant federal and/or state agencies; and (2) the financial assurances retained by the federal and/or state agencies.

Once states and/or federal land management agencies (i.e., the Forest Service and the BLM) integrated mine reclamation with surface water and ground water protection, geochemical prediction and financial assurance for such activities and related predictions, the chances of such facilities replicating the problems that arose in the Pre-Regulatory Era (Per-1970) became essentially impossible to duplicate ... and, indeed, such problems have not been recreated to date.

Thus, certain Transition Era (1970 through about 1990) hardrock mines created problems. There is no question there has been a "learning curve." State agencies began to create active groundwater management programs regulating hardrock mines that might impact ground water. And, the Forest Service and the BLM began to work in concert with the relevant states, as all parties sought to incorporate comprehensive surface and groundwater protection into NEPA planning, Mine Plan of Operation approvals and reclamation bonding programs to create regulatory programs that prevented the creation of water pollution in the first place and bonded for such protection from the outset of mining operations. This took time, but it was achieved. And, the most important single element is that since 1990, design, permitting, construction, operation, closure and reclamation of hardrock mines are integrated.

Initially, Western States hardrock mine regulation was limited to regrading and re-vegetation, similar to the early Forest Service and BLM programs. However, after water quality impacts were identified famously at hardrock mines at Zortman and Summitville, then the primary federal land management agencies (i.e., the Forest Service and BLM) shifted from reclamation as a merely regrading and revegetation exercise to comprehensive sustainable surface and ground water quality protection.

5.5 The National Environmental Policy Act of 1970

Nominally, the passage of the National Environmental Policy Act of 1969 (NEPA) was potentially applicable to hardrock mines and therefore could have heralded an immediate major shift in hardrock mine regulatory policy. In fact, initially, it did not. NEPA requires a "proposal" of a "major federal action" (including potentially approval of a

Mine Plan of Operation) "significantly affecting the environment."[35] Thus, NEPA regulation of hardrock mining typically is triggered by the filing of a request for an MPO with the Forest Service, the BLM or the EPA (for an NPDES permit). In fact, in the 1970's and 1980's there was significant state-by-state debate regarding whether the approval of a single hardrock mine constituted a "major" Federal action that was subject to NEPA, but it was not until 1995 that the first hardrock mine Environmental Impact Statement was issued in Nevada. Nevertheless, when it became clear that EPA and state NPDES jurisdiction could not adequately manage surface discharges as stand-alone issues at Zortman and Summitville, the Forest Service and the BLM used their Mine Plan of Operation approval processes to create comprehensive and integrated water quality protection for hardrock mines. Clearly, there were regulatory gaps that had to be addressed. This was part of the learning curve that delayed effective hardrock mine regulation until the 1990s. In fact, regarding current hardrock mine regulation, NEPA EIS evaluation of the environmental impacts and mitigation measures has become a major aspect of any hardrock mine approval with a federal nexus.

Nevertheless, prior to 1990, NEPA had little relevance to hardrock mine regulation.

5.6 Evaluation of the Effectiveness of Hardrock Mine Regulation based upon the Timing of Regulatory Developments

The above discussion provides a short jurisdictional history of the regulation of hardrock mining. To briefly summarize, there was literally no regulation and therefore no regulatory consideration of the environmental impacts of hardrock mining prior to 1970, so any site designed and constructed prior to this date provides no information about the effectiveness of hardrock mine regulation. NEPA was signed into law in 1970, but NEPA required other federal authorities and case law to be interpreted before NEPA could be implemented at hardrock mines. Accordingly, it is misleading, disingenuous, and certainly "arbitrary and capricious" to evaluate environmental issues associated with hardrock mines designed and operated prior to 1970 as examples of current hardrock mine regulation.

EPA's hardrock mine NPDES program was not published until 1982, and took years after that to properly implement the program. As discussed above, federal agencies were generally precluded from infringing upon state control of groundwater, and groundwater programs regulating hardrock mines were largely the product of the 1990s. Thus, it was not until the 1990s that federal and state agencies began to comprehensively address the water quality issues associated with hardrock mining.

EPA confirms this state of affairs when it stated in 1985 that:

> During active site life, during closure, and in the post-closure period, facilities could employ engineering controls to prevent erosion, to keep leachate out of the ground water, or to remove contaminants introduced into ground water. However, EPA data on management methods at mining

[35] American Law of Mining, Section 167.02.

> facilities indicate that only a small percentage of mines currently monitor their ground water, use run-on/runoff controls or liners, or employ leachate collection, detection, and removal systems. EPA has not determined the circumstances under which these waste measures would be appropriate at mine waste and mill tailing disposal sites.

RTC I, p. ES-10. It is only after 1990 that the lessons learned from the 1970 to 1990 Transition Era began to be more fully incorporated in the mine regulatory processes. Thus, it has only been in the last 20 years that hardrock mine permitting has first begun to more fully evaluate, predict and regulate long term water quality impacts.

The bi-partisan Western Governors' Association has characterized the situation as follows:

> ...
>
> 3. While older mines in western states have sometimes had harmful impacts on adjacent waters, the mining industry has improved its operation and reclamation track record in recent decades, to avoid or minimize such impacts.
> 4. Recent decades have also brought heightened attention to the importance of mine reclamation from state regulators across the west. All western states that host hardrock mining industries now have staff dedicated to ensuring that on-going mine operations develop and follow appropriate reclamation plans.

WGA, Policy Resolution 2011-4 (A)(3) and (4).

> All Western states have developed regulatory bonding programs to evaluate and approve the financial assurances required of mining companies. The states have developed the staff and expertise necessary to calculate the appropriate amount of the bonds, based upon the unique circumstances of each mining operation, as well as to make informed predictions of how the real value of current financial assurance may change over the life of mine, even post-closure.

WGA, Policy Resolution 2014-07 ("Bonding for Mine Reclamation"). In fact, the "bottom line" on the adequacy of hardrock mine regulation is fairly simple. Until changing societal cultural norms regarding environmental protection and Hardrock Mine regulation began to be implemented by federal and state regulatory agencies environmental problems arose. Since 1990 after federal and state agencies began paying attention with a degree of technical experience, the EPA has yet to designate even a single Western hardrock mine site to the National Priorities List.

The key to effective hardrock mine regulation is that there is *some* form of evaluation and planning. Neither the goals, nor the science, are that difficult to implement. It takes planning and application of existing knowledge. Almost all of the hardrock mines giving rise environmental problems on the CERCLA NPL arose when environmental goals and planning were nonexistent in the Pre-Regulatory Era (Pre-1970). And, while a few CERCLA NPL problems arose in the Transition Era (1970 through 1990) when practical experience was wholly-lacking, in the Regulatory Era (Post-1990) there have been no

Western hardrock mine sites that EPA has deemed to be a sufficient problem to require nomination to the National Priorities List.

6.0 Conclusion

The federal and state regulation of hardrock mining and milling facilities is a remarkable success story of changing law and policy environmental protection that is well-illustrated by the vintage of hardrock mines on the United States Environmental Protection Agency ("EPA") National Priorities List of environmental cleanup sites. To briefly summarize, there has never been an environmental problem at a Western hardrock mine that was approved by a federal or state agency in the West after 1990 that has required EPA to make such hardrock mine a Superfund "top priority among known response targets." To reiterate, no hardrock mine permitted in the West after 1990 has ever been placed on EPA's Superfund National Priorities List.

Current hardrock mine regulation on federal lands managed by the United States Forest Service and the Bureau of Land Management has been determined to be "complicated, but generally effective" by the federal government's independent National Academy of Sciences National Research Council in 1999. In 2011, Senator Murkoswki's investigation of the BLM and Forest Service mine regulation experience verified and updated the 1999 NAS/NRC determination. And, the Bi-partisan Western Governors' Association has stated that the Western states, which regulate Hardrock Mining on state and private lands within their borders "... impose permit conditions and stringent design and operating standards, to ensure that hardrock mining operations are conducted in a manner that is protective of human health and the environment" and that Western "... states have developed the staff and expertise necessary to calculate the appropriate amount of the bonds, based upon the unique circumstances of each mining operation, as well as to make informed predictions of how the real value of current financial assurance may change over the life of mine, even post-closure." WGA, Policy Resolution 10-16, Background (A)(8) ("National Minerals Policy"). Moreover, all programs of the federal and state agencies have continued to strengthen their reclamation and bonding programs on an ongoing basis.

The above-described regulatory success story is a direct result of society's change in values both outside of, and within, the hardrock mining industry to seek protection of the environment, not just to creates jobs, industrial production and tax revenue. Hardrock mines designed and built prior to 1970 were developed to maximize production and minimize cost with little or no regard for environmental values. After 1990, new hardrock mines have been designed, built and operated to integrate long-term environmental closure and reclamation as a primary design standard, as required by current law.

The above-described changes in values, law, design, permitting, operation closure and reclamation have had a major impact on the adequacy of financial assurances posted pursuant to routine individual financial assurances on a mine by mine basis. Using the co-authors' home states as examples, there has never been an Idaho or Nevada hardrock

mine for which financial assurances were posted that defaulted on the bonding such that the hardrock mine was not closed and reclaimed in accordance with: (1) the reclamation/closure plan approved by the relevant federal and/or state agencies; and (2) the financial assurances retained by the agencies. Thus, objectively, the existing regulation of hardrock mines is protecting the environment from releases and protecting public treasuries through posting of adequate financial assurances.

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MEMORANDUM

TO: Mr. Joe Baird – Baird Hanson LLP

FROM: Mr. Richard DeLong *RFD*

DATE: May 15, 2015

SUBJECT: Assessment of Mining and Milling Site on the National Priorities List

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At your request, Enviroscientists, Inc. (Enviroscientists) completed an assessment of the United States Environmental Protection Agency's (EPA's) National Priorities List (NPL) for Mining and Milling Sites (MMS). A search of the NPL was completed on April 21, 2015. See Attachment A for a printout of the list. In addition, a compact disk (CD) with the searchable excel version of the printout is included with is memorandum.

There are over 1,100 sites on the NPL. Of those, there are 100 that the EPA has classified as MMS. However, only 55 of those sites are actual mining operations where mineral resources were extracted from the earth. The other 45 are mineral processing facilities where a mineral product is delivered to the operation for further processing. The 55 "Hardrock Rock" MMS on the NPL fall into the following temporal classifications: 49 are prior to 1970; five are from 1970 through 1990; and one is post-1990. The one operation that was permitted and began operations post-1990 is the Barite Hill property in South Carolina. The operation was an open pit heap leach mine that ceased operation in 1995 and reclamation was completed in 1995 to 1999.

ATTACHMENT A

MAY 2013 VERSION OF THE MINING AND MILLING SITES ON THE NATIONAL PRIORITY LIST

Table 1

Summary - Mining and Milling Sites on the National Priorities L

Source: EPA AML - Status = "Final" as of May 2013 Update (list check April 21, 2

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	Site Name	EPA Region	State	Year Start	Year End	Year End	Design/Approval 1 - pre 1970 2 - 1970 - 1989 3 - 1990 and later	Mining/Milling or Other Processing	Type of Activity	Minerals	NPL Status	Site/CERCLIS ID Number
1	CALLAHAN MINING CORP	1	ME	1880's	1972	1972	1	M	Mining/milling (Open pit mine)	Zinc/copper	Final	MED980524128
2	ELIZABETH MINE	1	VT	early 1800s	1958	1958	1	M/O	Mining; copper smelting	Copper	Final	VTD988366621
3	ELY COPPER MINE	1	VT	1821	1920	1920	1	M/O	Mining/cobbing/roasting/smelting; (removal of ore)	Copper	Final	VTD988366571
4	PIKE HILL COPPER MINE	1	VT	1847	1919	1919	1	M	Mining	Copper	Final	VTD988366720
5	LI TUNGSTEN CORP	2	NY	1940's	1984	1984	1	O	Processing (Received tungsten ore's for processing).	Tungsten	Final	NYD986882660
6	MAYWOOD CHEMICAL CO.	2	NJ	1916	1955	1955	1	O	Processing (radioactive thorium ore).	Thorium	Final	NJD980529762
7	SHIELDALLOY CORP	2	NJ	1955	2006	2006	1	O	Processing (discharge to unlined pits prior to 1970 enforcment actions)	Chromium alloy	Final	NJD002365930
8	U.S. RADIUM CORP	2	NJ	1915	1926	1926	1	O	Processing/Tailings	Radium	Final	NJD980654172
9	W.R. GRACE & CO., INC./WAYNE INTERIM STORAGE SITE (USDO	2	NJ	1948	1971	1971	1	O	Processing/extraction	Monazite ore (thorium/rare earths)	Final	NJ1891837980
10	FOOTE MINERAL CO.	3	PA	1942	1991	1991	1	O	Processing/Manufacture of metal products	Lithium	Final	PAD077087989

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11	FRANKLIN SLAG PILE (MDC)	3	PA	1850's	1999	1999	1	O	MDC Industries sold the processing slag as sand blasting grit for 40 years. MDL Abandoned site 12/30/1999. Franklin Smelting and Refining Co smelting the ore. (lead contamination)	Copper	Final	PASFN0305549
12	JACKS CREEK/SITKIN SMELTING & REFINING, IN	3	PA	1958	1977	1977	1	O	Smelting processing and precious metals reclamation	Precious metals	Final	PAD980829493
13	PALMERTON ZINC PILE	3	PA	~1912	1982	1982	1	O	Smelting processing (NJ Zinc Co.)	Zinc	Final	PAD002395887
14	U.S. TITANIUM	3	VA	1931	1971	1971	1	O	Refining processing titanium ore/Titanium dioxide manufacturing	Titanium	Final	VAD980705404
15	BARITE HILL/NEVADA GOLDFIELDS	4	SC	1991	1995	1995	3	M	Mining (gold plant, heap leach)	Gold, Silver	Final	SCN000407714
16	BREWER GOLD MINE	4	SC	1828	1995	1995	1,2	M	Mining - CN heap leach pad 1987 - 1995.	Gold	Final	SCD987577913
17	MACALLOY CORPORATION	4	SC	1941	1998	1998	1	O	Ferrochromium alloy processing plant	Ferrochromium	Final	SCD003360476
18	NATIONAL SOUTHWIRE ALUMINUM CO.	4	KY	1969	active	active	1	O	Aluminum processing (north pond)	Aluminum	Final	KYD049062375
19	ORE KNOB MINE	4	NC	1850s	1962	1962	1	M	Mining, roasting, smelting	Copper	Final	NCN000409895
20	STAUFFER CHEMICAL CO. (TARPON SPRINGS)	4	FL	1950	1981	1981	1	O	Processed elemental phosphorous from phosphate ore.	Phosphate	Final	FLD010596013

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21	ASARCO TAYLOR SPRINGS	5	IL	1911	active	active	1	O	Zinc smelting/Processing zinc oxide	Zinc	Final	ILN000508170
22	DEPUE/NEW JERSEY ZINC/MOBIL CHEMICAL CORF	5	IL	1903	1990	1990	1	O	Zinc smelting/Processing/Phosphate fertilizer	Zinc	Final	ILD062340641
23	EAGLE ZINC CO DIV T L DIAMOND	5	IL	1923	2003	2003	1	O	Processing/zinc smelting	Zinc/Cadmium	Final	ILD980606941
24	HEGELER ZINC	5	IL	1906	1954	1954	1	O	Zinc smelter/Processing	Zinc	Final	ILN000508134
25	MATTHIESSEN AND HEGELER ZINC COMPAN'	5	IL	1858	1978	1978	1	O	Zinc Smelter (smelter closed 1961)/ Processing	Zinc	Final	IL0000064782
26	ORMET CORP	5	OH	1956	2005	2005	1	O	Aluminum reduction (unlined pits closed 1981)/ Processing	Aluminum	Final	OHD004379970
27	TORCH LAKE	5	MI	1890	1969	1969	1	M	Mining (copper mines dumped tailings into lake).	Copper	Final	MID980901946
28	U.S. SMELTER AND LEAD REFINERY, INC	5	IN	1920	1985	1985	1	O	Smelter/Processing	Lead	Final	IND047030226
29	CHEVRON QUESTA MINE (MOLYCORP)	6	NM	1920	Active (underground blockcave 1983 to present)	active	1,2	M/O	Mining/Milling	Molybdenum	Final	NMD002899094
30	CIMARRON MINING CORP.	6	NM	1960	1982	1982	1,2	O	Milling	Iron; Precious metals	Final	NMD980749378
31	HOMESTAKE MINING CO.	6	NM	1958	1990	1990	1	O	Milling	Uranium	Final	NMD007860935

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32	TAR CREEK (OTTAWA COUNTY)	6	OK	1850	1970s	1970	1	M	Mining district	Iron, Zinc	Final	OKD980629844
33	TEX-TIN CORP.	6	TX	1941	1989	1989	1	O	Smelter/Processing	Tin, Copper	Final	TXD062113329
34	TULSA FUEL AND MANUFACTURING	6	OK	1914	1925	1925	1	O	Smelter/Roaster/Processing	Zinc/lead	Final	OKD987096195
35	UNITED NUCLEAR CORP.	6	NM	1967	1986	1986	1,2	M/O	Mining/Processing/milling	Uranium	Final	NMD030443303
36	ANNAPOLIS LEAD MINE	7	MO	1920	1940	1940	1	M	Mining	Lead	Final	MO0000958611
37	BIG RIVER MINE TAILINGS/ST. JOE MINERALS CORP.	7	MO	1700's	1972	1972	1	O	Tailings disposal for lead mining	Lead	Final	MOD981126899
38	CHEROKEE COUNTY	7	KS	~1870	1970	1970	1	M	Mining (a/k/a Tri-State mining district)	Lead, zinc	Final	KSD980741862
39	MADISON COUNTY MINES	7	MO	1700's	1970s	1970	1	M	Mining (mining district)	Lead	Final	MOD098633415
40	NEWTON COUNTY MINE TAILINGS	7	MO	~1850s	1950	1950	1	M	Mining (Tri-State Mining District)	Lead, cadmium, zinc	Final	MOD981507585
41	OMAHA LEAD	7	NE	1870s	1996	1996	1	O	Smelting/Processing	Lead	Final	NESFN0703481

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42	ORONOGO-DUENWEG MINING BELT	7	MO	1848	late 1960s	1967	1	M	Mining (Tri-State Mining District)	Lead, cadmium, zinc	Final	MOD980686281
43	SOUTHWEST JEFFERSON COUNTY MINING	7	MO	early 1800s		1975	1	M/O	Historic mining district, smelting	Lead, zinc, barium	Final	MON000705443
44	WASHINGTON COUNTY LEAD DISTRICT - FURNACE CREEK	7	MO	1799	1980s (historic)	1980	1	M/O	Mining, milling, smelting	Lead, barite (barite 1926 - 1980s)	Final	MON000705842
45	WASHINGTON COUNTY LEAD DISTRICT - OLD MINES	7	MO	1700s		1980	1	M/O	Mining, milling, smelting			MON000705027
46	WASHINGTON COUNTY LEAD DISTRICT - POTOSI	7	MO	1700s		1980	1	M/O	Mining, milling, smelting			MON000705023
47	WASHINGTON COUNTY LEAD DISTRICT - RICHWOODS	7	MO	1700s		1980	1	M/O	Mining, milling, smelting			MON000705032
48	ACM SMELTER AND REFINERY	8	MT	1892	1972	1972	1	O	Smelting, refiningProcessing	Copper, zinc	Final	MTD093291599
49	ANACONDA CO. SMELTER	8	MT	late 1800s	1980	1980	1	O	SmeltingProcessing	Copper	Final	MTD093291656
50	BARKER HUGHESVILLE MINING DISTRICT	8	MT	1879	1970s	1970	1	M	Mining (only brief activity in 1940s, 1920s, and 1960s)	Silver, lead	Final	MT6122307485
51	BASIN MINING AREA	8	MT	late 1800s	1960s	1960	1	M	Mining (intermitent into 1960s)	Precious metals	Final	MTD982572562

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52	CALIFORNIA GULCH	8	CO	1895 (Yak Tunnel	Early 1980s	1980	1	M	Mining, processing, smelting	Gold, silver, lead, zinc	Final	COD980717938
53	CAPTAIN JACK MILL	8	CO	1860	1992	1992	1	M	Mining, milling	Gold, silver	Final	COD981551427
54	CARPENTER SNOW CREEK MINING DISTRICT	8	MT	1880s	1931	1931	1	M	Mining (last mine closed 1931 with intermittant mining after that)	Silver, lead, zinc	Final	MT0001096353
55	CENTRAL CITY, CLEAR CREEK	8	CO	1850s	active (limited)	2011	1	M	Mining District, any current operations small) (includes Argo Tunnel draining 30+ inactive mines)	Gold	Final	COD980717557
56	DAVENPORT AND FLAGSTAFF SMELTERI	8	UT	1870	1875	1875	1	O	SmeltingProcessing	Lead, silver	Final	UTD988075719
57	DENVER RADIUM SITE	8	CO	1915	1920s	1920	1	O	Processing (35 sites of Ra disposal)	Radium	Final	COD980716955
58	EAGLE MINE	8	CO	1880s	1984	1984	1	M	Mining	Gold, silver	Final	COD081961518
59	EAST HELENA SIT	8	MT	1888	2001	2001	1	O	SmelterProcessing	Lead, zinc	Final	MTD006230346
60	EUREKA MILLS	8	UT	1870	1958	1958	1	M/O	Mining and Milling	Gold, silver, lead, copper, arsenic	Final	UT0002240158
61	FLAT CREEK IMM	8	MT	1909	1953	1953	1	M/O	Mining and Milling	Silver, gold, copper, zinc, iron	Final	MT0012694970

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62	GILT EDGE MINE	8	SD	1876	1998	1998	1,2	M	Mining (1986 DENR permit for open pit with CN heap leach operations).	Gold, copper, tungsten	Final	SDD987673985
63	INTERNATIONAL SMELTING AND REFINING	8	UT	1910	1972	1972	1,2	O	Smelter/Processing	Copper, lead, zinc	Deleted (10/11/2011	UTD093120921
64	JACOBS SMELTER	8	UT	1870s	1970	1970	1	O	Smelting/Processing	Silver	Final	UT0002391472
65	LIBBY ASBESTOS SITE	8	MT	1920 - start of large scale mining	1990	1990	1	M	Mining	Vermiculite	Final	MT0009083840
66	LINCOLN PARK (Cotter Mill, Canyon City, Colorado)	8	CO	1958		1979	1	O	Milling	Uranium, vandadium	Final	COD042167858
67	MIDVALE SLAG	8	UT	1871	1971	1971	1	O	Smelting/MillingProcessing	Lead, copper	Final	UTD081834277
68	MILLTOWN RESERVOIR SEDIMENTS/Clark Fork	8	MT	1870s	1980	1980	1,2	M	Mining and Smelter (possible source of As also could be landfill as source) (120 miles of sediments above reservoir)	Copper	Final	MTD980717565
69	MONTICELLO MILL TAILINGS (USDOE)	8	UT	1942	1960	1960	1	M	Milling	Vanadium, uranium	Final	UT3890090035
70	MOUAT INDUSTRIES	8	MT	late 1950s	1973	1973	1	O	Processing	Chromium	Final	MTD021997689

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71	NELSON TUNNEL/COMMODORE WASTE ROCK	8	CO	1889	1985 (historic hard rock mine)	1985	1,2	M	Mining	Silver, lead, zinc	Final	CON000802630
72	SILVER BOW CREEK/BUTTE AREA	8	MT	~1870s	1963	1963	1	M	Mining, milling and smelting (contamination of 24 stream miles by industrial, ag, and municipal)	Copper	Final	MTD980502777
73	STANDARD MINE	8	CO	1874	1974	1974	1	M	Mining	Silver	Final	CO0002378230
74	SUMMITVILLE MINE	8	CO	1870	1992	1992	1,2	M	Mining (1984 - CN Heap Leach)	Gold, silver	Final	COD983778432
75	U.S. MAGNESIUM	8	UT	1872	Active	2013	1,2	O	Processing	Magnesium (from brine)	Final	UTN000802704
76	UPPER TENMILE CREEK MINING AREA	8	MT	1870	1930s	1930	1	M	Mining district	Gold, lead, zinc, copper	Final	MTSFN7578012
77	URAVAN URANIUM PROJECT (UNION CARBIDE CORP.)	8	CO	1912	1984	1984	1,2	O	Processing	Radium, uranium, vandaium	Final	COD007063274
78	VASQUEZ BOULEVARD AND I-70	8	CO	1870s	1950s	1950	1	O	Smelting (smelting center for Rocky Mountain west)/ Processing	Gold, silver, copper, lead, zinc	Final	CO0002259588
79	ATLAS ASBESTOS MINE	9	CA	1963	1979	1979	1	M/O	Mining/Mill	Asbestos	Final	CAD980496863

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80	CARSON RIVER MERCURY SITE	9	NV	late 1800s	~1950s (sporadic small mining after this)	1950	1	O	Milling(multiple mills (75) along Carson River; used Hg amalgam reactions)	Gold, Silver	Final	NVD980813646
81	IRON KING MINE - HUMBOLDT SMELTER	9	AZ	late 1300s, 1906	1969 (mining, 1960s (smelter)	1969	1	M/O	Mining, smelter/Processing	Lead, gold, silver, zinc, copper	Final	AZ0000309013
82	IRON MOUNTAIN MINE	9	CA	1860s	1963	1963	1	M	Mining	Silver, gold, coper, zinc, iron	Final	CAD980498612
83	ELAURBUENA VISTA MINE	9	CA	1868	1970	1970	1	M/O	Mining, milling	Mercury	Final	CA1141190578
84	LAVA CAP MINE	9	CA	1861	1943	1943	1	M	Mining (historical CN plant)	Gold, silver	Final	CAD983618893
85	LEVIATHAN MINE	9	CA	1860s	1962	1962	1	M	Mining	Sulfur	Final	CAD980673685
86	SULPHUR BANK MERCURY MINE	9	CA	1865	1957	1957	1	M	Mining	Sulfur, mercury	Final	CAD980893275
87	BLACK BUTTE MINE	10	OR	1890	1960s	1960	1	M	Mining	Mercury	Final	OR0000515759
88	BUNKER HILL MINING & METALLURGICAL COMPLEX	10	ID	1880s	1981	1981	1	M/O	Mining, milling, smelting/Processing	Lead, zinc	Final	IDD048340921
89	COMMENCEMENT BAY, NEAR SHORE/TIDE FLATS	10	WA	1890s	1985 (smelter closed)	1985	1	O	Smelter (also pulp mill, and chemical industries)/ Processing	Lead, copper	Final	WAD980726368

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90	EASTERN MICHAUD FLATS CONTAMINATION	10	ID	1944	Active	2013	1	O	Processing	Phosphate	Final	IDD984666610
91	FORMOSA MINE	10	OR	1910	1937	1993	1	M	Mining	Copper, zinc, thorium	Final	ORN001002616
92	FREMONT NATIONAL FOREST/WHITE KING AND LUCKY LASS URANIUM MINES (USDA)	10	OR	1955	mid-1960's	1960	1	M	Mining	Uranium	Final	OR7122307658
93	KAISER ALUMINUM (MEAD WORKS	10	WA	1942	Active?	2013	1	O	Processing (Aluminum Reduction) (1942 - 1978 on site disposal of pot linings)	Aluminum	Final	WAD000065508
94	MIDNITE MINE	10	WA	1955	1981	1981	1	M	Mining	Uranium	Final	WA0980978753
95	MONSANTO CHEMICAL CO. (SODA SPRINGS PLANT	10	ID	1952	Active	2013	1	O	Processing	Phosphate	Final	IDD081830994
96	REYNOLDS METALS COMPANY	10	OR	1941	2000	2000	1	O	Processing (Primary Aluminum Reduction Plant)	Aluminum	Final	ORD009412677
97	SALT CHUCK MINE	10	AK	1915	1941	1941	1	M/O	Mining/Milling	Gold, silver, copper	Final	AK0001897602
98	TELEDYNE WAH CHANG	10	OR	1957	Active as of 2010	2013	1	O	Processing	Zirconium, rare earths	Final	ORD050955848
99	BLUE LEDGE MINE	9	CA	1904		1930	1	M	Mining	Copper/Zinc	Final	CAN000906063
100	NEW IDRIA MERCURY MINE	9	CA	1854	1970s	1970	1	M/O	Mining/Processing	Mercury	Final	CA0001900463

Senator Tom Tiffany
Chair, Senate Committee on Sporting Heritage, Mining and Forestry
Ladysmith High School Auditorium
1700 Edgewood Avenue E
Ladysmith, WI, 54848

September 7, 2017

Re: SB 395

Chairman Tiffany and members of the Senate Committee on Sporting Heritage, Mining and Forestry, thank you for the opportunity to speak on behalf thousands of River Alliance of Wisconsin members--small business owners, individuals, and more than 80 local watershed protection groups. We ask you to reject SB 395 because Wisconsin communities will be exposed to a tremendous risk if this bill passes.

As a leader and representative of Wisconsin constituents, we depend on you to think long-term about impacts to quality of life, tourism, and public health, as well as to local business owners who depend on clean water. Sulfide mining, even in the best circumstances, has always polluted in water-rich environments. For our members, the potential short-term economic benefits do not merit the long-term risks to our Wisconsin way of life.

When water is polluted and a mining company leaves town, it is often local businesses that are harmed and local tax payers who are responsible for the cost of cleanup. And, as you likely know, mining communities across the U.S. are noted for high levels of unemployment, slow rates of growth of income and employment, high poverty rates, and stagnant or declining populations.

We can do better, SB 395 is unacceptable in light of the health and economic risks it would introduce. SB 395 will bring pollution to our state, while foreign mining companies profit.

Specifically, this bill raises concerns because it:

- Will harm our waters
    - This bill removes the prohibition for DNR to deny a high capacity well if the water withdrawal of groundwater will result in unreasonable detriment of public or private water supplies or the unreasonable detriment of public rights in the waters of the state. This is saying it is acceptable to cause harm to our waters.
    - This bill requires DNR to condition the high capacity well approvals to ensure detriments don't occur. Currently, DNR has very limited authority to condition a well, especially after Act 21. This bill is requiring DNR to condition high capacity wells in ways that are not allowed for the rest of the wells in the state.

RIVER ALLIANCE
of WISCONSIN
147 S. Butler Street, Suite 2
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- The conditions that DNR may consider are vague and are far from solutions. DNR could allow mining companies to replace water to private or public water supplies if their high capacity well results in unreasonable detriment to the water supply. Will home owners and famers have to rely on bottled water supplied by a mining company when their wells go dry?" DNR could also allow mining companies to "temporarily augment the quantity of water in, flowing into or from the affected bodies of water" if unreasonable detriment happens to rivers, streams, or lakes. Where will this water come from? Which invasive species from nearby waters will be introduced to healthy Wisconsin rivers, streams and lakes?

- Limits public engagement

  - It eliminates the public hearing of the draft environmental impact statement (EIS) and instead presents it prior to the Public Information Meeting that takes the place of the Master Hearing. Current law has three hearings: one after the Notice of Intent is issued (still in SB 395 but with a public comment period reduced to 45 days), one after the draft EIS is released, and finally the Master Hearing.
  - It also eliminates the contested case hearing in the Master Hearing where the Final EIS is reviewed with a public comment section and the automatic contested case section where testimony is taken under oath and subject to cross examination.
  - It moves the burden of proof from the applicant by making the public petition for a contest case AFTER DNR issues permits after the Public Information Hearing. It bars the Hearing Examiner in the contested case from halting any activities by the mining company that have been permitted by the DNR.

- Leaves too much risk to Wisconsin communities

  - Removes the irrevocable trust that requires the mining company to ensure the availability of funds to take care of things like spills of hazardous substances in **perpetuity**. Sulfide mines can cause pollution well after a mine is closed and reclaimed. Mining companies should not leave the long-term clean up to tax payers.

There are many other rollbacks and process changes in this bill that benefit the mining industry rather than our communities. And Wisconsinites want to keep existing sulfide mining laws intact to protect us from unacceptable pollution. Recent polls conducted by River Alliance of Wisconsin confirmed that the sentiments of our members are shared widely:

- 72% across Wisconsin want to keep bi-partisan "Prove it First" protections;

- 64% believe weakened water protections pose too much risk of exposing families to chemical byproducts of sulfide mining, like cyanide and sulfuric acid

- 50% do not agree that "streamlined or eliminated environmental regulations will create more mining jobs and help the Wisconsin economy."

I have attached our poll results for your reference.

SB 395 is wrong for Wisconsin. We urge you to do what is right and reject SB 395.

Sincerely,

Allison Werner

Allison Werner

Local Groups Director

Public Policy Polling

Wisconsin Survey Results

Q1 Do you approve or disapprove of Governor Scott Walker's job performance?

Approve	41%
Disapprove	53%
Not sure	6%

Q2 Do you approve or disapprove of the job the Wisconsin State Legislature is doing?

Approve	33%
Disapprove	51%
Not sure	15%

Q3 The Wisconsin Legislature is also considering a repeal of the "Prove It First" sulfide mining law, created with bipartisan support over twenty years ago. Since then, it has protected Wisconsin's waters by requiring that any mining companies who want to operate a sulfide mine in Wisconsin must demonstrate that they've successfully done so elsewhere, without polluting. Do you support or oppose keeping Wisconsin's existing Prove It First sulfide mining law?

Support	72%
Oppose	18%
Not sure	11%

Q4 Do you agree or disagree with the following statement: streamlined or eliminated environmental regulations will create more mining jobs and help the Wisconsin economy.

Agree	32%
Disagree	50%
Not sure	18%

Q5 Do you agree or disagree with the following statement: weakened water protections will expose Wisconsin families to unacceptable risks from chemical byproducts of sulfide mines like sulfuric acid and cyanide.

Agree	64%
Disagree	21%
Not sure	15%

Q6 In the 2016 presidential election, did you vote for Republican Donald Trump, Democrat Hillary Clinton, Libertarian Party candidate Gary Johnson, Green Party candidate Jill Stein, or someone else?

Donald Trump	44%
Hillary Clinton	43%
Gary Johnson	4%
Jill Stein	1%
Someone else	8%

Q7 If you are a woman, press 1. If a man, press 2.

Woman	53%
Man	47%

Q8 If you are a Democrat, press 1. If a Republican, press 2. If an independent or a member of another party, press 3.

Democrat	32%
Republican	32%
Independent / Other	36%

Q9 If you are white, press 1. If African-American, press 2. If other, press 3.

White	89%
African-American	7%
Other	4%

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Public Policy Polling

Q10 If you are 18-45 years old, press 1. If 46-65, press 2. If older than 65, press 3.

18 to 45	31%
46 to 65	40%
Older than 65	28%

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clean wisconsin

your environmental voice since 1970

Testimony of Sarah Barry, Director of Government Relations
SB 395 Public Hearing
Senate Committee on Sporting Heritage, Mining and Forestry
September 7, 2017

Clean Wisconsin is a non-profit environmental advocacy group focused on clean water, clean air and clean energy issues. We were founded forty-seven years ago as Wisconsin's Environmental Decade and we have 20,000 members and supporters around the state.

Chair Tiffany and members of the committee, I appreciate the opportunity to appear before you today in opposition to Senate Bill 395.

Throughout Wisconsin, we have clean water because of sound policies that enable economic development while protecting our natural resources. The cornerstone Prove it First law has kept Wisconsin communities from facing long term, irreparable damage from irresponsible mining practices. The sulfide mining industry has a long history of polluting water.

Prove it First is a common-sense requirement: before a mining company can dig, they must provide an example of a sulfide mine that hasn't polluted nearby water. The bi-partisan bill was passed twenty years ago and Governor Thompson signed it into law.

According to the Environmental Protection Agency, sulfide mining has accounted for 41 percent of all toxic materials released in the United States since 1997. Six of the World Health Organization's Top 10 toxins of major public health concern are associated with sulfide mining, including mercury, lead, arsenic, cadmium and asbestos. This industry is notorious for underestimating the impact on water quality at mining sites throughout the country. This industry has a track record of environmental contamination. According to the EPA, the metallic mining industry is responsible for polluting 440,000 acres of land. The US Forest Service estimates that 10,000 miles of rivers and streams have been contaminated by acid mine drainage from the industry. **Mines with high acid generating potential in close proximity to surface and groundwater pose the greatest risk for negative water quality impacts.**

The bill before you promotes mining at the expense of our clean water, healthy families, and strong communities by rolling back provisions that protect our state from the devastating and long lasting impacts of sulfide mining. Senate Bill 395 will put taxpayers on the hook financially for long term mining pollution. In addition, it reduces oversight of mining prospecting activities, it threatens our groundwater resources, and it removes public input from the permitting process.

We should all question a company that must roll back common-sense regulations in order to site and operate any industry in Wisconsin.

Specific Provisions of SB 395

Bulk Sampling

Under the bill, a mining entity would be able to engage in the bulk sampling of material up to 10,000 tons without a permit specific to mining. The bill describes how to design a bulk sampling plan, but this is optional for the mining company. Under current law, bulk sampling is governed by regulations related to prospecting. The bill changes the definition of prospecting so that it does not include bulk sampling. This change removes the following:

- A prospecting permit can be denied in areas unsuitable for prospecting; there is nothing that allows the DNR to reject a bulk sampling plan.
- Prospecting requires reclamation; bulk sampling provisions only require a revegetation plan.
- Prospecting requires monitoring of environmental impacts; bulk sampling has no monitoring requirement.
- Prospecting requires a bond equal to the estimated cost of reclamation, plus insurance for at least $50,000; bulk sampling only requires a $5,000 bond to cover revegetation.

Irrevocable Trust

This proposal removes the irrevocable trust requirement for mining companies who operate in Wisconsin. **The irrevocable trust is a financial safeguard that prevents Wisconsin citizens from being on the hook for the long-term costs of mining clean up.** It is currently the only form of financial assurance required that is safe from creditors and corporate restructuring. Removing the irrevocable trust leaves the public at risk. In contrast, Minnesota requires that any financial assurance cannot be dischargeable through bankruptcy. The metallic mining industry has a well-documented pattern of failed operations that lead to substantial environmental damage not paid for by the industry. For example, the federal government has spent at least $2.6 billion to clean up metallic mining sites between 1998 and 2007.

Examples of the public paying for sulfide mining clean-up after mining company bankruptcy:

- The owner of the Summitville (CO) mine filed for bankruptcy in 1992, and the EPA spent $192 million on cleanup as of October, 2007.
- The owner of the Gilt Edge (SD) mine filed for bankruptcy in 1999, and the EPA spent more than $56 million on cleanup as of October, 2007.
- The owner of the Zortman Landusky (MT) mine filed for bankruptcy in 1998, and cleanup costs are estimated to be $85 million, of which only $58 million will be paid by the mining company, leaving taxpayers to shoulder the remaining $27 million.

Groundwater Protections

Instead of denying a permit for a well that will result in the unreasonable detriment of public or private water supplies, as current law requires, under the bill the DNR is allowed to set conditions for these permits. These conditions can include that the applicant provide a replacement water supply or temporarily augment the quantity of water flowing in or out of an affected body of water. The language is vague regarding what these conditions would include. Given the water-intensive nature of the mining industry, we are concerned about the potential impact of this provision.

In addition to high capacity well provisions, the bill makes changes to enforcement of groundwater quality standards in the bedrock. The bill will require the mining company to prevent water quality impacts only to a certain depth. The DNR will be challenged to make this determination because of the complex fractured nature of the bedrock.

Public Input

Senate Bill 395 removes public input and transparency, weakening the permit process and opening the door to more legal challenges down the road. The master hearing process thoroughly investigates all the facts and legal issues being considered during the permitting process of a mine and it happens before any damage is done. A master hearing gives the public its only real, meaningful way to participate in the permitting process, by giving them the opportunity to bring in experts who can independently verify the technical data being submitted by the mining company, or challenge it if necessary. The company, the DNR, and interveners must all swear under oath that the information they offer is true. The bill requires a public informational hearing only, removing any meaningful scrutiny that is usually achieved through the master hearing process.

Hearings like the master hearing being eliminated in this bill are not only common, but sometimes automatic, for large-scale projects with the potential for large scale environmental impacts. Landfills are a great example of a project with somewhat similar impacts to mining. Landfill permitting allows for such a hearing. Power plants and transmission lines are given automatic administrative hearings at the Public Service Commission. Even issues like electricity and water rate increases are given such treatment at the PSC.

Conclusion

At Clean Wisconsin, we support the common sense Prove it First law. As I have highlighted, there are several points of concern with this proposal. **Any new sulfide mining project must meet our current environmental standards.** Forcing residents to decide between protecting natural resources and promoting economic development is a false choice. **We can maintain respect for our natural resources and those who rely on them.** That is especially clear in Wisconsin, where tourism is a $2.6 billion industry and our pristine natural resources lure anglers, hunters, and those seeking to recreate and enjoy our waterways from all over the country. We urge you to reject Senate Bill 395.

Contact: Sarah Barry, sbarry@cleanwisconsin.org, 608-251-7020 x 30

Dave Noel
Testimony

Re: Mark
Logsdon, PhD
Geochemica, Inc

BARIO NEAL

MANAGING ENVIRONMENTAL EFFECTS OF METAL MINING: INTERVIEW WITH MARK LOGSDON

By Page on March 31, 2008 at 4:55 pm

min_m_12.jpg

Photograph by David Maisel Mining Project 12 (Miami Arizona)

Anna & I recently attended a lecture at UPenn in which Mark Logsdon the President and Principal Geochemist at Geochimica spoke about his research in hydrogeological and hydrogeochemical studies of acid mine drainage, planning mine closures, water-quality site investigations, and geochemical modeling. The lecture focused on water-quality issues and their management, specifically for metals mines, using examples from Marks recent experience in North and South America, Australia, Indonesia, Papua New Guinea, and Laos. We had the opportunity to ask Mark some questions about his experiences and his research of a new tailing remediation system. Below are our questions and Marks answers, offering us some insight into the nuances of the metal mining industry.

***How long is the average gold/silver mine operational?**

Gold and silver mines, that is mines that are exclusively for precious metals, tend to be quite small, and therefore short-lived. Most silver and gold mines in Nevada that have been developed in the last 20 years will have life of span of 10-15 years. There are a few exceptions, such as the big open-pit mines at Elko (Barrick Goldstrike, for example), that will probably be 20-25 years. Very rare exceptions, such as the Homestake Mine in Leed, SD exist, but they tend to be a very different kind of gold deposit – deep vein systems in metamorphic rocks, that are extremely rare.

*** What happens to the mine site after it is no longer functional?**

The closure plan, pretty much everywhere in the world now, will have three major components. Firstly, a physical restructuring so that all slopes are safe and stable and surfaces can be revegetated. Secondly, a program for long-term management of water quality. This may have to include long-term, even "perpetual" water treatment, though what this actually means is still pretty murky. Thirdly, the company has to settle up with its employees and work out some sort of staged withdrawal that allows a socio-economic transition for the nearby towns that have grown to depend on it commercially. This also is a new feature (say the last 10 years).

***How do you ensure that sufficient funds are set aside for clean up & maintenance when maintenance is seemingly never-ending?**

Mines operate under a set of permits, and one or more of those permits (usually a "permit to Mine" from the state) will specify (a) the general terms of closure (see last Q) and (b) require the submission and approval of a closure plan, usually 5-10 years before the operation closes. The closure plan has to have costs associated with it, and the terms of the Permit to Mine require the miner to obtain a bond (from a reliable source) that covers all of those costs. The money going into the bond payments earns interest, and so it is a perpetually funded source. (Of course, assuming that the banking system survives.)

***When you spoke at Penn, you mentioned that in most cases, enough money is available for clean up; the real issue is who will monitor the clean up. Couldn't the funds ensure that there was an infrastructure to continually monitor the clean up? Does oversight (governmental or otherwise) become the issue?**

The funds ensure that there is money available to pay someone. The problem is to determine who that someone would be. Generally the fund includes money for regulatory oversight of the site, but it does not assume that the regulators will do the work. In fact, neither regulators nor companies think this is a good idea. So, there has to be some agreement on how the work will actually be done. The best (imo) approach is to establish a local company, as part of the socio-economic closure plan, far enough in advance that they can be trained to do the work. This leaves at least some residual economic benefit (through direct payments and multipliers) for the home team.

min_m_063.jpg

Photograph by David Maisel Mining Project 6 (Ray Arizona)

***Does a third-party usually project the cost required, and the amount dedicated by the mining companies for clean-up efforts? How much money is generally invested in clean up?**

This varies by jurisdiction. In Canada it is always an independent estimate, on which the company may comment. In US and Australia, it is almost always a canopy plan, on which they comment (and ultimately must approve). Mine closures today might run from a few tens of million dollars to well over a billion, depending on the size, longevity, and nature of the problems. A 10-year silver mining project in Nevada, if they run well, may be able to get out for $10-20 M. Costs estimates for the mining complexes at Butte MT or the Coeur d'Alene District in Idaho run into the billions of dollars.

***If the 1872 law is changed and U.S. mines begin paying royalties to the government, where do you think this money will/should be directed?**

This is one of the key stumbling blocks. The Government generally would like the funds to be designated for General Use, either actually to the General Fund or at least to the general budgets of the parent Departments (which would be either Interior (for BLM and parks) or Agriculture (for Forest Service). The Companies would like to see the royalties targeted in ways that are closely tied to mining (e.g., USGS; funding for mining research, support for overseas mining on development basis…). Probably a portion will go to the equivalent of Superfund, to pay for orphan-mine cleanups. Given the dire condition of the budget, I'd say General Fund wins.

***In the US are there any systems in place that will pay back communities that have been negatively affected by mining (especially in sites where the mining has occurred on public or indigenous lands)?**

There have been quite a number of mining Superfund sites - large portions of SW MO, SE KS, and NE OK (the: tri-State District); Leadville, CO; the Coeur d'Alene drainage; Butte, MT; old mines in and around several national parks; most of the old uranium mine son Navajo land. These remedial projects, some of which will continue for decades at least, provide local jobs in construction and other support services. Do they "pay back" the communities? Hard to say, and easy to argue about. In many cases the communities (Leadville, Butte and Leed are very good examples) are there only because there was mining to begin with, and pretty much all they have came form the mine. It's not just negative.

***What sort of regulations exist in the US for mines to monitor the air pollution produced during the smelting process?**

All smelters are and have been since it was passed in 1976 controlled by the Clean Air Act. The permitting and monitoring requirements are very extensive.

*** Does the lining in the tailing ponds wear over-time? If so, how often is the lining in the tailing ponds changed?**

Very few tailing ponds are lined; except for uranium tailings and cyanide leach systems. The longevity of the liners for these systems is not very well understood. Usually they will have multiple liners, at least one of which is compacted clay that presumably never "wears out." The synthetic liners are designed to last 100 years, but there is no special reason to think they will fail at that point - just no engineering basis to predict longevity beyond that. In 100 years, tailings should all be fully drained. Therefore, with a cover that limits infiltration (and can be replaced) a 100-year lifetime for liners should protect water resources. No one changes liners - there is no practicable way to do it.

Mark Logsdon, Principal Geochemist, Geochimica, Inc.: What Does "Perpetual" Management and Treatment Mean? Toward a Framework for Determining an Appropriate Period-of-Performance for Management of Reactive, Sulfide-Bearing Mine Wastes

When 01 Oct 2013
6:30 PM - 9:00 PM
Location Sheraton, 5151 E. Grant Rd., Tucson AZ 85712

Registration
(depends on selected options)

Base fee:

- Guest Dinner - $30.00
  Non-members RSVP here. Prepay online via credit after registering OR at the door with Cash or Check on the night of the meeting.
- Member Dinner - $27.00
  Members RSVP here. Pay online after registering via credit, OR pay at the door with Cash or Check on the night of the meeting.
- Student Member Dinner
  Free to Student members thanks to BHP Billiton: May join online free - click "Join or Renew"

Sponsored by: MAJOR Partners on the Ground

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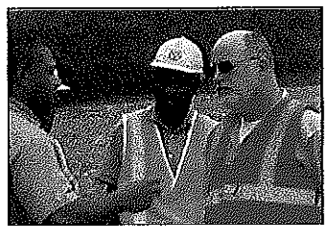

Photo: Mark and colleagues are standing on about 90 m thickness of mine waste in the upper Ok Mani, immediately below Ok Tedi pit and waste rock dumps.

Abstract

Mine wastes at closure typically amount to millions to billions of metric tonnes by mass and occupy hundreds to thousands of hectares of surface, with some structures extending over several hundreds of metres of vertical relief. Regardless of the specific climate of the mine site, reaction rates for sulphide oxidation show that the wastes will remain geochemically reactive for centuries to millenia if exposed to air and water. Additional issues, some related to geochemical ones, arise for geomechanical and geomorphic stability of engineered features and structures. Establishing a coherent basis for determining how far into the future proposed mine-site closure must be effective has too often been neglected.

Engineering structures, including mine structures, are designed to perform with respect to specific design criteria related to material properties and the natural environment, often organized around response to external forces with statistically-defined probabilities of occurring per unit. In engineering, one speaks of "design-basis events" and also considers the risks from "extreme events", incorporating both into the detailed design criteria for an entire project that ultimately will be defined. The geotechnical conventions deserve to be extended to considerations of geochemistry also.

Mine closure can be considered in terms of three overlapping, but distinguishable periods:

- Construction and active reclamation
- Final reclamation
- Long-term maintenance and monitoring that will document that the expectations for stable slopes with controlled water-quality performance have been met.

Consideration of these periods, the scientific basis for understanding closure risk, and established engineering practice leads us to suggest that a reasonable, total planning period for management of mine wastes should be in the range of 200 to 500 years, and it probably should include a semi-quantitative assessment of whether or not major changes in performance are likely to occur between approximately 500 and 1,000 years. Plans should include (1) identification of risks to surface and ground water in terms of adverse impacts to beneficial uses, (2) presentation of a case that mine-waste structures would be stable with respect to erosion by flooding or deep-seated shear failures, and (3) presentation of a case that reactive wastes as disposed for those periods will remain physically stable.

Biography

Mark Logsdon is a geochemist with 40 years of experience in geology, hydrogeology, and environmental chemistry related to mining and mine-waste management. He is a graduate of Princeton and has work experience that includes teaching, mine-exploration geochemistry, government service, research, and consulting. Since 1984, Mark has been in private consulting, focusing on mining issues, particularly (a) acidic and metalliferous drainage; (b) water-quality conditions in natural and mined ground, including surface and ground-waters; (c) planning for and executing mining exploration, development, operations, closures, and remediation/restoration. Such assessments typically involve not only geochemistry, but also the underlying geology and mineralogy and the relationships of hydrogeology, mining and site-engineering practices and costs. Mark has worked on more than 250 mining projects, including metal and nonmetal mines in the U.S.A., Canada, Mexico, Guatemala , Honduras, Argentina, Brazil, Chile, Columbia, Peru, Venezuela, Ireland, France, Portugal, Russia, Spain, Guinea, Mozambique, South Africa, Tanzania, Australia, Laos, Mongolia, New Zealand, Indonesia, Papua New Guinea, and the Philippines.

Midwest Environmental Advocates

Written testimony of James Parra, Midwest Environmental Advocates
Before the Senate Committee on Sporting Heritage, Mining and Forestry
September 7, 2017

Members of the Committee, thank you for the opportunity to speak to you today. My name is James Parra. I am an attorney at Midwest Environmental Advocates, a nonprofit environmental law center that serves the people and organizations in Wisconsin working for clean air, clean water and clean government.

Midwest Environmental Advocates is opposed to this legislation first and foremost because it would repeal a common sense environmental and public health protection that requires a mining company to actually show, not just say, that sulfide mining can be done safely. This type of protection makes particular sense for an industry like sulfide mining, which "carries with it potential for very serious environmental harm"[1] and an unreliable track record of predicting the likelihood of those harms.

Predictions about the impacts of sulfide mining on the environment and communities are notoriously unreliable. For example, a 2006 study examining "the reliability of pre-mining water quality predictions... in the United States" found that a majority of the mines studied caused pollution in surface and ground waters despite regulators often predicting that the potential for pollution was low. Perhaps most disturbingly, **90% of the mines for which regulators had predicted a low potential for acid mine drainage did in fact develop acid mine drainage.**[2] The "prove-it-first" law reduces some of the uncertainty around predicting the impacts of sulfide and provides assurances to the public that their health and environment can be protected.

Beyond just the repeal of the "prove-it-first" law, Midwest Environmental Advocates opposes SB 395 because it violates the State's responsibilities under the Public Trust Doctrine to protect public water resources from over pumping and depletion; exempts parts of the mining process from important environmental protections; and would further shift the burden and expense of protecting public health and the environment to the citizens of Wisconsin, while at the same time limiting the opportunities for public involvement. A summary of several of Midwest Environmental Advocates' concerns related to each of these points is included below:

- **SB 395 removes protections for both public and private water supplies and public rights in the waters of the State.** Under current law, the Wisconsin Department of Natural Resources (DNR) may not issue a groundwater pumping or mine dewatering permit to a mine operator if the pumping would "result in the unreasonable detriment of public or private water supplies or the unreasonable detriment of public rights in the waters of the state." SB 395 would authorize DNR to

[1] Wisconsin Department of Natural Resources, "An Overview Of Mining Waste Management Issues in Wisconsin", p. ii (July, 1995)
[2] Kuipers, et al., "Comparison of Predicted and Actual Water Quality at Hardrock Mines", ES-9 (2006) (available at: https://www.earthworksaction.org/files/publications/ComparisonsReportFinal.pdf).

issue the permit, even if the pumping would deplete water supplies and impact public resources, so long as the mining company provides a "replacement water supply of similar quality."

As far as Midwest Environmental Advocates is aware, this is the first time that the Legislature has considered allowing a Public Trust resource to be harmed under the condition that the harm may be mitigated through artificial supplementation of the water resource. Aside from questions about whether this proposal reflects sound science-based policy, this Committee should give strong consideration to whether such a proposal is consistent with the State's constitutional responsibilities under to protect Public Trust resources.

- **SB 395 creates what amounts to a voluntary regulatory scheme for bulk sampling.** The bill requires DNR to adopt "minimum standards" for bulk sampling that "ensure that such activities... will be conducted in a manner consistent with the purposes and intent" the statute. However, there is no way for DNR to ensure that those minimum standards are met. DNR would not have the authority to deny a bulk sampling plan *for any reason* and there is no approval process to determine whether the minimum standards will be met.

  The Wisconsin Legislature enacted a similar bulk sampling regulatory scheme for iron mining in 2013. Gogebic Taconite, LLC was the first mine operator to submit a bulk sampling plan for review under the new law. In response to DNR's request for additional information about the mining company's bulk sampling plans, Gogebic pushed back citing the limited authority that DNR had to oversee bulk sampling and ensure that the environment is protected:

  > "The bulk sampling plan itself is not subject to the Department's approval, nor is there any bulk sampling permit or other approval required. The bulk sampling plan is simply an informational filing by an applicant to enable the Department to specify required permits or approvals... "[3]

  Without the authority to approve or deny bulk sampling plans, or even request more information from entities engaging in bulk sampling, DNR cannot ensure that our public resources are being protected.

- **SB 395 exempts bulk sampling from groundwater quantity and quality requirements.** The bill would eliminate DNR's authority under Wis. Stat. § 293.15(11) to adopt and apply rules establishing groundwater quantity or quality standards for bulk sampling. DNR's authority to adopt such rules for prospecting and mining remains intact, however SB 395 does not extend that authority to bulk sampling. This means that no groundwater standards would apply to bulk sampling, including the standards in Wis. Admin. Code § NR 140. (NR 140 specifically states that it does not apply to activities regulated under Chapter 293).

- **SB 395 eliminates DNR's authority to issue an order to a bulk sampler requiring compliance with the State's mining laws.** Wis. Stat. §293.15(3) currently authorizes DNR to issue orders directing prospectors and miners to come into compliance with Chapter 293 of the statutes. While SB 395 amends other subsections of § 293.15 to include bulk sampling in the grants of authority to

[3] Correspondence from Timothy J Meyers, Engineer for Gogebic Taconite, LCC, to Wisconsin Department of Natural Resources, dated Jan, 8 2013 (available at: http://dnr.wi.gov/topic/Mines/documents/gogebic/GTACBulk SamplingResponse20140108.pdf)

DNR, the bill does not make any changes to subsection (3). Thus, DNR's authority to issue orders would extend only to prospectors and miners, and not to persons conducting bulk sampling.

- **SB 395 eliminates the right to a contested case hearing on any decision related to bulk sampling, including decisions on wastewater, stormwater, and wetland fill permits.** By eliminating the right to a contested case hearing, SB 395 effectively prevents any review, whether administrative or judicial, of some permitting decisions. For example, a contested case hearing pursuant to Wis. Stat.§ 283.63 is the exclusive means of review of DNR's decision to issue a Wisconsin Pollution Discharge Elimination System (WPDES) permit. Eliminating the public's right to seek review of a WPDES permit would put the State's water permitting program in conflict with federal law. And on this point, the Committee should be made aware of the fact that the U.S. EPA is currently investigating claims that DNR does not have adequate authority to implement the WPDES program consistent with federal law, and is specifically looking at whether Wisconsin provides adequate opportunities for review of WPDES permits.

  For other permitting decisions, circuit court review may still be available; however circuit court review is not a new trial, but merely a review of the paper files regarding a permit application decision. The whole point of a contested case hearing is to have a decision made on the basis of sworn testimony and admissible documents, subject to cross-examination, rather than based on unsworn reports and records and people's 3 or 5-minute unsworn comments at a public informational hearing. Eliminating contested hearings would leave no opportunity for anyone to testify under oath, or for DNR or anyone else to cross-examine even a single witness and require them to defend their reports, opinions, or decisions regarding a permit.

The above points do not encompass the entirety of the concerns that Midwest Environmental Advocates has related to SB 395. We share the concerns raised by many of our partner organizations and private citizens, including those related to the loss of the master hearing and reduced protections for wetlands, among others.

For these reasons I strongly urge you not to support SB 395.

Sincerely,

James Parra
Staff Attorney
Midwest Environmental Advocates

HARDROCK MINE RECLAMATION AND REGULATION

HOW CHANGING VALUES and CHANGING LAW CAUSED HARDROCK MINES to DESIGN, BUILD, and OPERATE for LONG-TERM CLOSURE and RECLAMATION: A FEDERAL and STATE REGULATORY SUCCESS STORY

prepared for the

AMERICAN EXPLORATION & MINING ASSOCIATION

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July 2017

TABLE OF CONTENTS

1.0 Executive Summary 1

2.0 Hardrock Mine Regulation Effectiveness – EPA has never determined that any hardrock mine approved by a federal or a Western State agency after 1990 to be among the "top priority among known response targets" 3

2.1 EPA's National Priorities List for CERCLA Cleanup 3

2.2 A specific hardrock mine clean-up case study cannot be used to evaluate the effectiveness of current hardrock mine regulation if that specific hardrock mine had not been subjected to regulation prior to its design and construction 4

2.3 Hardrock mines on the National Priorities List must be rationally classified into three (3) major eras based upon applicable regulation or the lack thereof: (1) Pre-Regulatory Era (prior to 1970); (2) Transition Regulatory Era (1970 through 1990); and, (3) the Regulated Hardrock Mine Era (post-1990).. 5

2.4 Northwest Mining Association June 30, 2013 Comments on EPA's Bristol Bay Watershed Assessment determined that current hardrock mining regulations were protective of the environment, citing to specific federal and state government studies that explicitly support this conclusion...7

2.5 The 2015 Enviroscientists Report confirms the NWMA/(AEMA) Comments on EPA's Bristol Bay Watershed Assessment in June 2013 that determined that no Western hardrock mine has been placed on the CERCLA NPL since 1990........... 8

3.0 Current hardrock mine regulation is protective of the environment, as determined by: (1) the United States National Academy of Sciences; (2) the Western Governors Association; and, (3) Senator Murkowski's 2011 Investigation 10

3.1 The National Academy of Sciences/National Research Council has determined that existing hardrock mine regulation on federal land is "complicated but generally effective" in protecting the environment.......10

3.1.1 The NAS/NRC Report determined that "[s]imple 'one-size-fits-all' solutions are impractical because mining confronts too great an assortment of site-specific technical, environmental, and social conditions."............. 10

3.1.2 The NAC/NRC Report correctly characterizes the current hardrock mining industry as having minimal impact on public lands and the NAC/NRC Report also correctly characterizes the importance of the hardrock mining to the US economy and to US manufacturing................ 11

3.2 Current hardrock mine regulation continues to be protective of the environment on federal lands as further evidenced by the United States Forest Service and United States Bureau of Land Management Responses to Senator Murkowski's 2011 Investigation....11

3.3 The Bi-Partisan Western Governors' Association confirms that the Western States "have a proven track record in regulating mine reclamation in the modern era, having developed appropriate statutory and regulatory controls" that are "protective of human health and the environment" as well as being protective of public treasuries....11

3.4 Current hardrock mine regulation is protective of the environment on all federal and state Western lands - A Summary 14

4.0 Changing Societal Values – The Great Depression, World War II, the Cold War, and the Modern Environmental Movement.... 125

4.1 Prior to 1970, there was virtually no direct regulation of municipal sewage, industrial wastes or hardrock mines. 15

4.2 Societal Values of "The Greatest Generation".... 15

4.3 Cultural Balance 18

4.4 The Modern Environmental Movement 18

4.5 Cultural and Legal Changes Incorporating Environmental Values.... 18

5.0 Development of Legally-Applicable Hardrock Mine Regulation.... 19

5.1 Regulation of the Natural Media Receptors – An Overview 19

5.2 Surface Water 20

5.3 Groundwater Protection at Hardrock Mines 21

5.3.1 State Protection of Groundwater at Hardrock Mines.... 21

5.3.2 Federal Protection of Groundwater at Hardrock Mines.... 21

5.4 Hardrock Mine Reclamation, Fincial Assurances and Water Quality Protection.. 22

5.5 The National Environmental Policy Act of 1970 24

5.6 Evaluation of the Effectiveness of Hardrock Mine Regulation based upon the Timing of Regulatory Developments.... 25

6.0 Conclusion **27**

1.0 Executive Summary

The federal and state regulation of hardrock mining and milling facilities (collectively, "hardrock mines")[1] is a success story of environmental protection that is well-illustrated by the fact that of the **none** of the Western hardrock mines that were designed, built and/or approved in the last 26 years are on the United States Environmental Protection Agency ("EPA") National Priorities List of environmental cleanup sites. To characterize this another way, there has never been an environmental problem at a hardrock mine approved by a federal or state agency in the West after 1990 that required EPA to make any such hardrock mine a Superfund "top priority among known response targets." Finally, and most succinctly, no hardrock mine permitted/approved in the West after 1990 has ever been placed on EPA's Superfund National Priorities List. This is in stark contrast to Western hardrock mines designed and built prior to 1970 when there were no regulatory approvals for such facilities and no cultural guidelines.

The reasons for this are straightforward and summarized below.

Current hardrock federal and state mine regulation is protecting the environment. This is not just the opinion of the relevant agencies or the hardrock mining industry. It is also the opinion of the federal government's National Academy of Sciences/National Research Council and the bi-partisan Western Governors' Association.

In 1999, the federal government's independent National Academy of Sciences/National Research Council produced a comprehensive report entitled "Hardrock Mining on Federal Lands" regarding then-current hardrock mine regulation on lands managed by the federal government and states agencies and determined:

> The overall structure of the federal and state laws and regulations that provide mining-related environmental protection is complicated but generally effective.
>
> ...
>
> Simple "one-size-fits-all" solutions are impractical because mining confronts too great an assortment of site-specific technical, environmental, and social conditions. Each proposed mining operation should be examined on its own merits. ... **Recommendation: BLM and the Forest Service should continue to base their permitting decisions on the site-specific evaluation process provided by NEPA [National Environmental Policy Act].** ...

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[1] For the purposes of this study, "hardrock mine" includes any facilities deemed to be a "mining" or "beneficiation" facility by the EPA. EPA has defined "mining and beneficiation" to include, generally, all metal mines, but EPA's use of the term "hardrock mine" also includes many non-metallic industrial mineral mines, such as phosphate rock, trona, fluorospar, and mica, as well as the mills required to concentrate the target minerals of these ores. See generally 40 C.F.R. 261.4(b)(7)(July 15, 2016). In common usage, EPA's "mining and beneficiation" is more typically referred to as "hardrock mining and milling" or just for the purposes of this Report sometimes "hardrock mine."

"Hardrock Mining on Federal Lands," National Academy of Sciences/National Research Council, Executive Summary, p. 5. Importantly, the bi-partisan Western Governors Association has determined that the Western States, which regulate hardrock mining on state and private lands within their borders, "... impose permit conditions and stringent design and operating standards, to ensure that hardrock mining operations are conducted in a manner that is protective of human health and the environment." WGA, Policy Resolution 10-16, Background (A)(8) ("National Minerals Policy"). Moreover, the states and federal agencies have continued to strengthen their reclamation and financial assurances requirements on an ongoing basis.

The correctness of the 1999 National Academy of Sciences determinations were revalidated and confirmed by Senator Murkowski's 2011 Investigation, when the United States Forest Service ("Forest Service") and the United States Bureau of Land Management ("BLM") reported to the Senator that out of 3,344 mining plans of operations approved by these two agencies since 1990, **none of these 3,344 federal mine plan approvals created an environmental problem that caused EPA to place any of these hardrock mines on EPA's highest priority environmental clean-up sites.** Therefore, Senator Murkowski's study objectively demonstrates the continued correctness of the National Academy/National Resources Council's 1999 determinations.

The development of the effective hardrock mine regulation and reclamation of the Forest Service, the BLM and Western States did not occur overnight. There was a "learning curve" that took a couple of decades. But the single most important factor creating effective hardrock mine regulation has been an American cultural shift since about 1970 with the advent of the modern environmental movement. Prior to 1970, municipal waste, industrial waste and hardrock mines were not regulated to protect the environment. Protecting the environment was not a major societal priority. The US hardrock has incorporated these environmental values into the cultural fabric of the industry.

The absence of environmental protections prior to 1970 was, in significant part, a legacy of the then-dominant American cultural focus from the Great Depression on jobs and the economy, followed immediately by World War II, the Cold War and the Korean War. All of these nation-threatening events caused the federal government to force dramatic and environmentally-harmful national efforts to quickly and heroically increase the chain of industrial and manufacturing production to historic heights. Hardrock mining was (and remains) the first and primary link in much of the manufacturing chain. Much of the CERCLA hardrock mine negative environmental legacy arose during this period or long before. Even in the late 1950s, President Eisenhower's forward-looking "Blueprint for America" did not even mention the environment.

The modern environmental movement, symbolized by the first Earth Day and by the enactment of the National Environmental Policy Act in 1970, evidenced a shift of our society from one that had been almost wholly-focused on industrial and manufacturing production values to a society where environmental values had a role, too. This shift in values was implemented by changes in law and regulation over the next twenty years as the United States adjusted to this more balanced approach to hardrock mining. As

discussed below, these laws, regulations and the collective experience of federal and states agencies, as well as the hardrock mine industry (learning from regulatory omissions along the way) have created a regulatory climate and an operating culture in which current hardrock mine regulation is an effective protector of the environment.

Hardrock mines designed and built prior to 1970 were developed to maximize production and minimize cost with little or no regard for environmental values. Importantly, however, after 1990, all new hardrock mines have been designed, built and operated to integrate long-term environmental closure and reclamation as a primary design standard. This is required by current law, but it is also required by the U.S. culture, generally, and by the U.S. hardrock mining industry, specifically.

Therefore, the EPA cannot rationally use information about environmental closure and reclamation costs from hardrock mines designed and approved prior to 1970 to assess the degree and duration of environmental risk associated with hardrock mines in 2017. Doing so would be as absurd as assuming that the design flaws of the 1964 Chevrolet Corvair, made infamous by Ralph Nader's 1966 book "Unsafe at Any Speed," should be used to assess whether any new National Highway Traffic Safety rules are needed in 2017. In both the hardrock mine and the NHTSA examples, the result of such assessments would be equally hopeless and comically out of date.

The Forest Service, the BLM, and the Western States reclamation agencies, in concert with the hardrock mining industry environmental management, have prevented any hardrock mine, designed and approved after 1990, from being deemed by EPA to be a "top priority" cleanup site.

This achievement is a genuine "success story."

2.0 Hardrock Mining Regulation Effectiveness – EPA has never determined that any hardrock mine approved by a federal or a Western State agency after 1990 to be among the "top priority among known response targets"

2.1 EPA's National Priorities List for CERCLA Cleanup

The federal "Comprehensive Environmental Response Compensation and Liability Act of 1980, as amended (commonly referred to as "CERCLA" or "Superfund"), requires EPA to publish the National Priorities List annually to identify the "national priorities among known releases or threatened releases [of hazardous substances] throughout the United States ...."[2] The National Priorities List identifies "[t]o the extent practicable, ... [EPA's] 'top priority among known response targets'...."[3] The National Priorities List ("NPL") includes over 1100 sites, which includes only about 50 hardrock mining sites, which, in turn are almost all pre-1970 facilities.[4]

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[2] 42 U.S.C. Section 9605(a)(8)(B).

[3] Id.

[4] http://www.epa.gov/superfund/sites/npl (March 30, 2012). Unfortunately, EPA had prepared and electronically-published a Table designated "Summary – Mining Sites on the National Priorities List"

EPA has specifically determined that hardrock mining wastes pose significantly lower environmental risk than "mineral processing" wastes, and so EPA has determined that "high volume" "low hazard" wastes should not be regulated as if they were "hazardous wastes."[5] Therefore, information about environmental problems with inorganic chemical plants and mineral processing facilities that generate actual "hazardous waste" does not provide any useful information to assess the environmental issues associated with hardrock mines. Accordingly, even more importantly, environmental regulatory issues associated with mineral processing facilities and inorganic chemical plants provide no information about the current regulation of hardrock mining. Mineral processing and inorganic chemical plants are subject to substantially different regulatory programs, standards and procedures than hardrock mines. In short, to have an intelligent discussion about the effectiveness of hardrock mine regulation one must evaluate hardrock mining and milling facilities that were actually subject to regulation since 1990. EPA's now-defunct NPL Mining Sites List failed to do this, since almost one-half of the EPA's so-called "Mining Sites" were in fact mineral processing or inorganic chemical plants.

2.2 A specific hardrock mine clean-up case study cannot be used to evaluate the effectiveness of *current* hardrock mine regulation if that specific hardrock mine had not been subjected to regulation prior to its design and construction

One cannot evaluate the effectiveness of hardrock mine regulation if one does not first consider whether or not a case study hardrock mine had been subject to regulation, and then second, if applicable, one must consider the nature of the specific regulation to which a hardrock mine had been subject to regulation *prior to its design and construction*. Obviously, it is utterly pointless, absurd, and deliberately misleading, to pretend to "evaluate" the effectiveness of hardrock mine regulation with reference to any hardrock mine that has never been subject to regulation! Nevertheless, nongovernmental organizations (NGO's) that seek their funding by opposing hardrock mines inevitably use

("EPA's Mining Site List," May 2013, www.epa.gov/aml), but EPA's Mining Site List was highly misleading because it did not include only hardrock mines, nor even just "hardrock mining and milling sites." Unfortunately, EPA's "Mining Sites List" included large numbers of downstream inorganic chemical plants and "mineral processing" sites that are not hardrock mines. This critical substantive distinction seems to have given rise to multiple legal actions filed by non-governmental organizations ("NGO") against the hardrock mining industry and against EPA speciously seeking regulation of hardrock pursuant CERCLA 108(b). Fortunately, after the NWMA/AEMA provided its public comments regarding EPA's fatally-flawed "Summary – Mining Sites on the National Priorities List" and other closely-related issues in EPA's "Bristol Bay" public docket (see discussion in Section 2.4 below), EPA terminated its dissemination of this particular grossly misleading information by removing it from EPA's website. Nonetheless, the NGO legal challenges against the mining industry that were apparently supported, in part, by EPA's years of misinformation regarding the hardrock mining industry, continue to this day.

[5] See 50 Fed. Reg. 40,292 (Oct. 2, 1985); EPA, "Report to Congress, Wastes from the Extraction and Beneficiation of Metallic Ores, Phosphate Rock, Asbestos, Overburden from Uranium Mining, and Oil Shale," (Dec. 31, 1985); 55 Fed. Reg. 32,135 (Aug. 7, 1990); and EPA, "Report to Congress on Special Wastes from Mineral Processing" (July 1990).

historical and factually irrelevant examples to suggest there are current problems with hardrock mines in both regulatory and litigation settings.[6]

Hardrock mines designed and built prior to 1970 were developed to maximize production and minimize cost, but after 1990, all new hardrock mines have been designed, built and operated to integrate long-term environmental closure and reclamation as a primary design standard, as required by current law and culture. Therefore, the success of hardrock mining regulation must be evaluated by using reasonably current applicable rules.

No one would suggest that General Motors (GM) should be prohibited from producing cars in 2017 or subject to new regulation because, in 1965, GM produced the Corvair (deemed "unsafe at any speed" by Ralph Nader[7]) which does not meet 2017 standards. Yet, critics of the hardrock mining industry repeatedly and constantly describe environmental problems at hardrock mines that were designed and operated prior to 1970 as illustrative of current hardrock mine.[8] This is absurd.

Hardrock mines designed and operated prior to 1970 were in place long before hardrock mines were subject to any regulation whatsoever. Thus, it is critical to determine, even if only generally, the extent to which any hardrock mine used as an example or case study to evaluate the effectiveness of hardrock mine regulatory programs has actually been subject to relevant regulatory programs.

2.3 Hardrock mines on the National Priorities List must be rationally classified into three (3) major eras based upon applicable regulation or the lack thereof: (1) Pre-Regulatory Era (prior to 1970); (2) Transition Regulatory Era (1970 through 1990); and, (3) the Regulated Hardrock Mine Era (post-1990).

Hardrock mine regulation must be classified into 3 major eras based upon the extent of applicable regulation or the lack thereof: (1) Pre-Regulatory Era (prior to 1970); (2) Transition Regulatory Era (1970 through 1990); and, (3) Regulated Hardrock Mine Era (Post-1990). Below, Section 4.0 ("Changing Societal Values – The Great Depression, World War II, the Cold War, and the Advent of the Modern Environmental Movement") provides some of the policy history supporting use of these three temporal classifications. Further below, Section 5.0 ("Development of Legally-Applicable Hardrock Mine

[6] Maest, A.S., Kuipers, J.R., Travers, C.L. and Atkins, D.A., 2005, "Predicting Water Quality at Hardrock Mines: Methods and Models, Uncertainties, and State-of-the Art." But importantly also see, Schlumberger Water Services, 2013, "Technical Review of the Kuipers Maest, 2006, 'Comparison of predicted and actual water quality at hardrock mines: The reliability of predictions in Environmental Impact Statements,'" p. 1, that determined *inter alia* that "The conclusions contained in the [Maest Kuipers, 2006] report are not relevant to any current mines that are being permitted, or to any future mines …[because] [m]odern-day characterization and analysis techniques have changed so radically from virtually all of the studies cited by the report that it is meaningless to draw any comparison to modern-day conditions." Emphasis added.

[7] Nader, Ralph, Unsafe at any speed: The Designed in Dangers of the American Automobile, Grossman Publishers, 1965.

[8] See footnote 6, supra.

Regulation") provides a summary of the primary legal support for using these three (3) temporal classifications.

Facilities designed and constructed in the Pre-Regulatory Era (prior to 1970) provide no useful information about the effectiveness of current hardrock mine regulation "predictions" since Pre-Regulatory Era Hardrock Mines were designed, constructed and operated to maximize production and minimize cost. Pre-Regulatory Era Hardrock mines did not even consider long-term environmental closure and reclamation. In stark contrast, long-term environmental closure and reclamation are required by current federal and state law, while Pre-1970 hardrock mines were never subject to any regulation whatsoever. Even worse, Pre-Regulatory Era facilities were conceived, designed and operated even before environmental values were imbedded in the American culture. Thus, when subsequently enacted laws and regulations were applied to these facilities after-the-fact, such regulatory efforts could not influence the facility design and construction. Thus, such regulation could never hope to prevent *all* releases to the environment from facilities. For example, tailings facilities from the Pre-Regulatory Era were often designed to release to the ground water for reasons of structural safety, while even simple release-reporting to ground water was only required starting in the 1980s, and even then, only under certain limited circumstances. In short, pre-1970 Pre-Regulatory Era facilities were not conceived, designed or operated with significant concern for the environment.

Importantly, even hardrock mines designed and constructed during the Transition Regulatory Era were often not subject to direct regulatory approvals. But at least there was an increasing cultural awareness of the regulated community and the government that environmental values needed to be considered, even if imperfectly. However, *those Transition Regulatory Era Mines that were actually subject to regulation* were never subject to full control of surface and ground water regulation and geochemical predictive modeling that characterizes current hardrock mine permitting.

For example, in 1985, it was EPA's assessment was that "EPA data on management methods at mining facilities indicate that only a small percentage of mines currently [i.e., 1985] monitor their ground water, use run-on/run-off controls or liner, or employ leachate collection, detection, and removal systems." 50 Fed. Reg. 40,292 (Oct. 2, 1985); EPA, "Report to Congress, Wastes from the Extraction and Beneficiation of Metallic Ores, Phosphate Rock, Asbestos, Overburden from Uranium Mining, and Oil Shale," (Dec. 31, 1985) ("RTC I," p. ES-10.) Therefore, as a practical matter, according to EPA, any discussion of the effectiveness of "environmental predictions" at facilities designed and approved prior to 1985 is utterly meaningless. To restate this point, hardrock mining facilities designed and approved prior to 1985 do not provide any useful information about current regulation of hardrock mines because pre-1985 hardrock mines were not designed, built and operated to integrate long-term environmental closure and reclamation. This is in sharp contrast to current law and regulation.

Therefore, per EPA, there was almost no comprehensive regulation of ground water discharges prior to 1985. Of course, such programs were not created overnight. Even in

1990, programs specifically designed to preclude groundwater releases from mining facilities were in their infancy and geochemical "predictive" modeling was largely conceptual at that time. Modern geochemical predictive modeling really did not begin practical application as a regulatory tool in the mid-1990s. For example, Earthworks, a group that opposes the hardrock mining industry, contracted for a report "Predicting Water Quality at Hardrock Mines: Methods and Models, Uncertainties, and State-of-the Art" in which of 202 references cited to, only 28 dated from before 1990, and most of the directly pertinent geochemical references have been published since 2000.[9] Nevertheless, if one evaluates and then assigns each hardrock mine that EPA has deemed to be among its "top priority among known response targets" (i.e., the NPL) to the major regulatory era when it was designed, constructed and approved, then a very clear and incontestable picture develops, as discussed immediately below.

2.4 Northwest Mining Association June 30, 2013 Comments on EPA's Bristol Bay Watershed Assessment determined that current hardrock mining regulations were protective of the environment, citing to specific federal and state government studies that explicitly support this conclusion.

The American Exploration & Mining Association (AEMA) (formerly Northwest Mining Association or "NWMA") provided comments to EPA's Bristol Bay Watershed Assessment concerning the Alaskan Pebble Project on June 30, 2013 regarding the effectiveness of existing hardrock mine regulation. Baird, 2013, "Hardrock Mining Reclamation and Reclamation – Developing Sustainable Environmental Protection through Changing Values, Changing Laws and Experience: A Federal State Success Story" (the "NWMA 2013 Study"). The NWMA 2013 Study provides detailed support to arrive at its conclusions that:

> Current Hardrock Mining regulation is protecting the environment. However, this is not just the opinion of the relevant agencies or the Hardrock Mining industry; it is the opinion of the National Academy of Sciences and the bi-partisan Western Governors' Association.

Unfortunately, EPA apparently wholly-ignored the NWMA 2013 Study with regard to the "Bristol Bay Watershed Assessment," except that the NWMA 2013 Study may have caused EPA's to terminate use of its so-called "NPL Mining Site List." Nevertheless, to date, EPA has never referenced the NWMA/AEMA's 2013 Study.

AEMA must assume EPA's failure to acknowledge the relevant indisputable facts described in NWMA's 2013 Report has something to do with the bias that occurred within EPA regarding the "Bristol Bay Watershed Assessment." More specifically, the respected Cato Institute "think tank" has stated:

> Because there was never a mining permit application [submitted for the Pebble Project], EPA charged a senior biologist (not a mining engineer)

[9] See footnote 6, supra.

named Phillip North to design a worst case scenario open-pit 'hypothetical mine' that could never be approved. … North then proceeded to 'model' the maximum deleterious impact of the nonexistent, unplanned, and imaginary mine …

EPA and North simply ignored … [a $150,000,000 in scientific study of the] biology, ecology, and dynamics of the Bristol Bay watershed. EPA and North simply ignored this remarkable repository of information before admitting, during the entire time that the Bristol Bay Watershed Assessment was written (2011-2014), that it was never really intended to provide a scientific foundation for regulatory decision-making, after all.

…

While he was creating his hypothetical mine, Mr. North also coached anti-Pebble activists on how to petition his own Agency to stop the real permit application. It appears he even wrote petitions. …

Mamula, Ned and Michaels, Patrick J., 2016, "A Green Mess: Is EPA in Hot Water over Alaska's Bristol Bay?" http://www.cato.org/publications/commentary/green-mess-epa-hot-water. Importantly, when the House Oversight Committee sought to bring Mr. North before a Committee Hearing in 2013:

… he delayed, bobbed and weave, and suddenly pulled his children out of school and fled the country.

Id. Therefore, the AEMA/NWMA must assume that the important information that it has previously presented to EPA regarding the adequacy of existing hardrock mine reclamation has been lost to EPA's unethical Bristol Bay Watershed Assessment sideshow.

Accordingly, the AEMA has developed this document in 2017 to further support its and refine the NWMA's original demonstration that currently, federal and state hardrock mine reclamation programs and financial assurance mechanism are protective of the environment. Therefore, the AEMA commissioned the independent expertise of Enviroscientists, Inc. to review and assess NWMA's 2013 Report to be sure that its information is fully considered by future EPA actions.

2.5 The 2015 Enviroscientists Report confirms the AEMA/NWMA Comments on the Bristol Bay Watershed Assessment in June 2013 that determined that no Western hardrock mine has been placed on the CERCLA NPL since 1990

Dr. Richard DeLong of Enviroscientists, Reno, Nevada, has completed an assessment of U.S. Environmental Protection Agency's National Priorities List ("NPL") for Mining and Milling Sites. Please see attached "Memorandum" from Richard DeLong to Joe Baird,

Baird Hanson LLP, dated, May 15, 2015, "Assessment of Mining and Milling Sites on the National Priorities List" ("Enviroscientists Memo"). Dr. DeLong's analysis states:

> There are over 1,100 sites on the NPL. Of those, there are 100 that the EPA has classified as MMS [i.e., "Mining and Milling Sites"]. However, only 55 of those sites are actual mining operations where mineral resources were extracted from the earth. The other 45 are mineral processing facilities where a mineral product is delivered to the operation for further processing. The 55 "hardrock" MMS on the NPL fall into the following temporal classifications: 49 are prior to 1970; five are from 1970 through 1990; and one is post-1990 and it is the Barite Hill property in South Carolina.

Therefore, per the Enviroscientists' Memorandum, the 55 Mining and Milling sites on the NPL fall into the following temporal classifications:

Pre-Regulatory Era (prior to 1970)	49
Transition Regulatory Era (1970 through 1990)	5
Regulated Hardrock Mine Era (post-1990)	1[10]

By eliminating the "red herring" mineral processing and inorganic chemical plants from the EPA's so-called "Mining" Sites List of 100 sites, the EPA List can be corrected to include about 55 sites that are hardrock mining sites, but **only if** one includes hardrock mining sites from ***all*** eras, including many historic facilities dating back to the 1800s, which obviously provided no information about 20th century mine design, construction, operation and reclamation/closure practices, let alone 21st century practices.

Obviously, and most importantly from the perspective of evaluating the success of current hardrock mine regulation, *none* of the hardrock mines on the National Priorities List were approved after 1990 in the West.[11] Moreover, this is validated and updated regarding federal lands by the Forest Service and the BLM, as discussed immediately below.

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[10] Barite Hill, McCormick County, South Carolina, EPA Facility ID SCN000407714. According to EPA, from 1991 to 1995, gold and silver mining was conducted at the site.

[11] It is important to note that eliminating mineral processing and inorganic chemical plant sites almost certainly does not affect the number of regulated facilities from EPA's so-called Mining Site List that would be deemed to be located on the NPL since 1990. In fact, there have been very few new mineral processing facilities constructed since 1990, other than updating of existing facilities (e.g., Rio Tinto's Utah Copper Division) or use of small "mineral processing" facilities such as the dore furnaces commonly located at gold mines. Very few, if any, new large regional mineral processing facilities have been constructed since 1990. Nevertheless, one cannot have an intelligent discussion about the efficacy of or even enumerate the issues related to regulating hardrock mines and mills if the data includes information about mineral processing and inorganic chemical plants.

3.0 Current hardrock mine regulation is protective of the environment, as determined by: (1) the United States National Academy of Sciences; (2) the Western Governors Association; and, (3) Senator Murkowski's 2011 Investigation.

3.1 The National Academy of Sciences/National Research Council has determined that existing hardrock mine regulation on federal land is "complicated but generally effective" in protecting the environment.

In 1999, the federal government's independent National Academy of Sciences/National Research Council ("NAS/NRC"), including several-related organizations,[12] produced a comprehensive report entitled "Hardrock Mining on Federal Lands" regarding then-current hardrock mine regulation on lands managed by the Forest Service and the Bureau of Land Management and determined:

> The overall structure of the federal and state laws and regulations that provide mining-related environmental protection is complicated but generally effective.
>
> . . .

NAS/NRC, 1999, "Hardrock Mining on Federal Lands," p.5. Importantly, the NAS/NRC also identified a number of areas where implementation of existing laws could be improved, Id., pp. 6 – 9, and all of the NAS/NRC recommendations that increased the protection of the environment have since been adopted into current federal law.

Importantly, the Forest Service and the BLM continue to improve their programs. Since the 1999 NAS/NRS determination, for example, the Forest Service developed a new "Training Guide for Reclamation Bond Estimation and Administration – For Mineral Plans of Operation authorized and administered under 36 CFR 228A" in 2004, which considered the decades of experience that had developed concerning creating financial assurances and distilled much of this practical knowledge into the Forest Service manual. Additionally, in 2001, the BLM expanded its program to provide for financial assurances on all surface disturbing activities, including notice-level exploration projects affecting fewer than five acres. Thus, the hardrock mining regulation protecting federal land is continually improving and adjusting to take into account the lessons learned from experience, as is required pursuant to NEPA "adaptive management" strictures. These existing regulatory programs already substantially limit or eliminate the degree and duration of environmental risk associated with the current hardrock mining industry.

3.1.1 The NAS/NRC Report determined that "[s]imple 'one-size-fits-all' solutions are impractical because mining confronts too great an assortment of site-specific technical, environmental, and social conditions."

[12] "Committee on Hardrock Mining on Federal Lands," "Committee on Earth Resources," "Board on Earth Sciences and Resources," "Commission on Geosciences, Environment, and Resources."

Over the last 40 years, the Forest Service and the BLM have developed complicated, but nonetheless workable and environmentally protective programs under the auspices of their own authorities comprehensively coordinated by the National Environmental Policy Act ("NEPA") to properly evaluate and take into account site-specific conditions. The NAS/NRC properly characterizes the situation.

> Conclusion: Federal land management agencies' regulatory standards for mining should continue to focus on the clear statement of management goals rather than on defining inflexible, technically prescriptive standards. Simple 'one-size-fits-all' solutions are impractical because mining confronts too great an assortment of site-specific technical, environmental, and social conditions. Each proposed mining operation should be examined on its own merits. ... Recommendation: BLM and the Forest Service should continue to base their permitting decisions on the **site-specific evaluation** [emphasis added] process provided by NEPA. The two land management agencies should continue to use comprehensive performance-based standards rather than rigid, technically prescriptive standards. ...

"Hardrock Mining on Federal Lands," Executive Summary, p.5. The NAC/NRC emphasis on the criticality of site-specific evaluation is emphasized by NEPA, CERCLA's ARARs process and state permitting for determining rational standards that are protective of the environment and create realistic mechanism for reclamation guarantees.

3.1.2 The NAC/NRC Report correctly characterizes current hardrock mining industry as having minimal impact on public lands and NAC/NRC Report also correctly characterizes the importance of hardrock mining to the US economy and to US manufacturing

The NAC/NRC Report "... respond[ed] to a request by Congress that the National Research Council assess the adequacy of the regulatory framework for hardrock mining on federal lands." "Hardrock Mining on Federal Lands," Executive Summary, p. 1. Importantly, the Report states that "[t]he area of federal land available to hardrock mining in the Western states is enormous, but the surface area actually physically disturbed by active mining is small in comparison ... [a]pproximately 0.06% of BLM lands are affected by active mining and mineral exploration operations." Id. And, "while society requires a healthy environment, it also requires sources of materials, many of which can be supplied only by mining." Id. Importantly:

> Regulations intended to control and manage the alteration of the landscape and the environment in an acceptable way are generally in place and are updated as new technologies are developed to improve mineral extraction, to reclaim mined lands, and to limit environmental impacts.

Thus, the NAC/NRC Hardrock Mining Report correctly notes that hardrock mining has a minor surface area "footprint" relative to total federal lands, and that society requires mining for survival.

3.2 Current hardrock mine regulation continues to be protective of the environment on federal lands as further evidenced by the United States Forest Service and the United States Bureau of Land Management Responses to Senator Murkowski's 2011 Investigation

By letter dated, March 8, 2011, Senator Murkowski's (R-AK) asked the Forest Service and the BLM how many mine plans of operations ("MPOs") the agencies had approved since 1990 and asked how many of those approved MPO facilities subsequently were listed by EPA on the NPL? The Forest Service responded to Senator Murkowski by stating that they had approved 2,685 MPOs since 1990 and stated that none of these required EPA to place them on the NPL. The BLM responded to Senator Murkowski by stating that they had approved 659 MPOs after 1990 and stated that none of these required EPA to place them on the NPL.

Thus, the 1999 NAS/NRC determination that current hardrock mine regulation was protective of federal lands was additionally confirmed and updated by Senator Murkowski's 2011 Investigation.

3.3 The Bi-Partisan Western Governors' Association confirms that the Western States "have a proven track record in regulating mine reclamation in the modern era, having developed appropriate statutory and regulatory controls" that are "protective of human health and the environment" as well as being protective of public treasuries

The Western Governors' Association has repeatedly determined that current Western States' hardrock mine regulation is protective of human health and the environment. The Western States have agencies and staffs that have been exclusively dedicated to prospective mine regulation and to prospectively requiring mine operating and mine reclamation plans. Additionally, good regulatory work and correct mine financial assurances have not only protected public health and the environment, but these regulatory programs have also protected state and federal public treasuries. Importantly, these WGA determinations have been Bi-Partisan. Even more importantly, these determinations regarding the quality of Western states mine regulation and reclamation have been on-going, made year-after-year, by an ever-changing group of Bi-Partisan Western Governors. Please note that WGA policy statements are either, renewed, updated or "sun-setted" every three (3) years, but it is also important to see the evolution of these policy statements.

In 2010, the Western Governors' Association ("WGA") stated:

> The Western States ... extensively regulate hardrock mining operations on both public and private lands, and uniformly impose permit conditions and

> stringent design and operating standards, to ensure that hardrock mining operations are conducted in a manner that is protective of human health and the environment, and that, at closure, the mined lands are returned to a safe, stable condition for productive post-mining use.

WGA, Policy Resolution 2010-16, Background (A)(8) ("National Minerals Policy"). More recently, in 2011, the Western Governors Association "Policy Statement" further emphasized the above points stating simply:

> The member states have a proven track record in regulating mine reclamation in the modern era, having developed appropriate statutory and regulatory controls, and are dedicating resources and staff to ensure responsible industry oversight.

WGA, Policy Resolution 2011-4 ("Bonding for Mine Reclamation"). Previous WGA policy determinations provided foundation for the correctness of the above determinations, stating that:

> All Western states ... have staff dedicated to ensuring that ongoing mine operations develop and follow appropriate reclamation plans.
>
> ...
>
> Western states have a proven track record in regulating mine reclamation in the modern era – including for hard rock mines – having developed appropriate statutory and regulatory controls, and are dedicating resources and staff to ensure responsible industry oversight.

WGA, Policy Resolution 2014-07 ("Bonding for Mine Reclamation"). Thus, while the National Academy of Science/NRC confirms that hardrock mine regulation on federal lands is "generally effective," the Western Governors' Association confirms that the Western States' hardrock mine regulation is also "protective of human health and the environment." Collectively, this means that all Western lands, federal and state (including private) lands are covered by adequate regulations regarding hard rock mining.

Thus, since it has been well-established that state regulatory and policy regulation of hardrock mining protects human health and the environment, it is important to also ensure that such regulation is protective of the state public finances, as well.

In 2014, the WGA correctly determined regarding the Western mining states that:

> An important component of a state's oversight of mine reclamation is the requirement that mining companies provide financial assurances in a form and sufficient to fund required reclamation if, for some reason, the company itself fails to do so [often referred to generically as "Bonding"].
>
> ...

All Western states have developed regulatory bonding programs to evaluate and approve the financial assurances required of mining companies. The states have developed the staff and expertise necessary to calculate the appropriate amount of the bonds, based upon the unique circumstances of each mining operation, as well as to make informed predictions of how the real value of current financial assurance may change over the life of mine, even post-closure.

WGA, Policy Resolution 2014-07 ("Bonding for Mine Reclamation"). These are powerful Bi-Partisan collective gubernatorial determinations made over a period of recent years. Importantly, these statements by Western State political leaders are well-supported by the independent factual record.

3.4 Current hardrock mine regulation is protective of the environment on all federal and state Western lands – A Summary

In 1999, federal hardrock mine regulation programs of the USFS and the BLM were deemed to be "generally effective" in protecting the environment by the National Academy of Science/National Research Council. In 2011, Senator Murkowski's investigation of the BLM and Forest Service mine regulation experience verified and updated the 1999 NAS/NRC determination. And the Bipartisan Western Governors' Association has determined that the state hardrock mine regulatory programs were both "protective of human health and the environment" and protective of public treasuries.

Importantly, such regulatory "treasury protection" does not even consider the major additional public benefit of mining revenue from state revenue from taxes, severances taxes, and employee income taxes, among other sources, which are substantial since mining jobs (i) are traditionally some of the highest paying hourly wages in any state (ii) like any industrial enterprise, have substantial job multiplier effects on supporting business and employment and (iii) typically produce products that are the necessary inputs for US manufacturing.

Nevertheless, it is reasonable to ask, "Why is hardrock mine regulation so effective now, when historic operations created significant problems?" Obviously, as discussed above, part of the answer is simply that prior to 1970 (i.e., the Pre-Regulatory Era) there was no significant environmental regulation of hardrock mines. However, it is also important to recognize that prior to 1970 there was also no significant environmental regulation of municipal waste or municipal sewage, nor was there any significant regulation of manufacturing environmental impacts. The "bottom line" is that the American culture has now made environmental protection a priority value – not only for the hardrock mining industry, but also for local communities, industry, the regulatory community, and the public. Therefore, unlike in decades gone-by, public, private and NGO managers are now paying close attention to hardrock mining environmental issues that did not even show up on the policy "radar screen" prior to 1970.

4.0 Changing Societal Values – The Great Depression, World War II, the Cold War, and the the Modern Environmental Movement

4.1 Prior to 1970, there was virtually no direct regulation of municipal sewage, industrial wastes or hardrock mines.

Prior to 1970, there was no significant regulation of hardrock mines at either the federal or state level. Mining was not an exceptional activity in this regard. Prior to 1970 there was very little direct regulation of municipal sewage or industrial waste discharges. The early federal water pollution control laws were primarily construction grants programs that were public works projects subsidizing certain activities, but these were not regulatory prohibitions. Rivers, lakes and other water bodies were deliberately used to dispose of all types of septic, chemical and industrial wastes.

Prior to 1970, government and industrial managers did not "see" environmental pollution as a problem or they simply did not know what to do about it. In 2017, this may seem incomprehensible. However, if one briefly reviews our history leading up to this point, one can quickly understand how the culture reached this point. More importantly, for the purpose of this report, in part, it explains why the regulatory omissions of the past will not be repeated, even without specific regulatory prohibitions.

4.2 Societal Values of "The Greatest Generation"

Tom Brokaw's iconic 1998 book *The Greatest Generation*[13] describes the generation of American who came of age in the poverty of the Great Depression and went on to fight World War II, the Korean War, the Cold War, and then participated in generating an era of comparative affluence in the 1950s and 1960s. The deprivation of the Great Depression created a culture in which jobs and manufacturing production were the primary concerns. Belching industrial smokestacks symbolized prosperity in one town, while clean air in the next town symbolized factory closure and unemployment. For example, in 2016, it is now ironic to note with regard to a historic smokestack at a Hoover vacuum manufacturing facility that:

> … the Hoover Co. understood the value of the tall chimney promoting the burgeoning company at a time when companies took pride in the height of their smokestacks. While today they may represent industrial pollution, in that era, the image of the black billowing smoke from a tall chimney stack represented prosperity. 'They wanted it to be a symbol of their company by putting their name on it,' Fernandez said. 'Every time somebody would take a picture of North Canton [Ohio], that chimney is in the picture.' 'It's certainly symbolic.'

"Iconic Hoover Smoke Stack to be Restacked," Robert, Wang, The Canton Repository, December 4, 2014. Obviously, this describes a very different set of values from the environmental values that are foundational to the US in 2017.

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13 Brokaw, Thomas, The Greatest Generation, Random House, New York, 1998.

The economic desperation of the Great Depression focused both public and private values upon the primary mission of finding ways to generate employment, manufacturing production and material prosperity to the exclusion of almost all other societal values. Thus, for example, when President Roosevelt's New Deal promoted multiple massive government dams on the Columbia River and Tennessee River systems progressive folk hero Woody Guthrie celebrated these achievements with songs like "Roll On, Columbia, Roll On" and "Grand Coulee Dam" unabashedly supporting such projects without any apparent concern about the associated major environmental, social or First Nation impacts. "Environmental concerns," as we now understand them were not part of the mainstream culture. The American culture of the Great Depression was one that necessarily worshiped jobs, production and material prosperity above all other values. These traits became even more deeply embedded into the American cultural fabric by the advent of World War II ("WWII") and its precursor events.

Strategically, WWII was to be won or lost based not just upon the bravery and sacrifice of soldiers, sailors and airmen, but also by delivering a crushing weight of one nation's gross national product ("GNP") onto the enemy nation. At the time, the United States excelled at this form of industrial warfare. At the time, the US could generate GNP quickly and in vast quantities of material, and the US did exactly that. Idled factories were brought back to smoking productively, while liquid (and solid) industrial wastes were conveniently disposed in the waterways behind these same plants.[14] Massive new industrial production facilities were conceived of and brought into production within months, not years. Enormous new manufacturing plants were constructed to build aircraft, ships, tanks, trucks, weapons and munitions, to name just a very few of the critical implements of war. Whole new cities were constructed, seemingly overnight, to meet various production goals, and indeed, the "Manhattan Project" developing atomic weapons built new towns and industrial facilities like Oak Ridge, Tennessee and Los Alamos, New Mexico in secret, without any oversight other than that that ensured production was achieve ASAP. There was no "permitting" of any of these great public works, and little or no consideration of environmental values.

Critically, all manufacturing requires mineral inputs as primary material ingredients and the wartime plants consumed the products of hardrock mines voraciously, demanding immediate expansion of the hardrock mining industry during WWII without regard to environmental impacts.

The federal government's direct orders and subsidies spurred the hardrock mining industry into what was the greatest periods of the industry's expansion in the shortest possible time. Providing immediate production, and lots of it, was the driving societal value. Generating GNP to deliver its brutal impact upon enemy nations was imperative. Indeed, *everyone* knew that American lives depended upon this industrial production, including the primary contribution of the hardrock mining industry. (Mining is referred to as being a "primary industry" for good reason!) Environmental values, as we now

[14] Obviously, the US could not duplicate these same achievements at this time.

understand them, were pushed to an obscure corner, or more typically, such values simply did not influence federal decision-making whatsoever.

Perhaps, no single visual image captures the difference in attitudes between this period and the present than the 1943 Pennsylvania Railroad calendar art by Dean Cornwell showing a PRR steam locomotive highballing past a massive steel mill belching fire and smoke, a munitions train on the foreground track, full coal hopper cars in the background and a pile of iron ore set to be charged into the steel production furnaces. Uncle Sam looms huge in the background, rolling up his sleeve to get down to work. There is no mistaking the message, even in 2017. In 1943, the Pennsylvania Railroad was proudly displaying the pollution it generated to help win World War II.

Nor did the post-WWII culture quickly change from its intense wartime focus on material production to the exclusion of other values. The Union of Soviet Socialist Republics (USSR), a World War II ally, immediately became the new "Cold War" enemy. Additionally, Communist China, also a then-recent WW II ally became a frightening new enemy in very real "hot" war in Korea in 1950. The Soviet Union's surprisingly swift development of nuclear weapons only exacerbated US concerns. Not only were many WWII attitudes of the USA about the production ethos maintained, but indeed many of the WWII industrial and mineral production subsidies were maintained through the Korean War, and for some time thereafter. Indeed, the most far-reaching federal statute explicitly supporting U.S. mineral production was passed during this period, i.e., the U.S. Defense Production Act of 1950.

If a town was in the way of the growth of mine production, then the town had to move, in whole or in part, as witnessed, e.g., at Butte, Montana or at Bingham Canyon Utah. Other values, be they cultural or environmental, were secondary to overall societal production needs. And, indeed, the core values of production, employment and prosperity continued well into the 1960s.

> In the 1960s, before the crises of energy shortages, sprawl, air and water pollution, and post-industrial economic restructuring gripped urban and rural places across America, unlimited growth was a primary goal of many communities. Growth, both economic and demographic, was a mark of progress, a source of pride, and a centerpiece of many communities' identifies.

Greenow, Linda, 2004, "When Growth was Good: Images of Prosperity in Mid-Twentieth Century America, Middle States Geographer, 2004, 37:pp. 53-61, p. 53.

In short, the current culture of the USA has embedded environmental values into all aspects of policy-making. In contrast, "The Greatest Generation" had no such luxury in the 1930s, 1940s or 1950s. The 1960s reaction to such attitudes is understandable. However, it is not only the hardrock mining industry that had to change and incorporate such values, it was society as a whole that had to make these changes. And, such

changes, did in fact occur, in the public, the government, and the hardrock mining industry.

4.3 Cultural Balance

Fear of unemployment, fear of war, and fear of losing wars were all factors that pushed the United States far into the public policy mode of production-at-all-costs during most of the Twentieth Century. Environmental values were almost entirely ignored regarding industrial production until 1970. Indeed, such values were rarely even articulated. At the time, the pendulum had swung too far in the direction of industrial production at all cost, which led to unnecessarily high costs to natural and environmental values. However, times *were* changing in the 1960s and 1970s. With the prosperity of the 1950's and 1960's, other values could and did enter or re-enter the American culture ... including environmental values.

4.4 The Modern Environmental Movement

There is no single event that marks the beginning of the environmental movement, but there are a series of events that collectively altered the mix of cultural norms regarding jobs, production, pollution, and the environment. Concerns about nuclear arms and the effects from nuclear fallout (e.g., strontium 90) from bomb testing raised consciousness about the "environment" in the 1950s. The controversy surrounding the proposal of several major dams on the Colorado River system provided a focus for environmental values in the late 1950s, perhaps most notably the work of the Sierra Club and David Brower to help thwart the building of the Echo Park Dam in Dinosaur National Monument. The 1962 publication of Rachel Carson's controversial book *Silent Spring* provided a counterpoint to the widespread use of chemicals in the U.S. and Dupont's "better living through chemistry" message. Shortly thereafter, changing values and changing politics allowed the passage of the landmark Wilderness Act of 1964. All of these and many other factors brought changes to America's culture and values.

America reached a symbolic turning-point on April 22, 1970, celebrated by the first Earth Day. The advent of the modern environmental movement was to generate major changes for the U.S. hardrock mining industry, and indeed, all of US industry, manufacturing, state and municipal government pollution. However, these changes were certainly not immediate, and many of the changes most applicable to hardrock mining, reclamation, environmental protection and financial assurances would take decades to develop and implement.

4.5 Cultural and Legal Changes Incorporating Environmental Values

The above discussion is provided to emphasize the extent and rapidity of the change in societal values that caught both government and industry off-guard in the 1970s. Prior to 1970, there was very little regulation of government or industrial pollution. Often, there was no regulation of pollution whatsoever. Even worse, the USA's pre-1970 values and norms were such that environmental values were not significantly impacting societal

decision-making in any way, because much of society did not even understand there was another way of conceiving of the world. In fact, it was only late in 1969 that the US enacted the National Environmental Policy Act of 1969 (NEPA), which was the forerunner of most modern federal environmental statutes.

Accordingly, there is nothing that can be learned about the effectiveness of current hardrock mine regulation by studying facilities that were designed or constructed prior to 1970. These facilities were designed, built and operated to maximize production and minimize cost, but hardrock mines permitted/approved after 1990 have been designed, built and operated to integrate long-term environmental closure and reclamation as a primary design standard, as required by current law and mining industry attitudes.

Importantly, as discussed immediately below, even though laws and attitudes were changing rapidly starting in the 1970s, there was certainly a very steep "learning curve" as both government and industry tried to cope with challenges of a sort that never had had to be addressed previously. This transition was hard for all concerned, and mistakes were made. For example, the infamous "Syringe Tide" of raw garbage and medical waste washed up onto New Jersey and Long Island beaches as late as 1988-1989 highlighted on-going municipal waste disposal practices, and indeed, well into the 1990s, New York City and various New Jersey communities were still ocean-dumping sewage sludge in the New York Bight and raw sewage via storm water overflow.

Fortunately, the Hardrock Mining Industry's transition problems was largely complete by 1990, and since 1990 environmental problems associated Hardrock Mining have been generally modest and manageable, as benchmarked, in part, by the lack of any new Western hardrock mines appearing on the CERCLA National Priorities List in the last 26 years.

Section 5.0, immediately below, provides a summary of the major environmental regulatory programs that have created the regulated hardrock mine era.

5.0 Development of Legally-Applicable Hardrock Mine Regulation

5.1 Regulation of the Natural Media Receptors – An Overview

Fundamentally, there are four major categories natural media that the environmental laws protect: (1) air; (2) surface water; (3) groundwater, and (4) land. As a practical matter, hardrock mining has not typically triggered significant scientific, policy or regulatory questions regarding air quality; therefore, this study does not evaluate hardrock mine regulation regarding protection of air quality.[16] Surface water quality protection has been

[16] For example, the only significant air quality policy issue that has arisen from hardrock mining concerns the emissions of mercury from gold mining operations in Nevada impacting Idaho dam-impounded reservoirs. However, these allegations were effectively discredited by the White Paper developed by the Idaho Association of Commerce and Industry/Idaho Council for Industry and the Environment Report "Sources and Receptors of Mercury in Idaho," January 28, 2009 ("Idaho Mercury Report"). Mercury in Idaho's waterways is primarily a result of geologic source mercury or legacy mining (i.e., historic mining

dominated by promulgation of federal statutory and regulatory programs, which then have typically been implemented by state agencies. On the other hand, ground water quality protection has been the province of State government with some specific notable exceptions.

Regulation of direct impacts to land (i.e., "reclamation") has been almost exclusively the province of the relevant land management authorities. The regulation of hardrock mine reclamation on National Forest System lands has been administered by the USFS since 1974, the regulation of hardrock mining on Department of Interior managed public domain lands has been administered by the BLM since 1981, and the regulation of state and private lands within a state are administered by the relevant state agency. Additionally, the integration of post-mining land use, continued protection of water quality and post-mining land uses following hardrock mine closure and reclamation, as well as bonding for these purposes, has been the unique province and expertise of the State and Federal Land management agencies. A brief history of these programs is provided below.

5.2 Surface Water

The Clean Water Act[17] was passed in 1972 and, among other things, created a requirement for a discharger of a "pollutant" to "navigable waters" (which later came to be more broadly defined as "waters of the United States") from a "point source" to obtain an NPDES permit.[18] In theory, the Clean Water Act, most particularly the NPDES permit system was one of the first federal laws potentially directly implementing regulation of hardrock mines. However, implementation was slow as EPA and the mining industry grappled with new concepts, new operational issues, and new regulatory concepts, including but not limited to programmatic litigation (see e.g., *U.S. Steel Corp. v. Train*, 556 F. 2d. 822 (7th Cir. 1977), and major statutory amendments[19] to address these issues. Thus, EPA did not promulgate 40 C.F.R. 440, Subpart J, concerning "Copper, Lead, Zinc, Gold, Silver, and Molybdenum Ores Subcategory," some of the most common Hardrock Mines, until December 1982. 47 FR 54609, Dec. 3, 1982.

Therefore, prior to 1982, EPA and delegated State programs had attempted to enforce on a case-by-case basis an inflexible and absolute "no discharge" requirement that did not take into account net contributions of rain and snow which contributed to unrealistic environmental evaluations that significantly contributed to environmental problems at early Transition Era hardrock mines. Thus, the very first practical federal regulatory scheme specifically regulating hardrock mine surface discharges did not even exist until the very end of 1982. Not surprisingly, sorting out the implementation of the NPDES program did not occur overnight.

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using historic mineral extraction technologies and practices long abandoned). Neither the EPA, nor the NGO's, have ever responded to the Idaho Mercury Report in writing.

[17] Technically, the Clean Water Act is the Federal Water Pollution Control Act Amendments of 1972, Pub. L. No. 92-500 (codified as amended at 33 U.S.C. Section 1251-1387.

[18] 33 U.S.C. Sections 1311(a), 1362(6), (7), (12), (14).

[19] 1977 Clean Water Act Amendments, Pub. L. No. 95-217, 91 Stat. 1581 (codified as amended in scattered sections of 33 U.S.C.)

5.3 Groundwater Protection at Hardrock Mines

5.3.1 State Protection of Groundwater at Hardrock Mines

Groundwater regulation is generally held to be the unique province of state government. Groundwater, unlike surface water, does not readily migrate across State borders. Thus, while the federal definition of "waters of the United States" has been construed broadly, it has not generally been construed to regulate groundwater. As the American Law of Mining states, "[t]he Clean Water Act makes a clear distinction between navigable waters on the one hand and groundwater on the other."[25]

Therefore, state hardrock mine regulation has emerged as the primary regulatory tool for preventing or otherwise regulating potential hardrock mining impacts to groundwater. However, these programs have been relatively recent developments (i.e., since 1990). For example, the Nevada "Mining Facilities" regulation explicitly protects against and regulates discharges to groundwater from mining facilities were promulgated on September 1, 1990.[26] And although Idaho's Ground Water Quality Plan became law in 1992,[27] it was not until 1997 that a detailed and comprehensive enforcement mechanism was promulgated. See IDAPA 58.01.11, 3-20-1997 ("Ground Water Quality Rule"). Alaska's Hardrock mine reclamation was codified and promulgated in 1991. Washington's Metal Mining and Milling Act protects against potential discharges to groundwater and was passed in 1994.[28]

Thus, comprehensive direct preventative regulation of potential groundwater impacts of hardrock mine regulation was only initiated in the 1990s.

5.3.2 Federal Protection of Groundwater at Hardrock Mines

The Clean Water Act regulates discharges from hardrock mines, to "waters of the United States," and as discussed above, this is generally limited exclusively to surface water discharges. Certain Federal programs, including the Safe Drinking Water Act,[29] the federal Resource Conservation and Recovery Act[30] and Uranium Mill Tailings Radiation Control Act of 1978[31] regulate specific, narrowly defined activities potentially relevant to hardrock mines. The federal public lands agencies (i.e., the Forest Service and the BLM) incorporate state groundwater standards into NEPA compliance and mitigation. Nevertheless, as discussed below, since these state programs were devised in the 1990s, even explicit federal incorporation of state groundwater standards did not provide significant preventative groundwater regulation until, at least 1990. EPA has confirmed this to be true.

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25 5 Am. L. of Mining Section 169.02[2][c] (2d ed.)
26 NAC 445A.350 et seq.
27 See Idaho Groundwater Plan, Section II-C, Senate Bill 1321 (1992).
28 Wash.Rev.Code 43.21.
29 Safe Drinking Water Act, 42 U.S.C Sections 300 et seq.
30 Resource Conservation and Recovery Act, 42 U.S.C. Sections 6901 et seq.
31 Uranium Mill Tailings Radiation Control Act of 1978, 42 U.S.C. Section 7901 et seq.

EPA's assessment of groundwater protection at hardrock mine in 1985 was as follows:

> Ground-water monitoring is difficult, expensive, and has seldom been conducted at mine sites on a comprehensive basis. Because of complex geologic strata (presence of an ore body) and the extensive size of many mine properties, proper ground-water monitoring is technically difficult and costly. Historical practice in the mining industry has not required such monitoring. As a result, there is very little available information in the literature, and almost none on a complete or comprehensive basis. Most mines have no historical or contemporary ground-water monitoring information.

RTC I, p. 6-7 (emphasis in original). In short, as late as 1985 EPA asserts that groundwater protection at hardrock mine sites was virtually nonexistent. Thus, per EPA's own study of the hardrock mining industry, one cannot rationally gauge the current effectiveness of hardrock mine regulation regarding groundwater protection with reference to sites designed and approved before 1985.

Accordingly, in the 1980s, federal regulation hardrock mining for protection of groundwater was limited, and virtually non-existent. This left the subject of groundwater regulation at hardrock mines to the state governments. The Western States stepped-up to manage this area in the 1990s, generally as part of mining specific statutes or regulations, and eventually tied directly to hardrock mine reclamation programs and financial assurance requirements.

5.4 Hardrock Mine Reclamation, Financial Assurances and Water Quality Protection

In 1974, the Forest Service promulgated regulations governing reclamation and performance bonding of hardrock mines on National Forest System Lands.[32] These were some of the first regulations governing Hardrock Mine reclamation promulgated by any agency, federal or state. In 1981, the BLM promulgated the surface management regulations applicable to Mine Plans of Operations ("MPOs") similar in concept to those of the Forest Service. The history of the impact and evolution of these programs is described in greater detail by Northwest Mining Association's "The Evolution of Federal and Nevada State Reclamation Bonding Requirements from Hardrock Exploration and Mining Projects: A Case History Documenting How Federal and State Regulators Used Existing Regulatory Authorities to Respond to Shortcomings in the Reclamation Bonding Program," prepared by Jeffrey V. Parshley and Debra W. Struhsacker, January 2008. That study documents federal and state interagency and industry cooperation by which hardrock mine regulation worked to create the currently effective hardrock mine regulation in Nevada; however, a similar history is reflected in most of the western mining states, as discussed above.

[32] 36 CFR Part 228 (2016).

However, hardrock mine regulation is certainly not only about the Forest Service and the BLM. The Western States have regulated hardrock mining for decades. For example, both Idaho and Colorado had mined land reclamation programs that dated back to the 1970s. Initially these programs, like those of the Forest Service and the BLM focused on regrading and revegetation of mined lands, and not on surface water quality and certainly not ground water protection. Indeed, initially, the Forest Service deferred protection of surface water to EPA enforcement of the Clean Water Act and EPA oversight of delegated state Clean Water Act programs, which gave rise to two of the most notorious hardrock mine regulatory failures during the Transition Era (1970-1990), specifically Summitville, Colorado and Zortman, Montana. Thus, it became clear to the BLM, the Forest Service and the Western States that closure, reclamation, post-mining land uses and water quality had to be integrally-related and "bonds" posted.

Accordingly, the current reclamation bonding programs are working very well. Not only are Regulated Hardrock Mines (i.e., post-1990) avoiding EPA CERCLA National Priorities List, but even more importantly, existing financial assurances (federal and state) are avoiding public liability, even when defaults have occurred. For example, in the co-authors' home states of Idaho and Nevada, there has never been a Hardrock Mine that was approved and for which financial assurances were posted that defaulted on the financial assurances such that the Mine was not closed and reclaimed in accordance with: (1) the reclamation/closure plan approved by the relevant federal and/or state agencies; and (2) the financial assurances retained by the agencies. This is discussed in greater detail below.

In Idaho, two relatively large hardrock mines in Idaho defaulted on their bonds in the 1990s such that the public agencies had to rely on financial assurance monies to close and reclaim the properties. Even though both mines dated from the Transition Era (i.e., pre-1990), in both situations (specifically, Dakota Mines-Stibnite and Black Pine), the bond amounts proved to be adequate. Interestingly, these two mines had been identified by Earthworks' (one of the CERCLA 108(b) plaintiffs) as being insufficiently bonded.[33] Earthworks was wrong, by a factor of ten. More specifically, Earthworks' stated that adequate bonding for each of these mines would be about $50,000 per acre; in fact, Dakota Stibnite and Black Pine were closed and reclaimed for $2,710 per acre and $7,383 per acre respectively.[34] In short, it is objectively demonstrable that any factual assertions by Earthworks are insufficiently grounded to be given serious consideration in any EPA rulemaking.

Nevada has the nation's largest and arguably the most successful state hardrock mine environmental closure and reclamation program. In part because it started later, Nevada developed water quality protection and land reclamation into an integrated and "bonded" hardrock mine program, essentially from the beginning. Nevada's "Mining Facilities" regulations protecting waters of the state (surface and groundwater) were promulgated in 1989, and then in 1990 the Nevada legislature passed the Nevada Reclamation Act. In

[33] Letter, Baird Hanson William LLP to USFS Salmon-Challis Nation Forest, May 24, 2007

[34] Thus, Earthworks and their NGO colleagues have been are fully informed of the adequacy of existing hardrock mine financial assurances for 20 years.

the mid-to-late 1990s, two permitted mines (Goldfields and Mt. Hamilton) defaulted on their "bonds," which were adequate but not immediately available for necessary water system management. This prompted voluntary efforts on the part of the Nevada mining industry to act to prevent any interim spills and this caused the Nevada Mining Association to seek a change in Nevada law to allow for immediate NDEP access to "fluid management bonding." This problem has never recurred.

Thus, every Idaho and Nevada hardrock mine (including those that have been in default) that was approved and subject to financial assurances has been closed and reclaimed in accordance with: (1) the reclamation/closure plan approved by the relevant federal and/or state agencies; and (2) the financial assurances retained by the federal and/or state agencies.

Once states and/or federal land management agencies (i.e., the Forest Service and the BLM) integrated mine reclamation with surface water and ground water protection, geochemical prediction and financial assurance for such activities and related predictions, the chances of such facilities replicating the problems that arose in the Pre-Regulatory Era (Per-1970) became essentially impossible to duplicate ... and, indeed, such problems have not been recreated to date.

Thus, certain Transition Era (1970 through about 1990) hardrock mines created problems. There is no question there has been a "learning curve." State agencies began to create active groundwater management programs regulating hardrock mines that might impact ground water. And, the Forest Service and the BLM began to work in concert with the relevant states, as all parties sought to incorporate comprehensive surface and groundwater protection into NEPA planning, Mine Plan of Operation approvals and reclamation bonding programs to create regulatory programs that prevented the creation of water pollution in the first place and bonded for such protection from the outset of mining operations. This took time, but it was achieved. And, the most important single element is that since 1990, design, permitting, construction, operation, closure and reclamation of hardrock mines are integrated.

Initially, Western States hardrock mine regulation was limited to regrading and re-vegetation, similar to the early Forest Service and BLM programs. However, after water quality impacts were identified famously at hardrock mines at Zortman and Summitville, then the primary federal land management agencies (i.e., the Forest Service and BLM) shifted from reclamation as a merely regrading and revegetation exercise to comprehensive sustainable surface and ground water quality protection.

5.5 The National Environmental Policy Act of 1970

Nominally, the passage of the National Environmental Policy Act of 1969 (NEPA) was potentially applicable to hardrock mines and therefore could have heralded an immediate major shift in hardrock mine regulatory policy. In fact, initially, it did not. NEPA requires a "proposal" of a "major federal action" (including potentially approval of a

Mine Plan of Operation) "significantly affecting the environment."[35] Thus, NEPA regulation of hardrock mining typically is triggered by the filing of a request for an MPO with the Forest Service, the BLM or the EPA (for an NPDES permit). In fact, in the 1970's and 1980's there was significant state-by-state debate regarding whether the approval of a single hardrock mine constituted a "major" Federal action that was subject to NEPA, but it was not until 1995 that the first hardrock mine Environmental Impact Statement was issued in Nevada. Nevertheless, when it became clear that EPA and state NPDES jurisdiction could not adequately manage surface discharges as stand-alone issues at Zortman and Summitville, the Forest Service and the BLM used their Mine Plan of Operation approval processes to create comprehensive and integrated water quality protection for hardrock mines. Clearly, there were regulatory gaps that had to be addressed. This was part of the learning curve that delayed effective hardrock mine regulation until the 1990s. In fact, regarding current hardrock mine regulation, NEPA EIS evaluation of the environmental impacts and mitigation measures has become a major aspect of any hardrock mine approval with a federal nexus.

Nevertheless, prior to 1990, NEPA had little relevance to hardrock mine regulation.

5.6 Evaluation of the Effectiveness of Hardrock Mine Regulation based upon the Timing of Regulatory Developments

The above discussion provides a short jurisdictional history of the regulation of hardrock mining. To briefly summarize, there was literally no regulation and therefore no regulatory consideration of the environmental impacts of hardrock mining prior to 1970, so any site designed and constructed prior to this date provides no information about the effectiveness of hardrock mine regulation. NEPA was signed into law in 1970, but NEPA required other federal authorities and case law to be interpreted before NEPA could be implemented at hardrock mines. Accordingly, it is misleading, disingenuous, and certainly "arbitrary and capricious" to evaluate environmental issues associated with hardrock mines designed and operated prior to 1970 as examples of current hardrock mine regulation.

EPA's hardrock mine NPDES program was not published until 1982, and took years after that to properly implement the program. As discussed above, federal agencies were generally precluded from infringing upon state control of groundwater, and groundwater programs regulating hardrock mines were largely the product of the 1990s. Thus, it was not until the 1990s that federal and state agencies began to comprehensively address the water quality issues associated with hardrock mining.

EPA confirms this state of affairs when it stated in 1985 that:

> During active site life, during closure, and in the post-closure period, facilities could employ engineering controls to prevent erosion, to keep leachate out of the ground water, or to remove contaminants introduced into ground water. However, EPA data on management methods at mining

[35] American Law of Mining, Section 167.02.

> facilities indicate that only a small percentage of mines currently monitor their ground water, use run-on/runoff controls or liners, or employ leachate collection, detection, and removal systems. EPA has not determined the circumstances under which these waste measures would be appropriate at mine waste and mill tailing disposal sites.

RTC I, p. ES-10. It is only after 1990 that the lessons learned from the 1970 to 1990 Transition Era began to be more fully incorporated in the mine regulatory processes. Thus, it has only been in the last 20 years that hardrock mine permitting has first begun to more fully evaluate, predict and regulate long term water quality impacts.

The bi-partisan Western Governors' Association has characterized the situation as follows:

> ...
>
> 3. While older mines in western states have sometimes had harmful impacts on adjacent waters, the mining industry has improved its operation and reclamation track record in recent decades, to avoid or minimize such impacts.
> 4. Recent decades have also brought heightened attention to the importance of mine reclamation from state regulators across the west. All western states that host hardrock mining industries now have staff dedicated to ensuring that on-going mine operations develop and follow appropriate reclamation plans.

WGA, Policy Resolution 2011-4 (A)(3) and (4).

> All Western states have developed regulatory bonding programs to evaluate and approve the financial assurances required of mining companies. The states have developed the staff and expertise necessary to calculate the appropriate amount of the bonds, based upon the unique circumstances of each mining operation, as well as to make informed predictions of how the real value of current financial assurance may change over the life of mine, even post-closure.

WGA, Policy Resolution 2014-07 ("Bonding for Mine Reclamation"). In fact, the "bottom line" on the adequacy of hardrock mine regulation is fairly simple. Until changing societal cultural norms regarding environmental protection and Hardrock Mine regulation began to be implemented by federal and state regulatory agencies environmental problems arose. Since 1990 after federal and state agencies began paying attention with a degree of technical experience, the EPA has yet to designate even a single Western hardrock mine site to the National Priorities List.

The key to effective hardrock mine regulation is that there is *some* form of evaluation and planning. Neither the goals, nor the science, are that difficult to implement. It takes planning and application of existing knowledge. Almost all of the hardrock mines giving rise environmental problems on the CERCLA NPL arose when environmental goals and planning were nonexistent in the Pre-Regulatory Era (Pre-1970). And, while a few CERCLA NPL problems arose in the Transition Era (1970 through 1990) when practical experience was wholly-lacking, in the Regulatory Era (Post-1990) there have been no

Western hardrock mine sites that EPA has deemed to be a sufficient problem to require nomination to the National Priorities List.

6.0 Conclusion

The federal and state regulation of hardrock mining and milling facilities is a remarkable success story of changing law and policy environmental protection that is well-illustrated by the vintage of hardrock mines on the United States Environmental Protection Agency ("EPA") National Priorities List of environmental cleanup sites. To briefly summarize, there has never been an environmental problem at a Western hardrock mine that was approved by a federal or state agency in the West after 1990 that has required EPA to make such hardrock mine a Superfund "top priority among known response targets." To reiterate, no hardrock mine permitted in the West after 1990 has ever been placed on EPA's Superfund National Priorities List.

Current hardrock mine regulation on federal lands managed by the United States Forest Service and the Bureau of Land Management has been determined to be "complicated, but generally effective" by the federal government's independent National Academy of Sciences National Research Council in 1999. In 2011, Senator Murkoswki's investigation of the BLM and Forest Service mine regulation experience verified and updated the 1999 NAS/NRC determination. And, the Bi-partisan Western Governors' Association has stated that the Western states, which regulate Hardrock Mining on state and private lands within their borders "... impose permit conditions and stringent design and operating standards, to ensure that hardrock mining operations are conducted in a manner that is protective of human health and the environment" and that Western "... states have developed the staff and expertise necessary to calculate the appropriate amount of the bonds, based upon the unique circumstances of each mining operation, as well as to make informed predictions of how the real value of current financial assurance may change over the life of mine, even post-closure." WGA, Policy Resolution 10-16, Background (A)(8) ("National Minerals Policy"). Moreover, all programs of the federal and state agencies have continued to strengthen their reclamation and bonding programs on an ongoing basis.

The above-described regulatory success story is a direct result of society's change in values both outside of, and within, the hardrock mining industry to seek protection of the environment, not just to creates jobs, industrial production and tax revenue. Hardrock mines designed and built prior to 1970 were developed to maximize production and minimize cost with little or no regard for environmental values. After 1990, new hardrock mines have been designed, built and operated to integrate long-term environmental closure and reclamation as a primary design standard, as required by current law.

The above-described changes in values, law, design, permitting, operation closure and reclamation have had a major impact on the adequacy of financial assurances posted pursuant to routine individual financial assurances on a mine by mine basis. Using the co-authors' home states as examples, there has never been an Idaho or Nevada hardrock

mine for which financial assurances were posted that defaulted on the bonding such that the hardrock mine was not closed and reclaimed in accordance with: (1) the reclamation/closure plan approved by the relevant federal and/or state agencies; and (2) the financial assurances retained by the agencies. Thus, objectively, the existing regulation of hardrock mines is protecting the environment from releases and protecting public treasuries through posting of adequate financial assurances.

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MEMORANDUM

TO: Mr. Joe Baird – Baird Hanson LLP

FROM: Mr. Richard DeLong RFD

DATE: May 15, 2015

SUBJECT: Assessment of Mining and Milling Site on the National Priorities List

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At your request, Enviroscientists, Inc. (Enviroscientists) completed an assessment of the United States Environmental Protection Agency's (EPA's) National Priorities List (NPL) for Mining and Milling Sites (MMS). A search of the NPL was completed on April 21, 2015. See Attachment A for a printout of the list. In addition, a compact disk (CD) with the searchable excel version of the printout is included with is memorandum.

There are over 1,100 sites on the NPL. Of those, there are 100 that the EPA has classified as MMS. However, only 55 of those sites are actual mining operations where mineral resources were extracted from the earth. The other 45 are mineral processing facilities where a mineral product is delivered to the operation for further processing. The 55 "Hardrock Rock" MMS on the NPL fall into the following temporal classifications: 49 are prior to 1970; five are from 1970 through 1990; and one is post-1990. The one operation that was permitted and began operations post-1990 is the Barite Hill property in South Carolina. The operation was an open pit heap leach mine that ceased operation in 1995 and reclamation was completed in 1995 to 1999.

ATTACHMENT A

MAY 2013 VERSION OF THE MINING AND MILLING SITES ON THE NATIONAL PRIORITY LIST

Table 1

Summary - Mining and Milling Sites on the National Priorities L
Source: EPA AML - Status = "Final" as of May 2013 Update (list check April 21, 2

The EPA AML program defines AMLs as:

"Those lands, waters, and surrounding watersheds contaminated or scarred by extraction, beneficiation or processing of ores and minerals, including phosphate but not coal". Abandoned mine lands include areas where mining or processing activity is temporarily inactive."

	Site Name	EPA Region	State	Year Start	Year End	Year End	Design/Approval 1 - pre 1970 2 1970 - 1989 3 - 19 and later	Mining/Milling or Other Processing	Type of Activity	Minerals	NPL Status	Site/CERCLIS ID Number
1	CALLAHAN MINING CORP	1	ME	1880's	1972	1972	1	M	Mining/milling (Open pit mine)	Zinc/copper	Final	MED980524128
2	ELIZABETH MINE	1	VT	early 1800s	1958	1958	1	M/O	Mining; copper smelting	Copper	Final	VTD988366621
3	ELY COPPER MINE	1	VT	1821	1920	1920	1	M/O	Mining/cobbing/roasting/smelting; (removal of ore)	Copper	Final	VTD988366571
4	PIKE HILL COPPER MINE	1	VT	1847	1919	1919	1	M	Mining	Copper	Final	VTD988366720
5	LI TUNGSTEN CORP.	2	NY	1940's	1984	1984	1	O	Processing (Received tungsten ore's for processing).	Tungsten	Final	NYD986882660
6	MAYWOOD CHEMICAL CO.	2	NJ	1916	1955	1955	1	O	Processing (radioactive thorium ore).	Thorium	Final	NJD980529762
7	SHIELDALLOY CORP.	2	NJ	1955	2006	2006	1	O	Processing (discharge to unlined pits prior to 1970 enforcement actions).	Chromium alloy	Final	NJD002365930
8	U.S. RADIUM CORP.	2	NJ	1915	1926	1926	1	O	Processing/Tailings	Radium	Final	NJD980654172
9	W.R. GRACE & CO., INC./WAYNE INTERIM STORAGE SITE (USDO	2	NJ	1948	1971	1971	1	O	Processing/extraction	Monazite ore (thorium/rare earths)	Final	NJ1891837980
10	FOOTE MINERAL CO.	3	PA	1942	1991	1991	1	O	Processing/Manufacture of metal products	Lithium	Final	PAD077087989

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11	FRANKLIN SLAG PILE (MDC)	3	PA	1950's	1999	1999	1	O	MDC Industries sold the processing slag as sand blasting grit for 40 years. MDL Abandoned site 12/30/1999. Franklin Smelting and Refining Co smelting the ore. (lead contamination)	Copper	Final	PASFN0305549
12	JACKS CREEK/SITKIN SMELTING & REFINING, IN	3	PA	1958	1977	1977	1	O	Smelting processing and precious metals reclamation	Precious metals	Final	PAD980829493
13	PALMERTON ZINC PILE	3	PA	~1912	1982	1982	1	O	Smelting processing (NJ Zinc Co.)	Zinc	Final	PAD002395887
14	U.S. TITANIUM	3	VA	1931	1971	1971	1	O	Refining processing titanium ore/Titanium dioxide manufacturing	Titanium	Final	VAD980705404
15	BARITE HILL/NEVADA GOLDFIELDS	4	SC	1991	1995	1995	3	M	Mining (gold plant, heap leach)	Gold, Silver	Final	SCN000407714
16	BREWER GOLD MINE	4	SC	1828	1995	1995	1,2	M	Mining - CN heap leach pad 1987 - 1995.	Gold	Final	SCD987577913
17	MACALLOY CORPORATION	4	SC	1941	1998	1998	1	O	Ferrochromium alloy processing plant	Ferrochromium	Final	SCD003360476
18	NATIONAL SOUTHWIRE ALUMINUM CO.	4	KY	1969	active	active	1	O	Aluminum processing (north pond)	Aluminum	Final	KYD049062375
19	ORE KNOB MINE	4	NC	1850s	1962	1962	1	M	Mining, roasting, smelting	Copper	Final	NCN000409895
20	STAUFFER CHEMICAL CO. (TARPON SPRINGS)	4	FL	1950	1981	1981	1	O	Processed elemental phosphorous from phosphate ore.	Phosphate	Final	FLD010596013

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21	ASARCO TAYLOR SPRINGS	5	IL	1911	active	active	1	O	Zinc smelting/Processing zinc oxide	Zinc	Final	ILN000508170
22	DEPUE/NEW JERSEY ZINC/MOBIL CHEMICAL CORF	5	IL	1903	1990	1990	1	O	Zinc smelting/Processing/Phosphate fertilizer	Zinc	Final	ILD062340641
23	EAGLE ZINC CO DIV T L DIAMOND	5	IL	1923	2003	2003	1	O	Processing/zinc smelting	Zinc/Cadmium	Final	ILD980606941
24	HEGELER ZINC	5	IL	1906	1954	1954	1	O	Zinc smelter/Processing	Zinc	Final	ILN000508134
25	MATTHIESSEN AND HEGELER ZINC COMPAN'	5	IL	1858	1978	1978	1	O	Zinc Smelter (smelter closed 1961)/ Processing	Zinc	Final	IL0000064782
26	ORMET CORP.	5	OH	1956	2005	2005	1	O	Aluminum reduction (unlined pits closed 1981)/ Processing	Aluminum	Final	OHD004379970
27	TORCH LAKE	5	MI	1890	1969	1969	1	M	Mining (copper mines dumped tailings into lake).	Copper	Final	MID980901946
28	U.S. SMELTER AND LEAD REFINERY, INC	5	IN	1920	1985	1985	1	O	Smelter/Processing	Lead	Final	IND047030226
29	CHEVRON QUESTA MINE (MOLYCORP)	6	NM	1920	Active (underground blockcave 1983 to present)	active	1,2	M/O	Mining/Milling	Molybdenum	Final	NMD002899094
30	CIMARRON MINING CORP.	6	NM	1960	1982	1982	1,2	O	Milling	Iron; Precious metals	Final	NMD980749378
31	HOMESTAKE MINING CO.	6	NM	1958	1990	1990	1	O	Milling	Uranium	Final	NMD007860935

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32	TAR CREEK (OTTAWA COUNTY)	6	OK	1850	1970s	1970	1	M	Mining district	Iron, Zinc	Final	OKD980629844
33	TEX-TIN CORP.	6	TX	1941	1989	1989	1	O	Smelter/Processing	Tin, Copper	Final	TXD062113329
34	TULSA FUEL AND MANUFACTURING	6	OK	1914	1925	1925	1	O	Smelter/Roaster/Processing	Zinc/lead	Final	OKD987096195
35	UNITED NUCLEAR CORP.	6	NM	1967	1986	1986	1,2	M/O	Mining/Processing/milling	Uranium	Final	NMD030443303
36	ANNAPOLIS LEAD MINE	7	MO	1920	1940	1940	1	M	Mining	Lead	Final	MO0000958611
37	BIG RIVER MINE TAILINGS/ST. JOE MINERALS CORP.	7	MO	1700's	1972	1972	1	O	Tailings disposal for lead mining	Lead	Final	MOD981126899
38	CHEROKEE COUNTY	7	KS	~1870	1970	1970	1	M	Mining (a/k/a Tri-State mining district)	Lead, zinc	Final	KSD980741862
39	MADISON COUNTY MINES	7	MO	1700's	1970s	1970	1	M	Mining (mining district)	Lead	Final	MOD098633415
40	NEWTON COUNTY MINE TAILINGS	7	MO	~1850s	1950	1950	1	M	Mining (Tri-State Mining District)	Lead, cadmium, zinc	Final	MOD981507585
41	OMAHA LEAD	7	NE	1870s	1996	1996	1	O	Smelting/Processing	Lead	Final	NESFN0703481

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	Site Name	EPA Region	State	Year Start	Year End	Year End	Design/Approval 1 - pre 1970 2 - 1970 - 1989 3 - 19[illegible] and later	Mining/Milling or Other Processing	Type of Activity	Minerals	NPL Status	Site/CERCLIS ID Number
42	ORONOGO-DUENWEG MINING BELT	7	MO	1848	late 1960s	1957	1	M	Mining (Tri-State Mining District)	Lead, cadmium, zinc	Final	MOD980686281
43	SOUTHWEST JEFFERSON COUNTY MINING	7	MO	early 1800s		1975	1	M/O	Historic mining district, smelting	Lead, zinc, barium	Final	MON000705443
44	WASHINGTON COUNTY LEAD DISTRICT - FURNACE CREEK	7	MO	1799	1980s (historic)	1980	1	M/O	Mining, milling, smelting	Lead, barite (barite 1926 - 1980s)	Final	MON000705842
45	WASHINGTON COUNTY LEAD DISTRICT - OLD MINES	7	MO	1700s		1980	1	M/O	Mining, milling, smelting			MON000705027
46	WASHINGTON COUNTY LEAD DISTRICT - POTOSI	7	MO	1700s		1980	1	M/O	Mining, milling, smelting			MON000705023
47	WASHINGTON COUNTY LEAD DISTRICT - RICHWOODS	7	MO	1700s		1980	1	M/O	Mining, milling, smelting			MON000705032
48	ACM SMELTER AND REFINERY	8	MT	1892	1972	1972	1	O	Smelting, refiningProcessing	Copper, zinc	Final	MTD093291599
49	ANACONDA CO. SMELTER	8	MT	late 1800s	1980	1980	1	O	Smelting/Processing	Copper	Final	MTD093291656
50	BARKER HUGHESVILLE MINING DISTRICT	8	MT	1879	1970s	1970	1	M	Mining (only brief activity in 1940s, 1920s, and 1960s)	Silver, lead	Final	MT6122307485
51	BASIN MINING AREA	8	MT	late 1800s	1960s	1960	1	M	Mining (intermitent into 1960s)	Precious metals	Final	MTD982572562

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52	CALIFORNIA GULCH	8	CO	1895 (Yak Tunnel	Early 1980s	1980	1	M	Mining, processing, smelting	Gold, silver, lead, zinc	Final	COD980717938
53	CAPTAIN JACK MILL	8	CO	1860	1992	1992	1	M	Mining, milling	Gold, silver	Final	COD981551427
54	CARPENTER SNOW CREEK MINING DISTRICT	8	MT	1880s	1931	1931	1	M	Mining (last mine closed 1931 with intermittant mining after that)	Silver, lead, zinc	Final	MT0001096353
55	CENTRAL CITY, CLEAR CREEK	8	CO	1880s	active (limited)	2011	1	M	Mining District, any current operations small) (includes Argo Tunnel draining 30+ inactive mines)	Gold	Final	COD980717557
56	DAVENPORT AND FLAGSTAFF SMELTER!	8	UT	1870	1875	1875	1	O	SmeltingProcessing	Lead, silver	Final	UTD988075719
57	DENVER RADIUM SITE	8	CO	1915	1920s	1920	1	O	Processing (35 sites of Ra disposal)	Radium	Final	COD980716955
58	EAGLE MINE	8	CO	1880s	1984	1984	1	M	Mining	Gold, silver	Final	COD081961518
59	EAST HELENA SIT	8	MT	1888	2001	2001	1	O	Smelter/Processing	Lead, zinc	Final	MTD006230346
60	EUREKA MILLS	8	UT	1870	1958	1958	1	M/O	Mining and Milling	Gold, silver, lead, copper, arsenic	Final	UT0002240158
61	FLAT CREEK IMM	8	MT	1909	1953	1953	1	M/O	Mining and Milling	Silver, gold, copper, zinc, iron	Final	MT0012694970

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62	GILT EDGE MINE	8	SD	1876	1998	1998	1,2	M	Mining (1986 DENR permit for open pit with CN heap leach operations).	Gold, copper, tungsten	Final	SDD987673985
63	INTERNATIONAL SMELTING AND REFINING	8	UT	1910	1972	1972	1,2	O	Smelter/Processing	Copper, lead, zinc	Deleted (10/11/2011	UTD093120921
64	JACOBS SMELTER	8	UT	1870s	1970	1970	1	O	Smelting/Processing	Silver	Final	UT0002391472
65	LIBBY ASBESTOS SITE	8	MT	1920 - start of large scale minin	1990	1990	1	M	Mining	Vermiculite	Final	MT0009083840
66	LINCOLN PARK (Cotter Mill, Canyon City, Colorado)	8	CO	1958		1979	1	O	Milling	Uranium, vandadium	Final	COD042167858
67	MIDVALE SLAG	8	UT	1871	1971	1971	1	O	Smelting/MillingProcessing	Lead, copper	Final	UTD081834277
68	MILLTOWN RESERVOIR SEDIMENTS/Clark Fork	8	MT	1870s	1980	1980	1,2	M	Mining and Smelter (possible source of As also could be landfill as source) (120 miles of sediments above reservoir)	Copper	Final	MTD980717565
69	MONTICELLO MILL TAILINGS (USDOE)	8	UT	1942	1960	1960	1	M	Milling	Vanadium, uranium	Final	UT3890090035
70	MOUAT INDUSTRIES	8	MT	late 1950s	1973	1973	1	O	Processing	Chromium	Final	MTD021997689

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71	NELSON TUNNEL/COMMODORE WASTE ROCK	8	CO	1899	1985 (historic hard rock mine)	1985	1,2	M	Mining	Silver, lead, zinc	Final	CON000802630
72	SILVER BOW CREEK/BUTTE AREA	8	MT	~1870s	1963	1963	1	M	Mining, milling and smelting (contamination of 24 stream miles by industrial, ag, and municipal)	Copper	Final	MTD980502777
73	STANDARD MINE	8	CO	1874	1974	1974	1	M	Mining	Silver	Final	CO0002378230
74	SUMMITVILLE MINE	8	CO	1870	1992	1992	1,2	M	Mining (1984 - CN Heap Leach)	Gold, silver	Final	COD983778432
75	U.S. MAGNESIUM	8	UT	1972	Active	2013	1,2	O	Processing	Magnesium (from brine)	Final	UTN000802704
76	UPPER TENMILE CREEK MINING AREA	8	MT	1870	1930s	1930	1	M	Mining district	Gold, lead, zinc, copper	Final	MTSFN7578012
77	URAVAN URANIUM PROJECT (UNION CARBIDE CORP.)	8	CO	1912	1984	1984	1,2	O	Processing	Radium, uranium, vandaium	Final	COD007063274
78	VASQUEZ BOULEVARD AND I-70	8	CO	1870s	1950s	1950	1	O	Smelting (smelting center for Rocky Mountain west)/ Processing	Gold, silver, copper, lead, zinc	Final	CO0002259588
79	ATLAS ASBESTOS MINE	9	CA	1963	1979	1979	1	M/O	Mining/Mill	Asbestos	Final	CAD980496863

Table 1

Summary - Mining and Milling Sites on the National Priorities L
Source: EPA AML - Status = "Final" as of May 2013 Update (list check April 21, 2

The EPA AML program defines AMLs as:

"Those lands, waters, and surrounding watersheds contaminated or scarred by extraction, beneficiation or processing of ores and minerals, including phosphate but not coal*. Abandoned mine lands include areas where mining or processing activity is temporarily inactive."

	Site Name	EPA Region	State	Year Start	Year End	Year End	Design/Approval 1 - pre 1970 2 1970 - 1988 3 - 19 and later	Mining/Milling or Other Processing	Type of Activity	Minerals	NPL Status	Site/CERCLIS ID Number
80	CARSON RIVER MERCURY SITE	9	NV	late 1800s	~1950s (sporadic small mining after this)	1950	1	O	Milling(multiple mills (75) along Carson River; used Hg amalgam reactions)	Gold, Silver	Final	NVD980813646
81	IRON KING MINE - HUMBOLDT SMELTER	9	AZ	late 1800s, 1906	1969 (mining, 1960s (smelter)	1969	1	M/O	Mining, smelter/Processing	Lead, gold, silver, zinc, copper	Final	AZ0000309013
82	IRON MOUNTAIN MINE	9	CA	1860s	1963	1963	1	M	Mining	Silver, gold, coper, zinc, iron	Final	CAD980498612
83	KLAU/BUENA VISTA MINE	9	CA	1868	1970	1970	1	M/O	Mining, milling	Mercury	Final	CA1141190578
84	LAVA CAP MINE	9	CA	1861	1943	1943	1	M	Mining (historical CN plant)	Gold, silver	Final	CAD983618893
85	LEVIATHAN MINE	9	CA	1860s	1962	1962	1	M	Mining	Sulfur	Final	CAD980673685
86	SULPHUR BANK MERCURY MINE	9	CA	1865	1957	1957	1	M	Mining	Sulfur, mercury	Final	CAD980893275
87	BLACK BUTTE MINE	10	OR	1890	1960s	1960	1	M	Mining	Mercury	Final	OR0000515759
88	BUNKER HILL MINING & METALLURGICAL COMPLEX	10	ID	1880s	1981	1981	1	M/O	Mining, milling, smeltingProcessing	Lead, zinc	Final	IDD048340921
89	COMMENCEMENT BAY, NEAR SHORE/TIDE FLATS	10	WA	1890s	1985 (smelter closed)	1985	1	O	Smelter (also pulp mill, and chemical industries)/ Processing	Lead, copper	Final	WAD980726368

Table 1

Summary - Mining and Milling Sites on the National Priorities L

Source: EPA AML - Status = "Final" as of May 2013 Update (list check April 21, 2

The EPA AML program defines AMLs as:

"Those lands, waters, and surrounding watersheds contaminated or scarred by extraction, beneficiation or processing of ores and minerals, including phosphate but not coal". Abandoned mine lands include areas where mining or processing activity is temporarily inactive."

	Site Name	EPA Region	State	Year Start	Year End	Year End	Design/Approval 1 - pre 1970 2 1970 - 1989 3 - 19 and later	Mining/Milling or Other Processing	Type of Activity	Minerals	NPL Status	Site/CERCLIS ID Number
90	EASTERN MICHAUD FLATS CONTAMINATION	10	ID	1944	Active	2013	1	O	Processing	Phosphate	Final	IDD984666610
91	FORMOSA MINE	10	OR	1910	1937	1993	1	M	Mining	Copper, zinc, thorium	Final	ORN001002616
92	FREMONT NATIONAL FOREST/WHITE KING AND LUCKY LASS URANIUM MINES (USDA)	10	OR	1955	mid-1960's	1960	1	M	Mining	Uranium	Final	OR7122307658
93	KAISER ALUMINUM (MEAD WORKS	10	WA	1942	Active?	2013	1	O	Processing (Aluminum Reduction) (1942 - 1978 on site disposal of pot linings)	Aluminum	Final	WAD000065508
94	MIDNITE MINE	10	WA	1955	1981	1981	1	M	Mining	Uranium	Final	WAD980978753
95	MONSANTO CHEMICAL CO. (SODA SPRINGS PLANT	10	ID	1952	Active	2013	1	O	Processing	Phosphate	Final	IDD081830994
96	REYNOLDS METALS COMPANY	10	OR	1941	2000	2000	1	O	Processing (Primary Aluminum Reduction Plant)	Aluminum	Final	ORD009412677
97	SALT CHUCK MINE	10	AK	1915	1941	1941	1	M/O	Mining/Milling	Gold, silver, copper	Final	AK0001897602
98	TELEDYNE WAH CHANG	10	OR	1957	Active as of 2010	2013	1	O	Processing	Zirconium, rare earths	Final	ORD050955848
99	BLUE LEDGE MINE	9	CA	1904		1930	1	M	Mining	Copper/Zinc	Final	CAN000906063
100	NEW IDRIA MERCURY MINE	9	CA	1854	1970s	1970	1	M/O	Mining/Processing	Mercury	Final	CA0001900463

TESTIMONY FOR SEPTEMBER 7, 2017, HEARING ON LEGISLATION TO OVERTURN MORATORIUM

My name is Al Christianson. I have been Ladysmith City Administrator for over 30 years, so saw the Flambeau Mine come and go. At work I was very involved with the mine. Outside of work I am a hobby forester and live in a largely passive solar home along the Flambeau River. I spend most of my free time in Rusk County's beautiful "blue hills". I consider myself environmentally friendly. I don't want to despoil anything. I love this area. I want to remain here, but I also want it to be possible for my children to have the economic option to remain here. I also want to take my share of responsibility for procurement of the metals we all use in our daily lives. Not depend on getting these metals from places where there are few, if any, environmental safeguards.

What stands out for me about the Flambeau Mine is that, during mining and for about a decade after, three local governments, working together, were able to use about $10 million in mining revenues to avoid the boom bust cycle that had historically been associated with mining. When these monies started to become available Ladysmith had some major industrial complexes that had been taken by tax title and Rusk County was in a bad way economically. About ten economic development projects were devised over the next few years which, between them, saved or added about 600 jobs to the local economy. About 8.5 times the number the mine had employed. The first of these involved rehabilitation of some decrepit and contaminated manufacturing facilities that had been empty for years. They were restored to operating condition and outfitted with new functional systems. Even though these initial projects were undertaken on a speculative basis, a ready market was found for this reclaimed space. When they were sold or leased and a demand remained, the next logical step was to construct new space. This was done and one firm, which employed over 100, relocated within the community rather than across the State as it had planned.

Despite those gains, however, Ladysmith and Rusk County were hit hard by the Great Recession and have struggled a great deal since. Because our economy was dominated by two large window plants that are part of the housing industry. So it is that our area has gone from what I'd call economic normalcy in the decade after mining to a slow decline now. Besides the recession, this has to do with outmigration of an already vastly smaller population of young folks now that the baby boomers look like me. We aren't alone as this same problem is apparent across much of the northern third of the State. While agriculture and timber remain important here both continue to mechanize. To stem the out-migration, we need better paying jobs to reverse our economic fortunes. Mining is an industry that has been of great importance here in the past and it can be again. There are at least 20 documented metallic mineral deposits across the northern tier of counties. Most within proximity of the Highway 8 corridor. We at least need to make it possible to consider mining these deposits in view of our laws; some of the most stringent laws in the world.

Isn't it ironic that a badger sits atop the crest on our State flag over there? That we are known as the Badger State because of our early mining history, but it isn't possible to even consider metallic mineral mining in Wisconsin today under the moratorium that is here sought to be replaced. That we are sandwiched between Michigan and Minnesota where such consideration is at least possible.

Last, but not least, where are the issues with the Flambeau Mine that some talk about? Per a requirement contained in the Local Agreement that was negotiated and adopted in 1988 I have, since that time and to this day, received copies of all correspondence between Flambeau Mining and WDNR. If there were significant issues I would know about them would I not? Ask the people of Ladysmith what they know. Many will probably tell you they know there was a mine, but likely won't know a whole lot more. Some won't even know where it was. The students who started another year in this building two days ago will probably learn about the Flambeau Mine in history class, if at all, as it was closed before they were born. Those are good things. That means the Flambeau Mine went well. It went very well.

American Exploration &
Mining Association

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P. 509.624.1158 | F. 509.623.1241
info@miningamerica.org | www.miningamerica.org

Testimony of Laura Skaer
Executive Director
American Exploration & Mining Association
In Support of Senate Bill 395

Senator Tiffany, Representative Hutton and members of the Committee, my name is Laura Skaer, and I am the Executive Director of the American Exploration & Mining Association (AEMA), headquartered in Spokane, Washington, a position that I have held for more than 20 years. AEMA is a 122-year-old, 2,000 member, national association representing primarily the hardrock mining industry with members residing in 42 U.S. states, including Wisconsin, seven Canadian provinces or territories and 10 other countries. AEMA is the recognized national voice for exploration, the junior mining sector and maintaining access to public lands and represents the entire mining lifecycle from exploration to reclamation and closure. Our broad-base membership ranges from exploration geologists and small miners to the largest mineral producers in the country.

AEMA was formerly known as the Northwest Mining Association, and in October, 1998, became the first U.S. mining trade association to adopt a Statement of Environmental Principles. Those principles are attached to this testimony. I would like to highlight three of the nine principles.

- That from project inception through closure, potential environmental impacts should be comprehensively identified, and appropriately evaluated, managed and mitigated;

- That environmental protection not just compliance with statutory and regulatory requirements should be the goal, and that technically and economically sound improvement in environmental performance should continually be sought and implemented;

- That the understanding should be promoted through educational programs and other means, within and beyond the mining industry, that mining and environmental protection are compatible, and that mineral products make possible both the development of our society and the mitigation of modern society's impact on the environment.

While we were the first mining association to adopt environmental principles, today, these principles guide every aspect of mining from exploration through development, construction, operation and closure.

I am appearing today to testify in support of Senate Bill (SB) 395, especially the repeal of WIS. STAT. §293.50, the Mining Moratorium section.

We have a history with this provision of Wisconsin law. In 1997, I participated in a conference in Milwaukee entitled *Environmentally Responsible Mining: The Technology, The People, The Commitment.* The conference demonstrated that modern mining is environmentally responsible mining. Our Association also opposed the Mining Moratorium provision when it was debated and adopted in 1998. Nicolet Minerals was a member and we supported their efforts. The Moratorium was unnecessary then and even more antiquated and unnecessary now.

Two of our members prepared the report that was filed on behalf of Nicolet Minerals to meet the unnecessary requirements of the law. Repealing the Mining Moratorium allows each mine to be evaluated on its own merits, as was the case when the Flambeau Mine was originally permitted. It also is the case in every state that has mining operations from sulfide ore bodies as well as the two federal land management agencies, the Bureau of Land Management (BLM) and the United States Forest Service (USFS). No other jurisdiction or regulatory body in the U.S. or Canada bans mining from sulfide ore bodies. A ban is unnecessary because if a mining company can't demonstrate that its mine plan will comply with all applicable environment laws and regulations, then it won't receive a permit; and that is how we strongly believe it should be.

The Mining Moratorium is unnecessary to protect Wisconsin waters and the environment, and it certainly does not help grow the Wisconsin economy. Wisconsin's stringent water quality standards and reclamation requirements combined with modern mining technology and practices will protect the environment.

Wisconsin has a rich mining history dating back to the 1820s. Environmental regulation of mining, like any other industrial activity, did not begin until the late 1960s and early 1970s with the adoption of the National Environmental Policy Act (NEPA), the Clean Water Act (CWA), the Clean Air Act (CAA) and other environmental statutes. In other words, there was more than 140 years of mining in Wisconsin and the United States prior to the enactment of the first environmental law. As the attached White Paper, *How Changing Values and Changing Law Caused Hardrock Mines to Design, Build and Operate for Long-term Closure and Reclamation: a Federal and State Regulatory Success Story* documents, the development and evolution of federal and state programs for hardrock mining and milling facilities is a success story of environmental protection. Since 1990, the BLM and the USFS have approved more than 3,300 mine plans of operation, and none of those mines are on the U.S. Environmental Protection Agency's National Priority List (NPL) of environmental cleanup sites.[1] This is in stark contrast to mines designed and built prior to 1970 when there were no regulatory approvals for such facilities and societal values were much different.

[1] BLM response dated June 21, 2011 and Senator Vilsack response dated July 20, 2011 to a March 8, 2011 letter from Senator Lisa Murkowski (R-AK) which asked how many mining and beneficiation plans of operation has your agency approved since 1990, and how many of those sites have been placed on the CERCLA (Superfund) NPL. The BLM answered 659 and zero. The USFS answered 2,685 and zero.

In 1999, The National Academies of Sciences/National Research Council (NRC) produced a comprehensive report at the request of Congress entitled *Hardrock Mining on Federal Lands* to assess the adequacy of the regulatory framework for hardrock mining on federal lands. The peer-reviewed report found:

> The overall structure of the federal and state laws and regulations that provide mining-related environmental protection is complicated but generally effective.
>
> ...simple: one-size-fits-all" solutions are impractical because mining confronts too great an assortment of site specific technical, environmental and social conditions. Each proposed mining operation should be examined on its own merit....[2]

The development of effective hardrock mine regulation and reclamation did not occur overnight. An important aspect of this development was a major shift in societal values from industrial and manufacturing to a need to protect our environment from industrial and manufacturing pollution. This change in societal values is described in the White Paper and is reflected in our Association's Statement of Environmental Principles and in the robust laws and regulations Wisconsin relies on to protect its own environment.

Hardrock mines designed and built prior to 1970 were developed to maximize production and minimize cost with little or no regard for environmental values. By the mid-1990s, mines were being designed, built and operated for long-term closure and protection of the environment. It was a continual learning process. It is important to highlight this regulatory success story because one cannot rationally use information about environment issues, closure and reclamation costs from hardrock mines designed and approved prior to the 1990s to evaluate today's mining projects. As I recall the debate over the Mining Moratorium, the proponents cited historic, pre-regulation legacy mining issues to support the Moratorium. This is the equivalent of showing a picture of a 1957 Chevrolet Bel Air and stating that it does not have seat belts, air bags, pollution control devices or meet CAFE requirements, and therefore GM should not be allowed to produce new cars in 2017.

Given Wisconsin's strong mine regulatory and financial assurance program, the fact that each hardrock mine is unique in terms of geology, geography and climate, and the fact that modern mines are not on EPA's NPL, it is time to repeal the Mining Moratorium and allow Wisconsin's professional regulators to do their job and examine each new mine proposal on its merits, as the NRC recommended in 1999.

Wisconsin is a state rich in important non-ferrous minerals such as copper, zinc and lead. Mining is an important economic contributor to local communities, states and nationally. Nationwide, metal mining has a direct and indirect contribution to gross domestic product of almost $155 billion. Average wages at hardrock mines across the country are $85,000 plus benefits. These are true generational family wage jobs, especially for rural Wisconsin.

Everything begins with mining. Think about all of the products that make modern life possible -- they all came from a hole in the ground. As our country seeks to rebuild its manufacturing base and repair and restore its aging infrastructure, mining will be essential. The United States

[2] *Hardrock Mining on Federal Lands*, National Academy Press (1999) at Page 5.

currently imports 100% of 20 strategic and critical minerals and is more than 50% import reliant on 43 minerals. Most of these minerals have deposits in the United States, including many in Wisconsin.

Producing minerals in Wisconsin will help reduce America's dependence on foreign sources of minerals, most of which come from China while providing significant economic benefits to the state. But in order to reap the economic benefits of mining, there must be a transparent and fair process for evaluating a mining project on its merits. Today, mining companies will not invest in a project if they are not convinced it can be done economically and safely while protecting the environment. Companies want their projects evaluated with respect to environmental protection in a process that is open and transparent to the public, consistent, and encompasses stringent water quality, air, ecological and land use standards. The U.S. mining industry accepts this and is proud of its record. The industry is only asking that the process be fair, unambiguous and has certainty. This bill will accomplish that by rescinding the Mining Moratorium which is viewed by mining companies, investors and Wisconsin citizens as Wisconsin saying "Wisconsin is not open for business."

Other states such as Minnesota and Michigan have considered similar moratoriums such as Wisconsin's and rejected them. That rejection has proven to be an economic lifesaver for many places in those regions. Those states rightfully trust their regulators to evaluate each project on its merits and assure compliance with all applicable federal and state environmental laws. To this day, the dire predictions of out-of-state anti-mining groups have wholly fallen flat.

We urge you to rescind the Moratorium and allow Northern Wisconsin to benefit from its mineral wealth by passing SB 395.

I will be happy to answer any questions. Thank you very much for this opportunity.

Respectfully submitted,

Laura Skaer

Laura Skaer
Executive Director

WISCONSIN STATE SENATE

Public Hearing

Written Testimony

James Penczykowski
Name

2118 Lakeland Av
Street Address or Route Number

Madison, WI
City/Zip Code

Self
Organization (*if applicable*)

Sept. 7, 2017
Date

SB 395
Subject

Mining

Registering: In Favor ☐ Against ☒

The State of WI should require mine owners prove responsible and safe history of mining elsewhere.

Please return this slip to a messenger promptly.

WISCONSIN STATE SENATE

Public Hearing

Written Testimony

Name: EARL DOUGOVITO

Date: 09-07-2017

Street Address or Route Number: 1212 SHORE DR

Subject: SB 395. Mining Regulation

City/Zip Code: MARINETTE, WI 54143

Organization (if applicable):

Registering: In Favor ☐ Against ☒

Wisconsin has a very long history of environmental protection and conservation, we are the gold standard. Today, through this legislation, we will loosen business requirements and regulations overseeing, verifying, and remedying issues. I believe this is the wrong tact. If state of the art mining practices have improved dramatically, allowing risk of accidents to come down precipitously then "Prove It First" should be no more than a speed bump. Please keep this provision in place.

Water is our richest resource, in the near future good quality and quantity scarce. Establish very tough standards on high capacity wells

Financial responsibility should extend, in time, while a risk of catastrophic accident exists. Provision must be in place to protect public welfare against footing clean up bills.

Please amend SB-395 to keep 'Prove It First' legislation in place, amend other parts to be more stringent, and/or kill this bill.

Please return this slip to a messenger promptly.

WISCONSIN STATE SENATE

Public Hearing

Written Testimony

SARA BAER
Name

9/7/17
Date

28405 STATEHWY 40
Street Address or Route Number

395
Subject

54757
City/Zip Code

Organization (*if applicable*)

Registering: In Favor ☐ Against ☒

FIRST WATER OVER METAL

Please return this slip to a messenger promptly.

Wisconsin State Senate

Public Hearing

Written Testimony

John H. Kraemer
Name

Date

321 Dwight St
Street Address or Route Number

Subject

Chippewa Falls WI 54729
City/Zip Code

Registering: In Favor ☐ Against ☑

Organization (*if applicable*)

All the data shows that the mine is polluting the Flambeau River. So when Tiffany says that this is not so — he's lying — pure and simple.

Please return this slip to a messenger promptly.

WISCONSIN STATE SENATE

Public Hearing

Written Testimony

Name: George W. Thompson

Date: 9-7-17

Street Address or Route Number: PO Box 67

Subject: proposed legislation / Mining

City/Zip Code: Lac du Flambeau, 54538

Organization (*if applicable*): Lac du Flambeau tribe

Registering: In Favor ☐ Against ☒

The lac du Flambeau tribe strongly opposes the legislation and further mining operation within the ceded territories Due to a lack of consultation with the tribe ~~...~~ ~~the~~ of lac du Flambeau.

I'd like to further address the need to increase regulations that ~~...~~ ~~...~~ ensure that contaminated site be ~~...~~ the held ~~to~~ the responsibility of the person who damaged the area.

I'd appreciate the chance for you to establish dialogue with the tribes and hear their concerns

Thank you

George W. T[signature]

Tribal Council

Please return this slip to a messenger promptly.

Water Resources
Explore WI Waters!
Watersheds
Watershed Search!
Project Search!
Water Search!
Great Lakes
Wetlands

Water Condition
Surface Water Viewer
Impaired Search!
2010 Water Quality Report To Congress

Resources
Find DNR Staff
Where You Live
Gateway to Basins
Water Successes
Ecological Landscapes
Wisconsin Waters

Programs
Watershed Management
Fisheries Management
Drinking Water and Groudwater

Impaired Water - Unnamed (Stream C, trib to Flambeau River)

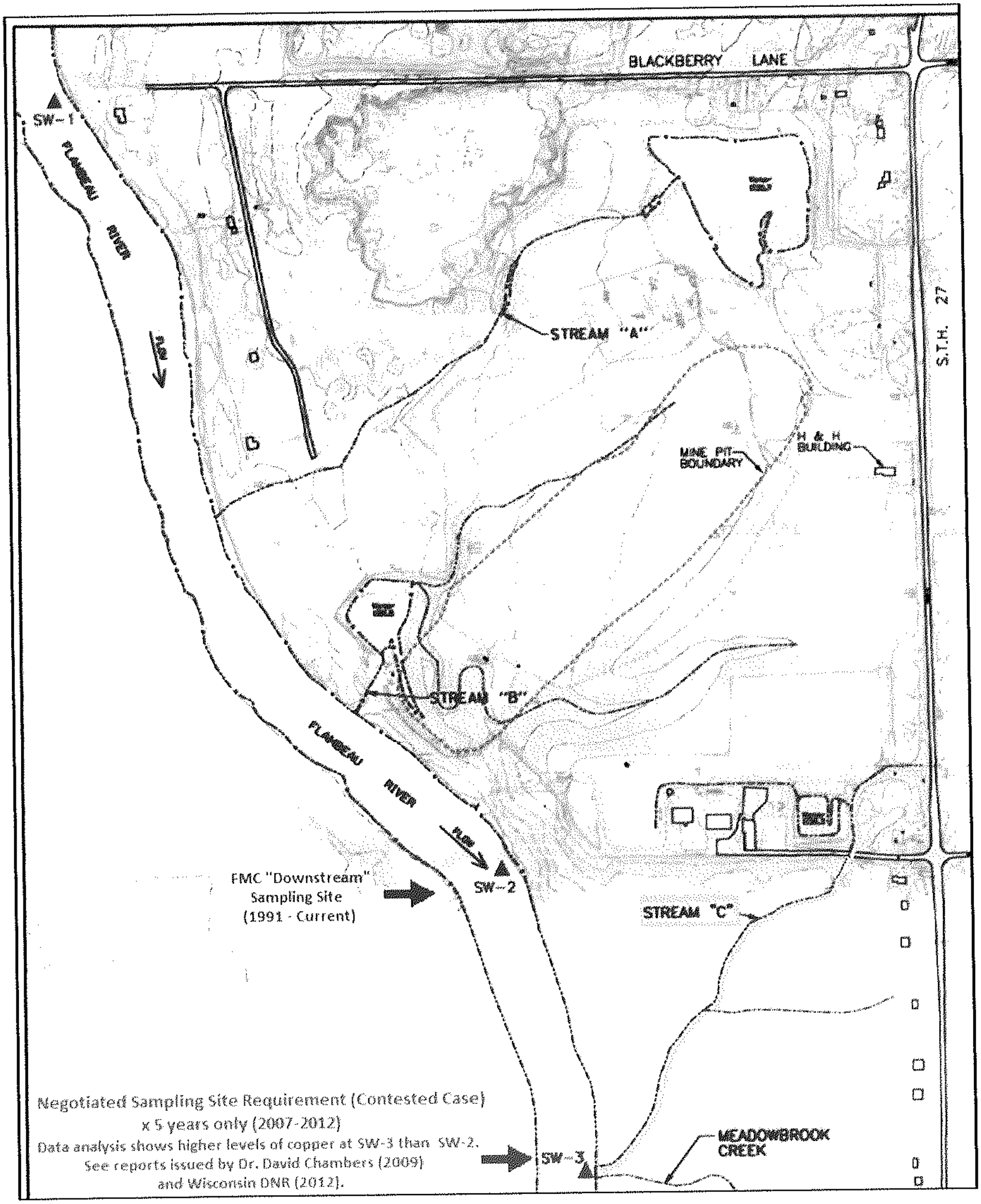
Return to Search

Location	Rusk County, Wisconsin
Watersheds	UC07
Water ID Code	7215137 View Water Details
Lake Acres	0.51
Water Condition	Water is impaired due to one or more pollutants and associated quality impacts.
Notes	

Listing Details

Pollutant	Copper	**Listed For**	Fish and Aquatic Life
Impairments	Acute Aquatic Toxicity	**Current Use**	FAL - Fish and Aquatic Life Community
Listing Status	Proposed for List	**Attainable Use**	FAL - Fish and Aquatic Life Community
Priority	Low	**Designated Use**	FAL - Fish and Aquatic Life Community
303(d) ID	2012-125	**Listing Date**	4/01/2012

Pollutant	Zinc	**Listed For**	Fish and Aquatic Life
Impairments	Acute Aquatic Toxicity	**Current Use**	FAL - Fish and Aquatic Life Community
Listing Status	Proposed for List	**Attainable Use**	FAL - Fish and Aquatic Life Community
Priority	Low	**Designated Use**	FAL - Fish and Aquatic Life Community
303(d) ID	2012-126	**Listing Date**	4/01/2012



BLACKBERRY LANE
SW-1
FLAMBEAU RIVER
FLOW
STREAM "A"
S.T.H. 27
MINE PIT BOUNDARY
H & H BUILDING
STREAM "B"
FLAMBEAU RIVER
FLOW
FMC "Downstream" Sampling Site (1991 - Current)
SW-2
STREAM "C"
Negotiated Sampling Site Requirement (Contested Case)
x 5 years only (2007-2012)
Data analysis shows higher levels of copper at SW-3 than SW-2.
See reports issued by Dr. David Chambers (2009)
and Wisconsin DNR (2012).
SW-3
MEADOWBROOK CREEK

SURFACE WATER QUALITY ASSESSMENT OF THE FLAMBEAU MINE SITE

WISCONSIN DEPARTMENT OF NATURAL RESOURCES
APRIL, 2012

Primary Author: Craig Roesler
Contributors: Phil Fauble, Larry Lynch, Jim Klosiewski, Chris Pracheil, Aaron Larson, Lonn Franson, Roger Bannerman, Tom Aartila, Tom Jerow, Cheryl Heilman, Jim Killian, Jeff Dimick, Jeff Scheirer, Kendal Liebzeit, Ann Coakley, Connie Antonuk

EXECUTIVE SUMMARY

The Flambeau mine was an open pit copper sulfide mine located just south of Ladysmith in Rusk County, Wisconsin. The mine was actively operated between 1993 and 1997 by the Flambeau Mining Company (FMC). 1.8 million tons of ore containing 181,000 tons of copper and 900 tons of zinc were extracted from the mine and passed through the southeast corner of the mine site where Steam C, an intermittent tributary of the Flambeau River, is located. The pit was backfilled by 1998 and surface reclamation took place between 1998 and 2001. Water quality monitoring done at the site between 2002 and 2011 showed that Stream C and its contributing drainageways contained copper and zinc concentrations that frequently exceeded acute toxicity criteria (ATC). On average, copper exceeded ATC's in 92% of samples, and zinc exceeded ATC's in 46% of samples. Results of a bioassay test and the presence of a fish and macroinvertebrate community in Stream C suggest that any potential toxicity is not severe.

Stream C was not monitored prior to mining so a pre and post mining comparison is not possible. Monitoring of the Flambeau River did not show any significant changes in copper and zinc concentrations in response to mining activities. Copper and zinc concentrations in the two intermittent streams in the fully reclaimed areas of the Flambeau mine site were low. A nearby intermittent stream also had low concentrations of copper and zinc. Monitoring results from these three streams indicates that local background concentrations of copper and zinc are generally low.

The southeast corner of the mine site that drains to Stream C was not fully reclaimed and soil sampling by FMC in this area found multiple locations with elevated copper concentrations. Areas with high soil copper concentrations were generally correlated with high runoff water copper concentrations. Past remedial actions taken by FMC to remove or cap soil with high copper concentrations resulted in reduced copper concentrations in runoff water. FMC is currently pursuing additional remedial actions that are likely to result in reductions in copper and zinc concentrations in Stream C.

SURFACE WATER QUALITY ASSESSMENT OF THE FLAMBEAU MINE SITE

INTRODUCTION

The Flambeau mine site comprises 181 acres located in Section 9, T34N, R6W, Rusk County, Wisconsin approximately two miles south of the City of Ladysmith (Figure 1 inset). The Flambeau Mining Company (FMC), a wholly owned subsidiary of the Kennecott Corporation, operated a 32 acre open pit copper sulfide mine at the site between 1993 and 1997. The pit was completely backfilled with waste rock amended with limestone by 1998 and surface reclamation activities continued until 2001.

Surface water monitoring conducted by FMC between 2002 and 2009 showed that Stream C and its contributing drainageways contained copper and zinc concentrations that frequently exceeded acute toxicity criteria (ATC). Stream C is an intermittent stream that drains the southeast corner of the Flambeau mine site including the area known as the Industrial Outlot. This area contained the ore storage, ore crushing, and transport facilities as well as the wastewater treatment and administrative buildings during the period of active mine operation.

The Wisconsin Department of Natural Resources (DNR) conducted water quality monitoring of Stream C and other nearby waters during 2010 and 2011 to better assess these water quality concerns. The monitoring effort included surface water, sediment, and macroinvertebrate sampling, and fish surveys. Surface water, soil, and sediment data collected by FMC was also reviewed and assessed. Potential sources of copper and zinc were examined based on sampling data evaluation, site observations, FMC reports, and other references.

The monitoring was intended to provide additional data to help determine whether Stream C should be added to DNR's 303d list of impaired waters. Impaired waters do not meet Wisconsin's water quality standards and are subsequently targeted for corrective actions. Specific conclusions and recommendations for corrective actions are not included as part of this assessment, but will be developed elsewhere. This assessment will also be used as a basis for developing future monitoring plans at the site.

METHODS

SURFACE WATER MONITORING

There were sixteen sites in the monitoring program (Figures 1 and 2), including:

- Nine sites on Stream C and its contributing drainageways. (BO-1, C8-2, MC3-3, CP-4, C1- 5, EB-6, SC-7, SEB-11, ED-14)
- Two sites on the Flambeau River, one above and one immediately below the mouth of stream C. (FA-8, FB-9)
- Two sites on other intermittent streams draining the Flambeau mine site (Streams A and B).(SA-13, SB-12)
- One site on an intermittent reference stream 2 ½ miles southwest of the Flambeau mine site. (RS-10)
- One site at a Highway 27 ditch not draining to Stream C. (ND-15), and

- One site at the mouth of Meadow Brook, a perennial stream just south of the Flambeau mine site. (MB-16)

Most sites were monitored on 3 separate dates when surface runoff was occurring. Sites at the mouths of Stream C and the reference stream were also monitored twice during baseflow conditions (no recent runoff). Some sites that were added part way through the monitoring period were monitored on less than 3 dates.

Monitoring included the following field and laboratory tests:

Field tests: temperature, dissolved oxygen, conductivity, and pH

Laboratory tests (first 2 sampling dates): arsenic, cadmium, calcium, chromium, copper, iron, lead, magnesium, manganese, mercury, nickel, zinc, hardness, and sulfate.

Laboratory tests (remaining sampling dates): copper, zinc, iron, manganese, hardness, and sulfate.

Metals were tested for total recoverable concentrations. Metals samples were preserved with nitric acid in the field. All samples were kept iced and shipped to the Wisconsin State Lab of Hygiene for analysis.

Samples from Stream C and the reference stream collected on June 19, 2011 were also tested for acute and chronic toxicity and dissolved organic carbon.

Surface water and soil monitoring data collected by FMC was reviewed and evaluated.

Drainage area boundaries for surface water monitoring sites were estimated using USGS quad maps (10 feet contour intervals) as well as 2 feet contour interval topographic maps provided in FMC reports for many areas. Observations of culvert locations and direction of flow during runoff events were also used, and occasionally altered boundaries substantially.

SEDIMENT MONITORING

Sediment samples were collected from the biofilter pond (2 sites), Stream C (4 sites) and the reference stream (2 sites)(Figures 4 and 2). Samples from the biofilter pond were collected with a stainless steel Eckmann dredge. Samples from the streams were collected with a stainless steel trowel. Samples were kept iced and shipped to the Wisconsin State Lab of Hygiene for analysis. Sediment samples were tested for arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, zinc, % solids, % volatile solids, % clay, % silt, and % sand.

Sediment monitoring data collected by FMC was reviewed and compared to data collected by DNR.

FISH SURVEYS

Fish surveys were conducted at Stream C and the reference stream in the fall of 2010 and the spring of 2011. A backpack shocker was used and collection of all fish and crayfish observed was attempted. Fish and crayfish were identified to species, counted, and released. Stream C was surveyed from its mouth to Copper Park Lane. The reference stream was surveyed from its mouth to a point at which a defined channel ended and a grassy swale began.

The biofilter pond was also checked for the presence of fish. A 200 feet length of shoreline was shocked with a backpack shocker.

MACROINVERTEBRATE SAMPLING

Kick net samples of macroinvertebrates were collected in October of 2010 from the lower ends of Stream C and the reference stream, and from the Flambeau River (Figures 5 and 2). For the Flambeau River, two samples were collected upstream of the mouths of both Stream C and the reference stream. Two samples were also collected downstream of the mouths of both Stream C and the reference stream. Samples from Stream C and the reference stream were collected in riffle areas with mostly gravel substrate. Samples from the Flambeau River were collected in run areas with mixed cobble and gravel substrate.

Samples from the lower ends of Stream C and the reference stream were also collected in May of 2011 in riffle areas with mostly cobble substrate. All samples were preserved in 85% ethanol and were analyzed by the Aquatic Entomology Laboratory at the University of Wisconsin, Stevens Point.

RESULTS AND DISCUSSION

WATERSHED AND MONITORING SITE CHARACTERISTICS

Stream C Watershed Area Characteristics and Surface Water Sampling Sites

The Stream C watershed is shown in Figure 1. The total watershed is the composite of the areas enclosed by yellow lines. Drainage areas for individual DNR sampling sites contributing to Stream C are also enclosed by yellow lines. Drainage areas for two DNR sampling sites (C1-5 and SC-7) are composites of all upstream drainage areas.

The largest drainage areas upstream of the Flambeau mine site are those for sites ED-14 and MC3-3 (52.5 acres and 42.9 acres respectively). The two areas are generally separated by the rail spur (Figure 4) for the mine, although a small area of drainage on the north side of the rail spur drains to MC3-3. These two areas are mostly undeveloped woods and wetlands, with some influence from the rail spur, one residence, Highway 27 (Figure 4) runoff, Jensen Road runoff, and a graveled access road between Jensen Road and the rail spur.

The next downstream site contributing drainage to Stream C is C8-2, which drains an area of 9.7 acres. The area is mix of woods, grassland, and wetland. It is also influenced by Highway 27 runoff and includes an area that was once disturbed by mining activities.

Sampling site BO-1 is the outflow of the biofilter pond. It receives drainage from the Industrial Outlot area (Figure 4) west of Stream C, an area of 23.1 acres. The area contains three buildings, a water storage structure, a large paved parking area, the equestrian trailhead and parking area, the biofilter pond, and grassland areas. A number of actions have been taken by FMC in this area to reduce copper and zinc concentrations in runoff entering the biofilter pond. Past actions include removal of soil from previously unpaved parking areas, capping of these areas with asphalt, replacement of drainage ditch soils, removal of rail spur ballast, and capping of the rail spur with topsoil (further described in results and discussion section).

Sampling site CP-4 drains a 1.5 acre area which is mostly grassland, and is influenced by Copper Park Lane (Figure 4) runoff and a very short section of Highway 27 runoff.

Sampling site C1-5 is located on Stream C shortly below Copper Park Lane. It receives drainage from all the upstream drainage areas as well as runoff from the north side of Copper Park Lane, west of Stream C, and runoff from the south side of Copper Park Lane, east of Stream C.

Sampling site SEB-11 drains a small wooded area of about 2.1 acres and appears to be influenced by residential wastewater.

Sampling site EB-6's drainage area (38.3 acres) straddles Highway 27 and is a mix of woods, wetlands, residential areas, and business areas. It is also influenced by runoff from Highway 27 and Jensen Road.

Sampling site SC-7 is at the mouth of Stream C and is influenced by all upstream land uses. The total area of the Stream C watershed is 220 acres.

Other Surface Water Sampling Sites and Their Drainage Areas

Sampling site FA-8 is along the east bank of the Flambeau River shortly above the mouth of Stream C.

Sampling site FB-9 is along the east bank of the Flambeau River just below the mouth of Stream C and is within the mixing zone of Stream C water with Flambeau River water.

Sampling site RS-10 is located near the mouth of an unnamed intermittent stream located 2 ½ miles southwest of the Flambeau Mine site (Figure 2). This unnamed stream also discharges to the Flambeau River and has been used as a reference stream for comparison to Stream C. The stream has a watershed of 250 acres, which is just slightly larger than the Stream C watershed. Land use is a mix of woods, pasture, cropland, wetland, and a farm residence with a barn.

Sampling site SB-12 is located near the mouth of Stream B that drains the central area of the reclaimed mine site including most of the area underlain by the former mine pit. The 95.7 acre drainage area (Figure 3) is mostly grassland with some wetland.

Sampling site SA-13 is located near the mouth of Stream A that drains the north side of the reclaimed mine site, as well as an area east of Highway 27. The 152 acre drainage area (Figure 3) is a mixture of woodland, wetland, and grassland. It receives some runoff from Highway 27.

Sampling site ND-15 drains a 4.4 acre area on the west side of Highway 27. Drainage from the area flows northward to the Flambeau River. The area is mostly residential and receives runoff from Highway 27.

Sampling site MB-16 is located near the mouth of Meadow Brook, which is a perennial stream. It has a watershed of 7.7 mi^2 that contains a mix of agricultural land, woodland, and wetland. Some residential and industrial areas are also present.

FMC Surface Water Sampling Sites

Primary surface water sites monitored by FMC between 2002 and 2011 are shown in Figure 3. FMC sites that are comparable to DNR sites are indicated in the Figure. Appendix 2 contains data collected by FMC from the sites shown in Figure 3. FMC also collected samples from a variety of other surface water monitoring sites between 2002 and 2011. Data from these sites was reviewed and is mentioned in later discussion, but is not otherwise presented in this report.

SURFACE WATER QUALITY

General Water Quality Conditions

Surface water quality data collected by DNR and much of the data collected by FMC is contained in Appendices 1 and 2. Table 1 lists mean concentrations for various water quality parameters. Mean pH values for monitoring sites within the Stream C watershed ranged from 5.4 to 6.95, with a combined mean of 6.4. Dissolved oxygen (D.O.) concentrations were > 5 mg/l at all sites on most dates (Appendix 1). June 19, 2011 monitoring showed D.O. concentrations < 5 mg/l at six of the eight sites measured in the Stream C watershed. D.O. concentrations were as low as 1.3 mg/l. Highway 27 ditch samples had the lowest D.O. concentrations. Warmer temperatures in June would increase rates of organic matter decomposition in wetland areas, resulting in lower D.O. concentrations.

For the DNR samples (Appendix 1) metal concentrations other than copper and zinc did not approach acute or chronic toxicity criteria at any of the monitoring sites, except for a single sample from the west ditch of Highway 27 (site C8-2) that had a lead concentration of 5.3 ug/l. The hardness for that sample was too low to allow determination of the chronic or acute toxicity criteria.

Acute Toxicity Criteria for Copper and Zinc

Acute toxicity criteria (ATC) are protective standards for Wisconsin surface waters. They are based on laboratory testing of a variety of diverse aquatic organisms. Copper and zinc ATC's are the maximum daily concentrations which ensure adequate protection of sensitive species of aquatic life from acute toxicity and will adequately protect the designated fish and aquatic life uses of the surface water if not exceeded more than once every three years (Wisconsin Administrative Code 2000). Copper and zinc ATC's are influenced by water hardness, since these metals are more toxic in soft water than in hard water. Formulas are applied to determine copper and zinc ATC's based on the hardness measured in the water sample.

Water hardness in the Flambeau mine area is very low and generally ranges from 10 – 50 mg/l (as $CaCO_3$). This results in very low values for copper and zinc ATC's. Copper ATC's can be as low as 3 ug/l and zinc ATC's can be as low as 18 ug/l.

ATC's for copper and zinc are based on total recoverable concentrations. Total recoverable metal concentrations include both dissolved forms and most forms attached to particulate matter. Thirty-three surface water samples collected by FMC during 2008 were tested for both total recoverable and dissolved copper (Foth 2008). On average, total recoverable and dissolved copper concentrations were very similar. Runoff water at most sites is relatively clear, indicating suspended solids (particulate) concentrations are low. Much of the copper may be attached to dissolved organic matter which would keep it in a dissolved form.

ATC's for copper and zinc were frequently exceeded in many surface water samples from the Stream C watershed (Appendix 2). For sampling site C1-5 (FMC SW-C1), located on Stream C just below Copper Park Lane, zinc ATC's were exceeded on all 13 sampling dates between 2002 and 2011. Copper ATC's were exceeded on 12 of the 13 dates, with the sample from one date having a hardness level too low to allow determination of the copper ATC.

Copper

Mining Activities as a Copper Source

The Flambeau Mine was the first copper sulfide mine to be permitted under Wisconsin's current mining statures. Ore shipment began in spring of 1993 and continued until August 1997. During the life of the mine, over 1.8 million tons of ore were shipped off site producing 181,000 tons of copper, 334,000 ounces of gold and 3.3 million ounces of silver (NRPC 2005).

A review of FMC reports to DNR, and other Flambeau mine related documents, suggests several mining activities that could have resulted in the dispersal of copper-bearing ore throughout adjacent areas during the period the mine was in operation. Mining activities such as blasting, bulldozing, truck loading and unloading, ore crushing (up to 250 tons per hour) and rail car loading (State of Wisconsin 1991) could have generated quantities of fine dust that could have been transported by the wind and deposited on nearby areas. Some losses of fine particulate ore and ore oxidation products from rail car spillage on the rail spur (FMC 2004) are also likely. Although the Industrial Outlot included a truck washing station, inadvertent tracking of copper rich soil by vehicles onto roadways is another way copper could have been transported to nearby areas.

During reclamation of the mine site most of the disturbed areas, including the pit and soil stockpiles, were re-capped with native topsoil. However, the 32 acre Iindustrial Outlot at the southeast corner of the mine site (Figure 4) was not re-capped with topsoil to allow the buildings and infrastructure to be put to other uses. The Industrial Outlot contained, or was adjacent to an ore crusher, an ore stockpile area, a rail spur where ore was loaded into rail cars, a vehicle washing area, and runoff ponds. The rail spur (Figure 4) extended east of Highway 27, so ore-laden rail cars were also present there at times.

Surface Water Copper Concentrations

Table 2 compares copper and zinc concentrations found at 22 surface water monitoring sites. The sites have been arranged by increasing mean copper concentrations. The lowest mean copper concentrations (<5 ug/l) were found in:

- the Flambeau River above Stream C,
- the Flambeau River below Stream C,
- a reference stream located 2 ½ miles southwest of Stream C,
- Stream A and Stream B which drain portions of the former mine site, and
- Meadow Brook, a perennial stream located just south of the mine site.

Mean copper concentrations < 5 ug/l appear to be representative of local background conditions for streams not significantly influenced by localized copper sources. Nearly all of Stream B's watershed and portions of Stream A's watershed are underlain by areas of formerly active mining activities, including the former mine pit. These areas were re-capped with native topsoil following mine closure, which appears to have been effective at minimizing copper concentrations in runoff from those watersheds.

Pre-mining copper concentrations were measured for the Flambeau River and the data does not indicate any significant change in copper concentrations in the Flambeau River due to mining activities (FMC 2012). The dilutional capacity of the Flambeau River would make it difficult to detect copper additions that are not relatively substantial. The river has a mean flow of 1,834 ft^3/second (cfs) and a mean copper concentration of 1.5 ug/l. An inflow of 1 cfs with a copper concentration of 500 ug/l, for example, would only raise the River's copper concentration by 0.3 ug/l, which would probably not be a discernable increase.

Most remaining surface water monitoring sites with mean copper concentrations > 5 ug/l are influenced by former mining activities or by runoff from Highway 27. The biofilter inlet site (BFSW-C1) had the highest mean copper concentration (651 ug/l). This site receives drainage from much of the Industrial Outlot area, where several locations were found to have high soil copper concentrations. Remedial actions have greatly reduced copper concentrations at this site (see discussion below).

The two ditch sites on the north side of Copper Park Lane (SW-CP-02 and CP-4) had the second and third highest mean copper concentrations (162 and 144 ug/l). High soil copper concentrations were found in the drainage area for site SW-CP-02 and remedial actions were taken which reduced surface water copper concentrations there (see discussion below). No soil sampling or remedial actions have occurred in the drainage area for site CP-4. The high copper concentrations in surface water there suggests high soil copper concentrations may also be present.

Site SW-C8 / C8-2 along the west side of Highway 27 had the fourth highest mean copper concentration (92.8 ug/l). Drainage area characteristics and potential copper sources for the site are discussed in the "Trends in Copper Concentrations" section below.

Site SW-C1 / C1-5 on Stream C below Copper Park Lane had a mean copper concentration of 27.5 ug/l. This reflects a mix of drainage received from mine impacted areas and Highway 27, and natural background copper concentrations. Copper concentrations at this site regularly exceeded the acute toxicity criteria (ATC). Pre-mining copper concentrations were not determined for Stream C, so a direct comparison of pre-mining and post-mining copper concentrations in the stream is not possible.

Site SW-C6 / SC-7 at the mouth of Stream C had a mean copper concentration of 19.1 ug/l. The decline in Stream C copper concentration between Copper Park Lane and the mouth is due to dilution by inflowing water with lower copper concentrations in the lower section of the Stream C watershed. Copper concentrations still exceed ATC's in 90% of the samples collected at this site.

The Flambeau River below the mouth of Stream C (SW-3 / FB-9) had a slightly higher mean copper concentration (2.7 ug/l) than the Flambeau River above the mouth of Stream C (SW-2 / FA-8)(1.5 ug/l copper). The difference may not be statistically significant, but mixing Stream C water with a mean copper concentration of 19.1 ug/l and Flambeau River water with a mean copper concentration of 1.5 ug/l would be expected to produce a somewhat elevated copper concentration in a very small area of the Flambeau River. The copper concentrations in the Flambeau River below the mouth of Stream C are still quite low and did not exceed ATC's with the exception of an April 25, 2008 sample that had a copper concentration of 5.6 ug/l and an ATC of 5.1 ug/l (Appendix 2). Variability in sampling and lab testing probably makes this difference insignificant.

Soil Copper Concentrations

Soil samples collected in the Stream A and B watersheds by FMC in 2008 after mine reclamation were found to mostly have low copper concentrations. Five samples had copper concentrations ranging from 8 to 13 mg/kg (Foth 2008). Two samples which appear to be associated with trails had copper concentrations of 43 and 94 ug/l. Four samples from the general mine area that are unlikely to be influenced by mining activities had copper concentrations ranging from 12 to 17 mg/kg (S-RR-08, S-RR-09, S-L-01, S-GP-01) (Foth 2008). It appears that copper concentrations < 20 mg/kg are representative of local background conditions for soil.

Soil sampling by FMC in 2005 identified numerous areas with elevated soil copper concentrations in the Industrial Outlot area (Foth and Van Dyke 2006). The highest soil copper concentration reported was 2,900 mg/kg and was located at a former vehicle washing station. The high soil concentration reported at this location, suggests that vehicles at the mine site may have accumulated significant amounts of copper-laden dust or soil while the mine was in operation. Unwashed or incompletely washed vehicles leaving the mine site may have carried such material onto nearby roadways. Fourteen of the eighteen soil sample results reported from the Industrial Outlot in May, 2006 had copper concentrations > 100 mg/kg.

High soil copper concentrations were found in the ditch on the north side of Copper Park Lane, west of Stream C in 2008. Six samples had copper concentrations ranging from 82 to 890 mg/kg, with a mean of 239 mg/kg. Two samples collected on the south side of Copper Park Lane had copper concentrations of 79 and 83 mg/kg (Foth 2008). Soil samples results were not reported for the area east of Stream C along Copper Park Lane. Runoff water samples collected by DNR from the north ditch in that area had high copper concentrations (mean = 144 ug/l), suggesting soils in that area may also be high in copper.

High soil copper concentrations were also found in the finer soils (sand sized and finer) above and below the ballast material in the rail spur within the Industrial Outlot area (Foth 2003). Copper concentrations in those samples ranged from 40 to 3,400 mg/kg, with a mean of 386 mg/kg.

Soil sampling by FMC has also identified areas with elevated soil copper concentrations outside of the Industrial Outlot area. Five samples collected near the H and H building, a storage building for mine-related equipment, (Figure 4) had a mean copper concentration of 112 mg/kg (Foth 2008). Sampling locations were reportedly "placed where impacts due to vehicle traffic may be the largest." Samples collected along the first 200 feet of the rail spur east of Highway 27 had copper concentrations ranging from 28 to 120 mg/kg, with a mean of 59 mg/kg (FMC 2004). Samples were taken in the fine gravel underlying the coarse ballast, after the ballast was removed. Finer soil materials (silts and clays) will tend to hold more copper, so fine gravel samples may not reflect maximum copper concentrations in the rail spur bed there.

Surficial soil pH's at most sampling sites were slightly acidic, thereby potentially contributing to increased copper mobility in local surface water. Soils sampled along Highway 27 had a mean pH of 5.8 (Foth 2008). Soils sampled near the H and H building had a mean pH of 5.6. Soil sampled along the rail spur east of Highway 27 had a mean pH of 5.8 (FMC 2004). Soils sampled in the reclaimed mine area had a mean pH of 6.0. Two soil samples collected on the south side of Copper Park Lane had a mean pH of only 4.6 (Foth 2008), possibly due to sulfide deposition in this area. The finer soils (sand sized and finer) above and below the ballast material in the rail spur within the Industrial Outlot area had pH's as low as 2.5 (Foth 2003), almost certainly due to the oxidation of spilled sulfide ore. The pH range in those samples was

2.5 to 5.9, with a mean of 4.2. Only two soil samples collected on the north side of Copper Park Lane had pH's > 7, with a mean of 7.6 (Foth 2008).

Organic soil materials tend to contain more copper than mineral soil materials. At eight sites sampled along Highway 27 organic materials contained 59 to 783% (mean = 234%) of the copper in adjoining mineral material (Foth 2008).

Reductions in Runoff Water Copper Concentrations in Response to Remedial Actions

High soil copper concentrations are generally associated with high copper concentrations in runoff water. Remedial actions have been taken by FMC which removed or capped areas of high soil copper concentrations in the Industrial Outlot area. The surface water testing results indicate that these actions have been successful in reducing copper concentrations in runoff water.

In 2006, graveled parking areas in the Industrial Outlot identified by FMC as having elevated levels of copper were partially excavated and then overlain with geotextile fabric, four inches of crushed limestone, and three inches of asphalt pavement. The perimeter ditch around the parking area was also modified by removing existing surface soil, installing a geotextile fabric, and covering the surface with four to six inches of crushed limestone (Foth and Van Dyke 2006).

Copper concentrations in runoff from the remediated area, as represented by the biofilter pond inflow site (BFSW-C1) declined from a mean of 1,035 ug/l prior to the remedial actions to a mean of 48 ug/l after removal of the impacted soils. Biofilter pond outflow site (BFSW-C2) copper concentrations declined from a mean of 50 ug/l to a mean of 13 ug/l (Appendix 2). The biofilter pond appears to have generally provided good levels of copper capture, both before and after remedial actions in the drainage area. Prior to these remedial actions, inflowing copper concentrations were reduced from 88 to 97% (mean = 93)(1-(outflow conc./ inflow conc.) x 100). After the remedial actions, inflowing copper concentrations were reduced from 0 to 83% (mean = 60%). However, copper reduction estimates are based on one inflow sample and one outflow sample per sampling event. For some sampling events, inflow and outflow samples were collected on the same date. For others, outflow samples were collected one day later than inflow samples. Since inflowing water will pass slowly through the biofilter pond to the outlet, single inflow and outflow samples may not accurately reflect biofilter pond copper removal. Shortly after a rainfall, a portion of the outflow will probably be rain water that has fallen directly on the pond surface.

The biofilter pond has an impermeable geomembrane liner that does not allow water to infiltrate into the ground. The geomembrane liner and the overlying sediment in the pond are scheduled to be removed and the pond converted to an infiltration basin in spring of 2012 (Foth 2011). Drainage modifications were made and another infiltration pond was constructed at the west end of the Industrial Outlot in 2011 to better manage stormwater. These actions should further reduce copper inputs to Stream C from the biofilter pond's former drainage area.

In November 2008 the ditch on the north side of Copper Park Lane had six inches of soil removed and replaced due to elevated copper concentrations (FMC 2009). Subsequently, copper concentrations in runoff from the ditch declined from a mean of 255 ug/l to a mean of 68 ug/l (based on two pre-treatment and two post-treatment samples)(Appendix 2).

In an earlier remedial action, rails and ties were removed from the rail spur west of Highway 27 and 200 feet east of Highway 27 in 2003. Ballast material and some gravel found to contain elevated levels of copper were also removed from the rail spur prior to capping with six to twelve inches of topsoil and seeding in 2004 (FMC 2004). There is no suitable surface water monitoring point to allow assessment of impacts from this remedial action.

Highway 27 as a Copper Source

Highway runoff is known to be a source of copper (Bannerman et al. 1993). Car brake pads and other components contain copper which can be shed on highway surfaces.

Seventeen soil samples collected along Highway 27 had copper concentrations ranging from 10 to 85 mg/kg (mean = 28 mg/kg) (Foth 2008). Six surface water samples collected from Highway 27 drainage ditches at sites where the highway and roadside area runoff appears to be the primary water source had copper concentrations ranging from 20 to 35 ug/l (mean = 28 ug/l)(Foth and Van Dyke 2006). All but one sampling site in Ladysmith were within 1 mile of the mine site. Samples collected along County Trunk Highway G/P at Doughty Road (about 1 mile northeast of the mine site) had a soil copper concentration of 12 mg/kg and a surface water copper concentration of 8.9 ug/l (Foth 2008).

It is uncertain how much of the copper present along Highway 27 near the mine site is due to normal traffic sources and how much may be due to past mining activities. Deposition of dust generated during active mining is a potential source. Some tracking of mine site soil onto Highway 27 by vehicles is also likely to have occurred. Copper from tracked soil could then be washed onto the shoulders and into the ditches by rainfall runoff.

Other Potential Copper Sources: Wastewater

Household wastewater can contain significant copper concentrations, primarily due to corrosion of copper pipes and brass plumbing fixtures. There are several residential homes along Highway 27. One of the homes is located in the drainage area of site SEB-11 (Figure 1). Site SEB-11 had copper concentrations ranging from 6 to 15 ug/l which exceeded ATC values. This site appears to be influenced by household wastewater. The site had high conductivity (257 umhos/cm) on one date when all other sites did not. It had a high chloride concentration (67 mg/l) and a high fecal coliform concentration (550 per 100ml). It also sustained surface flows when similar small drainage areas were dry. A holding tank for wastewater is reportedly present at the rented residence (Murphy 2011), but the evidence strongly indicates that some of the wastewater is being discharged to surface drainage. The holding tank is probably leaking. Wastewater discharges to surface drainage from other residences in the area are also possible.

Trends in Copper Concentrations

Copper concentrations have declined over time at several monitoring sites (Appendix 2). Declines in copper concentrations at some of the surface water monitoring sites in the Stream C watershed are probably a response to remedial actions that reduced copper sources.

Declines in copper concentrations may also be occurring as copper in soil is gradually mobilized and transported through the surface water drainage system. Two surface water monitoring sites are located upgradient of any remedial actions and show significant trends of declining copper concentrations (SW-C8 (DNR C8-2), $R^2 = 0.59$, $p = 0.0005$; and SW-C3, $R^2 = 0.62$, $p = 0.001$)(Figure 6). This indicates that a past source, quite possibly mining activities, deposited copper in the drainage areas of these sites. It also suggests higher copper concentrations may have been present prior to 2004 when monitoring began at these sites. If the copper concentrations at these sites were due solely to naturally occurring background sources, one would expect the concentrations to remain fairly stable over time.

Site SW-C8 (DNR C8-2) has had surface water copper concentrations ranging from 9 to390 ug/l (Appendix 2). The site is located in the west ditch of Highway 27 (Figure 1). It drains an area of 9.7 acres that is a mix of woods, grassland, and wetland. It is also receives runoff from Highway 27 and includes an area that had exposed soil during mining activities (Type II stockpile). The potential for having received direct runoff from the former sulfide stockpile area is low since the area was lined with a geomembrane and all contact water was routed to the wastewater treatment facility. Deposition of windblown dust from the former stockpile, as well as vehicle tracked mine site soil washed from the highway by rainfall, are more likely potential sources. The H and H building (Figure 4) where elevated soil copper concentrations have been found, is at the north edge of the drainage area. Soil sample copper concentrations in the Highway 27 ditch in this area ranged from 14 to 180 mg/kg (Foth 2008). FMC has scheduled construction of an infiltration basin in spring 2012 that will capture and infiltrate the runoff from the SW-C8 drainage area (Foth 2011). This is likely to help reduce copper concentrations in Stream C.

Site SW-C3 (Figure 1) has had surface water copper concentrations ranging from 6 to18 ug/l (Appendix 2). The site is located on the north side of the rail spur (Figure 4), upgradient of the segment where ballast was removed. Losses of fine particulate ore and ore oxidation products from rail cars in this area could have been a potential copper source. Deposition of dust generated during active mining is a second potential source.

Zinc

Potential Sources of Zinc

Zinc content of the supergene enriched ore body was generally less than 0.05% and lead was rarely detectable (May and Dinkowitz 1996). Based on the removal of 1.8 million tons or ore, no more than approximately 900 tons of zinc were extracted during the life of the mine. Like copper, some of the zinc present may have been redistributed during mining activities by windblown dust, vehicle tracking of mine site soil, and losses of fine particulate ore and ore oxidation products from rail cars. The low zinc concentrations in the ore suggest such contributions would have been relatively minor.

There are also other potential sources of zinc in surface waters. Zinc is used to galvanize steel surfaces. Galvanized building materials, especially roofing materials are known to contribute zinc to stormwater runoff (Bannerman et al. 1993). Galvanized steel drainage culverts can also contribute zinc to surface waters. Most power line post hardware and support cables are galvanized. Some highway sign posts and most sign post hardware is galvanized. Chain link fences and fence posts are galvanized. White paint and some lubricants contain zinc. Car tires and some other vehicle parts contain zinc which is shed onto road surfaces, and can then be carried by runoff.

Stream Background Zinc Concentrations

Surface water zinc concentrations for all monitoring sites are shown in Appendix 2. Mean zinc concentrations are listed in Table 2.

Zinc concentrations in most area streams sampled are fairly low. Intermittent streams A and B, the intermittent reference stream, and two sites on the Flambeau River had mean zinc concentrations < 8 ug/l, which appear to be representative of local background conditions for streams not significantly influenced by localized zinc sources. Two samples collected from Meadow Brook had zinc concentrations of 12 and 67 ug/l, so some additional zinc sources may be present in that stream's watershed.

Soil Zinc Concentrations

Results of most soil tests made by FMC provided copper concentrations, but not zinc concentrations. Eight soil samples collected along Highway 27 were tested for zinc. They had higher zinc concentrations (mean = 171 mg/kg) than copper concentrations (mean = 28 mg/kg) (Foth and Van Dyke 2006). These sites may be influenced by highway pavement runoff, runoff from residential structures, and galvanized surfaces on culverts, power poles, and road signs. No soil samples collected by FMC were found that might be representative of background soil zinc concentrations.

Stream C Watershed Zinc Concentrations

Zinc concentrations in Stream C just below Copper Park Lane (SW-C1 / C1-5) (37 – 78 ug/l) exceeded ATC's on all 13 dates sampled between 2002 and 2011 (Appendix 2). The frequency of ATC exceedences from zinc are less than those from copper in the Stream C watershed. Monitoring sites in the Stream C watershed had zinc concentrations exceeding ATC's 46% of the time, on average. Copper concentrations exceeded ATC's 92% of the time, on average.

The severity of ATC exceedences from zinc are also less than those from copper in the Stream C watershed. At the site just below Copper Park Lane (SW-C1 /C1-5) zinc concentrations as a percent of ATC's ranged from 105 to 241% (mean = 183%). Copper concentrations as a percent of ATC's ranged from 264 to 1,516% (mean = 670%).

The monitoring site in the Stream C watershed with the highest mean zinc concentration (233 ug/l) is SW-C7 (Figure 3) is located on Stream C upstream of the biofilter pond outlet. One sample had a zinc concentration of 600 ug/l. Even without this sample, the mean zinc concentration is 111 ug/l. Corrosion of zinc in culverts might be contributing to the high concentrations at this site. The site is located shortly below two galvanized steel culverts that conduct Stream C under the rail spur. The two culverts are four feet in diameter and 165 feet long. The culvert surfaces below the waterline are rusted, indicating the zinc coating has been completely lost. Stream C is pooled below and into the lower ends of the culverts, creating a depositional area where corroded zinc might accumulate during low flows, and then be resuspended during high flows. The culverts are scheduled for removal in 2012 as part of the FMC's current stormwater management work plan (Foth 2011). Losses of ore material from rail cars on the rail spur may also have influenced this site, although the low zinc content of the ore suggests that the zinc contribution from spillage would be relatively minor.

Site SW-C5, which is shortly below site SW-C7 and below the biofilter pond outlet, had a mean zinc concentration of 57 ug/l. The biofilter pond outlet (BFSW-C2 / BO-1) had a mean zinc concentration of 10 ug/l. Dilution of Stream C water with biofilter pond outlet water contributes to zinc concentration declines between SW-C7 and SW-C5. The Stream C course between these sites is wide and contains a dense stand of reed canary grass. Adsorption of zinc by organic matter in the channel, uptake by live grass, or entrapment of particulate bound zinc might also have an influence.

The biofilter pond inlet (BFSW-C1) had the second highest mean zinc concentration (99 ug/l) in the Stream C watershed. This mean is based on all samples collected, both before and after upgradient remedial actions were taken. Before remedial actions, zinc concentrations in biofilter pond inlet samples averaged 149 ug/l. After remedial actions, zinc concentrations averaged 28 ug/l. Zinc concentrations in biofilter pond inlet samples were 14 to 15% of copper concentrations, both before and after remedial actions.

Site CP-4 (Copper Park Lane north ditch, east of Stream C) had the third highest mean zinc concentration (95.3 ug/l) in the Stream C watershed. Tracking of mine site soil onto Copper Park Lane and deposition of dust during mining operations are possible sources for this zinc, but again, the low zinc content of the ore suggests it was a minor potential source. There is also one small galvanized steel culvert in the ditch and a galvanized chain link fence in the drainage area.

Correlation of mean copper and zinc concentrations at sites in the Stream C watershed is fairly low, with an R^2 of 0.27. This suggests copper and zinc sources are not uniform at the monitoring sites. Zinc sources unrelated to mining activities are probably more significant than copper sources unrelated to mining activities. Actions taken to reduce copper concentrations are likely to also reduce zinc concentrations in some, but possibly not all locations. Remedial actions taken upgradient of the biofilter pond did reduce both copper and zinc concentrations. Remedial actions there reduced copper concentrations by 95% and zinc concentrations by 81%.

Trends in Zinc Concentrations

Like copper, declines in zinc concentrations over time at some of the surface water monitoring sites in the Stream C watershed are probably a response to remedial actions that reduced zinc sources. Declines in zinc concentrations may also occur as zinc is gradually mobilized and transported through surface water drainage. Two surface water monitoring sites are located upgradient of any remedial actions and show significant trends of declining zinc concentrations (SW-C8 (DNR C8-2), $R^2 = 0.33$, $p = 0.012$; and SW-C3, $R^2 = 0.34$, $p = 0.046$)(Figure 7). This indicates that a past source, possibly associated with past mining activities, could have deposited zinc in the drainage areas for these sites. It also suggests higher zinc concentrations may have been present prior to 2004 when monitoring began at these sites. If the zinc concentrations at these sites were due solely to naturally occurring background sources, one would expect the concentrations to remain fairly stable over time.

Rates of concentration decline and R^2 values are lower for zinc than for copper. Less enrichment of zinc than copper, and the presence of more zinc sources not related to mining activity may account for this. Slower mobilization of deposited zinc is another possibility.

Site SW-C8 has had surface water zinc concentrations ranging from 15 to100 ug/l. Site SW-C3 has had surface water zinc concentrations ranging from 6.4 to 56 ug/l (one outlier removed). Potential mine related zinc sources are the same as those identified for copper at these sites.

Acute and Chronic Toxicity Test Results

There was no significant acute or chronic toxicity found in the June 19, 2011 samples collected from Stream C and the reference stream. The acute toxicity test exposed 10 day old fathead minnows (*Pimephales promlas*) and water fleas (*Ceriodaphnia dubia*) to stream water and lab control water for 48 to 96 hours. No significant mortality was found.

The chronic toxicity test observes fathead minnow growth and survival, and water flea reproduction and survival over about 7 days. None of these measures showed any significant chronic toxicity effects. The chronic toxicity test also measures the growth of an algae (*Selenastrum capricornutum*) over the same time period. Algae growth in the Stream C water was significantly lower (20% reduction) than in the lab control water. However, standard testing protocols require a growth reduction of greater than 50% before chronic toxicity is verified.

The June 19, 2011 sample from Stream C had a copper concentration of 23 ug/l that was 4.1 times higher than the ATC. It had a zinc concentration of 41 ug/l that was 1.05 times higher than the ATC. The lack of observed toxicity in the lab indicates other factors have influence. Copper toxicity is known to be reduced by the presence of dissolved organic matter (Erickson et al. 1996, De Schamphelaere et al. 2004). Copper will attach to dissolved organic matter, which reduces its availability for uptake by aquatic organisms. The Stream C sample had a moderately high dissolved organic carbon (DOC) concentration (11 mg/l), which is an indicator of dissolved organic matter. Wetlands in the Stream C watershed are probably the main source of the DOC. For comparison, the reference stream, with less wetland influence had a DOC concentration of 3.3 mg/l. The degree to which dissolved organic matter reduces copper toxicity varies with the type of dissolved organic matter that is present. Site specific information is generally needed to quantify this effect.

Further testing would be needed to reach more definitive conclusions regarding the biological effects of the observed concentrations of copper and zinc. In the tests conducted on the June 19, 2011 samples only two to three organisms were tested using water from a single point in time. ATC's are based on a broader and varied group of aquatic organisms and are meant to be protective of a full range of aquatic life thoughout their life cycles. For example, the water flea, *Ceriodaphnia dubia*, used in the lab tests is 10 times more tolerant of copper than another water flea, *Daphnia magna* (Johnson, et al. 2008) Some fish species are present in Stream C, but it is unknown if they can successfully reproduce. Fish eggs or newly hatched larval fish may be more sensitive to copper and zinc concentrations than adults.

SEDIMENT MONITORING RESULTS

DNR sediment monitoring results are listed in Table 3. Site locations are shown in Figures 4 and 2. Metal concentrations in sediment can be assessed using consensus-based sediment quality guidelines (DNR 2003). Threshold effect concentrations (TEC's) are sediment metal concentrations, below which toxicity to benthic dwelling organisms is unlikely. Probable effect concentrations (PEC's) are sediment metal concentrations, above which toxicity to benthic dwelling organisms is probable.

Metals concentrations were highest in the biofilter pond sediments. Only cadmium and lead concentrations were less than TEC's. Arsenic, chromium, iron, manganese, mercury, nickel, and zinc concentrations were above TEC's, but less than PEC's, suggesting marginal levels of toxicity from these metals may be occurring. Copper concentrations were 10 to 16 times higher than the PEC (up to 2,450 mg/kg), indicating toxicity to benthic organisms from copper is highly likely. Biofilter pond sediment samples collected by FMC showed similar levels of metals, with sediment furthest from the inlet tending to have lower levels (Foth and Van Dyke 2006, Foth 2008). Biofilter pond sediments are scheduled to be removed and placed in a landfill in spring of 2012 (Foth 2011).

Stream sediment samples from Stream C and the reference stream had concentrations of nearly all metals less than TEC's. Only manganese concentrations exceeded TEC's at two sites on Stream

C. None of the stream sediment samples collected by DNR had metals concentrations exceeding PEC's.

Sediment samples collected from Stream C were similar to samples collected from the reference stream except for copper and zinc concentrations. Copper concentrations in Stream C sediment (mean = 13.7 mg/kg) were 2.5 times higher than in the reference stream sediment (mean = 5.4 mg/kg). Zinc concentrations in Stream C sediment (49 mg/kg) were 1.8 times higher than the reference stream sediment (27 mg/kg).

One of two Stream C sediment samples collected by FMC had higher metal concentrations than found in samples collected by DNR (Foth 2008). The sampling site was just below Copper Park Lane. The stream bed was dry at the time of sample collection. The copper concentration was 180 mg/kg, which exceeds the PEC. The zinc concentration was 320 mg/kg, which exceeds the TEC, but is below the PEC. Since the stream was dry, the sample may have contained finer-grained or organically enriched material deposited during an earlier period of declining stream flow. These materials tend to have higher copper and zinc concentrations. Close proximity to Copper Park Lane where high soil concentrations of copper and zinc have been found may also be a factor.

FMC also collected six sediment samples from the constructed wetland pond near the mouth of Stream B (Foth 2008). Copper concentrations ranged from 28 to 71 mg/kg (mean = 44 mg/kg). Zinc concentrations ranged from 51 to 69 mg/kg (mean = 60 mg/kg). Five of the six samples exceeded the copper TEC, but all were below the copper PEC. All zinc samples were below the zinc TEC.

FISH SURVEY RESULTS

Fish survey results are summarized in Table 4. Comparisons of fish populations in the reference stream and Stream C are limited by physical differences between the streams. Both streams are intermittent and have similar watershed sizes, but the reference stream has a higher gradient, less meanders, and more cobble/boulder substrate. This results in the reference stream having a much smaller volume of water present in its channel. Total stream volume in the reference stream appeared to be only about 25% or less of stream volume in Stream C. The larger stream volume in Stream C gives it a greater potential to support fish.

Stream C had more fish species than the reference stream in both fall (6 and 3, respectively) and spring (6 and 4, respectively). The reference stream had more fish per 100 meters of stream length than Stream C in both fall (28 and 6, respectively) and spring (19 and 16, respectively). A larger percentage of the fish in Stream C than in the reference stream were species tolerant of low dissolved oxygen concentrations (42 – 65% in Stream C; 2 – 14% in the reference stream). Brook stickleback, central mudminnows, and fathead minnows are the low oxygen tolerant species present. Stream C is more influenced by wetland drainage that can result in low dissolved oxygen concentrations at times.

Brook sticklebacks full of eggs and creek chubs with spawning coloration were noted in Stream C, indicating these fish were prepared to spawn. The reference stream contained mostly juvenile fish and is probably not large enough to support much fish spawning.

Intermittent streams commonly support fish populations seasonally. A fish-based index of biotic integrity has been developed for intermittent streams in Wisconsin (Lyons 2006). Application of the index requires a fish population > 25 fish per 100 meters. Intermittent streams like Stream C and the reference stream, with watershed areas less than 1.5 mi^2, often do not support a population of this density.

Eleven fish were captured along 200 feet of shoreline in the biofilter pond near the outlet. Species captured were fathead minnows, central mudminnows, and a brook stickleback. The fish appeared to be in good condition.

MACROINVERTEBRATE SAMPLING RESULTS

A detailed report on the fall macroinvertebrate sample results was prepared by Jeff Dimick of the Aquatic Entomology Laboratory at the University of Wisconsin, Stevens Point.
The report is contained in Appendix 3. Biotic index values and number of species for samples is listed in Table 5.

The fall Stream C sample was dominated by chironomids (82%) and contained 27 species of macroinvertebrates. Several genera of chironomids found in Stream C are known to be tolerant to metals. The short life cycles of many chironomids allow them to survive in streams with intermittent flow. The riffle site sampled on Stream C was more subject to seasonal flow loss than the riffle site sampled on the reference stream.

The fall reference stream sample was dominated by isopods and amphipods (89%) and contained 13 species of macroinvertebrates. Isopods and amphipods are known to be especially sensitive to copper. Spring samples from the reference stream and Stream C both contained seventeen species of macroinvertebrates.

The macroinvertebrate index of biotic integrity (MIBI) is generally not sensitive to stream metals concentrations. In northern Wisconsin the MIBI reflects impairments to streams due to land use, bank erosion, embedded substrate, lack of buffer strips, and lack of habitat diversity. The Hilsenhoff biotic index is also generally not sensitive to stream metals concentrations. It responds primarily to organic pollution that results in lowered dissolved oxygen concentrations.

There were no indications of metals influence in the Flambeau River samples. Differences noted in these samples are probably mostly due to differences in fine sediment deposition and periphyton growth that caused shifts in the dominant mayfly species. Hilsenhoff biotic index (HBI) values were poorer below Stream C than above Stream C. Deposition of sediment below Stream C would be expected.

HBI values were better below the reference stream than above the reference stream. The Flambeau River sampling sites below the reference stream were more affected by scouring and had noticeably less fine sediment present than the sites above the reference stream. Further investigation would be needed to more definitively identify the reasons for the observed differences in the macroinvertebrate communities at the Flambeau River sites.

SUMMARY OF FINDINGS

- With the exception of Stream C, streams in the reclaimed areas of the Flambeau mine site (Stream A and B watersheds) exhibit low copper and zinc concentrations similar to a nearby reference stream (RS-10) uninfluenced by past mining activities.

- Monitoring of the Flambeau River before, during, and after mining activities has not shown any significant changes in copper and zinc concentrations. The Flambeau River has a very high dilutional capacity and fairly substantial inputs of copper and zinc would be needed to produce significant changes.

- The Stream C watershed includes the Industrial Outlot area at the southeast corner of the mine site, and a section of the rail spur used to transport ore. This area was not completely stripped of surface soils and revegetated as initially proposed in the Reclamation Plan, since the City of Ladysmith requested that the buildings and infrastructure be maintained and re-used.

- Surface water copper and zinc concentrations at multiple sites in the Stream C watershed exceed the acute toxicity criteria on a frequent basis.

- 1.8 million tons of ore containing approximately 181,000 tons of copper and no more than 900 tons of zinc were extracted from the mine. The copper sulfide ore was stored and loaded in the Industrial Outlot area and along the rail spur. Copper and zinc could potentially have been redistributed during mining activities in this area by wind transported dust, losses of fine particulate ore from rail car spillage, and tracking of copper rich soil and dust by vehicles.

- Soil sampling in the Industrial Outlot area and along the rail spur found multiple sites with elevated copper concentrations.

- Areas with elevated soil copper concentrations were generally correlated with elevated runoff water copper concentrations.

- Past remedial actions taken by FMC to remove or cap soils with elevated copper concentrations have been effective at reducing copper concentrations in runoff water. For the one remedial action where zinc data is available, zinc concentrations in runoff water were also reduced.

- Other potential sources of copper to Stream C include highway runoff and residential wastewater (in the case of one apparently leaking holding tank).

- The zinc content of the ore (0.05% or less) was much less than the approximate copper content (10.1%). Other potential sources of zinc include highway runoff and zinc galvanized surfaces on culverts, buildings, fences, signs and power line posts. White paint and some lubricants also contain zinc.

- At two sites in the Stream C watershed (SW-C3 and SW-C8) unaffected by any past remedial actions, copper and zinc concentrations show significant declining trends over time. This suggests that past deposition of copper and zinc occurred in the drainage areas for these sites, and that the metals are gradually being mobilized from the soils and transported by runoff. If the copper and zinc concentrations at these sites were due solely to naturally occurring background sources, one would expect the concentrations to remain fairly stable over time.

- FMC is currently pursuing additional remedial actions that are likely to result in noticeable reductions in copper and zinc concentrations in Stream C. In Fall of 2011 an infiltration basin was constructed at the west end of the Industrial Outlot and drainage modifications were made to divert more runoff to the basin. Actions scheduled for Spring 2012 include removal of the geomembrane liner and overlying sediment in the biofilter pond. The sediment will be landfilled and the biofilter pond will be converted to an infiltration basin. A third infiltration basin that captures the drainage from the SW-C8 drainage area will also be constructed. The remaining rail spur bed in the Industrial Outlot area will be removed along with the two large culverts currently passing beneath the rail spur bed.

- There was no significant acute or chronic toxicity found in the June 19, 2011 sample from Stream C. In the chronic toxicity test, algae growth was significantly lower (20% less) in the Stream C sample than in lab control water. However, standard testing protocols require a growth reduction of greater than 50% before toxicity is verified. Dissolved organic matter in Stream C may be reducing the toxicity of copper and zinc. Further testing would be needed to assess toxicity more fully and to determine the influence dissolved organic matter may be having.

- The most heavily contaminated sediment was found in the biofilter pond, with copper being the contaminant of greatest concern. Biofilter pond sediments are scheduled to be removed and placed in a landfill in Spring of 2012.

- Fall and spring fish surveys of Stream C found 6 species of fish present during each survey. Fish densities were lower in Stream C than in a reference stream, even though the volume of habitat in Stream C was considerably greater. About half of the fish present in Stream C were species that are tolerant of low dissolved oxygen concentrations. Wetland drainage in the Stream C watershed probably results in low dissolved oxygen concentrations at times.

- Macroinvertebrate samples from the Flambeau River showed no indications of metals influence. Stream C macroinvertebrate samples showed a good number of species present (17-27). Several genera of chironomids found in Stream C are known to be tolerant to metals.

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FIGURES

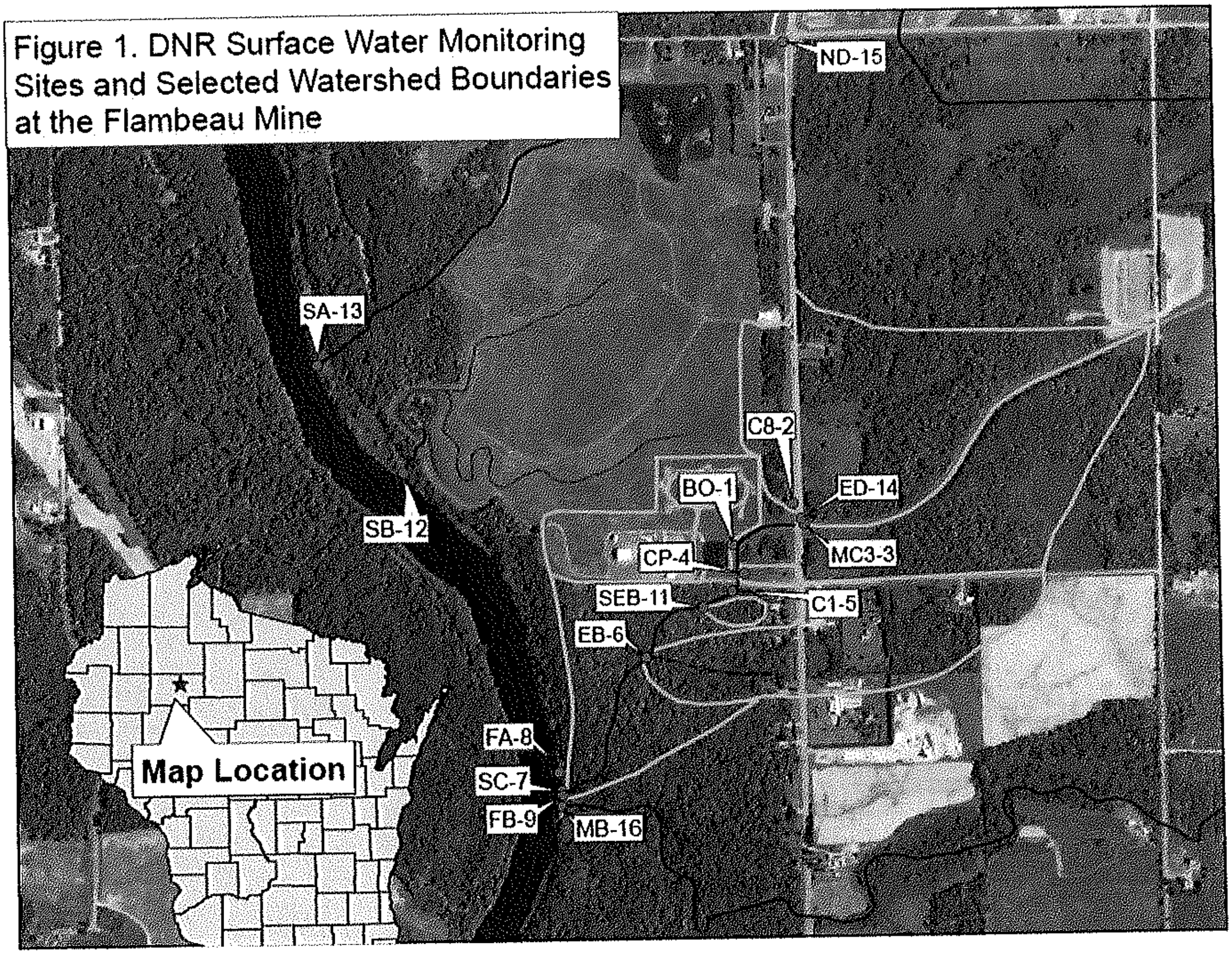
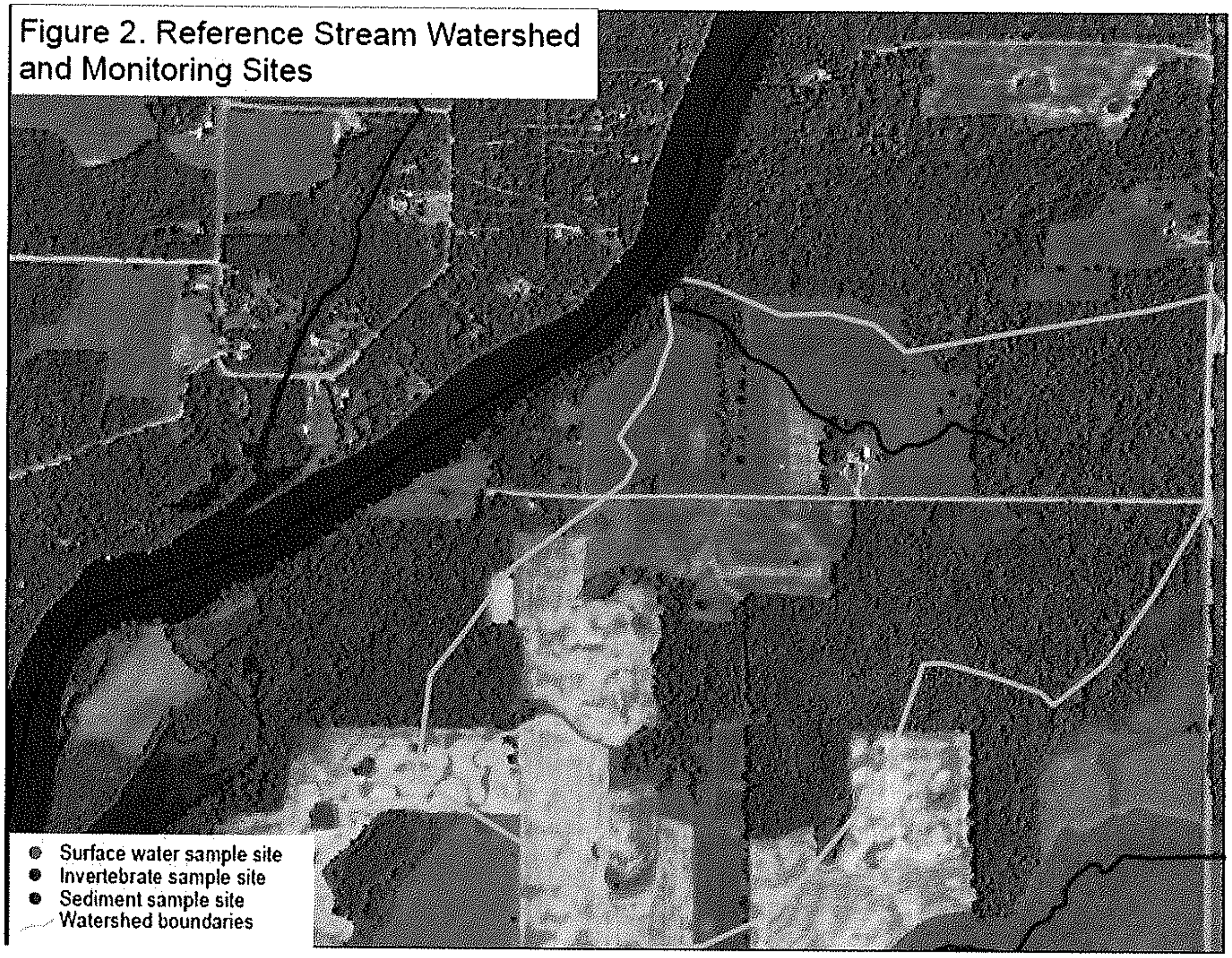


Figure 1. DNR Surface Water Monitoring Sites and Selected Watershed Boundaries at the Flambeau Mine
ND-15
SA-13
C8-2
BO-1
ED-14
SB-12
CP-4
MC3-3
SEB-11
C1-5
EB-6
Map Location
FA-8
SC-7
FB-9
MB-16

Figure 2. Reference Stream Watershed and Monitoring Sites



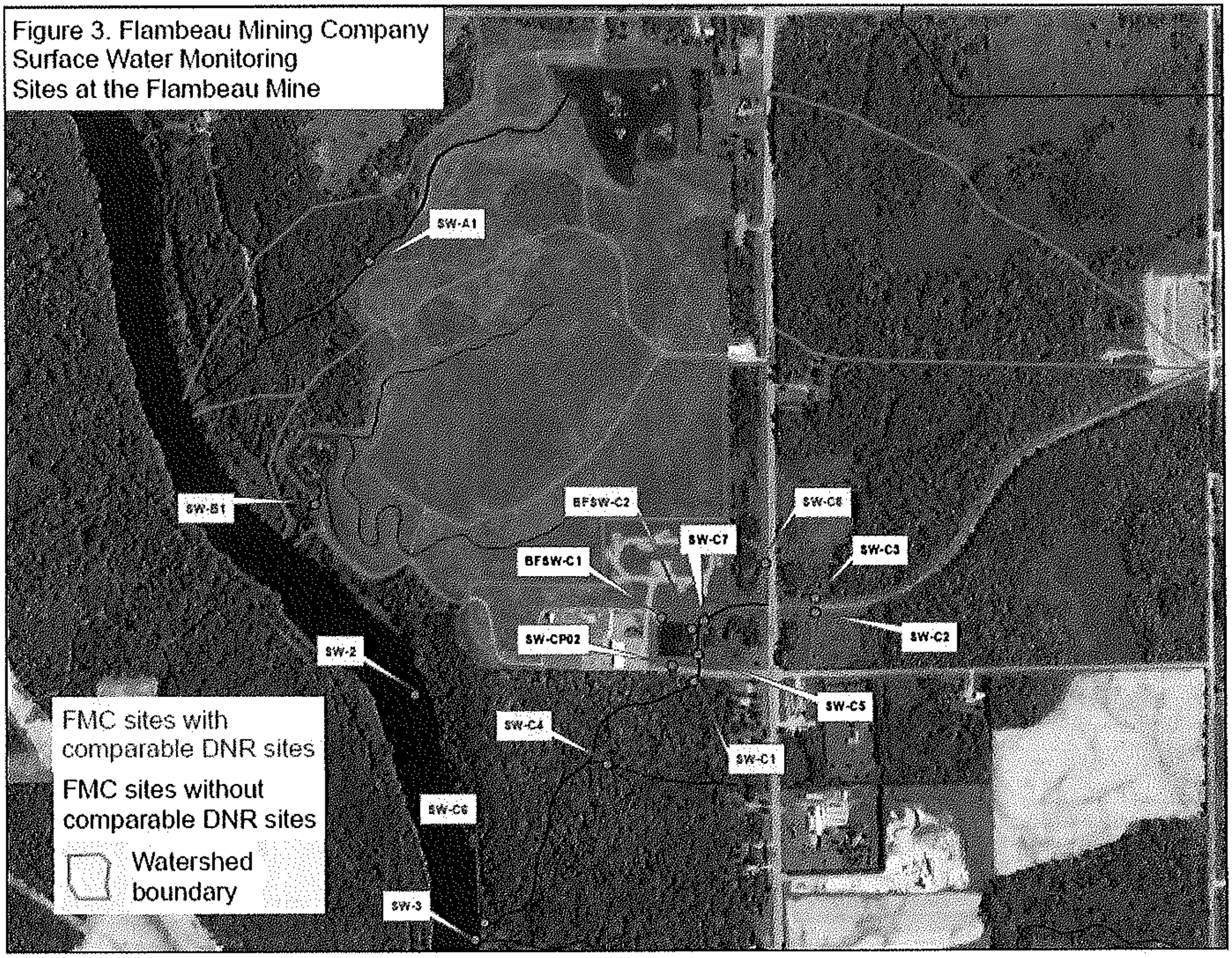


Figure 3. Flambeau Mining Company
Surface Water Monitoring
Sites at the Flambeau Mine
SW-A1
SW-B1
BFSW-C2
SW-C8
SW-C7
SW-C3
BFSW-C1
SW-CP02
SW-C2
SW-2
SW-C5
SW-C4
SW-C1
SW-C6
SW-3
FMC sites with
comparable DNR sites
FMC sites without
comparable DNR sites
Watershed
boundary

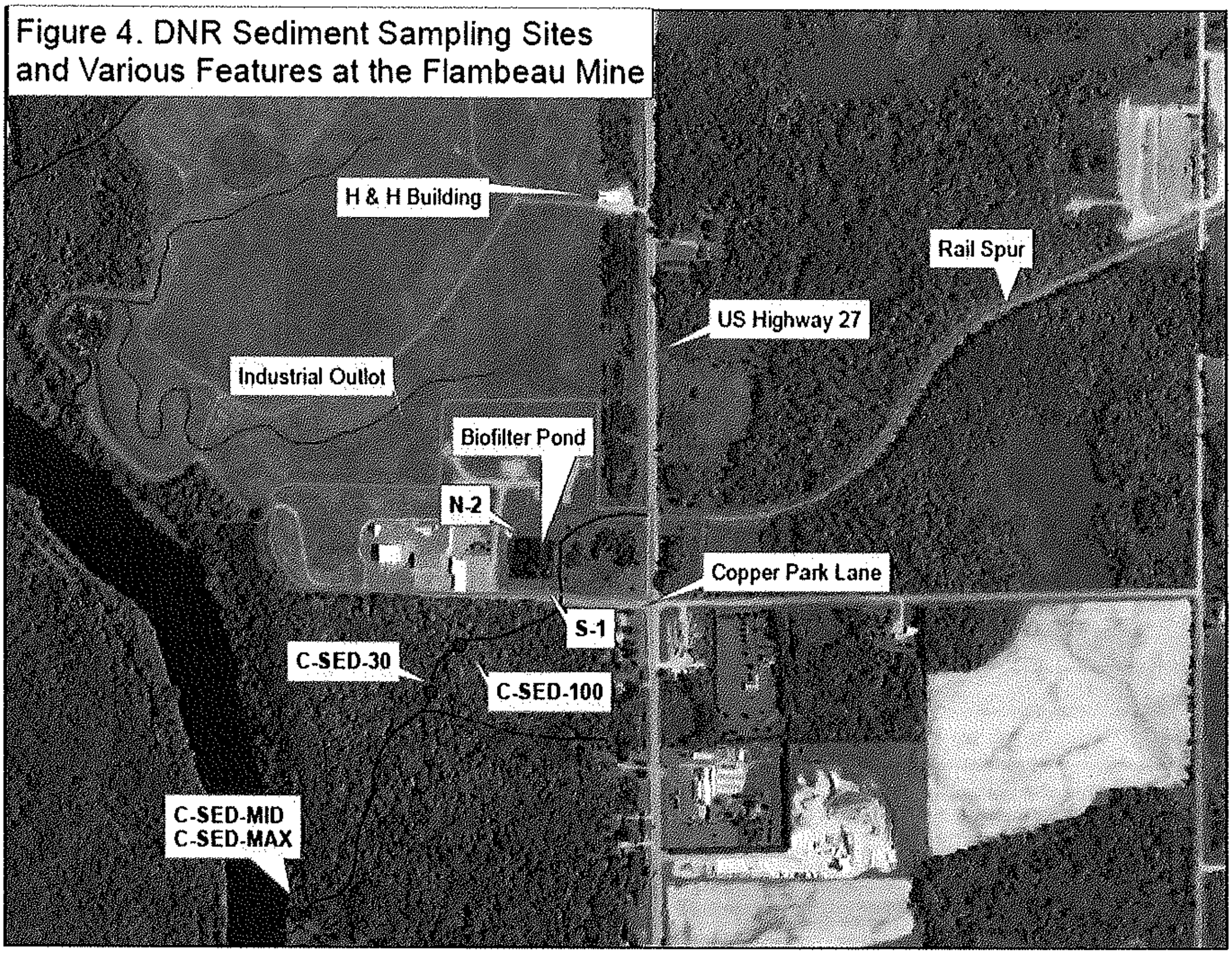


Figure 4. DNR Sediment Sampling Sites
and Various Features at the Flambeau Mine
H & H Building
Rail Spur
US Highway 27
Industrial Outlot
Biofilter Pond
N-2
Copper Park Lane
S-1
C-SED-30
C-SED-100
C-SED-MID
C-SED-MAX

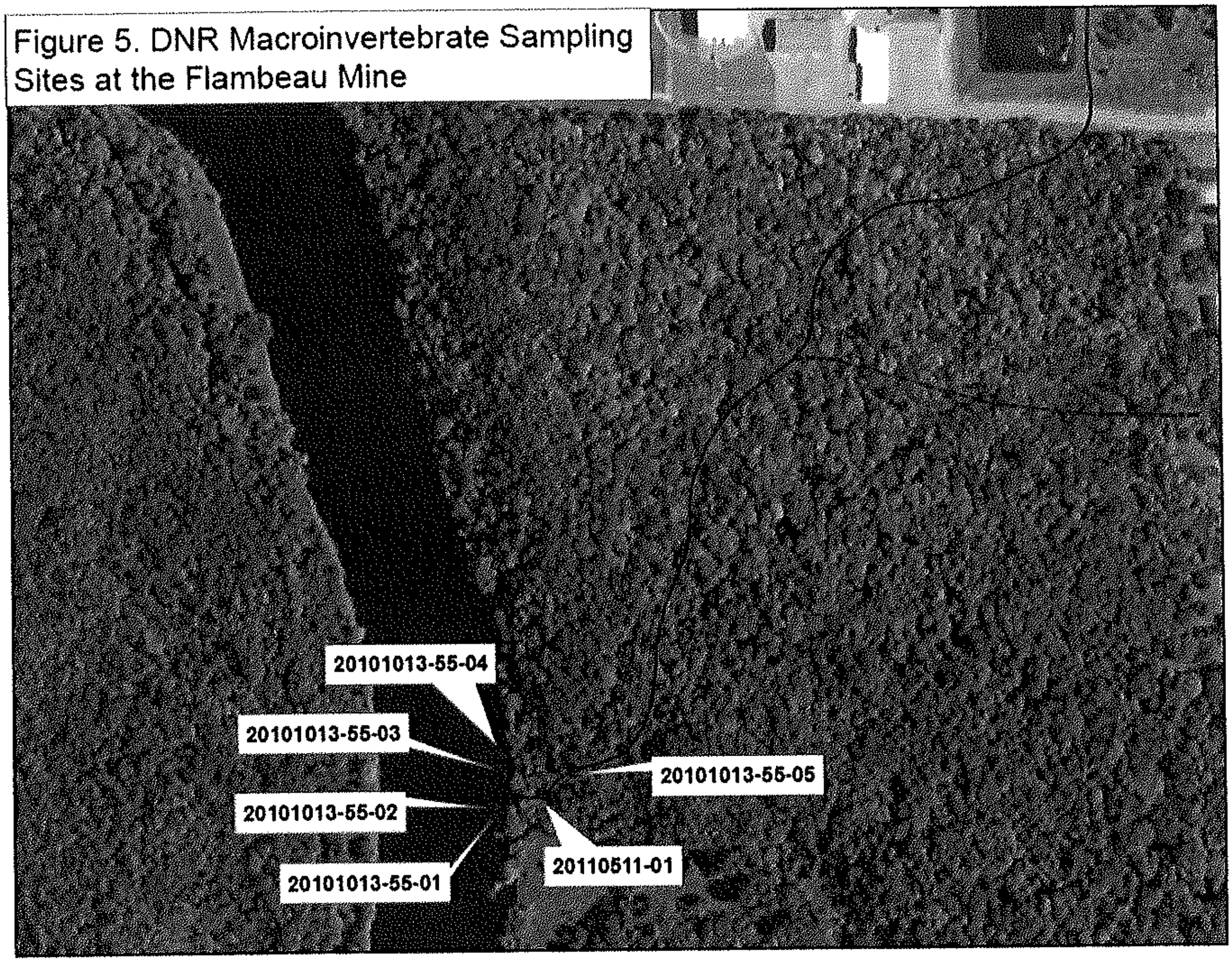
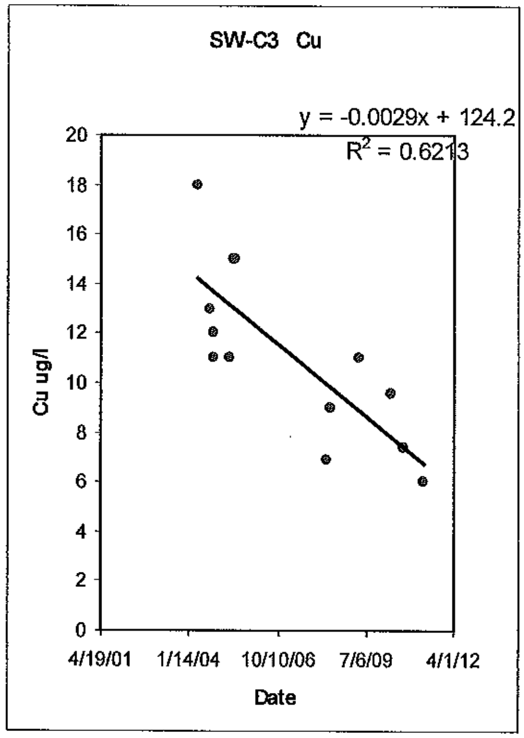


Figure 5. DNR Macroinvertebrate Sampling Sites at the Flambeau Mine

Figure 6. Copper Concentration Trends at Sites SW-C3 and SW-C8



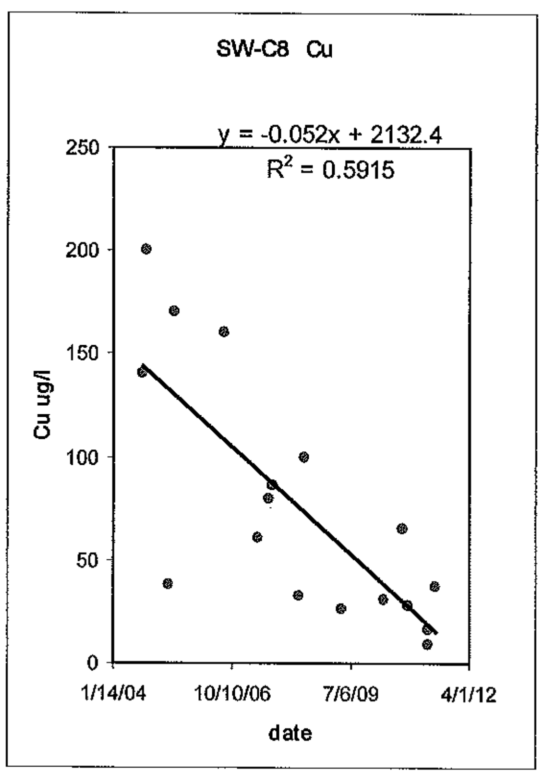
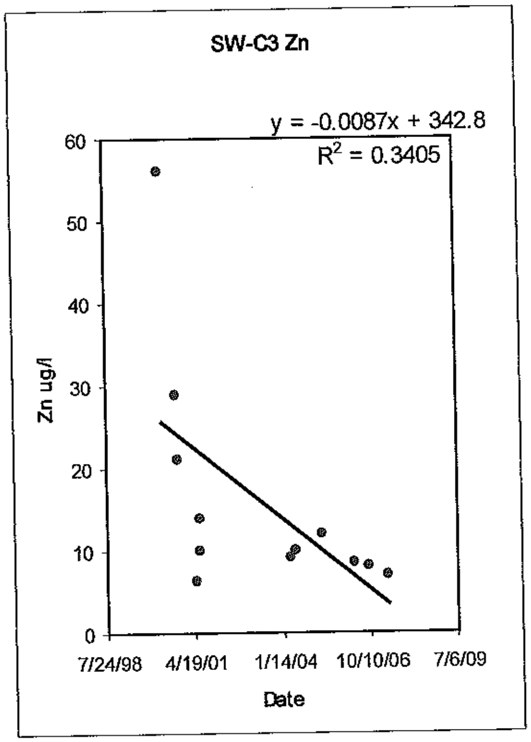
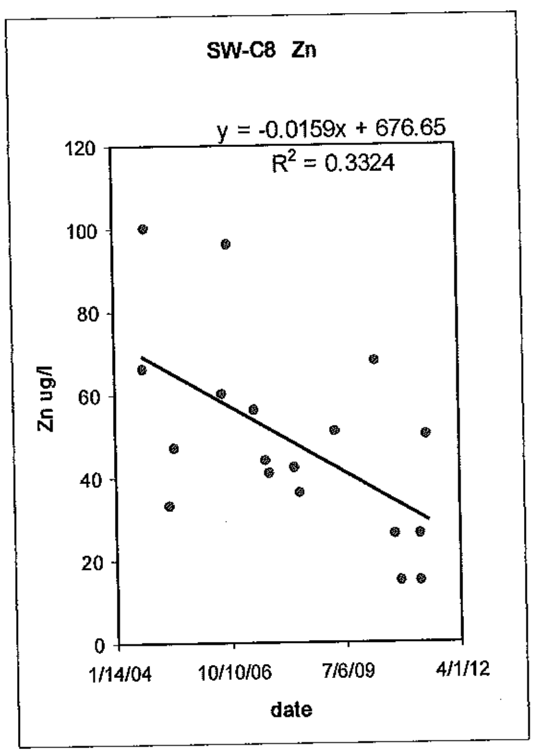


Figure 7. Zinc Concentration Trends at Sites SW-C3 and SW-C8





TABLES

TABLE 1. SURFACE WATER CONCENTRATION MEANS FOR THE FLAMBEAU MINE

Based on combined DNR and FMC data
***DNR monitoring site**

Site mean values

Stream C Watershed Sites	Copper ug/l	Zinc ug/l	Hardness mg/l CaCO3	Conductivity umhos/cm	Sulfate mg/l	Iron mg/l	Manganese ug/l	pH s.u.
SW-C3	11	27	16.8	45.9	7.7	0.93	134	6.6
SW-C2	12	47	10.6	29	2.5	0.19	11	6.2
MC3-3*	8	14	11.1	30.7	9.1	1.3	48	5.8
SW-C8 / C8-2*	93	48	20	356	7.2	1.77	153	6.4
SW-C7	26	233	25	128	9.6			6.7
BFSW-C1	651	99	51	220	38	0.32	168	6.7
BFSW-C2 / BO-1*	30	10	26	167	5.7	0.9	92	6.8
SW-C5	28	57	18.5	129	5.2	0.77	36	6.5
SW-CP-02	162	36	134	529	21	2.6	215	6.95
CP-4*	144	95	8	155	15.8	2.2	35	6.4
SW-C1/ C1-5*	27	52	19.7	123	6.7	1.2	62	6.6
SW-C4 / EB-6*	6.9	13	15.1	120	9	0.75	106	6.7
SW-C6 / SC-7*	19	34	36.5	142	9.4	1.42	101	6.6
SEB-11*	10	8.7	33.1	306	10.2	0.97	48	6.1
ED-14*	13	19	38.4	179	17.5	1.35	206	5.4
Stream C Watershed Site Means =	82.7	52.8	30.9	177.3	11.6	1.2	101.1	6.4
Other Sites								
SW-B1 / SB-12*	3	3.3	19.5	53	3.4	0.88	58	6.7
SW-A1 / SA-13*	2.7	4.8	25.5	72	6.1	0.75	43	6.8
SW-3 / FB-9*	2.7	7.3	42	108	7.2	0.88	93	7.2
SW-2 / FA-8*	1.5	4.6	40.5	98	6.6	0.64	76	7.3
RS-10*	2.2	6.4	42.7	90	8.3	1.24	110	6.5
ND-15*	20	32	9.6	158	11.6	1	63	5.6
MB-16*	4.6	40	56.2	119	10.1	1.33	250	7.3

TABLE 2. SUMMARIZED TOTAL RECOVERABLE COPPER AND ZINC CONCENTRATIONS FOR FLAMBEAU MINE SURFACE WATER MONITORING SITES

Arranged from lowest to highest mean copper concentrations

*DNR sites

**Concentrations below detection limits were assumed to be 1/2 of the detection limit for mean calculations

		Copper Concentrations (ug/l)			Zinc Concentrations (ug/l)		
Site	Description	Range	Mean**	No. of Samples	Range	Mean**	No. of Samples
SW-2 / FA-8*	Flambeau R. above Stream C	0.32 - 4	1.5	22	<2 - 8.8	4.6	22
RS-10*	Reference stream, 2 1/2 mi. SW of Stream C	<2 - 4	2.2	5	<3 - 13	6.4	5
SW-3 / FB-9*	Flambeau R. below Stream C	<1.3 - 5.6	2.7	10	<5 - 11	7.3	10
SW-A1 / SA-13*	Stream A at the Flambeau mine site	<1.3 - 5	2.7	7	<3 - 10	4.8	7
SW-B1 / SB-12*	Stream B at the Flambeau mine site	<1.3 - 5.9	3.0	9	<3 - 7.8	3.3	9
MB-16*	Meadow Brook	4.2 - 5	4.6	2	12 - 67	39.5	2
SW-C4 / EB-6*	East tributary to Stream C; enters below Copper Pk. Ln.	3.1 - 9	6.9	5	11 - 15	13	5
MC3-3*	Drainage from mostly S of rail spur, E of hwy. 27	2 - 15	8	3	11 - 17	14	3
SEB-11*	Smaller east tributary to Stream C; enters below Copper Pk. Ln.	6 - 15	10	3	6 - 11	8.7	3
SW-C2	Drainage along south side of rail spur	12 - 12	12	2	36 - 58	47	2
SW-C3	Drainage along north side of rail spur	6 - 18	12.4	13	6.4 - 160	27	13
ED-14*	Drainage from N of rail spur, east of hwy. 27	5 - 21	13	2	4 - 34	19	2
SW-C6 / SC-7*	Stream C near mouth	8 - 36	19.1	10	20 - 70	34	10
ND-15*	Hwy 27 ditch at Blackberry Ln	11 - 29	20	2	32 - 33	32.5	2
SW-C7	Stream C above biofilter outlet	14 - 41	25.8	4	38 - 600	233	4
SW-C1 / C1-5*	Stream C below Copper Pk Ln	9 - 77	27.5	13	37 - 78	52	13
SW-C5	Stream C below biofilter outlet, above Copper Pk. Ln.	9.1 - 74	28	19	32 - 100	57	19
BFSW-C2 / BO-1*	Biofilter outlet	4.8 - 67	30.2	19	<3 - 53	10	18
SW-C8 / C8-2*	Drainage along west side of hwy 27, just north of Stream C	9 - 390	92.8	18	15 - 100	48.4	18
CP-4*	Ditch along N side of Copper Pk Ln, east of Stream C	57 - 266	144	3	47 - 127	95.3	3
SW-CP-02	Ditch along N side of Copper Pk Ln, west of Stream C	56 - 340	162	4	31 - 41	36	2
BFSW-C1	Biofilter inlet	15 - 2000	651	18	4.7 - 365	99	17

TABLE 3. FLAMBEAU MINE DNR SEDIMENT SAMPLE DATA

BIOFILTRATION POND SEDIMENT DATA

		TEC/PEC's*:	9.8/33	0.99/5	43/110	32/150	20,000/40,000	36/130	460/1,100	0.18/1.1	23/49	120/460					
	SWIMS		arsenic	cadmium	chromium	copper	iron	lead	manganese	mercury	nickel	zinc	solids	solids	solids	solids	solids
Site	Sta. No.	Date	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	%	% volatile	%clay	%sand	%silt
S-1	10032169	12/22/2010	21	0.1	43.9	1,550	32,700	23	598	0.153	30	189	11.3	21.8	12	55	33
N-2	10032170	12/22/2010	25	< 0.1	46.5	2,450	33,400	26	487	0.186	33	186	27.9	12.3	17	41	42

Site	Latitude	Longitude	Description
S-1	45.43703	-91.11333	3 ft. water depth; 4.5 in. of dark brown fines with Nitella (an algae) at surface, underlain by 1.5 in. brown sandy layer, underlain by clayey layer
N-2	45.4372	-91.11337	5 ft. water depth; 4.5 in. of dark brown fines, unerlain by clayey layer

Samples were collected with stainless steel Eckmann dredge. Top 4 in. of sediment was sampled.

STREAM SEDIMENT DATA

		TEC/PEC's*:	9.8/33	0.99/5	43/110	32/150	20,000/40,000	36/130	460/1,100	0.18/1.1	23/49	120/460					
	SWIMS		arsenic	cadmium	chromium	copper	iron	lead	manganese	mercury	nickel	zinc	solids	solids	solids	solids	solids
Site	Sta. No.	Date	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	%	% volatile	%clay	%sand	%silt
CSED-MID	10031970	05/11/2011	3	<0.1	9.6	14.1	8630	6	419	0.018	6	50	66.9	3.1	0	90	10
CSED-MAX	10031970	05/11/2011	5	<0.1	10.2	10.5	15500	5	481	0.02	9	46	73.8	2.6	5	89	6
CSED -30	10033614	05/11/2011	4	<0.1	10.7	13.1	12400	5	225	<0.015	7	45	72.6	2.4	5	78	17
CSED-100	10033615	05/11/2011	3	<0.1	18.9	17	7770	4	483	<0.015	7	55	36.4	10.9	1	80	19
RSED-MID	10031973	05/11/2011	4	<0.1	8.4	5.1	11000	3	258	<0.015	6	24	71	1.9	3	94	3
RSED-MAX	10031973	05/11/2011	4	<0.1	9.3	5.7	13700	4	391	<0.015	7	30	53.1	5.3	5	89	6

Site	Latitude	Longitude	Description
CSED-MID	45.43235	-91.1178	10 m upstream of stream C mouth; 0.5 ft. water depth; medium brown sandy sediment, with some organic debris
CSED-MAX	45.43235	-91.1178	10 m upstream of stream C mouth; 1 ft. water depth; medium brown sandy sediment
CSED -30	45.43525	-91.11511	30 m upstream of horse bridge on stream C; 0.5 ft. water depth; medium brown sandy sediment

TABLE 3. FLAMBEAU MINE DNR SEDIMENT SAMPLE DATA (Cont.)

Site	Latitude	Longitude	Description
CSED-100	45.4358	-91.11533	100 m upstream of horse bridge on stream C; 0.8 ft. water depth; medium brown sandy sediment with decaying leaves
RSED-MID	45.42125	-91.16392	15 m upstream of reference stream mouth; 0.7 ft. water depth; medium brown sandy sediment
RSED-MAX	45.42125	-91.16392	16 m upstream of reference stream mouth; 1.2 ft. water depth; medium brown sandy sediment with some decaying leaves

Samples were collected with a stainless steel trowel. Top 0.2 ft. of sediment was sampled.

*TEC's are threshold effect concentrations at which toxicity to benthic dwelling organisms is unlikely.
PEC's are probable effect concentrations a which toxicity to benthic dwelling organisms is probable. (DNR, 2003)

TABLE 4. FLAMBEAU MINE FISH SURVEYS, 2010-2011

FLAMBEAU MINE STREAM C AND REFERENCE STREAM FISH SURVEY DATA, 09-27-2010

Single upstream pass with backpack shocker used.

Stream	Segment End Points	Segment length (m)	Number of fish	Number of rusty crayfish	No. fish per 100 m	No. crayfish per 100 m	No. of fish species
Stream C flow 0.26 cfs Temp 7.7C, D.O. 7.9 mg/l	mouth to Copper Park Lane culvert @ 45.43644 91.1127	912	57	7	6	0.8	6
Reference stream flow 0.21 cfs Temp 10.1C, D.O. 5.0 mg/l	30 m above mouth* to start of grass swale @ 45.4203 91.16227	165	46	6	28	3.6	3

*high water in Flambeau River prevented start at mouth

Stream C fish species	Number captured
brook stickleback	23
creek chub	18
central mudminnow	10
fathead minnow	4
pumpkinseed	1
yellow perch	1
Total	57

Reference stream fish species	Number captured
white sucker	23
creek chub	22
fathead minnow	1
Total	46

TABLE 4. FLAMBEAU MINE FISH SURVEYS, 2010-2011 (Cont.)

FLAMBEAU MINE STREAM C AND REFERENCE STREAM FISH SURVEY DATA, 05-06-2011

Single upstream pass with backpack shocker used.

Stream	Segment End Points	Segment length (m)	Number of fish	Number of rusty crayfish	No. fish per 100 m	No. crayfish per 100 m	No. of fish species
Stream C flow 0.21 cfs Temp 6.7C, D.O. 11.8 mg/l	mouth to Copper Park Lane culvert @ 45.43644 91.1127	912	146	1	16	0.1	6
Reference stream flow 0.12 cfs Temp 13.2 C, D.O. 8.7 mg/l	mouth to start of grass swale @ 45.4203 91.16227	195	37	1	19	0.5	4

Stream C fish species	Number captured
creek chub	75
brook stickleback	32
fathead minnow	19
central mudminnow	11
white sucker	8
nothern red bellied dace	1
Total	146

Reference stream fish species	Number captured
creek chub	25
white sucker	7
fathead minnow	4
central mudminnow	1
Total	37

FLAMBEAU MINE BIOFILTER POND FISH SURVEY, 10-05-2010

Backpack shocker used along 200 ft. of shoreline at northeast corner of pond.

Abundant filamentous algae and cattails limited capture efficiency.

Fish species	Number captured	Lengths in inches
fathead minnow	8	1.8, 1.3, 1.1, 1.2, 1.5, 1.6, 1.3, 1.3
central mudminnow	2	3.5, 3.3
brook stickleback	1	1.2

TABLE 5. FLAMBEAU MINE STREAM MACROINVERTEBRATE INDICES

October 13, 2010 samples

SWIMS Station No.	Site Description	Macroinvertebrate IBI	Value Description	Hilsenhoff BI	Value Description	No. of Species
10032094	Flambeau R. 5m UST of stream C mouth	3.65	fair	2.60	excellent	14
10032095	Flambeau R. 10m UST of stream C mouth	4.69	fair	2.90	excellent	19
10032092	Flambeau R. 6m DST of stream C mouth	6.38	good	3.90	very good	22
10032093	Flambeau R. 10m DST of stream C mouth	8.01	excellent	3.57	very good	22
10032099	Flambeau R. 279m UST of ref. stream mouth	5.59	good	3.81	very good	15
10032100	Flambeau R. 278m UST of ref. stream mouth	6.20	good	3.73	very good	18
10032097	Flambeau R. 12m DST of ref. stream mouth	3.54	fair	2.40	excellent	21
10032098	Flambeau R. 16m DST of ref. stream mouth	3.84	fair	2.32	excellent	23
10032096	Stream C 70m UST of mouth	8.74	excellent	6.98	fairly poor	27
10032101	Ref. stream 33m UST of mouth	4.26	fair	7.45	fairly poor	13

May 11, 2011 samples

		Macroinvertebrate IBI	Value Description	Hilsenhoff BI	Value Description	No. of Species
10031970	Stream C 35m UST of mouth	7.01	good	4.63	fair	17
10031973	Ref. stream 40m UST of mouth	1.17	poor	4.51	fair	17

TABLE 6. MACROINVERTEBRATE SAMPLING SITE DESCRIPTIONS FOR THE FLAMBEAU MINE

FIELD NO.	SITE DESCRIPTION	LATITUDE	LONGITUDE	SWIMS ID NO.	WBIC
20101013-55-01	Flambeau R. 10m downstream of stream C mouth	45.43236	91.11788	10032092	2225000
20101013-55-02	Flambeau R. 6m downstream of stream C mouth	45.43235	91.11787	10032093	2225000
20101013-55-03	Flambeau R. 5m upstream of stream C mouth	45.43246	91.11776	10032094	2225000
20101013-55-04	Flambeau R. 10m upstream of stream C mouth	45.43275	91.11784	10032095	2225000
20101013-55-05	Stream C 70m upstream of mouth	45.43245	91.11732	10032096	
20101013-55-06	Flambeau R. 12m downstream of reference stream mouth	45.42142	91.16415	10032097	2225000
20101013-55-07	Flambeau R. 16m downstream of reference stream mouth	45.42141	91.16415	10032098	2225000
20101013-55-08	Flambeau R. 279m upstream of reference stream mouth	45.42362	91.16265	10032099	2225000
20101013-55-09	Flambeau R. 278m upstream of reference stream mouth	45.42361	91.16265	10032100	2225000
20101013-55-10	Reference stream 33m upstream of mouth	45.42105	91.16393	10032101	5006202
20110511-55-01	Stream C 35m upstream of mouth	45.43242	91.11746	10031970	
20110511-55-02	Reference stream 40m upstream of mouth	45.42109	91.16393	10031973	5006202

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"Technical Support for Grassroots Public Interest Groups"

Report on Groundwater and Surface Water Contamination at the Flambeau Mine

David M Chambers, Ph.D.
Kendra Zamzow, Ph.D.

Center for Science in Public Participation

June 5, 2009

The Center for Science in Public Participation provides technical advice to public interest groups, non-governmental organizations, regulatory agencies, mining companies, and indigenous communities on the environmental impacts of mining. CSP² specializes in mining, especially with those issues related to water quality impacts and reclamation bonding.

SURFACE WATER

The Flambeau Mine, an open-pit copper-gold-silver mine located near Ladysmith, Wisconsin was permitted in January 1991 and began production in 1993. The ore body, characterized as a "Precambrian supergene enriched massive sulfide deposit,"[1] yielded 181,000 tons of copper, 334,000 ounces of gold and 3.3 million ounces of silver over the mine's brief four-year lifespan.[2] Approximately 4.5 million tons of waste rock characterized as "high sulfur" and 4 million tons of "low sulfur" waste were generated and stockpiled on site for eventual return to the pit.[3]

When mine operations ceased in 1997, the open pit was 220 feet deep, a half mile long and 32 acres in size. Backfill operations commenced promptly, and over 30,000 tons of limestone was blended into the sulfide-bearing waste rock on relocation.[4] In addition, a layer of non-acid generating waste was placed on top of the acid-generating waste backfilled into the pit. Although groundwater has infiltrated the backfilled pit, the combination of neutralizing limestone and submergence of the acid-generating material in water, which limits the availability of oxygen, is meant to slow the generation of acid and dissolution of metals in this material to an acceptable amount.

Backfill operations were completed by early 1998, at which time surface reclamation began. This entailed recontouring the surface, spreading topsoil and establishing plant communities. In late 2001 a Notice of Completion for reclamation activities was submitted to the state regulatory agency, followed by a mandatory four-year monitoring period.

A partial Certificate of Completion for reclamation activities was granted in May 2007 subsequent to an agreement negotiated between opposing parties at a contested case hearing. Groundwater contamination within the backfilled pit, exceedances of applicable groundwater standards at the mine's legally-

[1] "Flambeau – A Precambrian Supergene Enriched Massive Sulfide Deposit," *Geoscience Wisconsin*, July 1977
[2] Flambeau Mining Company, 2007 Annual Report, January 2008, pg 3
[3] Flambeau Mining Company, 1997 Backfilling Plan for Stockpiled Type II Material, March 1997, pg ii-iii
[4] Flambeau Mining Company, 2007 Annual Report, January 2008, pg 3

established intervention boundary, and data related to potential impacts of the mine on macroinvertebrates, sediment, crayfish, and walleye in the Flambeau River were not assessed as part of the certification process and therefore did not factor into the decision. Rather, partial certification for the site was based upon completion of backfill operations according to plan and successful revegetation of the surface. Due to ongoing problems with surface water pollution in a small creek that receives runoff from the mine site, certification was withheld for a 32-acre section of the mine site known as the Industrial Outlot. The Industrial Outlot includes the area where the mine's rail spur, runoff and surge ponds, water treatment plant and administrative building were located during the mining years, as well as a portion of the high sulfur waste rock stockpile.

During mining, water was pumped from the pit to keep it relatively dry. This pumping caused a groundwater cone of depression to form around the pit, directing all groundwater flow during mining toward the pit. At mine closure the pumping ceased and natural groundwater flow patterns were restored. The southwestern edge of the pit is 140 feet from the Flambeau River. The pit is separated from the Flambeau River by a slurry cutoff wall designed to limit groundwater flow to/from the river both during and after mining. The post-mining groundwater hydrology is described as flow from the pit towards the Flambeau River (see Figure A and Figure B).

Ore from the mine received only minimal processing at the mine site. An ore crusher was positioned close to a mine site rail terminal, and from there the ore was shipped to Canada for further processing. During mining, water pumped from the pit that came in contact with acid-generating rock and contaminated water from the mine's high sulfur waste rock stockpile was routed to a surge pond and from there to an onsite water treatment plant. After mining ceased, the reclamation plan was modified to allow the surge pond to stay in place, and the pond was modified to facilitate its use as a biofilter for treating water collected from the southeast corner of the mine site where the Industrial Outlot is located (see Figure C). This wetland, the "Outlot (0.9 acre) Biofilter," now discharges into Stream C, which flows into the Flambeau River (See Figure D).

There are presently two areas of concern with regard to contamination of water coming from the reclaimed mine site.

First: Water discharged from the Outlot Biofilter wetland into Stream C does not meet Wisconsin surface water quality standards. This water flows into the Flambeau River.

Second: Groundwater in a monitoring well between the pit and the Flambeau River (on the Flambeau River side of the slurry wall separating the pit from the river) does not meet Wisconsin groundwater quality standards.

Stream C

Stream C originates in an area just northeast of where the rail spur was located during mining, and then flows through the eastern portion of the Industrial Outlot where the discharge from the Outlot Biofilter joins it. Stream C flows southwest for approximately one half mile and discharges directly into the Flambeau River. Today the stream is relatively small and has little aquatic life. The pre-mining data is insufficient to document the flow or extent of aquatic life.

Stream C is classified as "navigable" and "intermittent." Presence of aquatic life in Stream C has been documented when it is flowing, and observation of unimpacted streams in the vicinity suggests that aquatic life was probably present before mining. Flow in Stream C is not likely to have been increased by mining activity and reclamation, since the backfilled pit constitutes a preferential flow path away from Stream C, and the industrial activities at the present site (roads, parking lots, buildings, etc.) would enhance stormwater runoff and lessen stream base flow related to groundwater recharge.

Stream C Water Quality

There appears to be no quantitative or qualitative pre-mining water quality data for Stream C, but there is nothing to indicate that the pre-mining background levels of copper in Stream C were at the levels measured post-mining. All indications appear to be that Stream C was much like other streams in this area – relatively clean water with low copper content. It is interesting to note that the discharge from the wetland/biofilter is a direct point discharge into a water of the State/US, hence could or should be governed by the discharge permit requirements of the Clean Water Act.

Water quality data for Stream C has been recorded only sporadically. In 2004-2005 Foth & Van Dyke of Green Bay, Wisconsin, recorded data from multiple Stream C locations on four different days. Although this may not be a true synoptic sample, it is probably as close as can be had to synoptic data for this site. Of the analytes recorded in the data for Stream C it appears that copper is a contaminant of significant concern. This is potentially significant since aquatic organisms are not only very sensitive to copper,[5] but also sensitive to changes in copper over background levels.[6]

At the present time the levels of copper in the discharge from the wetland/biofilter, and from Stream C into the Flambeau River, both exceed Wisconsin water quality standards.

The data in Table 1 is taken from the report "Stream C - 2005 Analysis of Collected Data," Foth & Van Dyke, October 10, 2005, Figure 2; and, "2008 Monitoring Results and Copper Park Lane Work Plan," Foth Infrastructure & Environment, Table 1 – 2008 Monitoring Results. The full Foth & Van Dyke Figure 2, which contains most of the reported surface water data from Stream C, is attached as Figure E. The data for two of these sites is presented in Table 1 – station BFSW-C2, the outlet from the wetland/biofilter, and station SW-C6, Stream C just before it flows into the Flambeau River.

Table 1: Stream C Water Quality Data

	Date						
*from WAC NR 105.06 (Nov08)	15Sep04	23Oct04	26Apr05	09Jun05	25Apr08	8Jun08	27Oct08
Biofilter Outlet BFSW-C2							
Copper (Cu) (µg/L)	67	28	27	46	22	8.8	16
Hardness (mg/L)	24	24	29	32	27	19	17
pH, Lab (s.u.)	6.37	6.64	6.82	6.85	7.63	7.31	6.83
Chronic Copper Water Quality Standard based on Hardness (µg/L)*	3.1	3.1	3.6	3.9	3.4	2.5	2.3
Acute Copper Water Quality Standard based on Hardness (µg/L)*	4.0	4.0	4.8	5.3	4.5	3.2	2.9
Stream C Outlet SW-C6							
Copper (Cu) (µg/L)	34	15	14	36	no data	no data	no data
Hardness (mg/L)	35	82	39	31	no data	no data	no data
pH, Lab (s.u.)	6.20	6.52	7.19	6.67	no data	no data	no data
Chronic Copper Water Quality Standard based on Hardness (µg/L)*	4.2	8.7	4.6	3.8	no data	no data	no data
Acute Copper Water Quality Standard based on Hardness (µg/L)*	5.8	12.9	6.4	5.1	no data	no data	no data

[5] Hall et al. 1988, Eisler 2000, Baldwin et al. 2003
[6] Baldwin et al. 2003

It can be seen that the copper level in the water entering Stream C from the wetland/biofilter is approximately a factor of two higher than the copper level in the discharge from Stream C as it entered the Flambeau River. It would be expected that some dilution would occur as water in Stream C gets closer to the Flambeau River because of the diluting effect of the unnamed stream that enters Stream C approximately half way between the wetland/biofilter discharge point to Stream C and where Stream C enters the Flambeau River. It is also probable that there is some groundwater recharge to Stream C.

It should be noted that copper in Stream C, as shown in Table 1, exceeds Wisconsin water quality standards both at the discharge from the wetland/biofilter and from Stream C as it flows into the Flambeau River.

The water quality standard for copper is a function of the hardness of the water. Since hardness data was available, the calculated hardness-dependent values for the chronic and acute copper standard are also listed in Table 1. As can be seen from this table, both the chronic and acute standard for copper was exceeded on each day for which data was recorded.

In the 2008 Foth report a proposal to remove and replace soil from the Copper Park Lane drainage ditch is discussed. It is clear from the monitoring data that copper is coming from the drainage ditch and is loading Stream C downstream of the biofilter. The removal of the surface material in the Copper Park Lane drainage ditch should help lower the level of copper in Stream C. However, it is also clear that the level of copper coming from the biofilter itself is still enough to cause an exceedance of Wisconsin water quality standards at Stream C at the mine boundary.

It was noted in the Foth & Van Dyke report:

> "The stream appears to be very limited in biota in all aspects including aquatic vegetation, macroinvertebrate populations, and fish."[7]

A slight increase in the level of copper can form a barrier to the migration of fish.[8] Stream C flows into the Flambeau River immediately upstream of Meadowbrook Creek. Copper could potentially impact the migration of fish into and out of Meadowbrook Creek.

With copper levels significantly exceeding both chronic and acute water quality criteria, it is likely that these high metal levels are contributing to the lack of aquatic life in Stream C. These levels also suggest that better monitoring of Stream C and the Flambeau River below Stream C should be done.

The discharge from the outlet of the wetland treatment system should meet Wisconsin water quality standards at that point. There is not enough dilution in Stream C to effectively dilute contaminants, so any contaminant will impact aquatic organisms along most or all of the length of Stream C. Because of this fact, Stream C is being presently used as a conduit for contaminated water from the mine site to the Flambeau River, where dilution by the large volume of water in the river occurs.

Surface water data from 2008 shows that at SW-C5 (below the biofilter discharge to Stream C, but above the contribution from the Copper Park Lane ditch) the copper level is approximately 10 times the hardness-based acute water quality standard, and the zinc level is approximately twice the hardness-based acute water quality standard.[9] Copper and zinc are synergistic metals, so their combined impact on aquatic organisms is greater than that of either by itself.

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[7] Foth & Van Dyke, 2005, p.4
[8] Baldwin et al. 2003, van Aardt et al. 2007
[9] Foth Infrastructure & Environment, 2008, Table 1 – 2008 Monitoring Results

Surface water data has been simultaneously sampled only three times at SW-2 (Flambeau River below the mine site) and SW-3 (Flambeau River just below Stream C, and below SW-2). On all three sampling dates the copper level is greater at SW-3, below the outlet of Stream C, than at SW-2. On April 25, 2008, the sample data for SW-3 show the copper level is approximately double the Wisconsin chronic water quality standard, while the copper level at SW-2 is below the standard.[10] The measured level for copper at SW-3 in the Flambeau River was 5.6 ug/L, while the hardness-based copper water quality standard is 3.2 µg/L for chronic effects, and 4.2 µg/L for acute effects. The copper level measured exceeds both the chronic and acute standards. If the copper is coming from Stream C, as would be likely, then it is probably being diluted to below the water quality standard as it enters the Flambeau River just above SW-3. Dilution of water from Stream C would constitute a "mixing zone" under a discharge permit which would extend below SW-3. At present no permit or authorized mixing zone exist.

Table 2: Flambeau River Water Quality Data

	Date		
***from WAC NR 105.06 (Nov08)**	**21Sep07**	**25Apr08**	**27Oct08**
SW-2 (Flambeau River at Mine Boundary)			
Copper (Cu) (µg/L)	<1.3	2.8	1.8
Hardness (mg/L)	60	27	57
pH, Lab (s.u.)	7.94	7.54	8.26
Chronic Copper Water Quality Standard based on Hardness (µg/L)*	6.7	3.4	6.4
Acute Copper Water Quality Standard based on Hardness (µg/L)*	9.6	4.5	9.1
SW-3 (Flambeau River below Stream C)			
Copper (Cu) (µg/L)	4.2	5.6	2.7
Hardness (mg/L)	53	25	56
pH, Lab (s.u.)	7.83	7.46	8.25
Chronic Copper Water Quality Standard based on Hardness (µg/L)*	6.0	3.2	6.3
Acute Copper Water Quality Standard based on Hardness (µg/L)*	8.5	4.2	9.0

In order to address the question of whether the increase in copper at SW-3 is coming from Stream C, water quality samples should be taken in Stream C just prior to its discharge point into the Flambeau River. This could be easily accomplished by reactivating sampling station SW-C6, which was sampled from September, 2004 to June, 2005.

At the present time the levels of copper in the discharge from the wetland/biofilter, and from Stream C into the Flambeau River, both exceed Wisconsin water quality standards. This discharge of copper appears to be impacting the water in the Flambeau River, as measured at SW-3 just downstream of the junction of Stream C with the river.

Recommendation: ***In order to address the question of the amount of copper contamination entering the Flambeau River from Stream C, and the increase in copper at SW-3, water quality samples should be taken in Stream C just prior to its discharge point into the Flambeau River. This should be done by reactivating sampling station SW-C6, which was sampled from September, 2004 to June, 2005.***

[10] Foth Infrastructure & Environment, 2008, Table 1 – 2008 Monitoring Results

An increase in monitoring frequency would better establish the risk presently being posed to aquatic organisms in the Flambeau River. Presently surface water sampling is being done twice per year.

Recommendation: ***Until it can be demonstrated that the water quality in Stream C, and in the Flambeau River below Stream C, is not being impacted by mine-related contamination, sampling in Stream C and at SW-3 in the Flambeau River, and at SW-1 and SW-2 in order to provide background water quality information, should be done at least quarterly. This frequency should be maintained for at least 5 years after water quality exceedances cease.***

Copper is demonstrably the contaminant of concern. The monitoring recommendation above is the minimum necessary to adequately monitor water quality to determine the presence/absence of copper contamination. A more thorough monitoring program would also look for the presence of other potential contaminants, since it is rare that only one metal is present at elevated levels.

Recommendation: ***It is also recommended that once per year, in the spring sampling event, a full suite of metals and their associated indicator parameters be sampled, until water quality exceedances cease. These parameters should include Conductivity (field), pH (field), Total Suspended Solids, Total Dissolved Solids, Aluminum, Arsenic, Cadmium, Chromium, Cobalt, Copper, Lead, Mercury, Nickel, Selenium, Silver, Uranium/Radioactivity, Zinc, Hardness, Iron, Manganese, and Sulfate.***

Potential Mitigation Measures for Stream C

In reviewing the Foth & Van Dyke data for Stream C it is also evident that the portion of Stream C above the junction with the wetland/biofilter also carries significant copper, and possibly some zinc contamination (See Figure E, station SW-C8). In general the data also indicates the pH is normal, with some fluctuations, and the sulfate level is low. These would all suggest that metals are being sequestered in the wetland/biofilter, but that copper may be attached to suspended sediment or organic particles flowing from the wetland/biofilter. It could also be that there is just too much copper to be effectively filtered by the existing wetland. There is little data available on total suspended solids to correlate with the available water quality data.

In either case an expanded wetland/biofilter could be constructed to give more residence/treatment time to remove copper not only from the mine site drainage, but also to include water from the upper portion of Stream C above the Lot, which also shows indications of contamination.

GROUNDWATER

The long term closure plans of the Flambeau Mining Company included backfilling the open pit with waste rock, sludge, and limestone and allowing the pit to fill with groundwater. This will submerge the rock to limit oxygen and oxidative reactions. However, this placement of reactive rock surfaces in contact with water will result in long term reactions within the pit that are unlikely to stabilize in the near future. Rock surfaces are reactive in terms of redox chemistry and solubility, resulting in localized reactions that form acid, dissolved metals, and secondary mineral oxides. To date it appears that backfilling has not resulted in additional acid production, but metal leaching is occurring and complex pit chemistry is difficult to predict over the long term. Some current and future issues include

- Solubility/precipitation reactions within the pit
- Depletion/passivation of limestone
- Dissolution and flushing of material out of the pit

Reactions within pit

To monitor pit chemistry, two pit monitoring well nests (MW-1013 and MW-1014) were constructed in September 1998 after the backfill had roughly a year to settle (see Figure F for well positions in pit). Wells were nested in order to sample water at different depths (24', 47', 86', 202' for MW-1013; 34', 64', 105', and 157' for MW-1014).

Groundwater only fully rebounded in pit wells (MW-1013, MW-1013A, MW-1014) in 2005, therefore some wells have only three years worth of water quality data. It has been recognized by FMC that pit reactions have not stabilized,[11] and that reactions (dissolution and precipitation of metals and ions) are controlled by pH and redox.[12] The long term stable condition of the pit will not be determined until redox and pH are stable. Redox continues to fluctuate in pit wells, particularly in the more shallow screens.[13] The pH is controlled by dissolution of limestone intentionally mixed with waste rock to control acid. It may take hundreds of years for the limestone to completely dissolve as FMC states,[14] but limestone could become ineffective much sooner if secondary minerals (hydroxides and carbonates) precipitate and coat limestone. If/when limestone stops going into solution, pH may drop and significantly affect the concentrations of minerals in solution.

Pit Chemistry

Sampling has indicated and continues to indicate that pit chemistry reactions have not stabilized. Manganese, copper, iron, zinc and redox remain in flux within the pit wells. This is likely due in part to localized oxidation reactions between waste rock and sludge: ferric iron (Fe^{3+}) that precipitated during mine-water treatment remains in sludge, and is available to oxidize the pyrite present in waste rock. This results in the release of ferrous iron (Fe^{2+}) and acid in localized pockets even under anoxic conditions:

$$FeS_2 + 8\,H_2O + 14\,Fe^{3+} \rightarrow 15\,Fe^{2+} + 2\,SO_4^{2-} + 16\,H^+$$

Where acid (H^+) is generated, dissolution of minerals – particularly of copper and manganese from sulfidic waste rock – will occur. To date, reactions continue to occur within the pit, as demonstrated by

- Increase of copper in MW-1013B
- Increases in manganese and iron in MW-1013C

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11 Flambeau Mining Company. 2007 Annual Report.
12 Foth and Van Dyke/SRK Consulting memorandum. Oct 12 2000. In Flambeau Mining Company 2000 Annual Report.
13 SRK Consulting memorandum Jan 25 2008 in Flambeau Mining Company 2007 Annual Report, Figures 14-15.
14 Flambeau Mining Company 2000 Annual Report

- Manganese decreases in MW-1014A and MW-1014B
- Iron decreases and loss of gypsum in MW-1014C
- Increasing redox in MW-1014A and decreasing redox in MW-1013A

Because the mixture within the pit is not homogenous, different reactions can be expected to occur and at different rates, making it quite difficult to develop accurate models.[15] Models for the Flambeau mine pit groundwater were generated in 1989, when the Mining Permit Application was submitted to the state regulatory agency for review. Specifically, the application included a data table entitled "Predicted Parameter Concentrations of Contact Groundwater Leaving the Backfilled Pit"[16] that is reproduced here for review (see Table 3). The table has utility from two viewpoints: (1) it summarizes projected water quality for pit water; and (2) per the terms of the Flambeau Mine Permit, it defines the applicable groundwater enforcement standards for monitoring wells MW-1000 and MW-1010 located between the backfilled pit and the Flambeau River.[17]

Table 3: Predicted Concentrations of Groundwater Contaminants[18]

TABLE NO. 2-5

Predicted Parameter Concentrations of Contact Groundwater Leaving the Backfilled Pit

Parameter	Concentration, mg/L	Years
Sulfate	1,360	0-8.42
	1,100	8.42-132
	832	132-2,850
	317	2,850-3,010
	9.9	3,010+
Manganese	0.550	0-3,920
	0.445	3,920-4,000
	0.350	4,000+
Iron	0.320	>4,000
Copper	0.014	>4,000

[15] Kuipers et al 2006
[16] Foth and Van Dyke, 1989
[17] Decision, Findings of Fact, Conclusions of Law and Permits [for the Flambeau Mine], State of Wisconsin Division of Hearings and Appeals, 1991, pp. 87-93.
[18] Table 2-5 from Appendix L of Flambeau Mine Permit Application, 1989

Column testing by the Flambeau Mining Company in 1997 was not able to produce the manganese concentrations predicted, but it was thought that "with an extended time manganese levels would decrease to those predicted in Table 4-23"[19]; i.e. 2 mg/L (2,000 µg/L) at 1% carbon dioxide.[20] However, ten years after backfilling, manganese concentrations in pit pore water remain underestimated by more than an order of magnitude in four of the eight pit monitoring wells (MW-1013, 1013B, 1013C, and 1014B), and fluctuate strongly in three of the remaining four (MW-1013A, 1014, 1014A) (Table 4 and Figure G).

Gypsum and metal hydroxides present in buried water treatment sludge can be expected to dissolve over time and flush down-gradient, making their way into or under the Flambeau River. Metals and mineral oxides that dissolve as a result of localized oxidation reactions within backfill can also be expected to flush down-gradient. Flushing will remain a concern for decades to come.

The most likely fate of manganese will be to flush out of the pit. It is unlikely to precipitate at neutral pH in the presence of iron. Dissolution reactions, in addition to influx of groundwater high in manganese, have likely contributed to the high manganese concentrations observed in the pit that were not predicted by modeling.

The fate of copper in the pore water within the backfilled mine pit depends on ion concentrations, pH, and redox conditions.

Copper may

- flush in the dissolved form
- precipitate as an oxide/carbonate
- sorb to surfaces

To date copper concentrations in pit pore water have generally reached concentrations expected from company modeling, but exceed expected concentrations by more than an order of magnitude at pit wells MW-1013B (86') and MW-1014B (105'), with no apparent trends (Table 5).

Similarly, iron levels reached expected concentrations in pit pore water measured at MW-1013A, 1013B, 1014, 1014A and 1014B, but were underestimated by more than an order of magnitude in pit wells MW-1013, 1013C, and 1014C (Table 6). No trends in iron are evident; while MW-1014C has generally declined in iron concentrations, MW-1013 and MW-1013C fluctuate.

The unpredictability observed in copper, iron, and manganese concentrations indicates that important assumptions were missing in original modeling or that more time is needed for complex dissolution and precipitation reactions to stabilize.

Limestone performance

Limestone is being relied on to neutralize acidity present at the time of backfill as well as any acidity produced after backfilling by reactions between ferric iron and waste rock. Ferric iron oxidation reactions may continue for some time, and until they stop, limestone will be required to neutralize acidity and precipitate resulting metal dissolution. Precipitation products such as aluminum hydroxide can be expected to settle on the limestone surface, and may render it less effective. It is not known how limestone will perform over the long term. If the limestone loses effectiveness, intervention wells along with pit wells will be important in tracking potential changes in pit water quality.

[19] Flambeau Mining Company, 1997, pg 68
[20] Flambeau Mining Company, 1997, Table 4-23 and Table 4-24

Unexamined Contaminants

Consideration should also be given to expanding the groundwater monitoring program at the Flambeau mine site to include more parameters. The geology of the area and of ore samples suggests nickel,[21] cobalt, aluminum,[22] and uranium[23] could be elevated. Although testing was conducted for all in 1987-1988, no groundwater analysis for these elements have been conducted since then, with the exception that samples were analyzed for nickel in July 2005. Shallow wells not recovered from groundwater drawdown did not yet have water and were therefore not sampled for nickel.

Monitoring wells MW-1014B, MW-1014C, and MW-1013C in the pit all had significant levels of nickel for the one reported nickel measurement taken in 2005, with MW-1014B as high as 440 ug/L. MW-1000PR was also sampled for nickel in 2005 and a level of 94 μg/L recorded. Effluent limits for nickel were set in the WPDES permit at a maximum discharge of 3100 ug/L daily.[24] The most stringent standard listed in 1992 was 38 ug/L.[25] The EPA water quality standard for nickel is hardness-dependant. A typical hardness for the Flambeau River is 60 mg/L (2007). At a hardness of 60 mg/L, the water quality limit for nickel would be 34 μg/L. Therefore, if well water from MW-1000PR was entering the Flambeau River at the measured level of 94 μg/L, it is possible that the water quality standard is being violated.

Other parameters that should be added to the list include cobalt and aluminum, since both were identified in measurable quantities in pore water obtained from leach extraction tests performed by the company on waste rock samples in 1997.[26] It is also recommended that groundwater and stream sediment be tested for radioactivity, since Rusk County has been identified by the United States Department of Energy in 1980 as "favorable for uranium deposits"[27] and enforcement standards specific to radioactivity were included in the Flambeau Mine Permit. Adding nickel, cobalt, aluminum, uranium and radioactivity to the list of parameters will not have a significant impact to the collection or analytical monitoring costs.

Pit Monitoring Wells

Monitoring of pit wells and downgradient intervention wells should be continued until the pit chemistry has stabilized. Original modeling predicted concentrations of manganese, iron, and copper exiting the pit would be near background concentrations early on.[28] In the case of manganese, and occasionally iron and copper, this has not proved to be the case (Table 4 to 7). In addition, sulfate was expected to be, and is, high in concentration in the pit.

Since chemistry in pit wells, intervention wells, and at the compliance well has not stabilized, and since it is not known how limestone will perform over the long term, monitoring should continue. Also, a measure of confidence would be added if samples collected by FMC were available for independent analysis, if this is not already being done.

Recommendation: Monitoring should be continued in the pit until redox stabilizes.

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[21] 2005 data for monitoring wells MW-1014B, MW-1014C, and MW-1013C
[22] Cobalt and aluminum identified in waste rock, Flambeau Mining Company 1997
[23] Cannon, WF and LG Woodruff. 2003. The Geochemical Landscape of Northwestern Wisconsin and adjacent parts of Northern Michigan and Minnesota (Geochemical Data Files). US Geological Survey Open File Report 03-259 http://pubs.usgs.gov/of/2003/of03-259/
[24] WDNR. 1992. An evaluation of endangered resources in the Flambeau River and a supplement to the Environmental Impact Statement for the Flambeau Mine project. Table 8.
[25] ibid Table 14.
[26] Flambeau Mining Company 1997
[27] Cannon, WF and LG Woodruff. 2003. The Geochemical Landscape of Northwestern Wisconsin and adjacent parts of Northern Michigan and Minnesota (Geochemical Data Files). US Geological Survey Open File Report 03-259 http://pubs.usgs.gov/of/2003/of03-259/
[28] Foth and Van Dyke, 1989, Appendix L

Recommendation: Add nickel, cobalt, aluminum, and uranium/radioactivity to parameters being measured.

Recommendation: Split groundwater samples with WDNR or the public, if requested.

Migration of Contaminants

Pit contaminants are moving out of the pit, as evidenced by concentrations of elements in the intervention boundary well MW1000PR, located on the Flambeau River side of the pit slurry wall. It is possible that contaminants may be moving around the ends of the slurry wall and/or under the bed of the Flambeau River. In addition, elevated copper has been consistently found in surface water near the Industrial Outlot, but there are no intervention or compliance wells between the Outlot and the western or southern compliance boundaries. Currently there is only one monitoring well (MW-1015) on the compliance boundary, which surrounds approximately 180 acres of the mine footprint.

If bedrock is permeable, then what occurs within the pit is relevant in that constituents move out of the pit. The bedrock forming the wall between the pit and the Flambeau River has been described as a "natural impermeable barrier"[29] but other statements referred to the river pillar of this area as "relatively highly permeable",[30] "fractured",[31] and that blasting during mining had the potential to increase fractures.[32]

The fractured bedrock forms a conduit from the pit to the River, allowing water movement in both directions. During operations, "water from the Flambeau River was drawn into the dewatered pit through fractured Precambrian bedrock that formed the western wall".[33] After closure, modeling in 1989 indicated that

> "groundwater flowing through the....pit will exit....through the Precambrian rock in the river pillar and flow directly into the bed of the Flambeau river.....Since there will be no dispersion, dilution or retardation in the river pillar, the concentrations of these constituents in the groundwater leaving the pit will be the same as the concentrations entering the river bed"[34]

Some of these constituents, as observed at MW-1000PR, fail to comply with Flambeau Mine groundwater enforcement standards.

Between the pit and the River, a bentonite slurry cutoff wall was built to limit water exiting from the pit. Whether pit water is moving around, under or through the slurry cutoff wall is not known. It is presumed that groundwater moves from the pit into the Flambeau River (see Figure A in this paper), but potentially groundwater could move under the river. MW-1000PR, which appears to be receiving groundwater from the pit, is located west of the slurry wall and below the bed of the Flambeau River.[35] It is not evident whether the bedrock itself under the river is impermeable, or contains fractures that could carry pit constituents to the west side of the river. The draft EIS refers to "groundwater movement to the

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[29] Preliminary Environmental Report, 1975, pg 29 and Figure 16 http://digital.library.wisc.edu/1711.dl/EcoNatRes.PreEnvRepAug75

[30] Foth and Van Dyke, 1989, Appendix L pg L4

[31] Foth and Van Dyke, 1989, Appendix L pg L32 says "...all of the groundwater flowing through the ...reclaimed pit will exit through the Precambrian rock in the river pillar and flow directly into the bed of the Flambeau River....Since this flow path is very short and occurs entirely within fractured crystalline rock....". Also see Environmental Impact Report for the Kennecott Flambeau Project (Report Narrative), 1989, pg. 3.6-33 and Foth & Van Dyke Memorandum to Jana Murphy, Flambeau Mining Company, October 12, 2000, p.13-14

[32] Final Environmental Impact Statement 1990, pg 76 http://digital.library.wisc.edu/1711.dl/EcoNatRes.FinEnvImpMar90

[33] Foth & Van Dyke, 2000, p.13-14

[34] Foth and Van Dyke, 1989, Appendix L pg L29

[35] Well begins at land elevation 1100.5' and ends 57' down at 1043.5'. The river bed is at 1080' elevation.

southwest along the strike of the ore body"[36] and the ore body is shown to extend under the river to the west side[37] although mining stopped just short of the river.

Flambeau Mine Management

Wisconsin law requires the establishment of two different boundaries at mine sites for enforcement of groundwater quality standards. The first, known as the compliance boundary, is located 1,200 feet from the outer perimeter of the mining waste facility (NR 182.075). The term "compliance boundary" was changed to "design management zone" when the statute was amended in 1998; it is referred to in the present document as the "compliance boundary". In the case of the Flambeau Mine, the unlined backfilled pit constitutes the mining waste facility. See Figure A for the location of the Flambeau Mine compliance boundary.

The compliance boundary marks the point where groundwater quality must be in compliance with the state's groundwater protection law. In particular, drinking water standards established in Chapter NR 140 of the *Wisconsin Administrative Code* cannot be exceeded at or beyond the boundary. These standards, known as Maximum Contaminant Levels (MCLs), were specifically listed in the 1991 Flambeau Mine Permit as the applicable groundwater enforcement standards for the mine's compliance boundary, with the exception of manganese.[38] Since baseline manganese levels at the mine site already exceeded the NR 140 MCL of 50 µg/L, the Flambeau-specific enforcement standards were set at 90 µg/L (overburden), 360 µg/L (shallow Precambrian) and 230 µg /L (deep Precambrian).

In addition to the 1,200-foot compliance boundary, an intervention boundary was established for the Flambeau Mine between the mine pit and compliance boundary, as required by law (NR 182.075). Monitoring groundwater quality at the intervention boundary is designed to help identify emerging pollution problems before they have a chance to reach the compliance boundary. As such, the applicable groundwater enforcement standards, known as Preventive Action Limits (PALs) and listed in Chapter NR 140 of the *Wisconsin Administrative Code*, are typically 10-20% of the corresponding MCLs, with some as high as 50%.

Intervention Boundary Wells

Five different monitoring wells (MW-1000, 1002, 1004, 1005 and 1010) constitute the intervention boundary established for the Flambeau Mine site when permits were granted in January 1991 (Figure A). Per the terms of the permit, two different sets of enforcement standards for groundwater pollution apply to the wells: (1) MW-1002, 1004 and 1005 are subject to PAL standards; and (2) MW-1000 and 1010 are subject to the same, except in the case of copper, iron, manganese and sulfate, where enforcement standards are based upon water quality projections for the backfilled pit as set forth in Appendix L of the Mining Permit Application.[39]

Intervention well MW-1002 in the northwest quadrant of the mine site is nested (16', 52'), as is MW-1004 at the northwest edge of the pit (13', 30', 76') and MW-1005 east of the former high sulfide rock stockpile (19', 52', 92'). Pit water is not expected to move towards these wells. Water sampling indicates these wells are stable with regards to redox, contain low concentrations of iron and manganese, and constituents do not exceed the baseline measurements. However, monitoring well MW-1004, listed as an active well in the Wisconsin DNR Groundwater Environmental Monitoring System (GEMS) database, has not since

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[36] Draft Environmental Impact Statement, 1976, pg 35 http://digital.library.wisc.edu/1711.dl/EcoNatRes.DraftEnvImpSep89
[37] Schwenk 1977, Figure 14
[38] Decision, Findings of Fact, Conclusions of Law and Permits [for the Flambeau Mine], State of Wisconsin Division of Hearings and Appeals, 1991, pp. 87-93.
[39] Foth & Van Dyke 1989, pg L27-L31.

1989 had the yearly sampling that other intervention wells are subjected to for a wide range of elements (arsenic, barium, cadmium, chromium, lead, mercury, silver, selenium, and zinc).

Pit water is expected to move to the southwestern end of the pit, near the slurry wall. The monitoring well MW-1001 is located just south of the west end of the pit. It appears that water is not being collected from MW-1001 (nested at 33', 52', and 95'), although the wells are listed as "active" in the WDNR GEMS database.[40] If possible, data should be collected from this nest in order to assist in characterizing groundwater quality and flow.

Between the pit and the river is a slurry cutoff wall. Intervention boundary wells MW-1000PR, MW-1000R and MW-1010P sit about 125' from the Flambeau River, directly between the backfilled pit and river, on the west side of the slurry cutoff wall. They are well-situated to indicate the quality of groundwater entering the river.

It appears that water is not being collected from MW-1000R (24.5', not nested). It is noteworthy that this well has not had water testing since 1988 when baseline data was reported, although it appears to remain an active well. If the well is operational, water samples should be collected.

Water samples are collected from MW-1010P (115', not nested). Although this well is not generally exceeding mine permit water quality standards, redox is not stable, indicating that water chemistry has not stabilized, and it has exceeded the PAL for arsenic (5 ug/L) in 21 out of 28 samples taken between 1999 and June 2008, with one of the highest concentrations detected in June 2008 (23 ug/L). It also has not been tested for uranium, thorium, or other radioactive material.

The intervention monitoring well MW-1000PR (57', not nested) may be a good indicator of the water quality entering the Flambeau River, in that it is located

> "within a weathered and highly fractured schist .... (and) pore water has begun migrating through this fracture zone from the backfill toward the Flambeau River and MW-1000PR"[41]

Water quality at MW-1000PR consistently exceeds 1991 baseline measurements in sulfate, total dissolved solids (TDS), conductivity, manganese, zinc and calcium; baseline iron and copper levels have also been exceeded on occasion.

There have been consistent and statistically significant exceedances of 1991 Flambeau mine permit standards at MW-1000PR for manganese, calcium, conductance and TDS; manganese exceeds standards by nearly an order of magnitude. In addition, although the PAL standard of 2500 μg/L for zinc has not been exceeded in MW-1000PR, the well often contains 600-800 μg/L, significantly elevated above the <70 μg/L baseline. Similarly sulfate has not exceeded the 1100 mg/L site-specific permit application standard, but has consistently been at or above 300 mg/L, greatly elevated above the baseline of <31 μg/L, and would exceed the NR 140 PAL of 125 μg/L had that standard been specified in the mine permit (Table 7).

It is possible that pit water could be moving around the ends of the slurry wall. Inspection of the projected groundwater flow directions in Figure A and the groundwater potentiometric surface lines in Figure B both support this hypothesis. It appears that both MW-1000PR[42] and MW-1010P are screened in bedrock. Since it is apparent from the MW-1000PR data that groundwater contamination is exiting the pit toward the river, two nested wells should be placed at the northwest and southeast ends of the slurry wall separating the pit from the Flambeau River. These wells would either confirm that no groundwater

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[40] http://prodoasext.dnr.wi.gov/inter1/gemsfac$points.startup?P_LIC_NUMBER=3180&P_0=3180&Z_CHK=57753
[41] Foth & Van Dyke, 2000, p.13
[42] Foth & Van Dyke Memorandum to Jana Murphy, Flambeau Mining Company, October 12, 2000, p.13

leakage is going around the slurry wall, or would provide a means to measure the amount and water quality of this leakage.

Recommendation: ***Place nested wells at either end of the slurry wall; if MW-1000R (25' deep) is active, this could serve as one of the new monitoring wells; a deeper well should be constructed next to it. In addition, samples should be taken from MW-1001 which, although not located at the slurry wall, is nested (33', 52', 95') and located just to the southeast of the wall and would aid in determining groundwater flow direction. A monitoring well on the southern compliance boundary would ensure no contaminants are moving in that direction.***

Recommendation: ***Site a monitoring well for "background" groundwater samples away from the mine site, Industrial Outlot, and roads.***

Compliance Boundary Well

Only one well is currently sited at a compliance boundary. This well, MW-1015A/B (64', 148') is located northwest of the former pit and about 320 feet from the Flambeau River. It was drilled in January 2001, three years after the mine pit was backfilled, so no pre-mine baseline water quality data exists.

The company's groundwater modeling suggests that MW-1015 is not likely to receive a substantial influx of groundwater from the backfilled pit.[43] However, the well remains unstable with regards to redox, and MW-1015B has shown exceedances of the applicable groundwater enforcement standard for manganese (2002-2004) and had an exceedance of the 1991 permit standard for iron in at least one sample in every year from 2002-2007[44] (Table 8).

Given that exceedances have occurred in the one compliance well, and given the movement of contaminants out of the pit towards MW-1000PR, and since it is theoretically possible that contaminated groundwater could move under the Flambeau River toward the compliance boundary located west of the mine site, it would be prudent to provide a nested monitoring well at the compliance boundary to the west of the Flambeau River to ensure that any residential or agricultural well water quality is not being impacted, and to provide a point of measurement for ensuring groundwater meets Wisconsin drinking water standards.

Recommendation: ***Place a nested well on the compliance boundary on the western side of the Flambeau River to determine if contaminated groundwater is moving under the River.***

[43] Final Environmental Impact Statement. 1990. Figure 3-7
[44] Flambeau Mining Company 2007 Annual Report, Appendix B, Attachment 1 "Historical Groundwater Results"

Monitoring Mine Management Wells

Long term monitoring will determine whether permit violations continue to occur at the Flambeau Mine intervention boundary (MW-1000PR and MW-1010) and compliance boundary (MW-1015). Since 1999, measured concentrations of manganese and iron in MW-1000PR (125' from the Flambeau River) have repeatedly been greater than the enforcement standards cited in the 1991 mine permit, and manganese significantly greater. MW-1015, 320' from the Flambeau River exceeded 1991 groundwater enforcement standards for iron at least once every year between 2002 and 2007, and remains unstable in redox, warranting continued monitoring.

A measure of confidence would be added if samples collected by FMC were available for independent analysis.

Recommendation: Monitoring should be continued at intervention and compliance wells until metal concentrations consistently remain below Wisconsin water quality standards and redox stabilizes.

Recommendation: Split groundwater samples with WDNR or the public, if requested.

MONITORING FLAMBEAU RIVER BIOTA

In 1991, Flambeau Mining Company initiated monitoring programs in the Flambeau River to assess potential accumulation of heavy metals in crayfish, walleye and sediment downstream from the mine site. Macroinvertebrate studies were also initiated to assess potential impacts of the mine on river health. Studies were performed on an annual basis through 1998 (macroinvertebrates), 2000 (walleye and sediment) and 2001 (crayfish). Additional studies were conducted in 2004 (crayfish and macroinvertebrates), 2005 (walleye), 2006 (crayfish, walleye, sediment and macroinvertebrates) and 2007 - 2008 (crayfish, walleye, and sediment). Additional crayfish and walleye studies are scheduled to be conducted on an annual basis through 2011.

Despite the assemblage of data, it is unclear how the monitoring programs for crayfish and walleye will provide statistically significant data regarding mine impacts to the Flambeau River and biota, or lack thereof. As discussed below, flaws may exist in the study design, methods, and/or presentation of information. This makes it difficult for the public to ascertain whether contaminants are moving into biota and sediment, or whether natural macroinvertebrate populations have been impacted downstream from the mine site.

Crayfish and Walleye

The current monitoring program for crayfish does not outline a determinate number of specimens to be collected at each sample site to ensure consistency, nor how a determination would provide statistically relevant information. Moreover, even though the walleye monitoring plan calls for sampling a set number of fish at each of two sampling sites in the river, the sample sizes are quite small – one to three fish each of 5 different sizes. The plan does not explain how the collected data of such a small sample set will be statistically relevant.

Monitoring plans do not provide information regarding the natural ranging and foraging habits of crayfish and walleye to determine if these species are likely to provide information on contaminant movement specifically from the mine site. Possibly shellfish located near mine site discharges would be better indicators, if shellfish are present. The choice of species lies primarily in what question is being answered. Is the question "Are bioavailable contaminants moving out of the mine area?" or is the question "Is aquatic life safe to eat?" It would be helpful for the Stipulation Monitoring Plan to state the question they want answered.

Macroinvertebrates

A common method for assessing stream health is bioassessment using macroinvertebrates. Bioassessments were conducted 1991-1998, 2004 and 2006. Although the full data is presented, it is not clear what the data indicates. Abundance of taxa, which is presented, does not necessarily imply stream health. Rather, it is the ratio of taxa that are sensitive to pollution (generally species within Ephemeroptera, Plecoptera, Trichoptera, or EPT) and those that are tolerant to pollution (such as Diptera) that provides information. Presentation of ratios and trends in ratios over time would allow the public to better understand impacts to aquatic life in the Flambeau River.

While it is essential and useful to provide raw numbers of species in order to allow independent experts the ability to analyze the data, the utility of the macroinvertebrate data would be enhanced by reporting summary information such as percent EPT of total abundance; richness of each of Ephemeroptera, Plecoptera, Trichoptera, and Diptera; percent taxa intolerant to pollution and percent taxa tolerant to pollution in a manner that allows the general public to understand trends.

CONCLUSIONS

Copper contamination in excess of Wisconsin water quality standards is reaching the Flambeau River from the Flambeau mine site and the Flambeau pit is leaching contaminants that exceed Wisconsin groundwater quality standards to beyond the slurry wall designed to separate pit water from the Flambeau River. It appears that the state is allowing these unpermitted discharges to continue under the assumptions that (1) dilution in the Flambeau River is such that no impact is occurring, and that (2) no contaminated groundwater from the pit is flowing under the Flambeau River toward the groundwater compliance boundary.

If all, or part of the groundwater contamination is not entering the Flambeau River, as is presently assumed, then it is going under the river towards the 1200 foot compliance boundary. There appears to be insufficient monitoring to determine either the quantity of groundwater movement, the quantity of contamination entering the Flambeau River, and/or the groundwater contamination migrating toward the southwest groundwater compliance boundary.

As discussed in this report, it is not clear from the monitoring data that there is no impact from the surface water discharge both into Stream C, and from Stream C into the Flambeau River, as it crosses Meadowbrook Creek. Since this is an ongoing discharge from an industrial facility, the discharge should be more carefully monitored, and should either be cleaned up before it leaves the mine site, or the discharge should be regulated under a Clean Water Act discharge permit which would place limits on the amount of contamination discharged, and the "mixing zone" which is currently being utilized in the Flambeau River.

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Figure A: Plan View Groundwater Flow

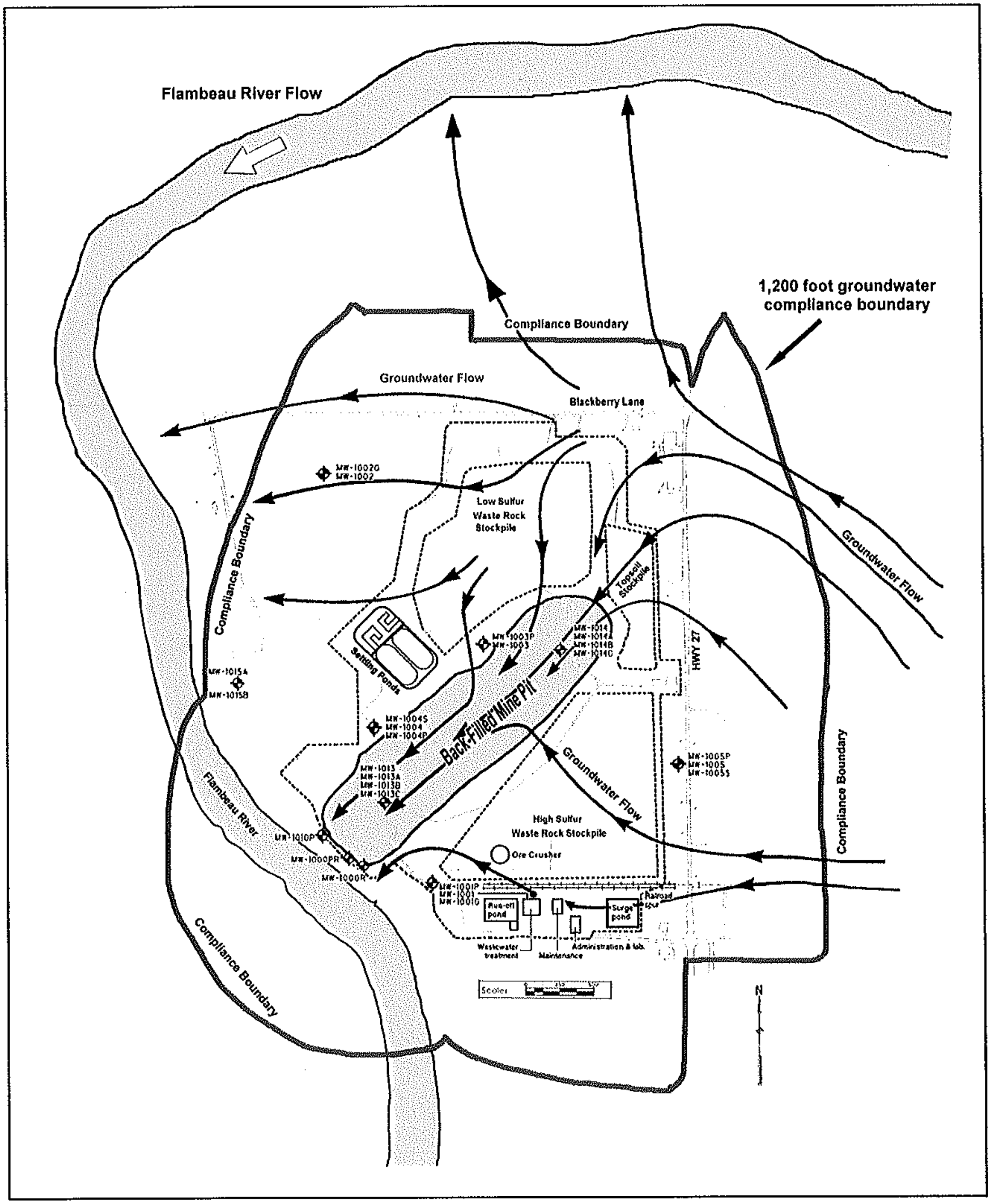


Figure B: Groundwater Potentiometric Surface

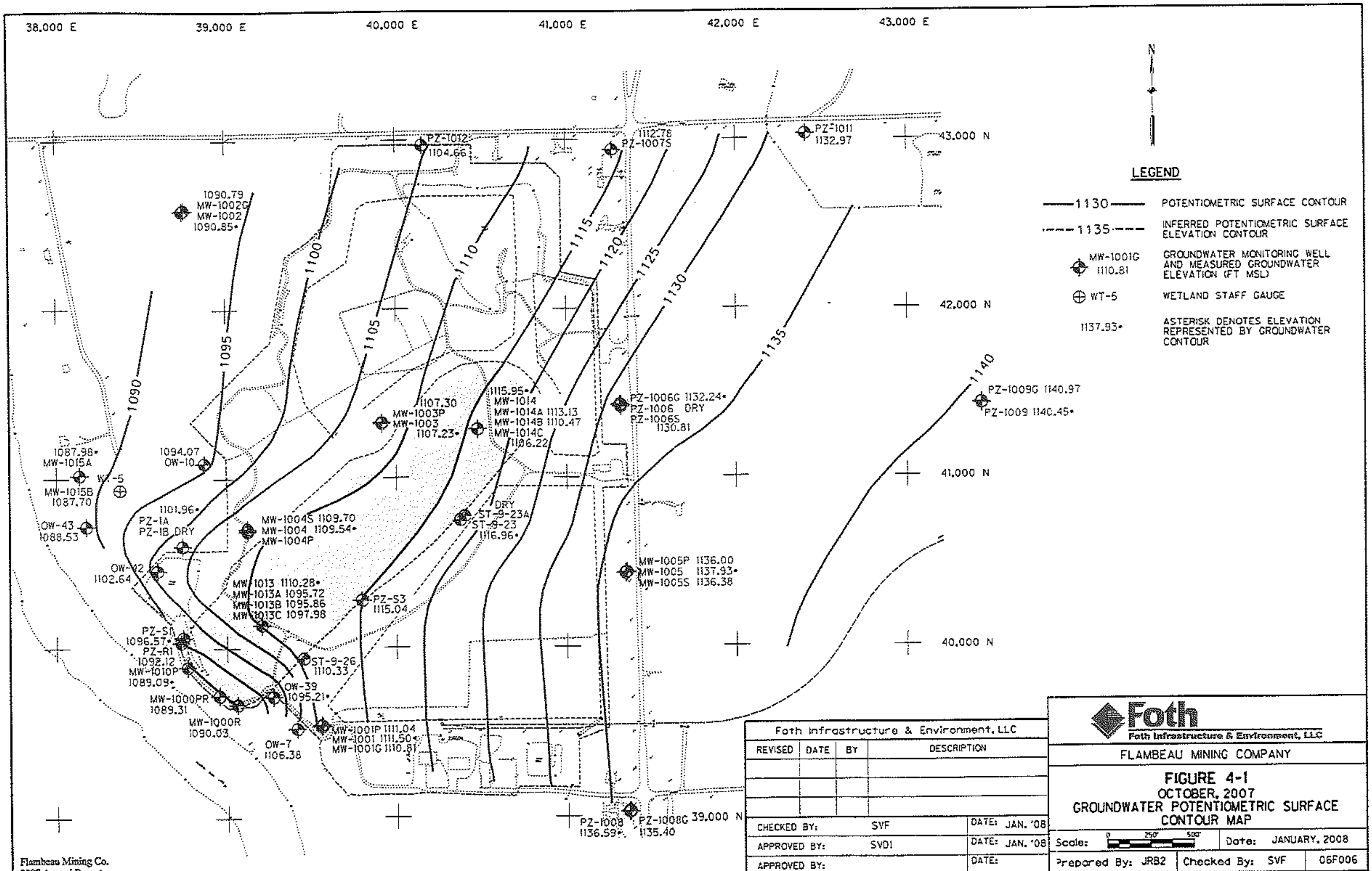


Figure C: Outlot Biofilter Drainage Area

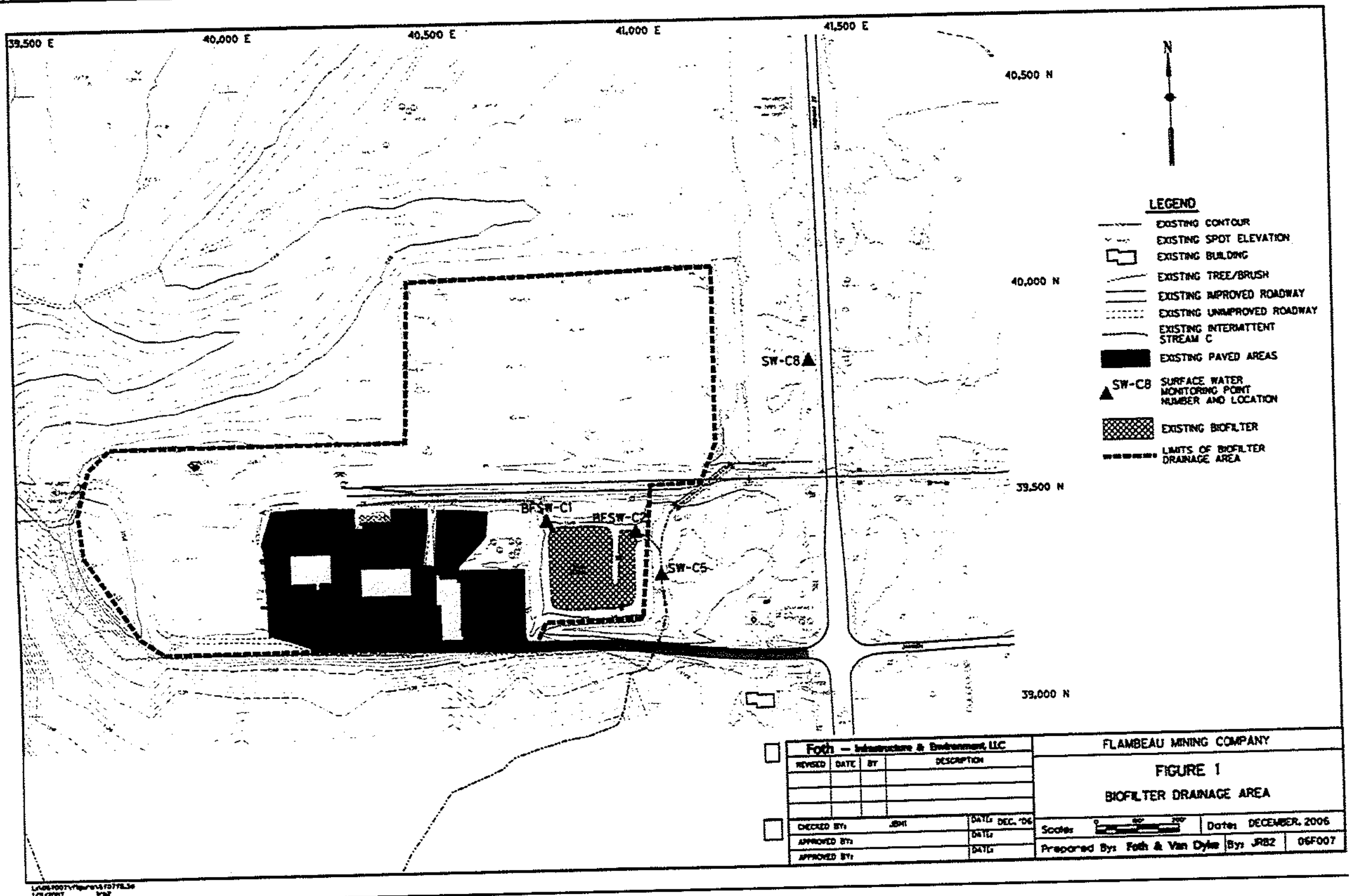
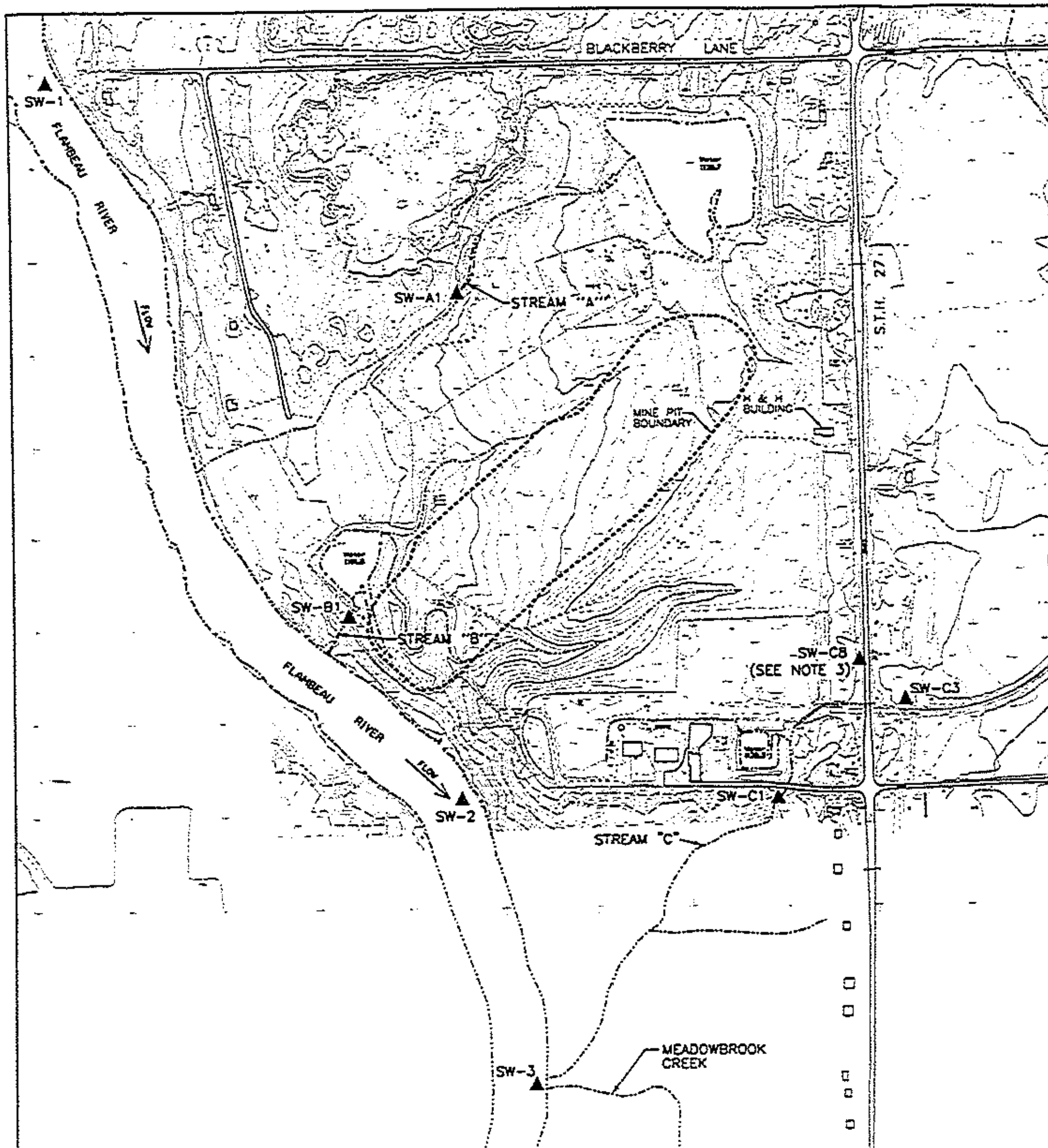


Figure D: Active Surface Water Monitoring Locations



Location	ug/L Copper.tot	mg/L Iron.tot	ug/L Mn	mg/L Sulfate	ug/L Zinc
SW-C8 (SEE NOTE 3)	86	2.5	140	5.3	41
SW-A1	[3.1]	0.37	61	<2.5	10
SW-B1	[2.7]	0.44	13	<2.5	[7.8]
SW-B1(DUP)	[2.9]	0.45	13	<2.5	[7.1]
SW-C1	47	1.3	23	5.8	52
SW-1	<1.3	0.57	130	10	[6.0]
SW-2	<1.3	0.50	130	11	[5.4]
SW-3	4.2	0.60	100	10	[8.6]

NOTES:
- < NOT DETECTED ABOVE THE LOD
- [ ] RESULTS ≥ THE LOD BUT < THE LOQ AND ARE WITHIN A REGION OF "LESS-CERTAIN QUANTITATION"
- LOD LIMIT OF DETECTION
- LOQ LIMIT OF QUANTITATION
- DUP DUPLICATE
- ug/L MICROGRAMS/LITER
- mg/L MILLIGRAMS/LITER

LEGEND

- SW-A1 ▲ SURFACE WATER SAMPLE NUMBER AND LOCATION
- EXISTING CONTOUR
- EXISTING SPOT ELEVATION
- EXISTING BUILDING
- EXISTING TREE/BRUSH
- EXISTING IMPROVED ROADWAY
- EXISTING UNIMPROVED ROADWAY

NOTES:

1. RESULTS POSTED FROM SEPTEMBER 2007.
2. SW-C3 WAS ADDED TO THE SAMPLING PLAN IN NOVEMBER 2007 AND WAS NOT SAMPLED IN SEPTEMBER 2007.
3. SW-C8 COC AND DATA SHEET SUBMITTED WITH THE BIOFILTER SUBMITTAL DATED 9/27/07

Foth — Infrastructure & Environment, LLC

REVISED | DATE | BY | DESCRIPTION

CHECKED BY: DATE:
APPROVED BY: DATE:
APPROVED BY: DATE:

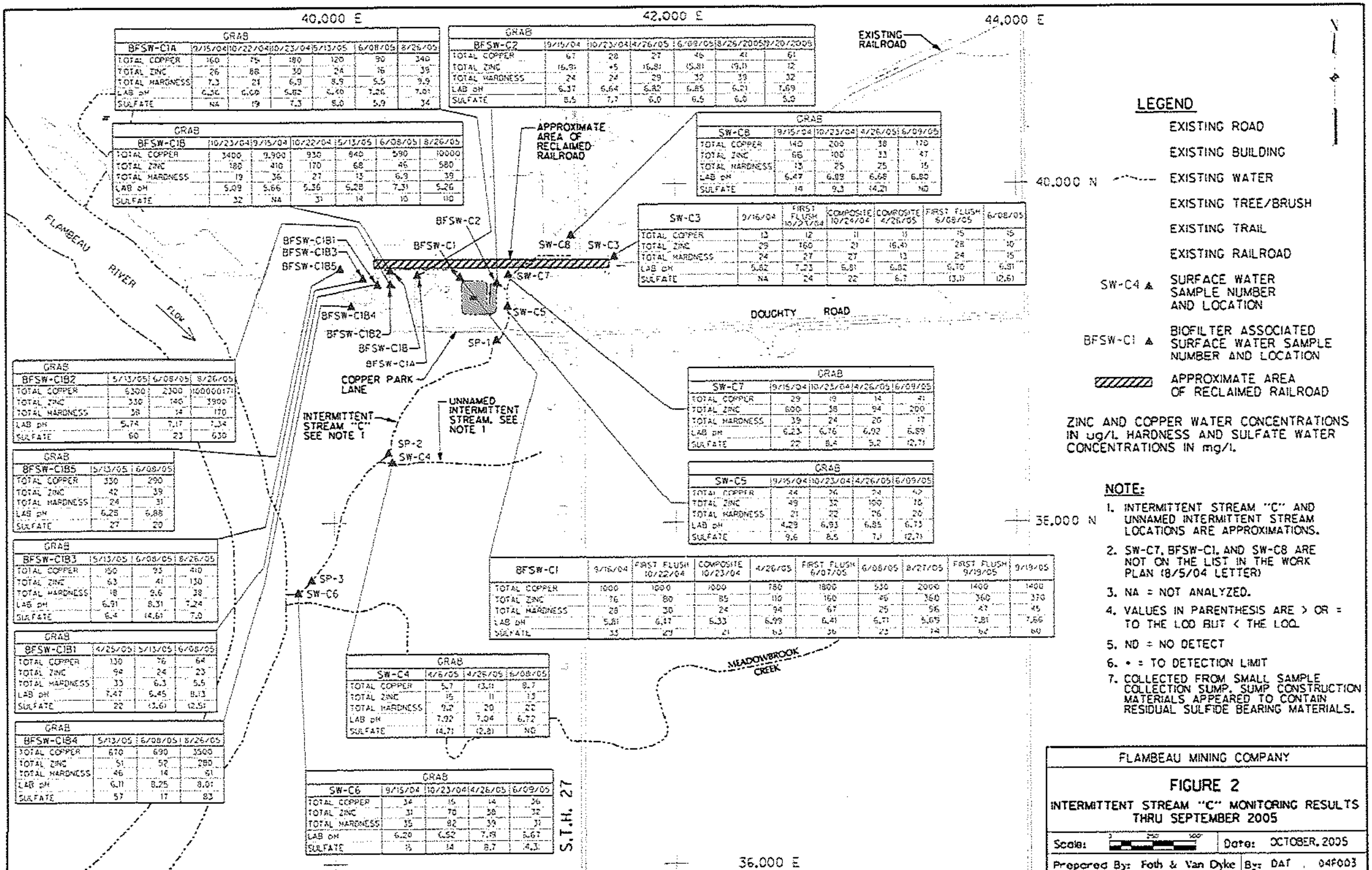
FLAMBEAU MINING COMPANY

FIGURE 1
STIPULATED MONITORING
SURFACE WATER SAMPLE LOCATIONS
AND SEPTEMBER 2007 RESULTS

Scale: 0 300' 600' | Date: DECEMBER, 2007
Prepared By: BLK | Checked By: SVF | 06F006

June 5, 2009
Page #22

Figure E: Stream C Water Quality Data



GRAB

BFSW-C1A	9/15/04	10/22/04	10/23/04	5/13/05	6/08/05	8/26/05
TOTAL COPPER	160	75	180	120	90	340
TOTAL ZINC	26	88	30	24	16	39
TOTAL HARDNESS	7.3	21	6.9	8.9	5.5	9.9
LAB pH	6.36	6.09	5.82	6.40	7.26	7.01
SULFATE	NA	19	7.3	5.0	5.9	34

GRAB

BFSW-C1B	10/23/04	9/15/04	10/22/04	5/13/05	6/08/05	8/26/05
TOTAL COPPER	3400	9,900	930	840	590	10000
TOTAL ZINC	180	410	170	68	46	580
TOTAL HARDNESS	19	36	27	13	6.9	39
LAB pH	5.09	5.66	5.36	5.28	7.31	5.26
SULFATE	32	NA	31	14	10	110

GRAB

BFSW-C2	9/15/04	10/23/04	4/26/05	6/08/05	8/26/2005	9/20/2005
TOTAL COPPER	67	28	27	46	41	61
TOTAL ZINC	(6.9)	•5	(6.8)	(5.8)	(9.1)	12
TOTAL HARDNESS	24	24	29	32	33	32
LAB pH	6.37	6.64	6.82	6.85	6.21	7.69
SULFATE	8.5	7.7	6.0	6.5	6.0	5.0

GRAB

SW-C8	9/15/04	10/23/04	4/26/05	6/09/05
TOTAL COPPER	140	200	38	170
TOTAL ZINC	66	100	33	47
TOTAL HARDNESS	13	25	25	15
LAB pH	6.47	6.89	6.68	6.80
SULFATE	14	9.3	(4.2)	ND

SW-C3	9/16/04	FIRST FLUSH 10/23/04	COMPOSITE 10/24/04	COMPOSITE 4/26/05	FIRST FLUSH 5/08/05	6/08/05
TOTAL COPPER	13	12	11	11	15	15
TOTAL ZINC	29	160	21	(6.4)	28	10
TOTAL HARDNESS	24	27	27	13	24	15
LAB pH	5.82	7.23	5.81	6.82	6.70	6.81
SULFATE	NA	24	22	6.7	(3.1)	(2.6)

GRAB

SW-C7	9/15/04	10/23/04	4/26/05	6/09/05
TOTAL COPPER	29	19	14	41
TOTAL ZINC	600	38	94	200
TOTAL HARDNESS	39	24	26	17
LAB pH	6.23	6.76	6.92	6.89
SULFATE	27	8.4	5.2	(2.7)

GRAB

SW-C5	9/15/04	10/23/04	4/26/05	6/09/05
TOTAL COPPER	24	26	24	47
TOTAL ZINC	49	32	150	15
TOTAL HARDNESS	21	22	26	20
LAB pH	4.29	6.93	6.85	6.73
SULFATE	9.6	8.5	7.1	(2.7)

BFSW-C1	9/16/04	FIRST FLUSH 10/22/04	COMPOSITE 10/23/04	4/26/05	FIRST FLUSH 6/07/05	6/08/05	8/27/05	FIRST FLUSH 9/19/05	9/19/05
TOTAL COPPER	1000	1000	1000	780	1800	530	2000	1400	1400
TOTAL ZINC	76	80	85	110	160	45	360	360	370
TOTAL HARDNESS	28	30	24	94	67	25	56	47	45
LAB pH	5.81	6.47	5.33	6.99	6.41	6.71	5.09	7.81	7.66
SULFATE	33	29	21	63	36	23	74	64	60

GRAB

BFSW-C1B2	5/13/05	6/08/05	8/26/05
TOTAL COPPER	6300	2300	10000(7)
TOTAL ZINC	330	140	3900
TOTAL HARDNESS	38	14	170
LAB pH	5.74	7.17	7.34
SULFATE	60	23	630

GRAB

BFSW-C1B5	5/13/05	6/08/05
TOTAL COPPER	330	290
TOTAL ZINC	42	39
TOTAL HARDNESS	24	31
LAB pH	6.25	6.88
SULFATE	27	20

GRAB

BFSW-C1B3	5/13/05	6/08/05	8/26/05
TOTAL COPPER	150	93	410
TOTAL ZINC	63	41	130
TOTAL HARDNESS	18	9.6	38
LAB pH	6.91	8.31	7.24
SULFATE	6.4	(4.6)	7.0

GRAB

BFSW-C1B1	4/25/05	5/13/05	6/08/05
TOTAL COPPER	130	76	64
TOTAL ZINC	94	24	23
TOTAL HARDNESS	33	6.3	5.5
LAB pH	7.47	5.45	8.13
SULFATE	22	(3.6)	(2.5)

GRAB

BFSW-C1B4	5/13/05	6/08/05	8/26/05
TOTAL COPPER	670	690	3500
TOTAL ZINC	51	52	280
TOTAL HARDNESS	46	14	51
LAB pH	6.11	8.25	8.01
SULFATE	57	17	83

GRAB

SW-C4	4/6/05	4/25/05	6/08/05
TOTAL COPPER	5.7	(3.1)	8.7
TOTAL ZINC	15	11	13
TOTAL HARDNESS	9.2	20	22
LAB pH	7.92	7.04	6.72
SULFATE	(4.7)	(2.8)	ND

GRAB

SW-C6	9/15/04	10/23/04	4/26/05	6/09/05
TOTAL COPPER	34	15	14	36
TOTAL ZINC	31	70	38	32
TOTAL HARDNESS	35	82	39	31
LAB pH	6.20	6.52	7.19	5.67
SULFATE	15	14	8.7	4.3

Figure F: Location of pit monitoring wells (Flambeau Mine Company Annual Report 2007)

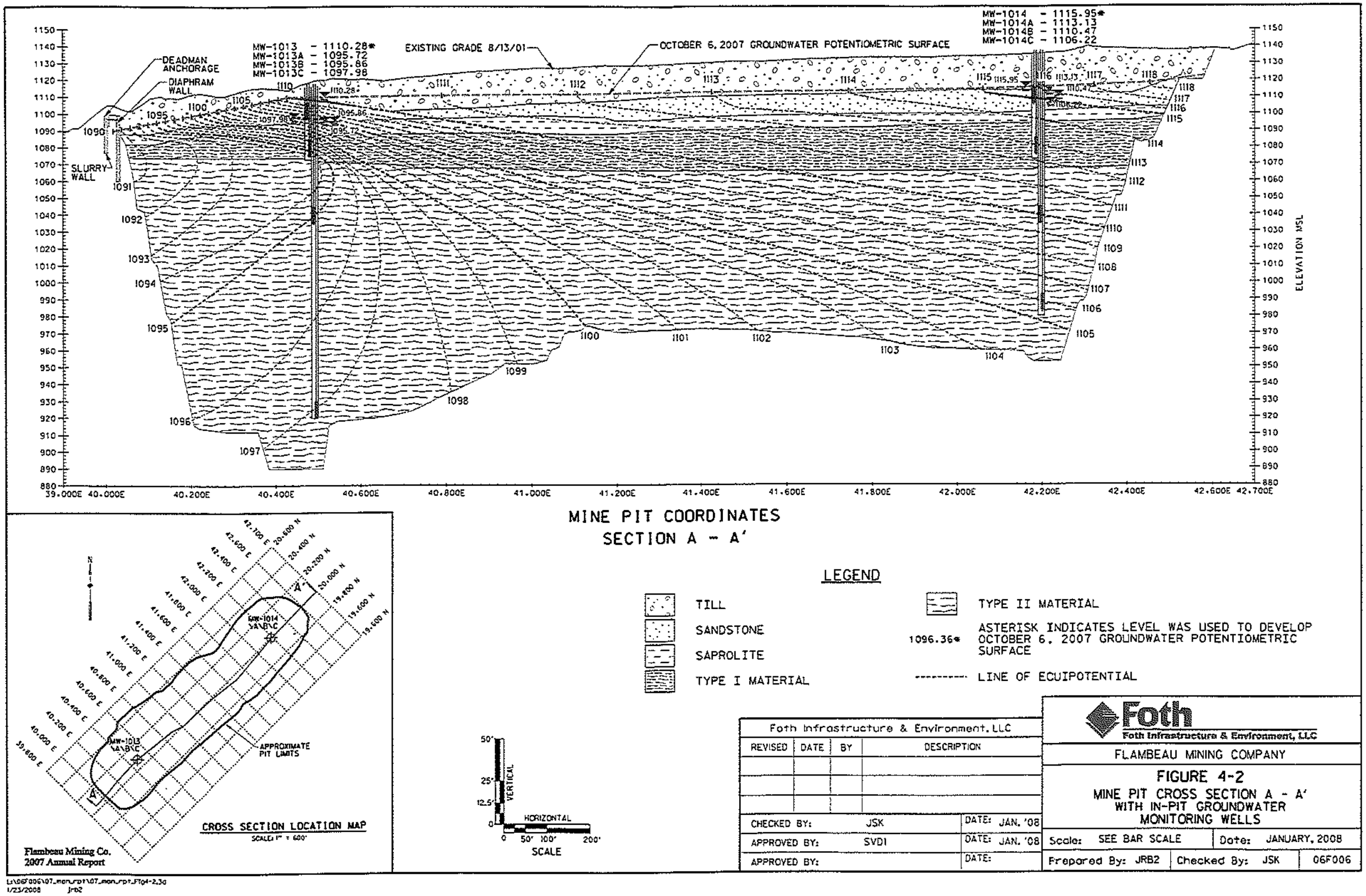


Figure G: Manganese Levels in Monitoring Well 1013-B at Reclaimed Flambeau Mine Site (1999-2007) (raw data obtained from Flambeau Mining Company, 2007 Annual Report, Appendix B – Groundwater Quality & Elevation/Surface Water Quality Trend and Flambeau Mining Company, Environmental Monitoring Results (Groundwater), First Quarter 2008, Second Quarter 2008, and Third Quarter 2008 reports)

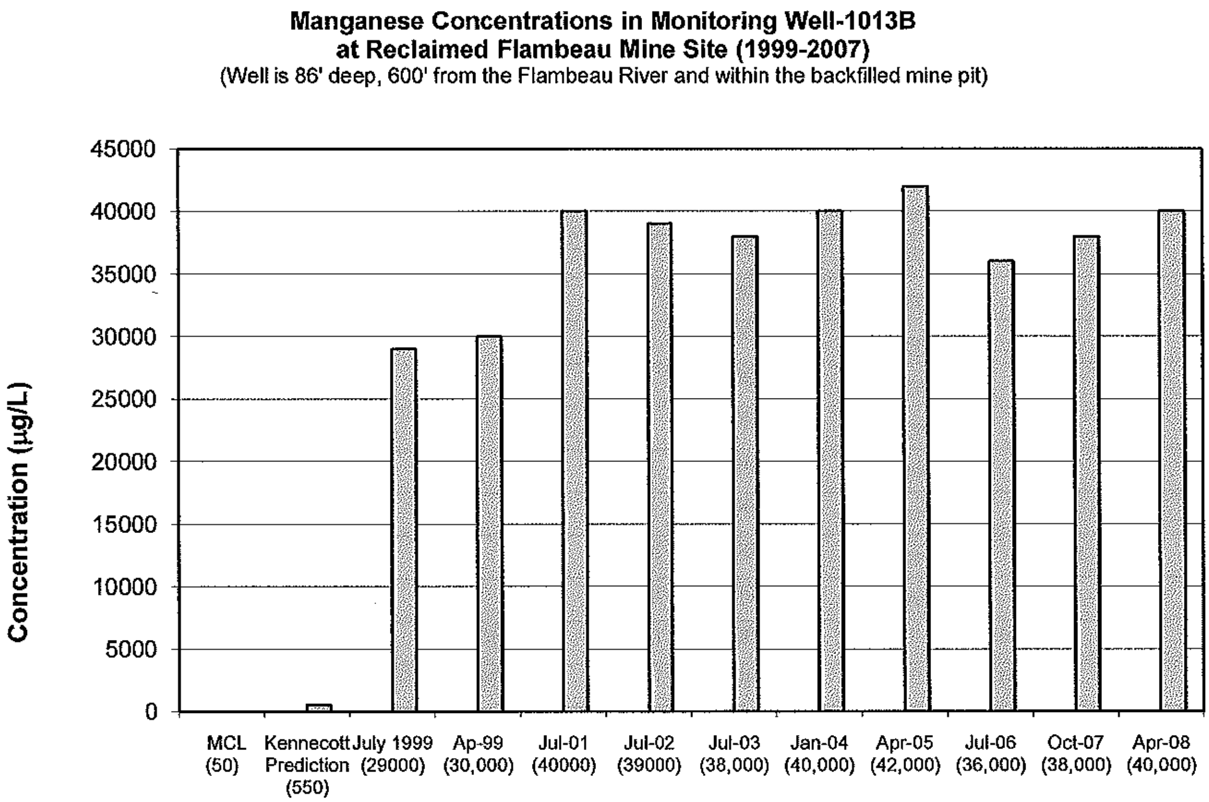


Table 4. Manganese Levels in Pore Water within Backfilled Flambeau Mine Pit Reported by Flambeau Mining Company (FMC) to the Wisconsin Department of Natural Resources (μg/L)[45]

	MW 1013	MW 1013A	MW 1013B	MW 1013C	MW 1014	MW 1014A	MW 1014B	MW 1014C
Depth	24'	47'	86'	202'	34'	64'	105'	157'
FMC Prediction [46]	550	550	550	550	550	550	550	550
Feb 99	Dry	Dry	25,000	7,200	Dry	Dry	23,000	4,300
Apr 99	Dry	Dry	30,000	7,700	Dry	Dry	23,000	4,500
Jul 99	Dry	Dry	29,000	7,300	Dry	Dry	23,000	4,000
Apr 00	Dry	Dry	32,000	7,800	Dry	7,200	22,000	3,600
Oct 00	Dry	Dry	35,000	8,200	Dry	6,700	21,000	3,200
Jul 01	Dry	Dry	40,000	9,000	Dry	6,500	20,000	3,000
Oct 01	Dry	Dry	34,000	8,500	Dry	6,000	18,000	2,900
Jul 02	Dry	Dry	39,000	10,000	Dry	6,100	19,000	2,700
Jan 03	Dry	Dry	33,000	9,500	Dry	5,300	17,000	2,400
Jul 03	Dry	Dry	38,000	9,600	Dry	4,200	16,000	2,500
Oct 03	Dry	Dry	37,000	9,800	Dry	3,000	19,000	2,400
Jan 04	Dry	Dry	40,000	9,100	Dry	3,100	17,000	2,300
Apr 04	Dry	Dry	32,000	9,700	Dry	3,100	14,000	2,300
Oct 04	Dry	Dry	34,000	9,800	Dry	2,000	17,000	2,100
Jan 05	Dry	Dry	24,000	9,500	Dry	2,000	16,000	2,000
Apr 05	Dry	Dry	42,000	10,000	Dry	2,000	16,000	2,300
Jul 05	Dry	Dry	39,000	11,000	Dry	1,400	17,000	2,200
Oct 05	25,000	4,500	30,000	11,000	1,300	1,500	15,000	2,200
Apr 06	21,000	3,900	25,000	11,000	1,200	2,100	14,000	2,100
Jul 06	20,000	1,700	36,000	9,800	940	1,400	12,000	1,900
Oct 06	24,000	2,400	23,000	11,000	880	820	13,000	2,000
Jan 07	24,000	1,700	24,000	11,000	1,300	780	15,000	1,900
Apr 07	24,000	1,700	23,000	11,000	610	920	14,000	2,000
Oct 07	24,000	2,600	38,000	11,000	580	890	13,000	2,000
Jan 08	24,000	2,100	31,000	10,000	800	940	14,000	1,800
Apr 08	23,000	2,800	40,000	11,000	260	1,100	14,000	1,900
Jun 08	22,000	3,500	21,000	10,000	830	410	14,000	1,800

45 Unless otherwise indicated, data was obtained from: (1) Flambeau Mining Company, 2007 Annual Report, Appendix B – Groundwater Quality & Elevation/Surface Water Quality Trends; or (2) Flambeau Mining Company, Environmental Monitoring Results (Groundwater), First Quarter 2008, Second Quarter 2008, and Third Quarter 2008 reports.

46 Foth & Van Dyke, 1989, pg L27-L31.

Table 5. Copper Levels in Pore Water within Backfilled Flambeau Mine Pit Reported by Flambeau Mining Company (FMC) to Wisconsin Department of Natural Resources (μg/l)[a]

	MW 1013	MW 1013A	MW 1013B	MW 1013C	MW 1014	MW 1014A	MW 1014B	MW 1014C
Depth	24'	47'	86'	202'	34'	64'	105'	157'
FMC Prediction[b]	14	14	14	14	14	14	14	14
Feb 99	Dry	Dry	36	100	Dry	Dry	810	<4.7
Jul 99	Dry	Dry	33	50	Dry	Dry	520	16
Oct 00	Dry	Dry	<12	<12	Dry	<12	430	<12
Oct 01	Dry	Dry	69	<13	Dry	<13	490	<13
Jul 02	Dry	Dry	150	<13	Dry	<13	550	<13
Jan 03	Dry	Dry	92	<13	Dry	<13	590	<13
Jul 03	Dry	Dry	120	<13	Dry	<13	500	<13
Oct 03	Dry	Dry	110	<13	Dry	<13	640	<1.3
Apr 04	Dry	Dry	230	<13	Dry	<13	440	<13
Oct 04	Dry	Dry	380	<13	Dry	<13	550	<13
Jan 05	Dry	Dry	180	<13	Dry	<13	520	<13
Apr 05	Dry	Dry	450	<13	Dry	<13	460	<13
Jul 05	Dry	Dry	400	<13	Dry	<13	560	<13
Oct 05	<13	<13	230	<13	<13	<13	400	<13
Apr 06	23	17	280	<13	36	22	530	<13
Jul 06	24	16	470	14	26	31	510	16
Oct 06	<13	<13	200	<13	<13	<13	460	<13
Jan 07	<13	<13	290	<13	39	<13	600	<13
Apr 07	<13	<13	230	<13	17	<13	470	<13
Jun 07	<13	<13	240	<13	<13	<13	600	<13
Oct 07	<13	<13	500	<13	33	<13	490	<13
Jan 08	<13	<13	400	<13	<13	<13	500	<13
Apr 08	<13	<13	530	<13	<13	<13	570	<13
June 08	[22]	<13	270	<13	22	<13	580	<13

[a] Unless otherwise indicated, data was obtained from: (1) Flambeau Mining Company, 2007 Annual Report, Appendix B – Groundwater Quality & Elevation/Surface Water Quality Trends; (2) Flambeau Mining Company, Environmental Monitoring Results (Groundwater), First Quarter 2008, Second Quarter 2008, and Third Quarter 2008 reports.

[b] Foth & Van Dyke, 1989, pg L27-L31.

Table 6. Iron Levels in Pore Water within Backfilled Flambeau Mine Pit Reported by Flambeau Mining Company (FMC) to Wisconsin Department of Natural Resources (µg/l)[a]

	MW 1013	MW 1013A	MW 1013B	MW 1013C	MW 1014	MW 1014A	MW 1014B	MW 1014C
Depth	24'	47'	86'	202'	34'	64'	105'	157'
FMC Prediction[b]	320	320	320	320	320	320	320	320
Feb 99	Dry	Dry	45	920	Dry	Dry	62	14,000
Jul 99	Dry	Dry	760	1,300	Dry	Dry	72	14,000
Oct 00	Dry	Dry	840	1,600	Dry	960	<360	12,000
Oct 01	Dry	Dry	660	2,700	Dry	1,500	<150	9,600
Jul 02	Dry	Dry	700	4,100	Dry	380	<150	9,400
Jan 03	Dry	Dry	150	5,400	Dry	540	<150	8,300
Jul 03	Dry	Dry	610	4,200	Dry	320	<290	8,200
Oct 03	Dry	Dry	<290	6,200	Dry	1,000	<290	7,800
Apr 04	Dry	Dry	<330	7,800	Dry	130	<330	7,500
Oct 04	Dry	Dry	<330	7,000	Dry	<330	<330	6,600
Jan 05	Dry	Dry	<330	7,200	Dry	<330	<330	6,400
Apr 05	Dry	Dry	<330	8,200	Dry	<330	<330	7,000
Jul 05	Dry	Dry	<330	8,500	Dry	<330	<330	6,900
Oct 05	22,000	<330	<330	8,300	<330	<330	<330	7,000
Apr 06	2,200	<330	<220	8,900	<330	<330	<330	6,400
Jul 06	3,200	<330	<330	7,000	<330	<330	<330	5,900
Oct 06	11,000	<330	<330	9,100	<330	<660	<330	6,100
Jan 07	12,000	<330	<330	9,500	<330	<330	<330	6,000
Apr 07	3,300	<330	<330	9,300	<33	530	<330	6,100
Jun 07	9,600	<330	<330	11,000	<330	<330	<330	5,800
Oct 07	15,000	<330	<330	9,700	<330	<330	<330	5,800
Jan 08	14,000	<330	<330	9,100	<330	<330	<330	5,400
Apr 08	4,100	<330	<330	9,600	<330	<330	<330	5,600
Jun 08	3,600	<330	<330	10,000	<330	<330	<330	5,400

[a] Unless otherwise indicated, data was obtained from: (1) Flambeau Mining Company, 2007 Annual Report, Appendix B – Groundwater Quality & Elevation/Surface Water Quality Trends; or (2) (2) Flambeau Mining Company, Environmental Monitoring Results (Groundwater), First Quarter 2008, Second Quarter 2008, and Third Quarter 2008 reports.

[b] Foth & Van Dyke, 1989, pg L27-L31.

Table 7. Groundwater Quality in Intervention Boundary Well MW-1000PR[a]

	Parameter							
	Calcium (mg/L)	Conductance, field (μmhos/cm)	Copper (μg/L)	Iron (μg/L)	Manganese (μg/L)	Sulfate (mg/L)	Total Diss. Solids (mg/L)	Zinc (μg/L)
1987-88 EIS Baseline (Prior to mining) [b]	9-26	98-251	< 66	< 620	260-590	16-31	100-350	<110
Flambeau Mine Permit Standard [c]	25 over baseline	200 over baseline	14	320	550	1100	200 over baseline	2500
Jul 1991 (Repeat Baseline)	20[d]	225	<14	650	850	<10	190	Not Done
Apr 96 (Prior to backfilling)	11[d]	150	31	18	64	16	130	Not Done
Apr 97 (During backfilling)	12[d]	133	32	43	190	10	160	Not Done
Jul 98 (After backfilling)	130[d]	1097	66	76	1800	350	250	42[d]
Apr 99	Not Done	1319	55	1300	5300	340	1200	Not Done
Jul 99	220	1310	97	3200	5600	350	1300	880
Oct 99	210	1400	17	3600	5200	680	1100	730
Oct 00	200[d]	1189	<2.6	6600	4200	460	1100	900
Oct 01	160	1109	<13	2800	3300	450	940	440
Jul 02	170	1093	<13	6200	3600	380	1000	640
Jan 03	170	1080	<13	6700	3200	390	990	700
Jul 03	170	1027	<6.7	6600	3200	360	810	730
Apr 04	151	1025	<6.7	7000	2900	330	720	623
Jul 04	150	998	28	2300	2800	310	690	830
Jul 05	160	962	27	1500	2900	330	680	650
Oct 05	Not Done	955	25	730	2900	330	730	Not Done
Apr 06	150	926	30	460	2600	300	620	560
Jul 06	130	928	21	620	2400	310	660	500
Oct 06	Not Done	948	12	490	2700	290	600	Not Done
Jan 07	Not Done	959	29	260	2600	290	570	Not Done
Apr 07	Not Done	929	13	380	2600	300	630	Not Done
Jul 07	140	887	12	660	2600	300	660	490
Oct 07	Not Done	933	<2.7	4700	2800	300	650	Not Done
Jan 08	Not Done	921	13	310	2400	310	690	Not Done
Apr 08	Not Done	880	7.8	330	2500	280	710	Not Done
Jun 08	140	932	21	460	2500	240	640	450

a Unless otherwise indicated, data was obtained from: (1) Flambeau Mining Company, 2007 Annual Report, Appendix B – Groundwater Quality & Elevation/Surface Water Quality Trends; or (2) Flambeau Mining Company, 2008 Environmental Monitoring Results (Groundwater) First Quarter, Second Quarter, and Third Quarter reports

b Data on file with Wisconsin Department of Natural Resources, Madison, WI

c Decision, Findings of Fact, Conclusions of Law and Permits [for the Flambeau Mine], State of Wisconsin Division of Hearings and Appeals, 1991, pp. 87-93.

d Since FMC did not report test results for the parameter in question, the indicated value is from split sample test results reported by the Wisconsin Department of Natural Resources and on file at Department headquarters in Madison, WI.

Table 8. Iron and Manganese Concentrations in Compliance Boundary Well MW-1015B [a]

	Parameter	
	Iron (µg/L)	**Manganese (µg/L)**
Pre-Mine Baseline[b]	Not Done	Not Done
Flambeau Mine Enforcement Standard[c]	300	230
Apr 01	69	140
Jul 01	<5	19
Oct 01	<5	8.6
Jan 02	<5	25
Apr 02	<5	73
Jul 02	69	53
Oct 02	420	380
Jan 03	120	440
Apr 03	210	250
Jul 03	450	170
Oct 03	670	290
Jan 04	440	240
Apr 04	380	120
Jul 04	450	190
Oct 04	300	140
Jan 05	220	120
Apr 05	290	130
Jul 05	400	140
Oct 05	300	140
Jan 06	320	110
Apr 06	440	100
Jul 06	52	97
Oct 06	320	110
Jan 07	350	120
Apr 07	160	81
Jul 07	340	100
Oct 07	330	100
Jan 08	290	94
Apr 08	300	86
Jun 08	200	89

[a] Unless otherwise indicated, data was obtained from: (1) Flambeau Mining Company, 2007 Annual Report, Appendix B – Groundwater Quality & Elevation/Surface Water Quality Trends; or (2) Flambeau Mining Company, 2008 Environmental Monitoring Results (Groundwater) First Quarter, Second Quarter, and Third Quarter reports

[b] The MW-1015 nest was not drilled until January 2001. Since the mine operated from 1993-1997 and the pit was backfilled in 1997, this means there are no pre-mine baseline measurements. The MW-1015 nest was first sampled in April 2001.

[c] Decision, Findings of Fact, Conclusions of Law and Permits [for the Flambeau Mine], State of Wisconsin Division of Hearings and Appeals, 1991, pp. 87-93.

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Report: Contamination at the Flambeau Mine

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FOR IMMEDIATE RELEASE

April 13, 2017

Legislators Urged to Preserve Mining Moratorium Law

Study Reveals Flambeau Mine Deeply Flawed

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Madison–The Sierra Club and Wisconsin Resources Protection Council today released an open letter and a policy briefing paper urging Wisconsin legislators to preserve Wisconsin's common sense "Prove It First" Mining Moratorium Law. 50 organizations to date, including Midwest Environmental Advocates, Trout Unlimited, the River Alliance of Wisconsin, the Mining Impact Coalition of Wisconsin, Clean Wisconsin, the Wisconsin League of Conservation Voters, the League of Women Voters, the Alliance for the Great Lakes and many more statewide, regional and national groups such as the Natural Resources Defense Council are joined together in opposition to efforts announced by state Senator Tiffany to repeal this landmark law.

The Mining Moratorium ("Prove It First") briefing includes this background information:

- To this day, the mining industry has yet to offer a single example of a successfully operated and closed mine in metallic sulfide minerals.
- The Flambeau mine violated the Clean Water Act, has ongoing water contamination issues and cannot be an example to satisfy the Moratorium law.
- The history including the votes of current legislators and elected officials who voted for the Moratorium in 1997. The list includes Governor Walker.

The organizations also released the summary of ongoing research revealing new details about water contamination from the Flambeau mine. Robert E. Moran, Ph.D. – a Geochemist and Hydrogeologist with 45 years of domestic and international experience with mining and water quality issues in both the public and private sectors – has reviewed the development of the mine including permitting efforts, the short operating period and years of monitoring.

Dr. Moran was asked to review public documents related to the Flambeau mine to help determine the state of public resources – ground and surface waters – impacted by the mine during and after mining. The summary released today includes important new findings:

- Ground and surface water quality is being and has been degraded at the Flambeau mine site—despite years of industry public relations statements touting the success of the Flambeau mining operation.
- The Flambeau mine is an example of a deeply flawed permitting and government oversight process. The opposite of a clean mining operation, groundwater quality data shows contaminants that greatly exceed baseline data and water quality and aquatic life criteria.
- The Flambeau mining and remediation practices are not a sustainable, long-term solution. The mining company may have satisfied the lax state oversight and disclosure requirements, but site ground waters are contaminated and treatment would be extremely costly.

Dr. Moran's summary can be found at: **www.sierraclub.org/wisconsin/issues/mining** It will be followed soon by a report that includes full documentation of the conclusions reached in his research. The summary is being released ahead of the full report to counter the ongoing false claims that the Flambeau mine safely mined in metallic sulfide ore without causing contamination of public waters. A one-page summary of critical points of information from the report follows on page 3.

From 1994-97, a large network of state and regional organizations including environmental and conservation groups, Wisconsin tribes, unions, churches and other citizen groups joined together to oppose the Crandon mine proposal and pass the Mining Moratorium law with overwhelming public support and signed by Governor Thompson in 1998. The network's efforts successfully educated the public on the dangers of mining in metallic sulfide minerals.

The documents released today (letter to legislators, briefing paper on Wisconsin's Mining Moratorium Law and Dr. Moran's summary of issues with the Flambeau mine) can be found at: **www.sierraclub.org/wisconsin/issues/mining** and at: **www.wrpc.net/**

– end –

*Deer Tail Press (**DeerTailPress.wordpress.com**) is a small publishing house founded in 2006 by the late Roscoe Churchill of Ladysmith, Wisconsin and Laura Gauger of Duluth, Minnesota. Its primary mission is to provide the public and government officials with fact-based information on Wisconsin's Flambeau Mine – the economics of the project, legal considerations, and most importantly, the environmental track record of the mine.*

Robert Moran, Ph.D. has 45 years of domestic and international experience in conducting and managing water quality, geochemical and hydrogeologic work. He has worked with private investors, industrial clients, tribal and citizen groups, non-governmental organizations, law firms, and governmental agencies at all levels. Examples of his work, his professional qualifications and more are at: ***http://remwater.org***

The Wisconsin Resources Protection Council (WRPC) is a statewide, environmental membership organization founded in 1982 to help counter the lack of information about the effects of large-scale metallic sulfide mining on our state's precious water supplies, on the tourism and dairy industries, and upon the many Native American communities that are located near potential mine sites.

Founded in 1892 by John Muir, the Sierra Club is America's oldest, largest and most influential grassroots environmental organization. The Sierra Club's mission is to explore, enjoy, and protect the wild places of the earth; to practice and promote the responsible use of the earth's ecosystems and resources; to educate and enlist humanity to protect and restore the quality of the natural and human environment; and to use all lawful means to carry out those objectives. The Sierra Club – John Muir Chapter is made up of 15,000 members and supporters working to promote clean energy and protect water resources in Wisconsin.

Critical Points extracted from:

SUMMARY – Flambeau Mine: Water Contamination and Selective "Alternative Facts"

Robert E. Moran, Ph.D. / **remwater.org** / April 11, 2017

- "Flambeau ground and surface water quality is being and has been degraded—despite years of industry public relations statements touting the success of the FMC operation. Rio Tinto said in a 2013 public relations (PR) release regarding the Flambeau Mine: "Testing shows conclusively that ground water quality surrounding the site is as good as it was before mining." In efforts to encourage development of the other metal-sulfide deposits in northern Wisconsin and the Great Lakes region, the industry approach has been to simply repeat this false statement over and over, assuming that repetition will make it believed. **Unfortunately, the FMC data show otherwise.**"
- "FMC wells within the backfilled pit have median dissolved concentrations as high as the following (2014-16): Copper = 503 µg/L; Iron = 14,000 µg/L; Manganese = 33,500 µg/L; Zinc = 1200 µg/L; Arsenic = 23 µg/L; Sulfate = 1600 mg/L; Alkalinity = 610 mg/L; Hardness = 2150 mg/L; Total Dissolved Solids = 3110 mg/L; Specific Conductance = 3180 µS. **These values greatly exceed baseline data and relevant water quality standards and aquatic life criteria.** FMCs "baseline" ground water data report that uranium was detected in between 64 to 100% of their samples, yet **uranium was not included in the routine monitoring**."
- "These ground waters are also being contaminated with numerous minor / trace constituents (e.g. aluminum, arsenic, chromium, lead, nickel, uranium, etc.) as a result of FMC operations. Drawing reliable, *quantitative* conclusions about these constituents is difficult as *FMC has been allowed to characterize the water quality using data that are not representative of the actual, chemically-unstable ground waters*."
- "The narrative "predictions" made by FMC's main Wisconsin consultant in the various permit-related and Annual Reports appear to be largely naïve geochemically and hydrogeologically. It is doubtful that these statements represented the opinions of FMCs technical experts. Such statements are most useful for obtaining permits, less so for generating quantitatively-reliable predictions."
- "FMC and their contractors supplied all of the data and interpretations used to compile the permit-related reports and subsequent Annual Reports. Such an approach obviously reflects FMC's interests, but is likely quite different from financially-independent, public-interest science. **In short, the Flambeau Mine is the poster child for a severely-flawed permitting and oversight process, that has likely generated long-term public liabilities.**"

- "FMC has failed to define either the actual flow pathways for ground waters exiting the backfilled pit, or to define the ground water-surface water interactions."
- "Contaminated discharges from the southeast corner of the FMC site have resulted in ... [a tributary of the Flambeau River] being added to the Environmental Protection Agency (EPA) impaired waters list for exceedances of acute aquatic toxicity criteria for copper and zinc. Since 1998, FMC has instituted six different work plans to address this soil and water contamination issue. As of fall 2016, copper levels in the Flambeau River tributary still exceed the acute toxicity criterion [despite passive water treatment], and FMC has not secured a mine reclamation Certificate of Completion (COC) for this portion of the mine site."
- "Backfilled waste rock was mixed with limestone to minimize the formation of acid and release of trace constituents into the pit waters. However, the rise in pH due to the addition of limestone (or especially lime) can also generate conditions that increase the water concentrations of those trace elements that form mobile species ***at elevated pHs, such as aluminum, arsenic, antimony, chromium, manganese, nickel, selenium, molybdenum, uranium, zinc, etc.***"
- "Wastes from the FMC operation will remain onsite *forever.* While limestone was added to the waste rock as it was backfilled into the pit, the ability of the limestone to neutralize the formation of acid waters is limited and finite. After the limestone has reacted with the waste rock, its neutralizing action will cease and the *pit waters are likely to become increasingly acidic and the concentrations of potentially-toxic contaminants are likely to increase.* The deeper pit well waters already show evidence of increased degradation of water quality, in roughly 20 years, post-closure. **It is reasonable to conclude that the Flambeau ground and surface water quality will further degrade in the coming decades if current site maintenance practices continue.**"
- **"Obviously the mining and remediation practices employed at Flambeau do not represent a *sustainable, long-term solution.* While FMC may have satisfied State oversight and disclosure requirements, the site ground waters are contaminated, and *these waters would require expensive, active water treatment to be made suitable for most foreseeable uses. Historically, most such costs are paid by the taxpayers."***

Tagged as: flambeau mine

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analytical results for many of these constituents were never made public. All similar massive sulfide deposits generate degraded water quality in the long-term.

11-The Flambeau River also received contaminants from numerous other sources of FMC property effluents: surface inflows from a tributary of the Flambeau River that crosses the southeast corner of the mine site (Stream C); the Copper Park Lane drainage ditch and other facilities adjacent to the ore crusher and rail spur; wetlands, storm runoff; stockpiled waste rock leachates and seeps; ore stockpiles; releases from the settling ponds; interceptor well discharges; inadequately-treated effluents from the Waste Water Treatment Plant (WWTP); clarifier underflow solids (sludges from WWTP). Several sources are presently contributing contaminants to the Flambeau River via surface water pathways, and possibly also via ground water pathways.

Contaminated discharges from the southeast corner of the FMC site have resulted in Stream C being added to the Environmental Protection Agency (EPA) impaired waters list for exceedances of acute aquatic toxicity criteria for copper and zinc. Since 1998, FMC has instituted six different work plans to address this soil and water contamination issue. As of fall 2016, copper levels in the Flambeau River tributary still exceed the acute toxicity criterion, and FMC has not secured a mine reclamation Certificate of Completion (COC) for this portion of the mine site.

12-Data are inadequate to demonstrate that Flambeau River chemical concentrations have been degraded, but *loads (mass)* of various metals, metalloids, sulfate, sediments, etc. have increased. Increasing the mass of metals in the Flambeau River, either as dissolved or particulate forms (suspended or bedload sediments), has the potential to harm the aquatic biota because these organisms are capable of consuming metal-laden particulates.

13-As the west end of the Flambeau pit is within 140 ft. of the Flambeau River, FMC should have been required to report all water quality constituents that have relevant Standards and Criteria (during both baseline and routine monitoring), to determine whether FMC releases might be damaging to any of the relevant water uses: human consumption; aquatic life; agricultural and irrigation. Such data would have required collection of both *filtered (Dissolved) and unfiltered (Total) samples for analysis of a much wider list of chemical constituents employing appropriate detection limits.* Unfiltered sample data are especially relevant where impacts to aquatic life may be anticipated. *Fish and macroinvertebrates are capable of ingesting both dissolved and particulate forms of chemicals discharged into aquatic environments, aggravating potentially-toxic impacts to the aquatic species and concentration up the food chain.*

14-The narrative "predictions" made by FMC's main Wisconsin consultant in the various permit-related and Annual Reports appear to be largely naïve geochemically and hydrogeologically. It is doubtful that these statements represented the opinions of FMCs technical experts. Such statements are most useful for obtaining permits, less so for generating quantitatively-reliable predictions.

Warning: mysql_query(): Access denied for user ''@'localhost' (using password: NO) in **/home/wrpc/www/www/wp-content/plugins/quickstats/quickstats.php** on line **345**

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WISCONSIN STATE SENATE

Public Hearing

Written Testimony

Name: Mary Louise Sutor

Date: 7 Sept 2017

Street Address or Route Number: 2380 Rux Rd

Subject: SB 395

City/Zip Code: Arbor Vitae 54568

acid & nonferous metal mining

Organization (*if applicable*):

Registering: In Favor ☐ Against ☑

Water is precious and life-giving. Anything that jeopardizes our water is terrible. Please do not rescind the moratorium on this mining!

Mary Louise Sutor

Please return this slip to a messenger promptly.

WISCONSIN STATE SENATE

Public Hearing

Written Testimony

Name: DAVE NOEL

Date: 9/7/2017

Street Address or Route Number: 7279 SAARI PT DR E

Subject: Proposed Sulfide mining Legislation

City/Zip Code: EAGLE RIVER

Organization (*if applicable*):

Registering: In Favor ☐ Against ☑

(see attached letter)

Please return this slip to a messenger promptly.

What the heck is sulfide mining...and why is Tiffany's new mining law bad for northern Wisconsin?

A few weeks ago I shared a letter that I had sent to Senator Tiffany pleading for him to not introduce his proposed legislation repealing the 20-year old moratorium on industrial (sulfide) acid mining. Last week the Senator announced his "Mining for America Act", which proposes to repeal the existing mining protection legislation, which many suggest would go even further to reduce existing safeguards and practices from sulfide ore mining.

Do you know what sulfide mining is? Sulfide mining is the practice of extracting metals such as copper, gold, silver and nickel from a sulfide-rich ore body. It typically involves explosives and heavy mining equipment to expose the rock containing the metal ore. The mining process is essentially traditional hard-rock mining from open-pit mines. There are a couple of major environmental issues that are cause for concern. The first is caused by run-off from the tailings – the rubble created when the rock containing the metal ore is broken up. A by-product of the metallic mining process are sulfides, that when exposed to water and air create sulfuric acid – *basically battery acid.* This runoff also carries heavy metal contaminates such as copper and zinc which are equally devastating to aquatic organisms.

The second issue is caused by the ore processing, separating the metals from the sulfide ore and other rock. In order to extract the precious metals, which are present in extremely small quantities, the mining company excavates large amounts of rock containing the metals and sulfides which are then pulverized, mixed with a cyanide compound, and left in a huge pile. The cyanide solution leaches the precious metals from the sulfide ore. The precious metals are then recovered from the cyanide solution by another process. In countless mining operations throughout the world this cyanide leaching solution has spilled into streams and subsurface water supplies causing serious environmental problems. In Colorado the tops of entire mountains were removed and, when the cyanide leaching solution spilled into nearby streams, the mining companies simply walked away, leaving monstrous superfund sites. There has never been a sulfide mine that has not polluted nearby water resources. The legacy of sulfide mining is very expense to remediate, and typically becomes a burden for taxpayers. Acid mine drainage poisons water forever. There is no antidote, and no fix for the damage caused in the effort to collect small amounts of these precious metals.

Finally, I want to clarify the action that Senator Tiffany wants to take. The current law, which has been in place since 1988, is often referred to as a "mining moratorium", but is more accurately named the "prove-it-first" mining law. The law does not prohibit sulfide mining companies from operating in Wisconsin, but rather *it requires companies that want to develop sulfide mines in Wisconsin to demonstrate that another mine located anywhere in the US has been able to operate for 10 years and then be closed for 10 years without polluting groundwater and surface water.* The bill that Tiffany introduced would repeal this requirement. This is the law that has kept mining out of Wisconsin since these requirements have never been met – anywhere. **Tiffany claims that sulfide mining can be done safely in the State, but the mining industry has yet to offer a single example of a successfully operated and closed sulfide metals mine.**

Senator Tiffany has erroneously cited the success of the Flambeau mine clean-up as the principle justification for the repeal of the "prove-it-first" law. However the results of this project are far from proving the environmental safety of sulfide mining. First, this small (32 acres) pilot project only operated for four years and second, it is far from clean. The small 32 acre pilot site produced over 8 million tons of sulfide rock tailings. The open pit was filled-in and the surface was re-contoured and replanted. However, while on the surface the former mine site may appear remediated, water runoff from the mine does not meet Wisconsin surface or groundwater water quality standards. Runoff continues to pollute a stream which flows into the Flambeau River. Multiple water samples taken since 2004 show significantly elevated levels of heavy metals including copper and zinc. At one sampling station the copper level is approximately 10 times that acute water quality standard, and the zinc level is approximately twice the water quality standard. Copper and zinc are synergistic metals, so their combined impact on aquatic life is devastating. In 2012 a federal judge ruled that the mining company had violated the US Clean Water Act.
http://www.miningtruth.org/wp-content/uploads/2013/01/Flambeau-Mine-fact-sheet-Final-1.pdf

Because the Flambeau mine was developed as a pilot project, the precious metal processing was not actually done on site, but rather the ore was hauled to another site for processing. Fortunately the Flambeau River watershed was spared the risk of poisonous cyanide contamination. This site does not even qualify as a candidate for the "prove-it-first" mine project, and it certainly doesn't earn the right to be an example of sulfide mining success.

The mining industry has yet to offer a single example of a successfully operated and closed sulfide metals mine anywhere in the United States in the past twenty years. We should not let Wisconsin be another example of failure. Wisconsin citizens and their representatives should wonder why Senator Tiffany wants to lead us into failure for a few pieces of silver.

Tell Senator Tiffany we like our existing "PROVE-IT-FIRST" mining law !

Dave Noel, engineer, retired
Sugar Camp, WI

IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF WISCONSIN

Wisconsin Resources Protection Council, Center for Biological Diversity, and Laura Gauger,

Plaintiffs,

v.

Case No. 11-cv-45

Flambeau Mining Company,

Defendant.

COMPLAINT

Plaintiffs Wisconsin Resources Protection Council, Center for Biological Diversity, and Laura Gauger ("Plaintiffs"), by and through their undersigned attorneys, complain and allege as follows:

INTRODUCTION

1. Plaintiffs file this civil action pursuant to the citizen suit provision of the Federal Water Pollution Control Act, commonly known as the Clean Water Act ("CWA" or "the Act"), 33 U.S.C. §§ 1251 et seq., to abate numerous ongoing violations of the Act caused by Defendant Flambeau Mining Company ("FMC" or "Defendant"), including FMC's unlawful discharge of pollutants to waters of the United States without a discharge permit issued under the CWA.

2. FMC has violated and continues to violate the CWA at its property near Ladysmith, Wisconsin. Since at least 1998, FMC has unlawfully discharged toxic pollutants including copper, zinc, and iron to surface waters that are tributary to the Flambeau River without complying with the explicit permitting and other substantive requirements of the Act.

3. Defendant's ongoing violations of the CWA have caused and, unless abated, will continue to cause harm to a stream known as "Stream C" and the Flambeau River, in Rusk County, Wisconsin, and have added and continue to add to existing pollution levels in those surface waters.

4. Plaintiffs seek a declaratory judgment, injunctive relief, remedial relief, the imposition of civil penalties, and the award of costs, including attorney and expert witness fees.

JURISDICTION AND VENUE

5. This Court has subject matter jurisdiction over the claims specified in this compliant pursuant to the CWA's "citizen suit" provision, 33 U.S.C. § 1365(a)(1), and 28 U.S.C. § 1331.

6. The relief requested is authorized by 33 U.S.C. §§ 1365(a) and 1319, and 28 U.S.C. §§ 2201 and 2202.

7. Pursuant to section 505(c)(1) of the CWA, 33 U.S.C. § 1365(c)(1), venue lies in the Western District of Wisconsin because Defendant's property from which the unlawful discharge occurs lies within this District.

8. As required by 33 U.S.C. §1365(b)(1)(A) and 40 C.F.R. § 135.2, Plaintiffs gave notice of the violations alleged in this complaint and of Plaintiffs' intent to file suit to address those violations to Defendant by letter dated November 16, 2010 ("Notice Letter"). Plaintiffs also gave notice to the Administrator of the United States Environmental Protection Agency ("USEPA"); the Regional Administrator of the USEPA; and the Secretary of the Wisconsin Department of Natural Resources ("WDNR"). A true and correct copy of the Notice Letter is attached to this complaint as Exhibit 1.

9. To Plaintiffs' knowledge, neither USEPA nor the State of Wisconsin has commenced or is diligently prosecuting a civil or criminal action against Defendant to abate the statutory, regulatory, or permit violations that form the basis for this complaint.

PARTIES

10. Plaintiff Wisconsin Resources Protection Council ("WRPC") is a statewide, non-profit membership organization concerned with educating the public about the consequences of allowing international mining corporations to develop a new mining district in the Lake Superior region under the present legal and regulatory framework. WRPC strives to protect the land and water resources of Wisconsin from the negative environmental impacts of metallic mining. WRPC has an address care of Al Gedicks, Executive Secretary, and 210 Avon Street #4, La Crosse, Wisconsin 54603.

11. Plaintiff Center for Biological Diversity ("the Center") is a national, non-profit membership organization with over 40,000 members including hundreds of members in Wisconsin. The Center has an office in Duluth, Minnesota. The Center works through science, law and creative media to secure a future for all species, great or small, hovering on the brink of extinction.

12. Several of WRPC's and the Center's members live, own property, or enjoy participating in recreational activities near Defendant's property and facilities that are in violation of the CWA, and on or near the waters that receive Defendant's polluted discharges (namely, Stream C and the Flambeau River near Ladysmith, Wisconsin). These members enjoy canoeing, kayaking, fishing, hiking, wildlife and bird watching, and the study of wildlife and aquatic life for personal and professional purposes on or near Stream C and the Flambeau River.

13. Several of WRPC's and the Center's members have aesthetic, economic, professional, or recreational interests in the waters that receive the pollutants discharged by Defendant, and they are adversely affected and injured by Defendant's discharges of pollutants because their use and enjoyment of the receiving waters and the natural resources of the area surrounding Defendant's facility is impaired.

14. Plaintiff Laura Gauger resides at 1321 E. 1st Street #210, Duluth, Minnesota 55805. Ms. Gauger lived in Spooner, Wisconsin until 2010. Ms. Gauger presently enjoys, and in the past has frequently enjoyed, hiking, canoeing, wildlife watching, and other recreational and aesthetic activities near the Flambeau Mine, including near Stream C and on the Flambeau River adjacent to the Flambeau Mine, and her recreational and aesthetic interests in Stream C and the Flambeau River have been adversely affected and injured by Defendant's unlawful discharge of pollutants to those surface waters. Ms. Gauger is a member of both WRPC and the Center.

15. Defendant Flambeau Mining Company owns property located at N4100 Highway 27, Ladysmith, WI 54848. This property contains an abandoned and partially reclaimed metallic mine and several related industrial facilities and structures. One such structure, described alternately by Defendant as a "surge pond" or "biofilter," holds, treats, and then discharges pollutants known to the USEPA and WDNR to be toxic to aquatic life and a threat to human health. Defendant has owned and operated this property and all relevant facilities at all times relevant to the claims asserted in this complaint.

LEGAL BACKGROUND

16. Congress passed the Clean Water Act in 1972 to "restore and maintain the chemical, physical, and biological integrity of the nation's waters." CWA § 101(a), 33 U.S.C. §

1251(a). In the CWA Congress set a national goal of eliminating "the discharge of pollutants into navigable waters" by 1985. Id. To advance this goal the CWA provides a comprehensive approach for the regulation of pollution discharges to waters of the United States.

17. Section 301(a) of the Act prohibits the "discharge of any pollutant by any person" unless such discharge is in compliance with the substantive requirements of the CWA, including the requirement to obtain a permit issued under section 402 (33 U.S.C. § 1342) or 404 (33 U.S.C. § 1344) of the Act. 33 U.S.C. § 1311(a).

18. The "discharge of any pollutant" means "any addition of any pollutant to navigable waters from any point source." 33 U.S.C. § 1362(12)(A). The term "point source" is further defined to mean "any discernible, confined and discrete conveyance, including but not limited to any . . . channel . . . [or] conduit . . . from which pollutants are or may be discharged." 33 U.S.C. § 1362(14).

19. The centerpiece of the CWA's regulatory programs is the National Pollutant Discharge Elimination System ("NPDES"), which authorizes EPA to issue discharge permits to persons seeking to discharge pollutants into waters of the United States. CWA § 402, 33 U.S.C. § 1342. NPDES Permits may only be issued upon condition that the permitted discharge will comply with all applicable CWA regulatory requirements, including compliance with effluent limitations and water quality standards established under section 301. CWA § 402(a)(1), 33 U.S.C. § 1342(a)(1).

20. Under section 402(b)-(c) of the CWA, 33 U.S.C. § 1342(b)-(c), USEPA may delegate its NPDES permit authority to States that have an EPA-approved permit program. Authority to issue NPDES permits in Wisconsin has been delegated by USEPA to WDNR, pursuant to CWA § 402(b), 33 U.S.C. § 1342(b). Under this delegated authority and authority of

state law, WDNR operates the NPDES permitting program within Wisconsin but calls it the Wisconsin Pollutant Discharge Elimination System ("WPDES"). *See generally* Wis. Stat. § 283.

21. State NPDES programs must be operated at all times "in accordance with" the substantive NPDES requirements of section 402 of the CWA, and the guidelines for monitoring, reporting, enforcement, funding, personnel, and manpower established by USEPA under section 304(i) of the CWA. 33 U.S.C. § 1342(c)(2).

22. Congress also provided for the enforcement of certain CWA requirements by citizens. The Act's citizen suit provision, § 505, states that "any citizen may commence a civil action on his own behalf . . . against any person . . . who is alleged to be in violation of . . . an effluent standard or limitation under" the Act. 33 U.S.C. § 1365(a)(1). The discharge of pollutants without an NPDES permit (or, in Wisconsin, a WPDES permit), is a violation of section 301(a) of the CWA, and therefore is among the enumerated CWA violations that fall within the scope of the citizen suit provision. 33 U.S.C. § 1365(f)(1).

23. The Act's citizen suit provision authorizes the district courts to enforce the applicable effluent standards and limitations; to apply civil penalties, as appropriate; and to award litigation costs including attorneys' fees to prevailing or substantially prevailing parties. 33 U.S.C. § 1365(a) and (d).

FACTUAL BACKGROUND

24. Defendant's property near Ladysmith, Wisconsin includes the Flambeau Mine site and various industrial or administrative buildings, facilities, and structures. Defendant actively mined the site for gold, silver, and copper during the years 1993 to 1997. Mining operations ceased in early 1997, and that same year FMC began reclamation activities that continue to this day.

25. During active mining operations, Defendant's property included an approximately 0.9-acre "Surge Pond" that received acid mine drainage from the mine's high sulfur waste rock stockpile; drainage from the mine's open pit; and overflow from an on-site wastewater treatment plant, among other wastewater streams.

26. Following the cessation of mining activities in 1997, FMC created an approximately 32-acre industrial park (called by FMC the "Industrial Outlot") at the southern edge of the mine site. As part of its reclamation activities at the Industrial Outlot, FMC reconstructed the Surge Pond into a stormwater detention basin or "Biofilter" in order to collect runoff from the Industrial Outlot prior to discharge to Stream C.

27. During periods of significant precipitation, the water level in the Biofilter rises to the point where some of the water contained in the Biofilter is discharged from an outlet that connects the Biofilter to Stream C.

28. The Biofilter and its outlet to Stream C is a "point source" under 33 U.S.C. § 1362(14).

29. When water flows from the Biofilter through the outlet to Stream C, it is the "discharge of a pollutant" under 33 U.S.C. § 1362(12).

30. FMC knows of this discharge from the Biofilter to Stream C, and intended for it to occur at least occasionally as a result of the reconstruction of the Biofilter.

31. In 1997 FMC submitted to WDNR a document entitled "Supplement to the Surface Reclamation Plan for the Flambeau Mine." In that document, which was prepared by FMC's consultants Applied Ecological Services, Inc., FMC stated that "stormwater from the industrial outlot would be directed to a constructed biofilter located in the area of the former surge pond. Flow from the biofilter would be directed to Stream C."

32. In the Surface Water Analysis included by FMC in the Supplement to the Surface Reclamation Plan for the Flambeau Mine, FMC stated that "[d]rainage from the future industrial area of the Flambeau Mine property (south of the reclaimed area) will be conveyed to the existing surge pond at the east side of the site. This surge pond will be reconstructed as a biofilter/detention basin, to improve the water quality and decrease the peak flow rates of runoff from the developed area prior to its discharge into Stream C."

33. In January 2007, FMC submitted to WDNR a report entitled "Biofilter Management Plan: Copper Park Business & Recreation Area – Formerly the Flambeau Industrial Outlot" ("Biofilter Management Plan"). A true and correct copy of the Biofilter Management Plan accompanied Plaintiffs' Notice Letter, and is attached to this compliant as part of Exhibit 1.

34. In the Biofilter Management Plan, which was prepared by FMC's consultants Foth Infrastructure and Environment, LLC, FMC stated that "[t]he purpose of the biofilter is to capture particulates in the surface water from the site prior to discharge to Intermittent Stream C."

35. At least twice per year since 1998, FMC has collected water samples from the Biofilter outlet to Stream C, at a surface water monitoring point identified by FMC and WDNR as "BFSW-C2." FMC has reported the results of laboratory analysis of each of these water samples to WDNR.

36. The pollutants discharged by FMC from the Biofilter to Stream C and the Flambeau River include the metals copper, iron, and zinc. These three pollutants are subject to state water quality standards established by WDNR, national recommended water quality criteria established by USEPA, or both. These pollutants can be toxic to aquatic life and human health, and can impair the uses of Stream C and the Flambeau River.

37. Between November 1999 and September 17, 2010, at least 28 water samples have been collected at monitoring point BFSW-C2 (the Biofilter outlet to Stream C) by either FMC or WDNR and analyzed for copper concentrations. The reported copper concentrations at the Biofilter outlet to Stream C have ranged from 4.8 μg/L to 91 μg/L.

38. Between November 1999 and September 17, 2010, at least 17 water samples have been collected at monitoring point BFSW-C2 (the Biofilter outlet to Stream C) by either FMC or WDNR and analyzed for iron concentrations. The reported iron concentrations at the Biofilter outlet to Stream C have ranged from 0.036 mg/L to 2.4 mg/L.

39. Between November 1999 and September 17, 2010, at least 28 water samples have been collected at monitoring point BFSW-C2 (the Biofilter outlet to Stream C) by either FMC or WDNR and analyzed for zinc concentrations. The reported zinc concentrations at the Biofilter outlet to Stream C have ranged from <5 μg/L to 53 μg/L.

40. FMC does not presently hold, nor has it held at any time since December 31, 2000, a "permit issued pursuant to" section 402 of the CWA, *see* 33 U.S.C. § 1342(k), including a WPDES permit issued by WDNR or an NPDES permit issued by USEPA for any discharge of pollutants from any point source at the Flambeau Mine site, including the Biofilter.

<u>The Receiving Waters</u>

41. Stream C is an intermittent stream that flows along the southeastern corner of Defendant's property.

42. Stream C is a water of the United States, and has been identified by WDNR as navigable water.

43. Approximately one-quarter mile from the Biofilter outlet (monitoring point BFSW-C2), Stream C joins the Flambeau River.

44. The Flambeau River is a water of the United States and a navigable water.

CLAIM FOR RELIEF:
DEFENDANT'S CLEAN WATER ACT VIOLATION

45. Paragraphs 1 through 44 are incorporated as if set forth fully herein.

46. On numerous occasions since 1998, FMC violated section 301(a) of the CWA, 33 U.S.C. § 1311(a), by discharging pollutants including copper, iron, and zinc from the Biofilter to Stream C and the Flambeau River without a permit issued under section 402 of the CWA, and without complying with the substantive requirements of sections 301 of the CWA.

47. Each time FMC discharges pollutants from the Biofilter into Stream C without an NPDES or WPDES permit, it violates the CWA.

48. FMC's CWA violations occurred on at least the 28 dates upon which FMC or the WDNR conducted water quality monitoring at Sampling Point BFSW-2. These specific dates are identified in Exhibit 1 (*See* Attachment D, "Discharges from Biofilter to Stream C and Sampling Results").

49. FMC violated section 301(a) of the CWA by discharging pollutants without complying with the requirements of CWA sections 301 and 402 of the on each of the additional dates identified in Exhibit 1 (*See* Attachment C, "Flambeau Mine / Industrial Outlot Rainfall Data") and on all other dates upon which precipitation-induced discharges from the Biofilter to Stream C and the Flambeau River occurred.

50. As of the date of this Complaint, FMC's CWA violations are ongoing because FMC has not taken action to eliminate its discharge, nor has it obtained the requisite permit authorizing the discharge of pollutants under section 402 of the CWA.

51. Unless abated by an order of this Court, FMC will continue to violate the CWA every time a discharge from the Biofilter to Stream C and the Flambeau River occurs.

RELIEF REQUESTED

WHEREFORE, Plaintiffs Wisconsin Resources Protection Council, Center for Biological Diversity, and Laura Gauger respectfully request that this Court grant it the following relief:

(1) A declaration that Defendant FMC violated and continues to violate the Clean Water Act as described above;

(2) An injunction requiring the Defendant to take all actions necessary to prevent future violations of the CWA, including the cessation of all discharges of pollutants unless authorized by an NPDES permit issued under section 402 of the CWA and in compliance with applicable requirements under section 301 of the CWA;

(3) An order requiring Defendant to remediate the harm caused by its CWA violations, to the extent possible;

(4) An order requiring Defendant to pay civil penalties in the appropriate amount for each day that Defendant violated the CWA;

(5) An order requiring Defendant to pay an appropriate sum for a Supplemental Environmental Project ("SEP") to benefit the water quality of Stream C and the Flambeau River and to further the economic, recreational, and aesthetic use of Flambeau River by the public;

(6) An order requiring Defendant to pay the costs of litigation, including Plaintiffs' reasonable attorneys fees and expert witness fees, as provided by 33 U.S.C. § 1365(d); and

(7) Such other relief the Court may find just and proper.

Respectfully submitted this 18th day of January, 2011.

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In the

United States Court of Appeals

For the Seventh Circuit

Nos. 12-2969 & 12-3434

WISCONSIN RESOURCES PROTECTION COUNCIL, ET AL.,

Plaintiff-Appellees, Cross-Appellants,

v.

FLAMBEAU MINING COMPANY,

Defendant-Appellant, Cross-Appellee.

Appeals from the United States District Court for the Western District of Wisconsin.
No. 3:11-cv-00045-bbc — **Barbara B. Crabb**, *Judge.*

ARGUED APRIL 23, 2013 — DECIDED AUGUST 15, 2013

Before RIPPLE and HAMILTON, *Circuit Judges*, and STADTMUELLER, *District Judge.**

RIPPLE, *Circuit Judge.* The Wisconsin Resources Protection Council, the Center for Biological Diversity and Laura Gauger (collectively the "plaintiffs") brought this action under the

* The Honorable J. P. Stadtmueller, of the United States District Court for the Eastern District of Wisconsin, sitting by designation.

Clean Water Act's ("CWA" or "the Act") citizen-suit provision, 33 U.S.C. § 1365(a)(1), alleging that Flambeau Mining Company ("Flambeau") violated the CWA by discharging pollutants without a permit. The district court denied Flambeau's motion for summary judgment, holding that Flambeau was not protected by the CWA's permit shield provision, *id.* § 1342(k). After a bench trial, the district court determined that Flambeau had violated the CWA and assessed penalties against Flambeau. Because the CWA's permit shield applies, we reverse the judgment of the district court.

I

BACKGROUND

A. Relevant Statutory and Regulatory Framework

Congress enacted the CWA, 33 U.S.C. § 1251 et seq., in 1972 "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." *Id.* § 1251(a). To achieve this purpose, the CWA generally prohibits "the discharge of any pollutant by any person" into navigable waters of the United States. *Id.* § 1311(a). However, such a discharge is permitted when done pursuant to a national pollution discharge elimination system ("NPDES") permit. *See id.* §§ 1311(a), 1342. NPDES permits are issued pursuant to section 402 of the CWA, codified at 33 U.S.C. § 1342(a), which authorizes the Act's administrator to "issue a permit for the discharge of any pollutant, or combination of pollutants, notwithstanding section 1311(a)."

The Environmental Protection Agency ("EPA") is the CWA's administrator. However, because the CWA also embodies Congress's intent "to recognize, preserve, and protect the primary responsibilities and rights of States to prevent, reduce, and eliminate pollution," 33 U.S.C. § 1251(b), it empowers the EPA to delegate its permitting and enforcement authority to individual states, *id.* § 1342(b). A state seeking to administer the CWA must submit for EPA approval "a full and complete description of the program it proposes to establish and administer under State law." *Id.* § 1342(b).[1] Once the EPA has approved a state's program, the EPA no longer has authority to issue NPDES permits under the CWA, *id.* § 1342(c); at that point the state permitting authority is the only entity authorized to issue NPDES permits within the state's jurisdiction. However, the EPA retains supervisory authority over the state program and is charged with "notify[ing] the State of any revisions or modifications [to the State's program] necessary to conform to [CWA] requirements or guidelines." *Id.* § 1342(c)(1).

It is undisputed that Wisconsin has obtained approval from the EPA to implement and administer its own NPDES permitting program, which it calls the Wisconsin Pollutant Discharge Elimination System ("WPDES") program.[2] The Wisconsin Department of Natural Resources ("WDNR") administers the WPDES program and Wisconsin Administrative Code NR

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[1] The requisite steps for obtaining EPA approval are set forth in 40 C.F.R. § 123.21(a).

[2] Appellee's Br. 17 ("Wisconsin has obtained this EPA approval. . . ."); *see also generally Andersen v. Dep't of Natural Res.*, 796 N.W.2d 1, 10-11 (Wis. 2011).

§ 283 governs the WPDES program.[3] Thus, within Wisconsin, the WDNR, not the EPA, issues NPDES permits.

After obtaining initial approval of a state NPDES program, a state with delegated authority can modify its program with EPA approval. When a state wishes to do so, the regulations direct it to "submit a modified program description" to the EPA for approval. 40 C.F.R. § 123.62(b)(1). The EPA "will approve or disapprove program revisions based on the requirements ... of the CWA." *Id.* § 123.62(b)(3). "A program revision shall become effective upon the approval of the Administrator. Notice of approval of any substantial revision shall be published in the FEDERAL REGISTER.[4] Notice of approval of non-substantial program revisions may be given by a letter from the Administrator to the State Governor or his designee." *Id.* § 123.62(b)(4).

In 1987, Congress amended the CWA to include regulation of storm water discharge. *See* The Water Quality Act of 1987, Pub. L. No. 100-4, 101 Stat. 7 (1987) (codified at 33 U.S.C. § 1342(p)). To comply with these amendments, Wisconsin proposed modifying Wisconsin Administrative Code NR § 216 to provide WPDES storm water discharge permits. Under Wisconsin's proposed revisions, storm water would be regulated either by a separate WPDES permit or, under NR

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[3] *See, e.g., Andersen*, 796 N.W.2d at 12 ("Wisconsin Stat. ch. 283 also codifies the WPDES permit program.").

[4] 40 C.F.R. § 123.62(b)(2) provides that "[w]henever EPA determines that the proposed program revision is substantial, EPA shall" take various steps, including providing for public notice and comment.

§ 216.21(3) (now renumbered NR § 216.21(4)(a)),[5] a different permit. The current version of NR § 216.21(4) provides:

> (4) OTHER ENVIRONMENTAL PROGRAMS. If one of the following conditions is met, the department may determine that a facility is in compliance with permit coverage required under s. 283.33, Stats. [part of the WPDES program], and will not be required to hold a separate permit under s. 283.33, Stats.:
>
> (a) The storm water discharge is in compliance with a department permit or approval, which includes storm water control requirements that are at least as stringent as those required under this subchapter.

Wis. Admin. Code NR § 216.21(4)(a) (2013).

Wisconsin submitted its proposed modifications, including NR § 216.21(4)(a), to the EPA for approval in 1994. The EPA apparently did not deem these modifications substantial and so did not follow the approval process outlined in 40 C.F.R. § 123.62(b)(2). Instead, the EPA sent the WDNR comments on the proposed changes, although it appears never to have issued a formal letter of approval. Among its comments to NR § 216.21, the EPA wrote: "We concur with the approach whereby facilities which are required under regulation to obtain permits, but which ... are currently controlled under other regulatory mechanisms, are handled in special ways

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[5] For clarity, we will refer to this section by its current numbering.

under the State's permit program."[6] After receiving and responding to the EPA's comments, Wisconsin enacted NR § 216.21(4)(a).

B. Flambeau's Operations

From 1993 until 1997, Flambeau operated an active mine in Ladysmith, Wisconsin, along the Flambeau River. During this time, WDNR regulated Flambeau under a separate WPDES permit and a mining permit, which also imposed restrictions on Flambeau's storm water discharge. Flambeau had a reclamation plan in place to restore the mine site after the cessation of active mining. However, the City of Ladysmith and the Ladysmith Community Industrial Development Corporation asked Flambeau to preserve the mine site's current buildings, which was not called for under the original reclamation plan. Flambeau agreed and sought modification from the WDNR of its reclamation plan and mining permit. After public notice and comment, the WDNR approved Flambeau's new reclamation plan and modified its mining permit.

In conjunction with its review of Flambeau's proposed modifications, the WDNR evaluated potential storm water discharge from the mine site. Eventually, the WDNR decided to terminate Flambeau's separate WPDES permit and instead, pursuant to its authority under NR § 216.21(4)(a), regulate Flambeau's storm water discharge under its mining permit. This approach permitted the WDNR to conduct more frequent inspections of the mine site than would a separate WPDES

[6] R.62-1 at 132.

permit. Moreover, the WDNR determined that this approach was permitted under NR § 216.21(4)(a) because the WDNR "had basically [determined there to be] a functional equivalence from the mining permit to the storm water permit at the time; that [WDNR] could have equal protection, if not greater protection, under the mining permit."[7] On March 20, 1998, the WDNR sent Flambeau a letter "to clarify how the department intends to regulate surface water management at the [mine] site," including storm water discharge.[8] The letter stated:

> The current water handling procedures are acceptable to the department and are consistent with the Mining Permit, including the Surface Water Management Plan, and the Wisconsin Pollutant Discharge Elimination System (WPDES) Permit. It is our intent that the WPDES permit will continue to regulate discharges from the site through outfalls 001 and 002 as long as water is being pumped from one location to another on the site. Any discharge through those outfalls must comply with the effluent limits and monitoring requirements specified in the WPDES permit[] … as long as the WPDES permit remains in force. Once all permanent water management structures and facilities are in place and pumping is no longer necessary, discharges through outfall 002 will cease to be covered under the WPDES permit. At that time, stormwater man-

[7] R.274 at 81 (testimony of WDNR's head of metallic mining).

[8] R.62-2 at 2.

> agement will fall under the regulatory authority of the Mining Permit and its associated plans.[9]

The WDNR reiterated its decision to regulate Flambeau's storm water discharge under the mining permit rather than a separate WPDES permit again on September 8, 1998. The WDNR wrote to Flambeau "to acknowledge that surface water management and related discharges … . at the Flambeau mining site are no longer subject to the provisions of the Wisconsin Pollutant Discharge Elimination System (WPDES) Permit. This is consistent with the regulatory approach outlined in [the WDNR's] letter to [Flambeau] dated March 29, 1998."[10] On September 23, 1998, the WDNR terminated Flambeau's WPDES permit.[11] All of Flambeau's subsequent storm water discharges complied with the mining permit.

C. District Court Proceedings

Plaintiffs brought this action in the district court under the citizen-suit provision of the CWA, 33 U.S.C. § 1365, which alleged that Flambeau discharged copper into navigable waters without a permit. The parties filed multiple pre-trial motions, including Flambeau's motion for summary judgment, alleging that the plaintiffs' suit was barred by the CWA's permit shield provision, *id.* Section 1342(k) of Title 33 provides that "[c]ompliance with a permit issued pursuant to this section shall be deemed compliance[]" with the CWA. The plaintiffs

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[9] *Id.*

[10] R.66-8 at 2.

[11] R.66-9 at 2.

contended that the permit shield did not apply because Flambeau did not have a WPDES permit during the relevant time period and its mining permit did not trigger the permit shield because it was not issued pursuant to the CWA. The plaintiffs' argument was based on the claim that NR § 216.21(4)(a) was not part of the WDNR's CWA program because Flambeau could not establish that the EPA specifically had approved of NR § 216.21(4)(a). The district court agreed and denied Flambeau's motion, ruling that § 1342(k)'s permit shield did not apply because Flambeau did "not show[] that the EPA has approved use of state mining permits via § NR 216.21(4) as substitute for [a WPDES] permit."[12]

A bench trial was held, after which the district court found that Flambeau had violated the CWA because copper was discharged eleven times from the mine site and reached navigable waters of the United States without a permit. The court emphasized that "[t]he amounts were so modest that I would declare them de minimis"[13] and that Flambeau's "efforts to protect the environment during its mining operations and reclamation effort" were "exemplary" and "deserve commendation, not penalties."[14] However, because the CWA is a strict liability statute, *see Kelly v. United States EPA*, 203 F.3d 519, 522 (7th Cir. 2000), the district court found Flambeau liable and

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[12] *Wis. Res. Prot. Council v. Flambeau Mining Co.*, 903 F. Supp. 2d 690, 720 (W.D. Wis. 2012).

[13] R.256 at 3.

[14] *Id.* at 4.

imposed a penalty of $25.00 for each of the eleven discharges.[15] The court also *sua sponte* declined to award plaintiffs attorneys' fees under the CWA. It stated that fees were inappropriate under the "unusual circumstances of th[e] case," where "it remains unclear … why [plaintiffs] would have expended so much time and energy litigating against a company that seems every bit as committed as they are to the protection of the environment and preservation of water quality."[16] Plaintiffs moved for reconsideration of the denial of attorneys' fees, which was denied. Flambeau timely appealed and plaintiffs cross-appealed on the issue of their entitlement to fees.

II

DISCUSSION

Flambeau raises a variety of issues on appeal. It asserts that the district court erred at summary judgment when it determined that the CWA's permit shield did not apply and that Wisconsin is not a necessary party whose joinder is required. Flambeau next submits that the district court's determination that Flambeau violated the CWA eleven times is erroneous because the court failed to perform the correct analysis and erroneously determined certain waterways to be within the CWA's jurisdiction. We begin with the permit shield.

A.

The CWA makes "unlawful" "the discharge of any pollutant by any person" "[e]xcept as in compliance with" certain

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[15] *Id.* at 39.

[16] *Id.* at 38.

statutory provisions. 33 U.S.C. § 1311(a). One such provision is the NPDES permit, which "sets out the allowable departures from the CWA's baseline of total liability for discharges." *Piney Run Pres. Ass'n v. Cnty. Comm'rs*, 268 F.3d 255, 266 (4th Cir. 2001). The CWA's permit shield provision, 33 U.S.C. § 1342(k), specifies that "if a [NPDES] permit holder discharges pollutants precisely in accordance with the terms of its permit, the permit will 'shield' its holder from CWA liability." *Piney Run Pres. Ass'n*, 268 F.3d at 266; *see also* 33 U.S.C. § 1342(k) (providing that "[c]ompliance with a permit issued pursuant to this section shall be deemed compliance[]" for purposes of the federal compliance provision and the citizen suit provision); *Coon v. Willet Dairy, LP*, 536 F.3d 171, 173 (2d Cir. 2008) (noting that, under the permit shield, "compliance with an authorized permit is deemed compliance with the CWA, so as long as [the defendant] was acting in accordance with its permit it could not be liable in a citizen suit for CWA violations"). The Supreme Court has explained that the permit shield's purpose is "to relieve [permit holders] of having to litigate in an enforcement action the question whether their permits are sufficiently strict. In short, [the permit shield] serves the purpose of giving permits finality." *E.I. du Pont de Nemours & Co. v. Train*, 430 U.S. 112, 138 n.28 (1977).

Plaintiffs contend that Flambeau is not entitled to the permit shield because Flambeau does not hold a WPDES permit and its mining permit was not issued pursuant to the CWA. Plaintiffs allege that Wisconsin's NR § 216.21(4)(a), although codified in Wisconsin's Administrative Code as part of the state's WPDES program, is not part of Wisconsin's approved NPDES program because the EPA never approved

NR § 216.21(4)(a). Flambeau responds that the EPA did in fact approve Wisconsin's scheme and, in the alternative, even if it did not, Flambeau had no notice that it needed a different permit nor could it obtain one. In support of its position that the EPA approved NR § 216.21(4)(a), Flambeau points to the EPA's comments on the proposed regulations, which indicate that the EPA reviewed NR § 216.21(4)(a) and in which the EPA stated that it "concur[red] with the approach whereby facilities which are required under regulation to obtain permits, but which … are currently controlled under other regulatory mechanisms, are handled in special ways under the State's permit program."[17] The district court refused to apply the permit shield, holding that for the shield to apply, a valid permit is required. The court determined that Flambeau "has not shown that the EPA has approved use of state mining permits via § NR 216.21(4) as [a] substitute for [WPDES] permit"[18] and so had not established that it possessed a qualifying permit for purposes of the CWA.

B.

Whether the CWA's permit shield applies to Flambeau is a question of law, which we review de novo. *See Elusta v. City of Chicago*, 696 F.3d 690, 693 (7th Cir. 2012). We begin by noting that there is evidence that the EPA approved NR

[17] R.62-1 at 132.

[18] *Wis. Res. Prot. Council*, 903 F. Supp. 2d at 720.

§ 216.21(4)(a).[19] However, we need not decide whether the EPA approved this specific provision of Wisconsin's WPDES scheme[20] because, even if Flambeau's permit were legally invalid, we cannot, consistent with the requirements of due process, impose a penalty on Flambeau for complying with what Wisconsin deemed a valid WPDES permit.[21]

Informed by basic principles of due process, it is "a cardinal rule of administrative law" that a regulated party must be given "fair warning" of what conduct is prohibited or required

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[19] *See* R.62-1 at 132-33 (comments from the EPA concerning Wisconsin's modifications of its WPDES program in response to CWA amendments); *see generally* Brief of the State of Wisconsin as Amicus Curiae Supporting Appellant. The regulations do not provide a definitive or exclusive form of agency approval for a state's NPDES program modification. The only guidance provided is that "[n]otice of approval of non-substantial program revisions [which the EPA's actions suggest Wisconsin's were] *may* be given by a letter from the Administrator to the State Governor or his designee." 40 C.F.R. § 123.62(b)(4) (emphasis added).

[20] The district court found that Flambeau made eleven unpermitted discharges into the navigable waters of the United States. It also found that "plaintiffs have not shown that any such discharges are occurring under defendant's new system of infiltration basins, installed in 2011 and afterwards," and so refused to issue plaintiffs' requested injunction. R.256 at 35-37. This finding has not been challenged on appeal. Therefore, because only past, not continuing, violations of the CWA are before us, we need not consider whether Flambeau's mining permit is a WPDES permit or determine whether the EPA approved NR § 216.41(4)(a).

[21] We note that in its briefing at summary judgment to the district court and to this court on appeal, Flambeau did not use the phrase "due process." However, its arguments concerning notice and fundamental fairness clearly raise the issue of due process.

of it. *Rollins Envtl. Servs. (NJ), Inc. v. United States EPA*, 937 F.2d 649, 655 (D.C. Cir. 1991) (Edwards, J., dissenting in part and concurring in part) (internal quotation marks omitted); *see also United States v. Cinergy Corp.*, 623 F.3d 455, 458-59 (7th Cir. 2010) (holding that defendant could not be sanctioned and found to have violated the Clean Air Act when it complied with regulations as codified, despite having knowledge that the EPA requested amendment of the regulations to prohibit defendant's conduct); *United States v. Trident Seafoods Corp.*, 60 F.3d 556, 559 (9th Cir. 1995) ("[T]he responsibility to promulgate clear and unambiguous standards is on the [agency]. The test is not what [the agency] might possibly have intended, but what [was] said. If the language is faulty, the [agency] had the means and obligation to amend." (first alteration added, other alterations in original) (internal quotation marks omitted)).

The United States Court of Appeals for the District of Columbia Circuit has explained:

> In the absence of notice–for example, where the regulation is not sufficiently clear to warn a party about what is expected of it—an agency may not deprive a party of property by imposing civil or criminal liability. Of course, it is in the context of criminal liability that this "no punishment without notice" rule is most commonly applied. But as long ago as 1968, we recognized this "fair notice" requirement in the civil administrative context. In *Radio Athens, Inc. v. FCC*, we held that when sanctions are drastic—in that case, the FCC dismissed the petitioner's application for a radio station license—"elementary fairness compels clarity" in the

> statements and regulations setting forth the actions with which the agency expects the public to comply. 401 F.2d 398, 404 (D.C. Cir. 1968). This requirement has now been thoroughly "incorporated into administrative law." *Satellite Broadcasting Co. v. FCC*, 824 F.2d 1, 3 (D.C. Cir. 1987); *see also Rollins*, 937 F.2d at 654 n.1, 655 (Edwards, J., dissenting in part and concurring in part) (principle is not constitutional, but "basic hornbook law in the administrative context," and "simple principle of administrative law").

Gen. Elec. Co. v. United States EPA, 53 F.3d 1324, 1328-29 (D.C. Cir. 1995) (citations omitted) .

In determining whether a party received fair notice, courts frequently look to the regulations and other agency guidance. "If, by reviewing the regulations and other public statements issued by the agency, a regulated party acting in good faith would be able to identify, with ascertainable certainty, the standards with which the agency expects parties to conform, then the agency has fairly notified a petitioner … ." *Howmet Corp. v. EPA*, 614 F.3d 544, 553-54 (D.C. Cir. 2010) (internal quotation marks omitted). In *United States v. Cinergy Corp.*, we held that the defendant did not have fair notice of an EPA prohibition under the Clean Air Act where it "complie[d] with a State Implementation Plan that the EPA ha[d] approved," even though the defendant knew that the EPA intended for the state to amend its plan. 623 F.3d at 458. Agency guidance provided privately to a regulated entity other than the defendant also is insufficient because it does not permit the defendant to determine "with ascertainable certainty" what is required of him. *See, e.g.*, *Rollins*, 937 F.2d at 655 (Edwards, J., dissenting in part and concurring in part) (internal quotation marks omitted); *see also id.* at 653-54 (finding inadequate notice where the EPA's regulatory interpretation was provided only in a letter to a private attorney, where "th[e] letter was never sent to [the defendant] or its attorneys and it was never made public").

Here, Flambeau did not have notice that its permit might not be a valid WPDES permit or that it needed a permit other than the one the WDNR determined was required. First, it is undisputed that Wisconsin, through the WDNR, is the proper, and only, CWA administrator with authority to issue NPDES/WPDES permits for Flambeau's mine site. As Flambeau transitioned from active mining to reclamation, the WDNR determined that Flambeau did not require a separate, specifically termed "WPDES" permit apart from its mining permit and sua sponte terminated the separate permit. Thus, the only available guidance from the only CWA permit-issuer was that the mining permit was a WPDES permit. This is the same position the WDNR still maintains—that Flambeau's mining permit is a WPDES permit. We do not require a regulated party to establish that the regulating agency had actual authority to issue a facially proper, and therefore presumptively valid, regulation before complying with the agency's command.

In this case, however, even if Flambeau consulted Wisconsin's Administrative Code, in which the WPDES program is codified, a reasonable, diligent search would have found statutory authorization under the WPDES program for the WDNR to regulate Flambeau in the manner it did and for the

WDNR to deem the mining permit a WPDES permit. As plaintiffs' briefing has demonstrated, to discover that there is even a *potential* issue concerning the validity of NR § 216.21(4)(a) as part of the WPDES program, a party must conduct legislative and regulatory history research, as well as submit document requests to the WDNR. Private parties are entitled to rely on "duly-enacted, and therefore presumptively legitimate, statute[s]" and regulations, so long as such reliance is not unreasonable, such as when the citizen has actual notice that the statute was not properly enacted or that the provision plainly is unconstitutional. *Cohn v. G.D. Searle & Co.*, 784 F.2d 460, 464 (3d Cir. 1986); *see also id.* ("We cannot say that [defendant's] reliance is unreasonable where the statute's constitutionality has never been judicially questioned and where the reach of the constitutional principles involved is as uncertain as here.").

We recently affirmed the principle that a private party is entitled to rely on published regulations. In *Cinergy*, we held that the defendant could not be charged with violating the Clean Air Act when it complied with the published version of a regulation that was part of Indiana's administration of the Clean Air Act. The EPA had secured Indiana's agreement to amend the regulation but Indiana had yet to do so. The EPA sought to impose a penalty on the defendant for violating the future amended version of the regulation. The EPA submitted that there was no due process problem because the defendant "was 'on notice' that [the regulation] did not mean what it said." *Cinergy Corp.*, 623 F.3d at 458. We rejected this argument, holding that the defendant was only on notice of what "a straightforward reading of [the regulation] permitted." *Id.*

Similarly, Flambeau was on notice only of the command of the only relevant CWA permitting authority and the powers conferred on the WDNR by statute. It is this lack of notice that distinguishes Flambeau's case from those relied on by the district court.[22]

Plaintiffs contend that Flambeau was on notice that it lacked a valid WPDES permit. According to plaintiffs, Flambeau had notice because it possessed a separate WPDES permit in the past and language on its mining permit requires the permitee to obtain other permits as required by law.[23] These contentions are unpersuasive. First, Flambeau knew that it needed a WPDES permit but was informed by the WDNR that its mining permit would serve as a WPDES permit, consistent with NR § 216.21(4)(a), and the WDNR sua sponte terminated Flambeau's separate WPDES permit. Plaintiffs maintained at oral argument that Flambeau's proper course of action was to apply for a WPDES permit. However, the WDNR made clear, by its termination of the separate permit and by its consistent position that a separate WPDES permit was unnecessary, that

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[22] *See, e.g., Citizens for a Better Env't-Cal. v. Union Oil Co.*, 83 F.3d 1111, 1120 (9th Cir. 1996) (refusing to apply the CWA's permit shield where "[i]t is not disputed that these regulations [governing modifications of NPDES programs] were not followed" and so the defendant's permit clearly was insufficient); *Oregon State Pub. Interest Research Grp., Inc. v. Pac. Coast Seafoods Co.*, 361 F. Supp. 2d 1232, 1243 (D. Or. 2005) (holding that a state permit did not trigger the CWA's permit shield where "[n]othing in the federal or state statutes provides that a state-issued SCO is the equivalent of an NPDES permit[]").

[23] *See* Appellees' Br. 23.

it would not issue a separate permit. "The law does not require the doing of a futile act," *Ohio v. Roberts*, 448 U.S. 56, 74 (1980), *abrogated on other grounds by Crawford v. Washington*, 541 U.S. 36 (2004), and so we shall not penalize Flambeau for failing to apply for a separate WPDES permit after the WDNR terminated its prior one.

Second, the mining permit language directing the permit holder to obtain all other permits required by law does not answer the question. For NR § 216.21(4)(a) provides that the WDNR can determine that a separate WPDES permit is unnecessary. Moreover, neither of these facts—Flambeau's prior possession of a separate WPDES permit or the language of its mining permit—put Flambeau on notice of the risk that NR § 216.21(4)(a) was not actually approved by the EPA and so was beyond the WDNR's CWA authority. Rather, plaintiffs have established only that Flambeau knew that it no longer held a separate WPDES permit.

At bottom, plaintiffs are attempting to attack collaterally the validity of Wisconsin's WPDES program by requiring Flambeau to prove that the specific provision of the program under which the WDNR granted its putative WPDES permit, NR § 216.21(4)(a), is valid. There are two problems with this approach.

First, forcing a permit holder to establish that the undisputed permitting entity had actual authority to issue the permit, despite a facially valid law authorizing the entity to issue the permit, would vitiate the permit shield. Permit holders would be brought into court to establish not only the validity of their permits, but also the validity of the issuing entity's asserted authority to issue such a permit, requiring permit holders to prove the validity of legislative and regulatory transactions to which they were not parties. This undermines the purpose of the shield provision, which the Supreme Court has stated is to "giv[e] permits finality," *E.I. du Pont de Nemours*, 430 U.S. at 138 n.28.

Second, plaintiffs' approach constitutes a collateral attack on Wisconsin's WPDES program, specifically NR § 216.21(4)(a). Plaintiffs claim to challenge only Flambeau's conduct; however, integral to this challenge is plaintiffs' assertion that Flambeau lacks a WPDES permit and that NR § 216.21(4)(a) is not, contrary to Wisconsin's view and the section's plain language, part of the WPDES program. Plaintiffs fault Flambeau for doing what its CWA administrator and Wisconsin law authorize it to do. This is impermissible. *See Kelley v. Bd. of Trs., Univ. of Illinois*, 35 F.3d 265, 272 (7th Cir. 1994) (holding that "insofar as the University actions were taken in an attempt to comply with the requirements of Title IX, plaintiffs' attack on those actions is merely a collateral attack on the statute and regulations and is therefore impermissible"); *Milwaukee Cnty. Pavers Ass'n v. Fiedler*, 922 F.2d 419, 424 (7th Cir. 1991) ("Insofar as the state is merely doing what the statute and regulations envisage and permit, the attack on the state is an impermissible collateral attack on the statute and regulations. We add that the federal regulations explicitly permit the state or other entity [to engage in the conduct plaintiffs challenged].").

In sum, Flambeau was told by the WDNR that its mining permit constituted a valid WPDES permit. The WDNR's authority to regulate Flambeau under its CWA authority was confirmed by NR § 216.21(4)(a), and Flambeau had no notice that NR § 216.21(4)(a) was potentially invalid as an exercise of that delegated authority. Under these circumstances, where the permitting authority issues a facially valid NPDES permit and the permit holder lacks notice of the permit's (potential) invalidity, we hold that the permit shield applies. To hold otherwise would be inconsistent with the requirements of due process. Plaintiffs have not alleged or demonstrated that Flambeau failed to comply with its mining permit. Because the permit shield applies, Flambeau is deemed to be in compliance with the CWA, and summary judgment should have been granted for Flambeau. Therefore, we do not reach Flambeau's other arguments on appeal.

C.

Furthermore, we deny plaintiffs' cross-appeal. In order to be entitled to attorneys' fees under the CWA, plaintiffs must be "a[] prevailing or substantially prevailing party." 33 U.S.C. § 1365(d). Here, plaintiffs are not entitled to attorneys' fees because they have failed to establish a violation of the CWA.

Conclusion

Accordingly, we must reverse the judgment of the district court.

REVERSED

Flambeau Mine

Ladysmith, Wisconsin, U.S.A.

Michael-Moran Assoc., LLC

CLIENT : Sierra Club Wisconsin; Wisconsin Resources Protection Council; Deer Tail Press.

TASK : Reviewed historical and modern documents; authored report on closed metal-sulfide site.

DATE : 2017

Roughly 20 years after the cessation of active mining, Flambeau Mine ground waters are contaminated by past Flambeau Mining Company (FMC) activities. FMC data confirm that, as a minimum, dissolved concentrations of the following constituents significantly exceed FMCs baseline concentrations (1987-88): copper, iron, manganese, zinc, sulfate, alkalinity, hardness, total dissolved solids, specific conductance (field). Interestingly, these are practically the only parameters routinely reported by FMC in their quarterly monitoring.

Project Documentation and Supporting Articles

Moran, Robert E., 2017 (April), Summary: Flambeau Mine: Water Contamination and Selective "Alternative Facts"; 4pg. Prepared for Sierra Club Wisconsin; Wisconsin Resources Protection Council; Deer Tail Press.

https://remwater.org/projects/flambeau-mine-ladysmith-wisconsin-u-s/

Robert E. Moran, Ph.D.
Michael-Moran Assoc., LLC
Water Quality/Hydrogeology/Geochemistry
Golden, Colorado, U.S.A.
remwater@gmail.com
remwater.org

Dr. Robert Moran has more than 45 years of domestic and international experience in conducting and managing water quality, geochemical and hydrogeologic work for private investors, industrial clients, tribal and citizens groups, NGO's, law firms, and governmental agencies at all levels. Much of his technical expertise involves the quality and geochemistry of natural and contaminated waters and sediments as related to mining, nuclear fuel cycle sites, industrial development, geothermal resources, hazardous wastes, and water supply development. In addition, Dr. Moran has significant experience in the application of remote sensing to natural resource issues, development of resource policy, and litigation support. He has often taught courses to technical and general audiences, and has given expert testimony on numerous occasions. Countries worked in include: Australia, Greece, Bulgaria, Mali, Senegal, Guinea, Gambia, Ghana, South Africa, Iraqi Kurdistan, Oman, Pakistan, Kazakhstan, Kyrgyzstan, Mongolia, Romania, Russia, Papua New Guinea, Argentina, Bolivia, Chile, Colombia, Guatemala, Haiti, Honduras, Mexico, Peru, El Salvador, Belgium, France, Canada, Germany, Great Britain, Netherlands, Spain, United States.

EDUCATION

University of Texas, Austin: Ph.D., Geological Sciences, 1974
San Francisco State College: B.A., Zoology, 1966

PROFESSIONAL HISTORY

Michael-Moran Assoc., LLC, Partner, 2003 to present
Moran and Associates, President, 1983 to 1992; 1996 to 2003
Woodward-Clyde Consultants, Senior Consulting Geochemist, 1992 to 1996
Gibbs and Hill, Inc., Senior Hydrogeologist, 1981 to 1983
Envirologic Systems, Inc., Senior Hydrogeologist/Geochemist, 1980 to 1981
Tetra Tech Int'l. / Sultanate of Oman, Senior Hydrogeologist, 1979 to 1980
Science Applications, Inc., Geochemist/Hydrologist, 1978 to 1979
U.S. Geological Survey, Water Resources Division, Hydrologist/Geochemist, 1972 to 1978
Texas Bureau of Economic Geology, Research Scientist Assistant, 1970 to 1971

LANGUAGES

English, Spanish

CITIZENSHIP: United States of America, Ireland https://remwater.org/

Flambeau Mine, Ladysmith, Wisconsin, U.S.A.

Roughly 20 years after the cessation of active mining, Flambeau Mine ground waters are contaminated by past Flambeau Mining Company (FMC) activities.

Learn more

https://remwater.org/projects/flambeau-mine-ladysmith-wisconsin-u-s/

4.11.2017

Robert E. Moran, Ph.D.
Michael-Moran Assoc., LLC
Water Quality/Hydrogeology/Geochemistry
Golden, Colorado, U.S.A.
remwater@gmail.com
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SUMMARY
Flambeau Mine: Water Contamination and Selective "Alternative Facts"

1-Roughly 20 years after the cessation of active mining, Flambeau Mine *ground waters* are contaminated by past Flambeau Mining Company (FMC) activities. FMC data confirm that, as a minimum, *dissolved* concentrations of the following constituents significantly exceed FMCs baseline concentrations (1987-88): copper, iron, manganese, zinc, sulfate, alkalinity, hardness, total dissolved solids, specific conductance (field). Interestingly, these are practically the only parameters routinely reported by FMC in their quarterly monitoring.

FMC wells within the backfilled pit have *median* dissolved concentrations as high as the following (2014-16): Copper = 503 µg/L; Iron = 14,000 µg/L; Manganese = 33,500 µg/L; Zinc = 1200 µg/L; Arsenic = 23 µg/L; Sulfate = 1600 mg/L; Alkalinity = 610 mg/L; Hardness = 2150 mg/L; Total Dissolved Solids = 3110 mg/L; Specific Conductance = 3180 µS. These values greatly exceed baseline data and relevant water quality standards and aquatic life criteria. FMCs "baseline" ground water data report that uranium was detected in between 64 to 100% of their samples, yet uranium was not included in the routine monitoring.

2-These ground waters are also being contaminated with numerous minor / trace constituents (e.g. aluminum, arsenic, chromium, lead, nickel, uranium, etc.) as a result of FMC operations. Drawing reliable, *quantitative* conclusions about these constituents is difficult as *FMC has been allowed to characterize the water quality using data that are not representative of the actual, chemically-unstable ground waters.*

3-Parameter concentrations from most FMC wells are not quantitatively-reliable due to inadequate well construction, well development and purging, and sampling procedures. Frequently, important chemical constituents were missing from analyses, inappropriate analytical detection limits were employed, and crucial data were not reported. FMC permit reports and subsequent public documents were based on these inadequate data.

4-FMC has constructed dozens of monitoring wells since the early 1970s. Many older wells still exist, but are no longer monitored; several have been replaced, sometimes under questionable circumstances, breaking the historical data continuity.

5-FMC has incorrectly defined baseline conditions, thereby biasing later conclusions. Exploration drilling has been conducted at Flambeau since roughly 1970. Thus, hundreds or more exploration boreholes, together with road and site construction, trenches, dozens of monitoring wells and piezometers, and possibly tunnels have been constructed at the site prior to actual mining of ore. Such activities increase sediment loads and create pathways interconnecting the various horizontal and vertical portions of the local rocks, introducing atmospheric oxygen and other gases, microbes, and surface water, all of which alter the original baseline water quality and geochemical conditions. Hence, FMC's 1987-88 baseline data actually represent water quality that has been altered and somewhat degraded by these pre-mining activities.

6-FMC waste rocks were acidic and releasing contaminated leachates long before they were returned to the pit (both "low" sulfur and "high" sulfur types). Few data have been made public. One sample of water seeping from a "low" sulfur waste rock pile had a dissolved copper concentration = 50,000 μg /L. Other waste rock leachate waters were already mildly acidic by 1994 and became more acidic by the first quarter of 1996 ("low" sulfide pH = 6.3; "high" sulfide pH = 6.3); by the fourth quarter of 1996 the high sulfide waste leachates had pH = 3.1, and copper concentration = 450,000 μg/L. Chromium was reported in low sulfide waste effluents. At a pH of 3.1, it is clear that many other trace and minor elements would also be present in these leachates, but FMC failed to report them, and has failed to identify the results as "Dissolved" or "Total Recoverable".

7-During active mining (1993-97) and immediately after, FMC reported limited water quality data from wells outside the pit on a quarterly basis. A more extensive, but still inadequate list of trace constituents was not reported until 1999, and to the present time is still reported only once per year. Review of company reports revealed no actual water quality data reported for waters being discharged from the exposed pit walls, floor or ore piles.

8-Monitoring wells located outside the pit in the downgradient flow direction show clear evidence of contamination relative to baseline concentrations. For example, a well 175 feet from the Flambeau River shows dissolved manganese concentrations of 13,800 μg/L and a specific conductance of 660 μS (Oct 2016).

9-FMC has failed to define either the actual flow pathways for ground waters exiting the backfilled pit, or to define the ground water-surface water interactions. FMC has not determined whether pit seepage is limited to shallow pathways through alluvium and fractured bedrock into the river, or whether deeper pathways under the bed of the river may be viable. Apparently no recent monitoring of wells on the west side of the river (opposite side from pit) has been conducted by FMC or the State. Thus, it is also not possible to determine whether ground waters west of the Flambeau River have been negatively-impacted by FMC operations.

10-Similar sulfide deposits, worldwide, routinely contain elevated concentrations of: aluminum, antimony, arsenic, barium, cadmium, copper, chromium, cobalt, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, zinc, sulfate, sulfide, nitrate, ammonia, boron, fluoride, chloride, natural radioactive constituents (sometimes uranium, radium, thorium, potassium-40, gross alpha and beta). Flambeau rocks and waters likely contain these constituents, but adequate

analytical results for many of these constituents were never made public. All similar massive sulfide deposits generate degraded water quality in the long-term.

11-The Flambeau River also received contaminants from numerous other sources of FMC property effluents: surface inflows from a tributary of the Flambeau River that crosses the southeast corner of the mine site (Stream C); the Copper Park Lane drainage ditch and other facilities adjacent to the ore crusher and rail spur; wetlands, storm runoff; stockpiled waste rock leachates and seeps; ore stockpiles; releases from the settling ponds; interceptor well discharges; inadequately-treated effluents from the Waste Water Treatment Plant (WWTP); clarifier underflow solids (sludges from WWTP). Several sources are presently contributing contaminants to the Flambeau River via surface water pathways, and possibly also via ground water pathways.

Contaminated discharges from the southeast corner of the FMC site have resulted in Stream C being added to the Environmental Protection Agency (EPA) impaired waters list for exceedances of acute aquatic toxicity criteria for copper and zinc. Since 1998, FMC has instituted six different work plans to address this soil and water contamination issue. As of fall 2016, copper levels in the Flambeau River tributary still exceed the acute toxicity criterion, and FMC has not secured a mine reclamation Certificate of Completion (COC) for this portion of the mine site.

12-Data are inadequate to demonstrate that Flambeau River chemical concentrations have been degraded, but *loads (mass)* of various metals, metalloids, sulfate, sediments, etc. have increased. Increasing the mass of metals in the Flambeau River, either as dissolved or particulate forms (suspended or bedload sediments), has the potential to harm the aquatic biota because these organisms are capable of consuming metal-laden particulates.

13-As the west end of the Flambeau pit is within 140 ft. of the Flambeau River, FMC should have been required to report all water quality constituents that have relevant Standards and Criteria (during both baseline and routine monitoring), to determine whether FMC releases might be damaging to any of the relevant water uses: human consumption; aquatic life; agricultural and irrigation. Such data would have required collection of both *filtered (Dissolved) and unfiltered (Total) samples for analysis of a much wider list of chemical constituents employing appropriate detection limits.* Unfiltered sample data are especially relevant where impacts to aquatic life may be anticipated. *Fish and macroinvertebrates are capable of ingesting both dissolved and particulate forms of chemicals discharged into aquatic environments, aggravating potentially-toxic impacts to the aquatic species and concentration up the food chain.*

14-The narrative "predictions" made by FMC's main Wisconsin consultant in the various permit-related and Annual Reports appear to be largely naïve geochemically and hydrogeologically. It is doubtful that these statements represented the opinions of FMCs technical experts. Such statements are most useful for obtaining permits, less so for generating quantitatively-reliable predictions.

15-Backfilled waste rock was mixed with limestone to minimize the formation of acid and release of trace constituents into the pit waters. However, the rise in pH due to the addition of limestone (or especially lime) can also generate conditions that increase the water concentrations of those trace elements that form mobile species *at elevated pHs, such as aluminum, arsenic, antimony, chromium, manganese, nickel, selenium, molybdenum, uranium, zinc, etc.* The Flambeau Mining Feasibility Study by Pincock Allen & Holt Inc. likely contains data on such testing. *Feasibility studies are required to inform potential investors, but normally are not released to the public.*

16-Wastes from the FMC operation will remain onsite *forever*. While limestone was added to the waste rock as it was backfilled into the pit, the ability of the limestone to neutralize the formation of acid waters is limited and finite. After the limestone has reacted with the waste rock, its neutralizing action will cease and the *pit waters are likely to become increasingly acidic and the concentrations of potentially-toxic contaminants are likely to increase.* The deeper pit well waters already show evidence of increased degradation of water quality, in roughly 20 years, post-closure. It is reasonable to conclude that the Flambeau ground and surface water quality will further degrade in the coming decades if current site maintenance practices continue.

17-I know of no metal-sulfide mines anywhere in the world that have met the criteria of Wisconsin's 1998 moratorium on issuance of permits for mining of sulfide ore bodies without degrading the original water quality, long-term.

18-Obviously the mining and remediation practices employed at Flambeau do not represent a *sustainable, long-term solution*. While FMC may have satisfied State oversight and disclosure requirements, the site ground waters are contaminated, and *these waters would require expensive, active water treatment to be made suitable for most foreseeable uses. Historically, most such costs are paid by the taxpayers.*

19-FMC and their contractors supplied all of the data and interpretations used to compile the permit-related reports and subsequent Annual Reports. Such an approach obviously reflects FMC's interests, but is likely quite different from financially-independent, public-interest science. In short, the Flambeau Mine is the poster child for a severely-flawed permitting and oversight process, that has likely generated long-term public liabilities.

20-Flambeau ground and surface water quality is being and has been degraded—despite years of industry public relations statements touting the success of the FMC operation. Rio Tinto said in a 2013 public relations (PR) release regarding the Flambeau Mine: "Testing shows conclusively that ground water quality surrounding the site is as good as it was before mining." In efforts to encourage development of the other metal-sulfide deposits in northern Wisconsin and the Great Lakes region, the industry approach has been to simply repeat this false statement over and over, assuming that repetition will make it believed. Unfortunately, the FMC data show otherwise.

Flambeau Mining Company
4700 Daybreak Parkway
South Jordan, UT 84095
801-204-2526

Flambeau Reclaimed
promises made, promises kept

December 23, 2015

Mr. Philip Fauble
Hydrogeologist
Wisconsin Department of Natural Resources
101 S. Webster Street – GEF2
P.O. Box 7921
Madison, WI 53707-7921

RE: Flambeau Mining Company
Environmental Monitoring (Fourth Quarter 2015)

Dear Phil:

Enclosed please find copies of the fourth quarter 2015 environmental monitoring groundwater data, which include analyses of groundwater collected from wells surrounding the backfilled pit and pore water from the monitoring wells constructed in the backfill. The fourth quarter groundwater sampling was completed on October 6, 2015.

Certification is attached and electronic monitoring is enclosed.

Duplicate samples were collected for MW1002 (MW DUP) and MW1014C (BACKFILL DUP).

If you have any questions, please contact me at (801) 204-2526 or Sharon Kozicki, of Foth Infrastructure & Environment, LLC, at (920) 496-6737.

Sincerely

Dave Cline
Vice President – Flambeau Mining Company

Enclosures

cc: Kyle McLaughlin, WDNR (w/o enclosures)
Zoe McManama, WDNR (w/o enclosures)
Al Christianson, City of Ladysmith (w/o enclosures)
Randy Tatur, Rusk Co. (w/o enclosures)
Tom Riegel, Town of Grant (w/o enclosures)
CeCe Tesky, Rusk Co. Zoning (w/o enclosures)
Sharon Kozicki, Foth Infrastructure & Environment, LLC (w/ enclosures)

Attachment 1

Fourth Quarter 2015 GW Analytical Data

Flambeau Mining Company

Fourth Quarter 2015 Environmental Monitoring
October 6, 2015

Reviewer's Key

Groundwater Quality Wells

MW-1010P, MW-1000PR, MW-1000R (West Wall)
MW-1004, MW-1004S, MW-1004P (North Wall)
MW-1002, MW-1002G (South Gravel Pit)
MW-1005, MW-1005S, MW-1005P (Highway 27; Background)
MW-1015A, MW-1015B (Adjacent to NW Compliance Boundary)

Backfill Wells
MW-1013, MW-1013A, MW-1013B, MW-1013C (West Pit)
MW-1014, MW-1014A, MW-1014B, MW-1014C (East Pit)

Duplicate Groundwater Samples
MW-1014C (Backfill Dup) and MW-1002 (MW Dup) were sampled in duplicate.

Turbidity, Color, and Odor
If there was any notable turbidity, color or odor, the results are provided in the Units column.

Wetland Water Level Elevation
WT-5 designates the remaining staff gauge from which readings are taken of water elevations in Wetland 1. Wetland water elevations are read three times per year – spring, summer and fall.

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South Jordan, UT 84095
801-204-2526

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December 23, 2015

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Dave Cline
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Randy Tatur, Rusk Co. (w/o enclosures)
Tom Riegel, Town of Grant (w/o enclosures)
CeCe Tesky, Rusk Co. Zoning (w/o enclosures)
Sharon Kozicki, Foth Infrastructure & Environment, LLC (w/ enclosures)

Pace Analytical®
www.pacelabs.com

Pace Analytical Services, Inc.
1241 Bellevue Street - Suite 9
Green Bay, WI 54302
(920)469-2436

November 05, 2015

SHARON KOZICKI
Foth Infrastructure & Environment, LLC
2121 Innovation Court
Suite 300
De Pere, WI 54115

RE: Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Dear SHARON KOZICKI:

Enclosed are the analytical results for sample(s) received by the laboratory on October 07, 2015. The results relate only to the samples included in this report. Results reported herein conform to the most current TNI standards and the laboratory's Quality Assurance Manual, where applicable, unless otherwise noted in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Tod Noltemeyer

Tod Noltemeyer
tod.noltemeyer@pacelabs.com
Project Manager

Enclosures

Pace Analytical
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1241 Bellevue Street - Suite 9
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(920)469-2436

CERTIFICATIONS

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Green Bay Certification IDs

1241 Bellevue Street, Green Bay, WI 54302
Florida/NELAP Certification #: E87948
Illinois Certification #: 200050
Kentucky Certification #: 82
Louisiana Certification #: 04168
Minnesota Certification #: 055-999-334
Virginia VELAP ID: 460263
North Dakota Certification #: R-150
South Carolina Certification #: 83006001
Texas Certification #: T104704529-14-1
US Dept of Agriculture #: S-76505
Virginia VELAP ID: 460263
Virginia VELAP Certification ID: 460263
Wisconsin Certification #: 405132750

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(920)469-2436

SAMPLE SUMMARY

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Lab ID	Sample ID	Matrix	Date Collected	Date Received
40122298001	MW-1000R-2015_10	Water	10/06/15 07:50	10/07/15 09:05
40122298002	MW-1000PR-2015_10	Water	10/06/15 08:00	10/07/15 09:05
40122298003	MW-1010P-2015_10	Water	10/06/15 08:15	10/07/15 09:05
40122298004	MW-1013-2015_10	Water	10/06/15 10:35	10/07/15 09:05
40122298005	MW-1013A-2015_10	Water	10/06/15 10:40	10/07/15 09:05
40122298006	MW-1013B-2015_10	Water	10/06/15 10:50	10/07/15 09:05
40122298007	MW-1013C-2015_10	Water	10/06/15 10:25	10/07/15 09:05
40122298008	MW-1014-2015_10	Water	10/06/15 08:25	10/07/15 09:05
40122298009	MW-1014A-2015_10	Water	10/06/15 08:35	10/07/15 09:05
40122298010	MW-1014B-2015_10	Water	10/06/15 08:45	10/07/15 09:05
40122298011	MW-1014C-2015_10	Water	10/06/15 09:15	10/07/15 09:05
40122298012	MW-1004-2015_10	Water	10/06/15 11:20	10/07/15 09:05
40122298013	MW-1004P-2015_10	Water	10/06/15 11:00	10/07/15 09:05
40122298014	MW-1004S-2015_10	Water	10/06/15 11:45	10/07/15 09:05
40122298015	MW-1015A-2015_10	Water	10/06/15 12:20	10/07/15 09:05
40122298016	MW-1015B-2015_10	Water	10/06/15 12:25	10/07/15 09:05
40122298017	MW-1002-2015_10	Water	10/06/15 12:50	10/07/15 09:05
40122298018	MW-1002G-2015_10	Water	10/06/15 13:05	10/07/15 09:05
40122298019	MW-1005-2015_10	Water	10/06/15 14:10	10/07/15 09:05
40122298020	MW-1005S-2015_10	Water	10/06/15 13:40	10/07/15 09:05
40122298021	MW-1005P-2015_10	Water	10/06/15 14:25	10/07/15 09:05
40122298022	MW-DUP-2015_10	Water	10/06/15 00:00	10/07/15 09:05
40122298023	BACKFILL-DUP-2015_10	Water	10/06/15 00:00	10/07/15 09:05

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SAMPLE ANALYTE COUNT

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Lab ID	Sample ID	Method	Analysts	Analytes Reported
40122298001	MW-1000R-2015_10	EPA 6020	JBR	5
		EPA 120.1	DEY	1
		SM 2540C	SJR	1
		SM 4500-H+B	DEY	1
		EPA 300.0	HMB	1
		EPA 310.2	DAW	1
40122298002	MW-1000PR-2015_10	EPA 6020	JBR	5
		EPA 120.1	DEY	1
		SM 2540C	SJR	1
		SM 4500-H+B	DEY	1
		EPA 300.0	HMB	1
		EPA 310.2	DAW	1
40122298003	MW-1010P-2015_10	EPA 6020	JBR	5
		EPA 120.1	DEY	1
		SM 2540C	SJR	1
		SM 4500-H+B	SJR	1
		EPA 300.0	HMB	1
		EPA 310.2	DAW	1
40122298004	MW-1013-2015_10	EPA 6020	DS1, JBR	5
		EPA 120.1	DEY	1
		SM 2540C	SJR	1
		SM 4500-H+B	DEY	1
		EPA 300.0	HMB	1
		EPA 310.2	DAW	1
40122298005	MW-1013A-2015_10	EPA 6020	JBR	5
		EPA 120.1	DEY	1
		SM 2540C	SJR	1
		SM 4500-H+B	DEY	1
		EPA 300.0	HMB	1
		EPA 310.2	DAW	1
40122298006	MW-1013B-2015_10	EPA 6020	DS1, JBR	5
		EPA 120.1	DEY	1
		SM 2540C	SJR	1
		SM 4500-H+B	DEY	1
		EPA 300.0	HMB	1
		EPA 310.2	DAW	1
40122298007	MW-1013C-2015_10	EPA 6020	DS1, JBR	5

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SAMPLE ANALYTE COUNT

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Lab ID	Sample ID	Method	Analysts	Analytes Reported
		EPA 120.1	DEY	1
		SM 2540C	SJR	1
		SM 4500-H+B	DEY	1
		EPA 300.0	HMB	1
		EPA 310.2	DAW	1
40122298008	MW-1014-2015_10	EPA 6020	JBR	5
		EPA 120.1	DEY	1
		SM 2540C	SJR	1
		SM 4500-H+B	DEY	1
		EPA 300.0	HMB	1
		EPA 310.2	DAW	1
40122298009	MW-1014A-2015_10	EPA 6020	JBR	5
		EPA 120.1	DEY	1
		SM 2540C	SJR	1
		SM 4500-H+B	DEY	1
		EPA 300.0	HMB	1
		EPA 310.2	DAW	1
40122298010	MW-1014B-2015_10	EPA 6020	DS1, JBR	5
		EPA 120.1	DEY	1
		SM 2540C	SJR	1
		SM 4500-H+B	DEY	1
		EPA 300.0	HMB	1
		EPA 310.2	DAW	1
40122298011	MW-1014C-2015_10	EPA 6020	JBR	5
		EPA 120.1	DEY	1
		SM 2540C	SJR	1
		SM 4500-H+B	DEY	1
		EPA 300.0	HMB	1
		EPA 310.2	DAW	1
40122298012	MW-1004-2015_10	EPA 6020	JBR	5
		EPA 120.1	DEY	1
		SM 2540C	SJR	1
		SM 4500-H+B	DEY	1
		EPA 300.0	HMB	1
		EPA 310.2	DAW	1
40122298013	MW-1004P-2015_10	EPA 6020	JBR	5
		EPA 120.1	DEY	1

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SAMPLE ANALYTE COUNT

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Lab ID	Sample ID	Method	Analysts	Analytes Reported
		SM 2540C	SJR	1
		SM 4500-H+B	DEY	1
		EPA 300.0	HMB	1
		EPA 310.2	DAW	1
40122298014	MW-1004S-2015_10	EPA 6020	JBR	5
		EPA 120.1	DEY	1
		SM 2540C	SJR	1
		SM 4500-H+B	DEY	1
		EPA 300.0	HMB	1
		EPA 310.2	DAW	1
40122298015	MW-1015A-2015_10	EPA 6020	JBR	5
		EPA 120.1	DEY	1
		SM 2540C	SJR	1
		SM 4500-H+B	DEY	1
		EPA 300.0	HMB	1
		EPA 310.2	DAW	1
40122298016	MW-1015B-2015_10	EPA 6020	JBR	5
		EPA 120.1	DEY	1
		SM 2540C	SJR	1
		SM 4500-H+B	DEY	1
		EPA 300.0	HMB	1
		EPA 310.2	DAW	1
40122298017	MW-1002-2015_10	EPA 6020	JBR	5
		EPA 120.1	DEY	1
		SM 2540C	SJR	1
		SM 4500-H+B	DEY	1
		EPA 300.0	HMB	1
		EPA 310.2	DAW	1
40122298018	MW-1002G-2015_10	EPA 6020	JBR	5
		EPA 120.1	DEY	1
		SM 2540C	SJR	1
		SM 4500-H+B	DEY	1
		EPA 300.0	HMB	1
		EPA 310.2	DAW	1
40122298019	MW-1005-2015_10	EPA 6020	JBR	5
		EPA 120.1	DEY	1
		SM 2540C	SJR	1

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SAMPLE ANALYTE COUNT

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Lab ID	Sample ID	Method	Analysts	Analytes Reported
		SM 4500-H+B	SJR	1
		EPA 300.0	HMB	1
		EPA 310.2	DAW	1
40122298020	MW-1005S-2015_10	EPA 6020	JBR	5
		EPA 120.1	DEY	1
		SM 2540C	SJR	1
		SM 4500-H+B	SJR	1
		EPA 300.0	HMB	1
		EPA 310.2	DAW	1
40122298021	MW-1005P-2015_10	EPA 6020	JBR	5
		EPA 120.1	DEY	1
		SM 2540C	SJR	1
		SM 4500-H+B	SJR	1
		EPA 300.0	HMB	1
		EPA 310.2	DAW	1
40122298022	MW-DUP-2015_10	EPA 6020	JBR	5
		EPA 120.1	DEY	1
		SM 2540C	SJR	1
		SM 4500-H+B	SJR	1
		EPA 300.0	HMB	1
		EPA 310.2	DAW	1
40122298023	BACKFILL-DUP-2015_10	EPA 6020	JBR	5
		EPA 120.1	DEY	1
		SM 2540C	SJR	1
		SM 4500-H+B	SJR	1
		EPA 300.0	HMB	1
		EPA 310.2	DAW	1

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PROJECT NARRATIVE

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Method: **EPA 6020**
Description: 6020 MET ICPMS, Dissolved
Client: FOTH INFRASTRUCTURE & ENVIRONMENT
Date: November 05, 2015

General Information:
23 samples were analyzed for EPA 6020. All samples were received in acceptable condition with any exceptions noted below or on the chain-of custody and/or the sample condition upon receipt form (SCUR) attached at the end of this report.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Sample Preparation:
The samples were prepared in accordance with EPA 3010 with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Internal Standards:
All internal standards were within QC limits with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Additional Comments:

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PROJECT NARRATIVE

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Method: EPA 120.1
Description: 120.1 Specific Conductance
Client: FOTH INFRASTRUCTURE & ENVIRONMENT
Date: November 05, 2015

General Information:
23 samples were analyzed for EPA 120.1. All samples were received in acceptable condition with any exceptions noted below or on the chain-of custody and/or the sample condition upon receipt form (SCUR) attached at the end of this report.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

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PROJECT NARRATIVE

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Method: **SM 2540C**
Description: 2540C Total Dissolved Solids
Client: FOTH INFRASTRUCTURE & ENVIRONMENT
Date: November 05, 2015

General Information:
23 samples were analyzed for SM 2540C. All samples were received in acceptable condition with any exceptions noted below or on the chain-of custody and/or the sample condition upon receipt form (SCUR) attached at the end of this report.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

QC Batch: WET/23448

R1: RPD value was outside control limits.
- DUP (Lab ID: 1237496)
  - Total Dissolved Solids

Additional Comments:

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PROJECT NARRATIVE

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Method: SM 4500-H+B
Description: 4500H+ pH, Electrometric
Client: FOTH INFRASTRUCTURE & ENVIRONMENT
Date: November 05, 2015

General Information:
23 samples were analyzed for SM 4500-H+B. All samples were received in acceptable condition with any exceptions noted below or on the chain-of custody and/or the sample condition upon receipt form (SCUR) attached at the end of this report.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

H6: Analysis initiated outside of the 15 minute EPA recommended holding time.

- BACKFILL-DUP-2015_10 (Lab ID: 40122298023)
- MW-1000PR-2015_10 (Lab ID: 40122298002)
- MW-1000R-2015_10 (Lab ID: 40122298001)
- MW-1002-2015_10 (Lab ID: 40122298017)
- MW-1002G-2015_10 (Lab ID: 40122298018)
- MW-1004-2015_10 (Lab ID: 40122298012)
- MW-1004P-2015_10 (Lab ID: 40122298013)
- MW-1004S-2015_10 (Lab ID: 40122298014)
- MW-1005-2015_10 (Lab ID: 40122298019)
- MW-1005P-2015_10 (Lab ID: 40122298021)
- MW-1005S-2015_10 (Lab ID: 40122298020)
- MW-1010P-2015_10 (Lab ID: 40122298003)
- MW-1013-2015_10 (Lab ID: 40122298004)
- MW-1013A-2015_10 (Lab ID: 40122298005)
- MW-1013B-2015_10 (Lab ID: 40122298006)
- MW-1013C-2015_10 (Lab ID: 40122298007)
- MW-1014-2015_10 (Lab ID: 40122298008)
- MW-1014A-2015_10 (Lab ID: 40122298009)
- MW-1014B-2015_10 (Lab ID: 40122298010)
- MW-1014C-2015_10 (Lab ID: 40122298011)
- MW-1015A-2015_10 (Lab ID: 40122298015)
- MW-1015B-2015_10 (Lab ID: 40122298016)
- MW-DUP-2015_10 (Lab ID: 40122298022)

Method Blank:
All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

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PROJECT NARRATIVE

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Method: EPA 300.0
Description: 300.0 IC Anions 28 Days,Diss
Client: FOTH INFRASTRUCTURE & ENVIRONMENT
Date: November 05, 2015

General Information:
23 samples were analyzed for EPA 300.0. All samples were received in acceptable condition with any exceptions noted below or on the chain-of custody and/or the sample condition upon receipt form (SCUR) attached at the end of this report.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Additional Comments:

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PROJECT NARRATIVE

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Method: EPA 310.2
Description: 310.2 Alkalinity, Dissolved
Client: FOTH INFRASTRUCTURE & ENVIRONMENT
Date: November 05, 2015

General Information:
23 samples were analyzed for EPA 310.2. All samples were received in acceptable condition with any exceptions noted below or on the chain-of custody and/or the sample condition upon receipt form (SCUR) attached at the end of this report.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Additional Comments:

This data package has been reviewed for quality and completeness and is approved for release.

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ANALYTICAL RESULTS

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Sample: MW-1000R-2015_10 **Lab ID: 40122298001** Collected: 10/06/15 07:50 Received: 10/07/15 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS, Dissolved	Analytical Method: EPA 6020 Preparation Method: EPA 3010								
Arsenic, Dissolved	**0.29J**	ug/L	1.0	0.099	1	10/27/15 09:26	10/31/15 08:07	7440-38-2	
Copper, Dissolved	**89.7**	ug/L	1.0	0.26	1	10/27/15 09:26	10/31/15 08:07	7440-50-8	
Iron, Dissolved	**18.3J**	ug/L	250	10.0	1	10/27/15 09:26	10/31/15 08:07	7439-89-6	
Manganese, Dissolved	**10600**	ug/L	10.0	1.8	10	10/27/15 09:26	10/31/15 07:33	7439-96-5	P6
Total Hardness by 2340B, Dissolved	**336**	mg/L	50.0	1.5	10	10/27/15 09:26	10/31/15 07:33		
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**696**	umhos/cm	10.0	1.5	1		10/09/15 11:05		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**450**	mg/L	20.0	8.7	1		10/08/15 17:51		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH	**6.1**	Std. Units	0.10	0.010	1		10/08/15 13:20		H6
300.0 IC Anions 28 Days,Diss	Analytical Method: EPA 300.0								
Sulfate, Dissolved	**69.2**	mg/L	20.0	10.0	5		10/13/15 12:04	14808-79-8	
310.2 Alkalinity, Dissolved	Analytical Method: EPA 310.2								
Alkalinity, Total as CaCO3, Dissolved	**247**	mg/L	20.0	8.6	1		10/12/15 11:54		

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ANALYTICAL RESULTS

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Sample: MW-1000PR-2015_10 **Lab ID: 40122298002** Collected: 10/06/15 08:00 Received: 10/07/15 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS, Dissolved	Analytical Method: EPA 6020 Preparation Method: EPA 3010								
Arsenic, Dissolved	**6.8**	ug/L	1.0	0.099	1	10/27/15 09:26	10/31/15 08:54	7440-38-2	
Copper, Dissolved	**2.7**	ug/L	1.0	0.26	1	10/27/15 09:26	10/31/15 08:54	7440-50-8	
Iron, Dissolved	**642**	ug/L	250	10.0	1	10/27/15 09:26	10/31/15 08:54	7439-89-6	
Manganese, Dissolved	**2150**	ug/L	1.0	0.18	1	10/27/15 09:26	10/31/15 08:54	7439-96-5	
Total Hardness by 2340B, Dissolved	**434**	mg/L	5.0	0.15	1	10/27/15 09:26	10/31/15 08:54		
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**822**	umhos/cm	10.0	1.5	1		10/09/15 11:06		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**534**	mg/L	20.0	8.7	1		10/08/15 17:51		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH	**6.4**	Std. Units	0.10	0.010	1		10/08/15 13:20		H6
300.0 IC Anions 28 Days,Diss	Analytical Method: EPA 300.0								
Sulfate, Dissolved	**68.3**	mg/L	40.0	20.0	10		10/13/15 12:17	14808-79-8	
310.2 Alkalinity, Dissolved	Analytical Method: EPA 310.2								
Alkalinity, Total as CaCO3, Dissolved	**225**	mg/L	20.0	8.6	1		10/12/15 11:54		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 14F777.14 4Q GROUNDWATER 2015

Pace Project No.: 40122298

Sample: MW-1010P-2015_10 **Lab ID: 40122298003** Collected: 10/06/15 08:15 Received: 10/07/15 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS, Dissolved	Analytical Method: EPA 6020 Preparation Method: EPA 3010								
Arsenic, Dissolved	**23.0**	ug/L	1.0	0.099	1	10/27/15 09:26	10/31/15 09:08	7440-38-2	
Copper, Dissolved	**0.55J**	ug/L	1.0	0.26	1	10/27/15 09:26	10/31/15 09:08	7440-50-8	
Iron, Dissolved	<10.0	ug/L	250	10.0	1	10/27/15 09:26	10/31/15 09:08	7439-89-6	
Manganese, Dissolved	**83.4**	ug/L	1.0	0.18	1	10/27/15 09:26	10/31/15 09:08	7439-96-5	
Total Hardness by 2340B, Dissolved	**185**	mg/L	5.0	0.15	1	10/27/15 09:26	10/31/15 09:08		
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**367**	umhos/cm	10.0	1.5	1		10/09/15 11:07		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**188**	mg/L	20.0	8.7	1		10/08/15 17:52		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH	**7.3**	Std. Units	0.10	0.010	1		10/08/15 13:20		H6
300.0 IC Anions 28 Days,Diss	Analytical Method: EPA 300.0								
Sulfate, Dissolved	**24.4**	mg/L	4.0	2.0	1		10/12/15 23:30	14808-79-8	
310.2 Alkalinity, Dissolved	Analytical Method: EPA 310.2								
Alkalinity, Total as CaCO3, Dissolved	**161**	mg/L	20.0	8.6	1		10/12/15 11:55		

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ANALYTICAL RESULTS

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Sample: MW-1013-2015_10 **Lab ID: 40122298004** Collected: 10/06/15 10:35 Received: 10/07/15 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS, Dissolved	Analytical Method: EPA 6020 Preparation Method: EPA 3010								
Arsenic, Dissolved	**0.63J**	ug/L	1.0	0.099	1	10/27/15 09:26	10/31/15 09:14	7440-38-2	
Copper, Dissolved	**7.6**	ug/L	1.0	0.26	1	10/27/15 09:26	10/31/15 09:14	7440-50-8	
Iron, Dissolved	**4570**	ug/L	250	10.0	1	10/27/15 09:26	10/31/15 09:14	7439-89-6	
Manganese, Dissolved	**26200**	ug/L	100	17.9	100	10/27/15 09:26	11/03/15 19:07	7439-96-5	
Total Hardness by 2340B, Dissolved	**568**	mg/L	5.0	0.15	1	10/27/15 09:26	10/31/15 09:14		
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**1140**	umhos/cm	10.0	1.5	1		10/09/15 11:08		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**692**	mg/L	20.0	8.7	1		10/08/15 17:53		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH	**6.3**	Std. Units	0.10	0.010	1		10/08/15 13:20		H6
300.0 IC Anions 28 Days,Diss	Analytical Method: EPA 300.0								
Sulfate, Dissolved	**24.9**	mg/L	20.0	10.0	5		10/12/15 23:42	14808-79-8	
310.2 Alkalinity, Dissolved	Analytical Method: EPA 310.2								
Alkalinity, Total as CaCO3, Dissolved	**630**	mg/L	100	43.2	5		10/12/15 12:20		

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ANALYTICAL RESULTS

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Sample: MW-1013A-2015_10 **Lab ID: 40122298005** Collected: 10/06/15 10:40 Received: 10/07/15 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS, Dissolved	Analytical Method: EPA 6020 Preparation Method: EPA 3010								
Arsenic, Dissolved	**0.26J**	ug/L	1.0	0.099	1	10/27/15 09:26	10/31/15 09:21	7440-38-2	
Copper, Dissolved	**0.47J**	ug/L	1.0	0.26	1	10/27/15 09:26	10/31/15 09:21	7440-50-8	
Iron, Dissolved	**54.7J**	ug/L	250	10.0	1	10/27/15 09:26	10/31/15 09:21	7439-89-6	
Manganese, Dissolved	**4330**	ug/L	1.0	0.18	1	10/27/15 09:26	10/31/15 09:21	7439-96-5	
Total Hardness by 2340B, Dissolved	**468**	mg/L	5.0	0.15	1	10/27/15 09:26	10/31/15 09:21		
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**960**	umhos/cm	10.0	1.5	1		10/09/15 11:08		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**586**	mg/L	20.0	8.7	1		10/08/15 17:53		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH	**6.6**	Std. Units	0.10	0.010	1		10/08/15 13:20		H6
300.0 IC Anions 28 Days,Diss	Analytical Method: EPA 300.0								
Sulfate, Dissolved	**163**	mg/L	40.0	20.0	10		10/13/15 12:54	14808-79-8	
310.2 Alkalinity, Dissolved	Analytical Method: EPA 310.2								
Alkalinity, Total as CaCO3, Dissolved	**353**	mg/L	20.0	8.6	1		10/12/15 13:25		

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ANALYTICAL RESULTS

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Sample: MW-1013B-2015_10 **Lab ID: 40122298006** Collected: 10/06/15 10:50 Received: 10/07/15 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS, Dissolved	Analytical Method: EPA 6020 Preparation Method: EPA 3010								
Arsenic, Dissolved	**1.0**	ug/L	1.0	0.099	1	10/27/15 09:26	10/31/15 09:28	7440-38-2	
Copper, Dissolved	**510**	ug/L	1.0	0.26	1	10/27/15 09:26	10/31/15 09:28	7440-50-8	
Iron, Dissolved	**63.2J**	ug/L	250	10.0	1	10/27/15 09:26	10/31/15 09:28	7439-89-6	
Manganese, Dissolved	**30800**	ug/L	100	17.9	100	10/27/15 09:26	11/03/15 19:13	7439-96-5	
Total Hardness by 2340B, Dissolved	**2030**	mg/L	500	15.0	100	10/27/15 09:26	11/03/15 19:13		
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**3380**	umhos/cm	10.0	1.5	1		10/09/15 11:11		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**2970**	mg/L	20.0	8.7	1		10/08/15 17:53		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH	**6.3**	Std. Units	0.10	0.010	1		10/08/15 13:20		H6
300.0 IC Anions 28 Days,Diss	Analytical Method: EPA 300.0								
Sulfate, Dissolved	**1600**	mg/L	200	100	50		10/13/15 13:07	14808-79-8	
310.2 Alkalinity, Dissolved	Analytical Method: EPA 310.2								
Alkalinity, Total as CaCO3, Dissolved	**523**	mg/L	100	43.2	5		10/12/15 14:34		

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ANALYTICAL RESULTS

Project: 14F777.14 4Q GROUNDWATER 2015

Pace Project No.: 40122298

Sample: MW-1013C-2015_10 **Lab ID: 40122298007** Collected: 10/06/15 10:25 Received: 10/07/15 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS, Dissolved	Analytical Method: EPA 6020 Preparation Method: EPA 3010								
Arsenic, Dissolved	**21.2**	ug/L	1.0	0.099	1	10/27/15 09:26	10/31/15 09:35	7440-38-2	
Copper, Dissolved	**0.78J**	ug/L	1.0	0.26	1	10/27/15 09:26	10/31/15 09:35	7440-50-8	
Iron, Dissolved	**13700**	ug/L	250	10.0	1	10/27/15 09:26	10/31/15 09:35	7439-89-6	
Manganese, Dissolved	**9600**	ug/L	100	17.9	100	10/27/15 09:26	11/03/15 19:20	7439-96-5	
Total Hardness by 2340B, Dissolved	**1940**	mg/L	500	15.0	100	10/27/15 09:26	11/03/15 19:20		
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**3320**	umhos/cm	10.0	1.5	1		10/09/15 11:12		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**2840**	mg/L	20.0	8.7	1		10/08/15 17:54		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH	**6.4**	Std. Units	0.10	0.010	1		10/08/15 13:20		H6
300.0 IC Anions 28 Days,Diss	Analytical Method: EPA 300.0								
Sulfate, Dissolved	**1550**	mg/L	400	200	100		10/13/15 13:19	14808-79-8	
310.2 Alkalinity, Dissolved	Analytical Method: EPA 310.2								
Alkalinity, Total as CaCO3, Dissolved	**522**	mg/L	40.0	17.3	2		10/12/15 13:26		

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ANALYTICAL RESULTS

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Sample: MW-1014-2015_10 **Lab ID: 40122298008** Collected: 10/06/15 08:25 Received: 10/07/15 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS, Dissolved	Analytical Method: EPA 6020 Preparation Method: EPA 3010								
Arsenic, Dissolved	**<0.099**	ug/L	1.0	0.099	1	10/27/15 09:26	10/31/15 09:41	7440-38-2	
Copper, Dissolved	**5.2**	ug/L	1.0	0.26	1	10/27/15 09:26	10/31/15 09:41	7440-50-8	
Iron, Dissolved	**<10.0**	ug/L	250	10.0	1	10/27/15 09:26	10/31/15 09:41	7439-89-6	
Manganese, Dissolved	**455**	ug/L	1.0	0.18	1	10/27/15 09:26	10/31/15 09:41	7439-96-5	
Total Hardness by 2340B, Dissolved	**332**	mg/L	5.0	0.15	1	10/27/15 09:26	10/31/15 09:41		
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**737**	umhos/cm	10.0	1.5	1		10/09/15 11:13		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**446**	mg/L	20.0	8.7	1		10/08/15 17:54		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH	**6.4**	Std. Units	0.10	0.010	1		10/08/15 13:20		H6
300.0 IC Anions 28 Days,Diss	Analytical Method: EPA 300.0								
Sulfate, Dissolved	**128**	mg/L	40.0	20.0	10		10/13/15 13:32	14808-79-8	
310.2 Alkalinity, Dissolved	Analytical Method: EPA 310.2								
Alkalinity, Total as CaCO3, Dissolved	**194**	mg/L	20.0	8.6	1		10/12/15 13:27		

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ANALYTICAL RESULTS

Project: 14F777.14 4Q GROUNDWATER 2015

Pace Project No.: 40122298

Sample: MW-1014A-2015_10 **Lab ID: 40122298009** Collected: 10/06/15 08:35 Received: 10/07/15 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS, Dissolved	Analytical Method: EPA 6020 Preparation Method: EPA 3010								
Arsenic, Dissolved	**0.81J**	ug/L	1.0	0.099	1	10/27/15 09:26	10/31/15 10:01	7440-38-2	
Copper, Dissolved	**3.8**	ug/L	1.0	0.26	1	10/27/15 09:26	10/31/15 10:01	7440-50-8	
Iron, Dissolved	**<10.0**	ug/L	250	10.0	1	10/27/15 09:26	10/31/15 10:01	7439-89-6	
Manganese, Dissolved	**156**	ug/L	1.0	0.18	1	10/27/15 09:26	10/31/15 10:01	7439-96-5	
Total Hardness by 2340B, Dissolved	**1400**	mg/L	5.0	0.15	1	10/27/15 09:26	10/31/15 10:01		
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**2370**	umhos/cm	10.0	1.5	1		10/09/15 11:14		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**1790**	mg/L	20.0	8.7	1		10/08/15 17:55		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH	**6.6**	Std. Units	0.10	0.010	1		10/08/15 13:20		H6
300.0 IC Anions 28 Days,Diss	Analytical Method: EPA 300.0								
Sulfate, Dissolved	**931**	mg/L	80.0	40.0	20		10/13/15 13:44	14808-79-8	
310.2 Alkalinity, Dissolved	Analytical Method: EPA 310.2								
Alkalinity, Total as CaCO3, Dissolved	**488**	mg/L	100	43.2	5		10/12/15 14:35		

REPORT OF LABORATORY ANALYSIS

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ANALYTICAL RESULTS

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Sample: MW-1014B-2015_10 **Lab ID: 40122298010** Collected: 10/06/15 08:45 Received: 10/07/15 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS, Dissolved	Analytical Method: EPA 6020 Preparation Method: EPA 3010								
Arsenic, Dissolved	**1.3**	ug/L	1.0	0.099	1	10/27/15 09:26	10/31/15 10:08	7440-38-2	
Copper, Dissolved	**372**	ug/L	1.0	0.26	1	10/27/15 09:26	10/31/15 10:08	7440-50-8	
Iron, Dissolved	**<10.0**	ug/L	250	10.0	1	10/27/15 09:26	10/31/15 10:08	7439-89-6	
Manganese, Dissolved	**9970**	ug/L	50.0	9.0	50	10/27/15 09:26	11/03/15 19:27	7439-96-5	
Total Hardness by 2340B, Dissolved	**1730**	mg/L	250	7.5	50	10/27/15 09:26	11/03/15 19:27		
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**2970**	umhos/cm	10.0	1.5	1		10/09/15 11:14		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**2460**	mg/L	20.0	8.7	1		10/08/15 17:55		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH	**6.4**	Std. Units	0.10	0.010	1		10/08/15 13:20		H6
300.0 IC Anions 28 Days,Diss	Analytical Method: EPA 300.0								
Sulfate, Dissolved	**1340**	mg/L	400	200	100		10/14/15 15:24	14808-79-8	
310.2 Alkalinity, Dissolved	Analytical Method: EPA 310.2								
Alkalinity, Total as CaCO3, Dissolved	**512**	mg/L	100	43.2	5		10/12/15 14:36		

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ANALYTICAL RESULTS

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Sample: MW-1014C-2015_10 **Lab ID: 40122298011** Collected: 10/06/15 09:15 Received: 10/07/15 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS, Dissolved	Analytical Method: EPA 6020 Preparation Method: EPA 3010								
Arsenic, Dissolved	**22.6**	ug/L	1.0	0.099	1	10/27/15 09:26	10/31/15 10:15	7440-38-2	
Copper, Dissolved	**0.36J**	ug/L	1.0	0.26	1	10/27/15 09:26	10/31/15 10:15	7440-50-8	
Iron, Dissolved	**4640**	ug/L	250	10.0	1	10/27/15 09:26	10/31/15 10:15	7439-89-6	
Manganese, Dissolved	**1610**	ug/L	1.0	0.18	1	10/27/15 09:26	10/31/15 10:15	7439-96-5	
Total Hardness by 2340B, Dissolved	**545**	mg/L	5.0	0.15	1	10/27/15 09:26	10/31/15 10:15		
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**1100**	umhos/cm	10.0	1.5	1		10/09/15 11:16		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**676**	mg/L	20.0	8.7	1		10/08/15 17:56		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH	**6.6**	Std. Units	0.10	0.010	1		10/08/15 13:20		H6
300.0 IC Anions 28 Days,Diss	Analytical Method: EPA 300.0								
Sulfate, Dissolved	**215**	mg/L	20.0	10.0	5		10/13/15 01:35	14808-79-8	
310.2 Alkalinity, Dissolved	Analytical Method: EPA 310.2								
Alkalinity, Total as CaCO3, Dissolved	**273**	mg/L	40.0	17.3	2		10/12/15 13:31		

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ANALYTICAL RESULTS

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Sample: MW-1004-2015_10 **Lab ID: 40122298012** Collected: 10/06/15 11:20 Received: 10/07/15 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS, Dissolved	Analytical Method: EPA 6020 Preparation Method: EPA 3010								
Arsenic, Dissolved	**<0.099**	ug/L	1.0	0.099	1	10/27/15 09:26	10/31/15 10:22	7440-38-2	
Copper, Dissolved	**4.2**	ug/L	1.0	0.26	1	10/27/15 09:26	10/31/15 10:22	7440-50-8	
Iron, Dissolved	**<10.0**	ug/L	250	10.0	1	10/27/15 09:26	10/31/15 10:22	7439-89-6	
Manganese, Dissolved	**1.4**	ug/L	1.0	0.18	1	10/27/15 09:26	10/31/15 10:22	7439-96-5	
Total Hardness by 2340B, Dissolved	**58.9**	mg/L	5.0	0.15	1	10/27/15 09:26	10/31/15 10:22		
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**145**	umhos/cm	10.0	1.5	1		10/09/15 11:17		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**92.0**	mg/L	20.0	8.7	1		10/08/15 17:56		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH	**6.1**	Std. Units	0.10	0.010	1		10/08/15 13:20		H6
300.0 IC Anions 28 Days,Diss	Analytical Method: EPA 300.0								
Sulfate, Dissolved	**20.5**	mg/L	4.0	2.0	1		10/13/15 01:48	14808-79-8	
310.2 Alkalinity, Dissolved	Analytical Method: EPA 310.2								
Alkalinity, Total as CaCO3, Dissolved	**41.3**	mg/L	20.0	8.6	1		10/12/15 13:31		

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ANALYTICAL RESULTS

Project: 14F777.14 4Q GROUNDWATER 2015

Pace Project No.: 40122298

Sample: MW-1004P-2015_10 Lab ID: **40122298013** Collected: 10/06/15 11:00 Received: 10/07/15 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS, Dissolved	Analytical Method: EPA 6020 Preparation Method: EPA 3010								
Arsenic, Dissolved	**0.46J**	ug/L	1.0	0.099	1	10/27/15 09:26	10/31/15 10:28	7440-38-2	
Copper, Dissolved	**<0.26**	ug/L	1.0	0.26	1	10/27/15 09:26	10/31/15 10:28	7440-50-8	
Iron, Dissolved	**418**	ug/L	250	10.0	1	10/27/15 09:26	10/31/15 10:28	7439-89-6	
Manganese, Dissolved	**149**	ug/L	1.0	0.18	1	10/27/15 09:26	10/31/15 10:28	7439-96-5	
Total Hardness by 2340B, Dissolved	**156**	mg/L	5.0	0.15	1	10/27/15 09:26	10/31/15 10:28		
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**318**	umhos/cm	10.0	1.5	1		10/09/15 11:18		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**160**	mg/L	20.0	8.7	1		10/08/15 17:57		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH	**7.2**	Std. Units	0.10	0.010	1		10/08/15 13:20		H6
300.0 IC Anions 28 Days,Diss	Analytical Method: EPA 300.0								
Sulfate, Dissolved	**3.6J**	mg/L	4.0	2.0	1		10/13/15 02:00	14808-79-8	
310.2 Alkalinity, Dissolved	Analytical Method: EPA 310.2								
Alkalinity, Total as CaCO3, Dissolved	**167**	mg/L	20.0	8.6	1		10/12/15 13:32		

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ANALYTICAL RESULTS

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Sample: MW-1004S-2015_10 **Lab ID: 40122298014** Collected: 10/06/15 11:45 Received: 10/07/15 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS, Dissolved	Analytical Method: EPA 6020 Preparation Method: EPA 3010								
Arsenic, Dissolved	**0.13J**	ug/L	1.0	0.099	1	10/27/15 09:26	10/31/15 10:35	7440-38-2	
Copper, Dissolved	**1.8**	ug/L	1.0	0.26	1	10/27/15 09:26	10/31/15 10:35	7440-50-8	
Iron, Dissolved	**<10.0**	ug/L	250	10.0	1	10/27/15 09:26	10/31/15 10:35	7439-89-6	
Manganese, Dissolved	**0.73J**	ug/L	1.0	0.18	1	10/27/15 09:26	10/31/15 10:35	7439-96-5	
Total Hardness by 2340B, Dissolved	**67.2**	mg/L	5.0	0.15	1	10/27/15 09:26	10/31/15 10:35		
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**160**	umhos/cm	10.0	1.5	1		10/09/15 11:18		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**106**	mg/L	20.0	8.7	1		10/08/15 17:57		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH	**6.1**	Std. Units	0.10	0.010	1		10/08/15 13:20		H6
300.0 IC Anions 28 Days,Diss	Analytical Method: EPA 300.0								
Sulfate, Dissolved	**24.7**	mg/L	4.0	2.0	1		10/13/15 17:55	14808-79-8	
310.2 Alkalinity, Dissolved	Analytical Method: EPA 310.2								
Alkalinity, Total as CaCO3, Dissolved	**40.9**	mg/L	20.0	8.6	1		10/12/15 15:15		

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ANALYTICAL RESULTS

Project: 14F777.14 4Q GROUNDWATER 2015

Pace Project No.: 40122298

Sample: MW-1015A-2015_10 Lab ID: **40122298015** Collected: 10/06/15 12:20 Received: 10/07/15 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS, Dissolved	Analytical Method: EPA 6020 Preparation Method: EPA 3010								
Arsenic, Dissolved	**<0.099**	ug/L	1.0	0.099	1	10/27/15 09:26	10/31/15 10:42	7440-38-2	
Copper, Dissolved	**0.46J**	ug/L	1.0	0.26	1	10/27/15 09:26	10/31/15 10:42	7440-50-8	
Iron, Dissolved	**10.1J**	ug/L	250	10.0	1	10/27/15 09:26	10/31/15 10:42	7439-89-6	
Manganese, Dissolved	**6.8**	ug/L	1.0	0.18	1	10/27/15 09:26	10/31/15 10:42	7439-96-5	
Total Hardness by 2340B, Dissolved	**96.4**	mg/L	5.0	0.15	1	10/27/15 09:26	10/31/15 10:42		
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**194**	umhos/cm	10.0	1.5	1		10/09/15 11:20		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**120**	mg/L	20.0	8.7	1		10/08/15 17:57		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH	**6.8**	Std. Units	0.10	0.010	1		10/08/15 13:20		H6
300.0 IC Anions 28 Days,Diss	Analytical Method: EPA 300.0								
Sulfate, Dissolved	**8.7**	mg/L	4.0	2.0	1		10/13/15 18:33	14808-79-8	
310.2 Alkalinity, Dissolved	Analytical Method: EPA 310.2								
Alkalinity, Total as CaCO3, Dissolved	**83.5**	mg/L	20.0	8.6	1		10/12/15 13:34		

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ANALYTICAL RESULTS

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Sample: MW-1015B-2015_10 **Lab ID: 40122298016** Collected: 10/06/15 12:25 Received: 10/07/15 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS, Dissolved	Analytical Method: EPA 6020 Preparation Method: EPA 3010								
Arsenic, Dissolved	**0.16J**	ug/L	1.0	0.099	1	10/27/15 09:26	10/31/15 10:49	7440-38-2	
Copper, Dissolved	**<0.26**	ug/L	1.0	0.26	1	10/27/15 09:26	10/31/15 10:49	7440-50-8	
Iron, Dissolved	**138J**	ug/L	250	10.0	1	10/27/15 09:26	10/31/15 10:49	7439-89-6	
Manganese, Dissolved	**34.3**	ug/L	1.0	0.18	1	10/27/15 09:26	10/31/15 10:49	7439-96-5	
Total Hardness by 2340B, Dissolved	**161**	mg/L	5.0	0.15	1	10/27/15 09:26	10/31/15 10:49		
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**508**	umhos/cm	10.0	1.5	1		10/09/15 11:21		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**252**	mg/L	20.0	8.7	1		10/08/15 17:58		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH	**7.6**	Std. Units	0.10	0.010	1		10/08/15 13:20		H6
300.0 IC Anions 28 Days,Diss	Analytical Method: EPA 300.0								
Sulfate, Dissolved	**3.2J**	mg/L	4.0	2.0	1		10/13/15 18:46	14808-79-8	
310.2 Alkalinity, Dissolved	Analytical Method: EPA 310.2								
Alkalinity, Total as CaCO3, Dissolved	**184**	mg/L	20.0	8.6	1		10/12/15 13:34		

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ANALYTICAL RESULTS

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Sample: MW-1002-2015_10 **Lab ID: 40122298017** Collected: 10/06/15 12:50 Received: 10/07/15 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS, Dissolved	Analytical Method: EPA 6020 Preparation Method: EPA 3010								
Arsenic, Dissolved	**<0.099**	ug/L	1.0	0.099	1	10/27/15 09:26	10/31/15 10:55	7440-38-2	
Copper, Dissolved	**0.67J**	ug/L	1.0	0.26	1	10/27/15 09:26	10/31/15 10:55	7440-50-8	
Iron, Dissolved	**<10.0**	ug/L	250	10.0	1	10/27/15 09:26	10/31/15 10:55	7439-89-6	
Manganese, Dissolved	**<0.18**	ug/L	1.0	0.18	1	10/27/15 09:26	10/31/15 10:55	7439-96-5	
Total Hardness by 2340B, Dissolved	**67.8**	mg/L	5.0	0.15	1	10/27/15 09:26	10/31/15 10:55		
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**156**	umhos/cm	10.0	1.5	1		10/09/15 11:21		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**96.0**	mg/L	20.0	8.7	1		10/08/15 17:58		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH	**6.4**	Std. Units	0.10	0.010	1		10/08/15 13:20		H6
300.0 IC Anions 28 Days,Diss	Analytical Method: EPA 300.0								
Sulfate, Dissolved	**4.6**	mg/L	4.0	2.0	1		10/13/15 18:58	14808-79-8	
310.2 Alkalinity, Dissolved	Analytical Method: EPA 310.2								
Alkalinity, Total as CaCO3, Dissolved	**61.2**	mg/L	20.0	8.6	1		10/12/15 13:37		

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ANALYTICAL RESULTS

Project: 14F777.14 4Q GROUNDWATER 2015

Pace Project No.: 40122298

Sample: MW-1002G-2015_10 **Lab ID: 40122298018** Collected: 10/06/15 13:05 Received: 10/07/15 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS, Dissolved	Analytical Method: EPA 6020 Preparation Method: EPA 3010								
Arsenic, Dissolved	**<0.099**	ug/L	1.0	0.099	1	10/27/15 09:26	10/31/15 11:02	7440-38-2	
Copper, Dissolved	**0.35J**	ug/L	1.0	0.26	1	10/27/15 09:26	10/31/15 11:02	7440-50-8	
Iron, Dissolved	**<10.0**	ug/L	250	10.0	1	10/27/15 09:26	10/31/15 11:02	7439-89-6	
Manganese, Dissolved	**0.23J**	ug/L	1.0	0.18	1	10/27/15 09:26	10/31/15 11:02	7439-96-5	
Total Hardness by 2340B, Dissolved	**144**	mg/L	5.0	0.15	1	10/27/15 09:26	10/31/15 11:02		
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**324**	umhos/cm	10.0	1.5	1		10/09/15 11:22		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**190**	mg/L	20.0	8.7	1		10/08/15 17:58		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH	**6.5**	Std. Units	0.10	0.010	1		10/08/15 13:20		H6
300.0 IC Anions 28 Days,Diss	Analytical Method: EPA 300.0								
Sulfate, Dissolved	**9.2**	mg/L	4.0	2.0	1		10/13/15 19:11	14808-79-8	
310.2 Alkalinity, Dissolved	Analytical Method: EPA 310.2								
Alkalinity, Total as CaCO3, Dissolved	**98.2**	mg/L	20.0	8.6	1		10/12/15 13:38		

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ANALYTICAL RESULTS

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Sample: MW-1005-2015_10 **Lab ID: 40122298019** Collected: 10/06/15 14:10 Received: 10/07/15 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS, Dissolved	Analytical Method: EPA 6020 Preparation Method: EPA 3010								
Arsenic, Dissolved	**1.2**	ug/L	1.0	0.099	1	10/27/15 09:26	10/31/15 11:22	7440-38-2	
Copper, Dissolved	**1.6**	ug/L	1.0	0.26	1	10/27/15 09:26	10/31/15 11:22	7440-50-8	
Iron, Dissolved	**16200**	ug/L	250	10.0	1	10/27/15 09:26	10/31/15 11:22	7439-89-6	
Manganese, Dissolved	**540**	ug/L	1.0	0.18	1	10/27/15 09:26	10/31/15 11:22	7439-96-5	
Total Hardness by 2340B, Dissolved	**418**	mg/L	5.0	0.15	1	10/27/15 09:26	10/31/15 11:22		
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**1490**	umhos/cm	10.0	1.5	1		10/09/15 11:22		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**1070**	mg/L	20.0	8.7	1		10/08/15 17:59		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH	**5.9**	Std. Units	0.10	0.010	1		10/08/15 13:20		H6
300.0 IC Anions 28 Days,Diss	Analytical Method: EPA 300.0								
Sulfate, Dissolved	**14.9**	mg/L	4.0	2.0	1		10/13/15 19:23	14808-79-8	
310.2 Alkalinity, Dissolved	Analytical Method: EPA 310.2								
Alkalinity, Total as CaCO3, Dissolved	**57.3**	mg/L	20.0	8.6	1		10/12/15 13:38		

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ANALYTICAL RESULTS

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Sample: MW-1005S-2015_10 Lab ID: 40122298020 Collected: 10/06/15 13:40 Received: 10/07/15 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS, Dissolved	Analytical Method: EPA 6020 Preparation Method: EPA 3010								
Arsenic, Dissolved	**2.4**	ug/L	1.0	0.099	1	10/27/15 09:26	10/31/15 11:29	7440-38-2	
Copper, Dissolved	**<0.26**	ug/L	1.0	0.26	1	10/27/15 09:26	10/31/15 11:29	7440-50-8	
Iron, Dissolved	**4290**	ug/L	250	10.0	1	10/27/15 09:26	10/31/15 11:29	7439-89-6	
Manganese, Dissolved	**237**	ug/L	1.0	0.18	1	10/27/15 09:26	10/31/15 11:29	7439-96-5	
Total Hardness by 2340B, Dissolved	**177**	mg/L	5.0	0.15	1	10/27/15 09:26	10/31/15 11:29		
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**360**	umhos/cm	10.0	1.5	1		10/09/15 11:48		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**198**	mg/L	20.0	8.7	1		10/08/15 17:59		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH	**7.0**	Std. Units	0.10	0.010	1		10/08/15 13:20		H6
300.0 IC Anions 28 Days,Diss	Analytical Method: EPA 300.0								
Sulfate, Dissolved	**2.3J**	mg/L	4.0	2.0	1		10/14/15 13:56	14808-79-8	
310.2 Alkalinity, Dissolved	Analytical Method: EPA 310.2								
Alkalinity, Total as CaCO3, Dissolved	**179**	mg/L	40.0	17.3	2		10/12/15 13:39		

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ANALYTICAL RESULTS

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Sample: MW-1005P-2015_10 **Lab ID: 40122298021** Collected: 10/06/15 14:25 Received: 10/07/15 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS, Dissolved	Analytical Method: EPA 6020 Preparation Method: EPA 3010								
Arsenic, Dissolved	**0.32J**	ug/L	1.0	0.099	1	10/27/15 09:33	11/04/15 16:34	7440-38-2	
Copper, Dissolved	**0.32J**	ug/L	1.0	0.26	1	10/27/15 09:33	11/04/15 16:34	7440-50-8	
Iron, Dissolved	**1070**	ug/L	250	10.0	1	10/27/15 09:33	11/04/15 16:34	7439-89-6	
Manganese, Dissolved	**71.6**	ug/L	1.0	0.18	1	10/27/15 09:33	11/04/15 16:34	7439-96-5	
Total Hardness by 2340B, Dissolved	**240**	mg/L	50.0	1.5	10	10/27/15 09:33	11/04/15 16:08		
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**485**	umhos/cm	10.0	1.5	1		10/09/15 11:48		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**234**	mg/L	20.0	8.7	1		10/12/15 21:00		R1
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH	**7.2**	Std. Units	0.10	0.010	1		10/08/15 13:20		H6
300.0 IC Anions 28 Days,Diss	Analytical Method: EPA 300.0								
Sulfate, Dissolved	**<2.0**	mg/L	4.0	2.0	1		10/13/15 19:48	14808-79-8	
310.2 Alkalinity, Dissolved	Analytical Method: EPA 310.2								
Alkalinity, Total as CaCO3, Dissolved	**251**	mg/L	20.0	8.6	1		10/12/15 13:39		

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ANALYTICAL RESULTS

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Sample: MW-DUP-2015_10 Lab ID: 40122298022 Collected: 10/06/15 00:00 Received: 10/07/15 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS, Dissolved	Analytical Method: EPA 6020 Preparation Method: EPA 3010								
Arsenic, Dissolved	**0.10J**	ug/L	1.0	0.099	1	10/27/15 09:33	11/04/15 17:18	7440-38-2	
Copper, Dissolved	**1.1**	ug/L	1.0	0.26	1	10/27/15 09:33	11/04/15 17:18	7440-50-8	
Iron, Dissolved	**25.9J**	ug/L	250	10.0	1	10/27/15 09:33	11/04/15 17:18	7439-89-6	
Manganese, Dissolved	**0.37J**	ug/L	1.0	0.18	1	10/27/15 09:33	11/04/15 17:18	7439-96-5	
Total Hardness by 2340B, Dissolved	**69.0**	mg/L	5.0	0.15	1	10/27/15 09:33	11/04/15 17:18		
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**161**	umhos/cm	10.0	1.5	1		10/09/15 11:49		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**104**	mg/L	20.0	8.7	1		10/12/15 21:01		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH	**6.4**	Std. Units	0.10	0.010	1		10/08/15 13:20		H6
300.0 IC Anions 28 Days,Diss	Analytical Method: EPA 300.0								
Sulfate, Dissolved	**4.5**	mg/L	4.0	2.0	1		10/13/15 20:26	14808-79-8	
310.2 Alkalinity, Dissolved	Analytical Method: EPA 310.2								
Alkalinity, Total as CaCO3, Dissolved	**58.6**	mg/L	20.0	8.6	1		10/12/15 13:40		

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ANALYTICAL RESULTS

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Sample: BACKFILL-DUP-2015_10 **Lab ID: 40122298023** Collected: 10/06/15 00:00 Received: 10/07/15 09:05 Matrix: Water

Parameters	Results	Units	LOQ	LOD	DF	Prepared	Analyzed	CAS No.	Qual
6020 MET ICPMS, Dissolved	Analytical Method: EPA 6020 Preparation Method: EPA 3010								
Arsenic, Dissolved	**22.8**	ug/L	1.0	0.099	1	10/27/15 09:33	11/04/15 17:31	7440-38-2	
Copper, Dissolved	**<0.26**	ug/L	1.0	0.26	1	10/27/15 09:33	11/04/15 17:31	7440-50-8	
Iron, Dissolved	**4830**	ug/L	250	10.0	1	10/27/15 09:33	11/04/15 17:31	7439-89-6	
Manganese, Dissolved	**1580**	ug/L	1.0	0.18	1	10/27/15 09:33	11/04/15 17:31	7439-96-5	
Total Hardness by 2340B, Dissolved	**528**	mg/L	5.0	0.15	1	10/27/15 09:33	11/04/15 17:31		
120.1 Specific Conductance	Analytical Method: EPA 120.1								
Specific Conductance	**1070**	umhos/cm	10.0	1.5	1		10/09/15 11:50		
2540C Total Dissolved Solids	Analytical Method: SM 2540C								
Total Dissolved Solids	**670**	mg/L	20.0	8.7	1		10/12/15 21:01		
4500H+ pH, Electrometric	Analytical Method: SM 4500-H+B								
pH	**6.7**	Std. Units	0.10	0.010	1		10/08/15 13:20		H6
300.0 IC Anions 28 Days,Diss	Analytical Method: EPA 300.0								
Sulfate, Dissolved	**214**	mg/L	20.0	10.0	5		10/13/15 20:38	14808-79-8	
310.2 Alkalinity, Dissolved	Analytical Method: EPA 310.2								
Alkalinity, Total as CaCO3, Dissolved	**274**	mg/L	40.0	17.3	2		10/12/15 13:40		

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QUALITY CONTROL DATA

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

QC Batch: MPRP/12813 | Analysis Method: EPA 6020
QC Batch Method: EPA 3010 | Analysis Description: 6020 MET Dissolved
Associated Lab Samples: 40122298001, 40122298002, 40122298003, 40122298004, 40122298005, 40122298006, 40122298007, 40122298008, 40122298009, 40122298010, 40122298011, 40122298012, 40122298013, 40122298014, 40122298015, 40122298016, 40122298017, 40122298018, 40122298019, 40122298020

METHOD BLANK: 1246856 | Matrix: Water
Associated Lab Samples: 40122298001, 40122298002, 40122298003, 40122298004, 40122298005, 40122298006, 40122298007, 40122298008, 40122298009, 40122298010, 40122298011, 40122298012, 40122298013, 40122298014, 40122298015, 40122298016, 40122298017, 40122298018, 40122298019, 40122298020

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Arsenic, Dissolved	ug/L	<0.099	1.0	10/31/15 07:20	
Copper, Dissolved	ug/L	<0.26	1.0	10/31/15 07:20	
Iron, Dissolved	ug/L	<10.0	250	10/31/15 07:20	
Manganese, Dissolved	ug/L	<0.18	1.0	10/31/15 07:20	
Total Hardness by 2340B, Dissolved	mg/L	<0.15	5.0	10/31/15 07:20	

LABORATORY CONTROL SAMPLE: 1246857

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Arsenic, Dissolved	ug/L	500	532	106	80-120	
Copper, Dissolved	ug/L	500	534	107	80-120	
Iron, Dissolved	ug/L	5000	5200	104	80-120	
Manganese, Dissolved	ug/L	500	523	105	80-120	
Total Hardness by 2340B, Dissolved	mg/L		32.2			

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1246858 | 1246859

Parameter	Units	40122298001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Arsenic, Dissolved	ug/L	0.29J	500	500	522	529	104	106	75-125	1	20	
Copper, Dissolved	ug/L	89.7	500	500	590	608	100	104	75-125	3	20	
Iron, Dissolved	ug/L	18.3J	5000	5000	4980	5090	99	102	75-125	2	20	
Manganese, Dissolved	ug/L	10600	500	500	11000	11600	90	196	75-125	5	20	P6
Total Hardness by 2340B, Dissolved	mg/L	336			367	387				5	20	

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QUALITY CONTROL DATA

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

QC Batch: MPRP/12814 Analysis Method: EPA 6020
QC Batch Method: EPA 3010 Analysis Description: 6020 MET Dissolved
Associated Lab Samples: 40122298021, 40122298022, 40122298023

METHOD BLANK: 1246881 Matrix: Water
Associated Lab Samples: 40122298021, 40122298022, 40122298023

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Arsenic, Dissolved	ug/L	<0.099	1.0	11/04/15 15:56	
Copper, Dissolved	ug/L	<0.26	1.0	11/04/15 15:56	
Iron, Dissolved	ug/L	<10.0	250	11/04/15 15:56	
Manganese, Dissolved	ug/L	<0.18	1.0	11/04/15 15:56	
Total Hardness by 2340B, Dissolved	mg/L	<0.15	5.0	11/04/15 15:56	

LABORATORY CONTROL SAMPLE: 1246882

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Arsenic, Dissolved	ug/L	500	541	108	80-120	
Copper, Dissolved	ug/L	500	532	106	80-120	
Iron, Dissolved	ug/L	5000	5400	108	80-120	
Manganese, Dissolved	ug/L	500	522	104	80-120	
Total Hardness by 2340B, Dissolved	mg/L		34.8			

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1246883 1246884

Parameter	Units	40122298021 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Arsenic, Dissolved	ug/L	0.32J	500	500	513	517	103	103	75-125	1	20	
Copper, Dissolved	ug/L	0.32J	500	500	499	497	100	99	75-125	0	20	
Iron, Dissolved	ug/L	1070	5000	5000	6180	6270	102	104	75-125	1	20	
Manganese, Dissolved	ug/L	71.6	500	500	572	582	100	102	75-125	2	20	
Total Hardness by 2340B, Dissolved	mg/L	240			257	270				5	20	

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QUALITY CONTROL DATA

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

QC Batch: WET/23423 Analysis Method: EPA 120.1
QC Batch Method: EPA 120.1 Analysis Description: 120.1 Specific Conductance
Associated Lab Samples: 40122298001, 40122298002, 40122298003, 40122298004, 40122298005, 40122298006, 40122298007, 40122298008, 40122298009, 40122298010, 40122298011, 40122298012, 40122298013, 40122298014, 40122298015, 40122298016, 40122298017, 40122298018, 40122298019

METHOD BLANK: 1235424 Matrix: Water
Associated Lab Samples: 40122298001, 40122298002, 40122298003, 40122298004, 40122298005, 40122298006, 40122298007, 40122298008, 40122298009, 40122298010, 40122298011, 40122298012, 40122298013, 40122298014, 40122298015, 40122298016, 40122298017, 40122298018, 40122298019

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Specific Conductance	umhos/cm	<1.5	10.0	10/09/15 10:59	

LABORATORY CONTROL SAMPLE: 1235425

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Specific Conductance	umhos/cm	644	650	101	80-120	

SAMPLE DUPLICATE: 1235426

Parameter	Units	40122380001 Result	Dup Result	RPD	Max RPD	Qualifiers
Specific Conductance	umhos/cm	3860	3860	0	20	

SAMPLE DUPLICATE: 1235427

Parameter	Units	40122298010 Result	Dup Result	RPD	Max RPD	Qualifiers
Specific Conductance	umhos/cm	2970	2980	0	20	

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QUALITY CONTROL DATA

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

QC Batch: WET/23425 — Analysis Method: EPA 120.1
QC Batch Method: EPA 120.1 — Analysis Description: 120.1 Specific Conductance
Associated Lab Samples: 40122298020, 40122298021, 40122298022, 40122298023

METHOD BLANK: 1235529 — Matrix: Water
Associated Lab Samples: 40122298020, 40122298021, 40122298022, 40122298023

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Specific Conductance	umhos/cm	<1.5	10.0	10/09/15 11:42	

LABORATORY CONTROL SAMPLE: 1235530

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Specific Conductance	umhos/cm	644	644	100	80-120	

SAMPLE DUPLICATE: 1235531

Parameter	Units	40122207001 Result	Dup Result	RPD	Max RPD	Qualifiers
Specific Conductance	umhos/cm	12200	12400	1	20	

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QUALITY CONTROL DATA

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

QC Batch: WET/23411
QC Batch Method: SM 2540C
Analysis Method: SM 2540C
Analysis Description: 2540C Total Dissolved Solids
Associated Lab Samples: 40122298001, 40122298002, 40122298003, 40122298004, 40122298005, 40122298006, 40122298007, 40122298008, 40122298009, 40122298010, 40122298011, 40122298012, 40122298013, 40122298014, 40122298015, 40122298016, 40122298017, 40122298018, 40122298019, 40122298020

METHOD BLANK: 1234744 Matrix: Water
Associated Lab Samples: 40122298001, 40122298002, 40122298003, 40122298004, 40122298005, 40122298006, 40122298007, 40122298008, 40122298009, 40122298010, 40122298011, 40122298012, 40122298013, 40122298014, 40122298015, 40122298016, 40122298017, 40122298018, 40122298019, 40122298020

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Total Dissolved Solids	mg/L	<8.7	20.0	10/08/15 17:50	

LABORATORY CONTROL SAMPLE: 1234745

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Total Dissolved Solids	mg/L	637	582	91	80-120	

SAMPLE DUPLICATE: 1234746

Parameter	Units	40122298001 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Dissolved Solids	mg/L	450	452	0	5	

SAMPLE DUPLICATE: 1234747

Parameter	Units	40122298011 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Dissolved Solids	mg/L	676	676	0	5	

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QUALITY CONTROL DATA

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

QC Batch: WET/23448 Analysis Method: SM 2540C
QC Batch Method: SM 2540C Analysis Description: 2540C Total Dissolved Solids
Associated Lab Samples: 40122298021, 40122298022, 40122298023

METHOD BLANK: 1237494 Matrix: Water
Associated Lab Samples: 40122298021, 40122298022, 40122298023

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Total Dissolved Solids	mg/L	<8.7	20.0	10/12/15 20:59	

LABORATORY CONTROL SAMPLE: 1237495

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Total Dissolved Solids	mg/L	637	594	93	80-120	

SAMPLE DUPLICATE: 1237496

Parameter	Units	40122298021 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Dissolved Solids	mg/L	234	250	7	5	R1

SAMPLE DUPLICATE: 1237497

Parameter	Units	40122575002 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Dissolved Solids	mg/L	1940	1990	3	5	

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QUALITY CONTROL DATA

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

QC Batch: WET/23417
QC Batch Method: SM 4500-H+B
Analysis Method: SM 4500-H+B
Analysis Description: 4500H+B pH
Associated Lab Samples: 40122298001, 40122298002, 40122298003, 40122298004, 40122298005, 40122298006, 40122298007, 40122298008, 40122298009, 40122298010, 40122298011, 40122298012, 40122298013, 40122298014, 40122298015, 40122298016, 40122298017, 40122298018, 40122298019, 40122298020

SAMPLE DUPLICATE: 1235211

Parameter	Units	40122298001 Result	Dup Result	RPD	Max RPD	Qualifiers
pH	Std. Units	6.1	6.1	0	5	H6

SAMPLE DUPLICATE: 1235212

Parameter	Units	40122298003 Result	Dup Result	RPD	Max RPD	Qualifiers
pH	Std. Units	7.3	7.4	1	5	H6

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REPORT OF LABORATORY ANALYSIS

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QUALITY CONTROL DATA

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

QC Batch: WET/23418
QC Batch Method: SM 4500-H+B
Analysis Method: SM 4500-H+B
Analysis Description: 4500H+B pH
Associated Lab Samples: 40122298021, 40122298022, 40122298023

SAMPLE DUPLICATE: 1235213

Parameter	Units	40122330002 Result	Dup Result	RPD	Max RPD	Qualifiers
pH	Std. Units	7.5	7.6	1	5	H6

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QUALITY CONTROL DATA

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

QC Batch: WETA/30663 Analysis Method: EPA 300.0
QC Batch Method: EPA 300.0 Analysis Description: 300.0 IC Anions,Dissolved
Associated Lab Samples: 40122298001, 40122298002, 40122298003, 40122298004, 40122298005, 40122298006, 40122298007, 40122298008, 40122298009, 40122298010, 40122298011, 40122298012, 40122298013

METHOD BLANK: 1237130 Matrix: Water
Associated Lab Samples: 40122298001, 40122298002, 40122298003, 40122298004, 40122298005, 40122298006, 40122298007, 40122298008, 40122298009, 40122298010, 40122298011, 40122298012, 40122298013

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Sulfate	mg/L	<2.0	4.0	10/12/15 19:56	

LABORATORY CONTROL SAMPLE: 1237131

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Sulfate	mg/L	20	19.5	97	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1237132 1237133

Parameter	Units	40122259006 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Sulfate	mg/L	41.0	100	100	134	134	93	93	90-110	0	20	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1237134 1237135

Parameter	Units	40122298013 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Sulfate	mg/L	3.6J	20	20	21.7	21.7	90	91	90-110	0	20	

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QUALITY CONTROL DATA

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

QC Batch: WETA/30667 Analysis Method: EPA 300.0
QC Batch Method: EPA 300.0 Analysis Description: 300.0 IC Anions,Dissolved
Associated Lab Samples: 40122298014, 40122298015, 40122298016, 40122298017, 40122298018, 40122298019, 40122298020, 40122298021, 40122298022, 40122298023

METHOD BLANK: 1237270 Matrix: Water
Associated Lab Samples: 40122298014, 40122298015, 40122298016, 40122298017, 40122298018, 40122298019, 40122298020, 40122298021, 40122298022, 40122298023

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Sulfate	mg/L	<2.0	4.0	10/13/15 16:53	

LABORATORY CONTROL SAMPLE: 1237271

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Sulfate	mg/L	20	19.3	96	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1237272 1237273

Parameter	Units	40122298014 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Sulfate	mg/L	24.7	20	20	45.5	45.9	104	106	90-110	1	20	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1237274 1237275

Parameter	Units	40122310010 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Sulfate	mg/L	90.8	100	100	190	188	99	97	90-110	1	20	

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QUALITY CONTROL DATA

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

QC Batch: WETA/30653 | Analysis Method: EPA 310.2
QC Batch Method: EPA 310.2 | Analysis Description: 310.2 Alkalinity, Dissolved
Associated Lab Samples: 40122298001, 40122298002, 40122298003, 40122298004

METHOD BLANK: 1235898 | Matrix: Water
Associated Lab Samples: 40122298001, 40122298002, 40122298003, 40122298004

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Alkalinity, Total as CaCO3, Dissolved	mg/L	<8.6	20.0	10/12/15 11:38	

LABORATORY CONTROL SAMPLE: 1235899

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Alkalinity, Total as CaCO3, Dissolved	mg/L	100	103	103	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1235900 1235901

Parameter	Units	40122228005 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Alkalinity, Total as CaCO3, Dissolved	mg/L	515	500	500	1030	1000	102	98	90-110	2	20	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1235902 1235903

Parameter	Units	40122298004 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Alkalinity, Total as CaCO3, Dissolved	mg/L	630	500	500	1140	1140	103	102	90-110	0	20	

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QUALITY CONTROL DATA

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

QC Batch: WETA/30664 Analysis Method: EPA 310.2
QC Batch Method: EPA 310.2 Analysis Description: 310.2 Alkalinity, Dissolved
Associated Lab Samples: 40122298005, 40122298006, 40122298007, 40122298008, 40122298009, 40122298010, 40122298011, 40122298012, 40122298013, 40122298014, 40122298015, 40122298016, 40122298017, 40122298018, 40122298019, 40122298020, 40122298021, 40122298022, 40122298023

METHOD BLANK: 1237194 Matrix: Water
Associated Lab Samples: 40122298005, 40122298006, 40122298007, 40122298008, 40122298009, 40122298010, 40122298011, 40122298012, 40122298013, 40122298014, 40122298015, 40122298016, 40122298017, 40122298018, 40122298019, 40122298020, 40122298021, 40122298022, 40122298023

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Alkalinity, Total as CaCO3, Dissolved	mg/L	<8.6	20.0	10/12/15 13:23	

LABORATORY CONTROL SAMPLE: 1237195

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Alkalinity, Total as CaCO3, Dissolved	mg/L	100	102	102	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1237196 1237197

Parameter	Units	40122298014 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Alkalinity, Total as CaCO3, Dissolved	mg/L	40.9	100	100	142	141	101	100	90-110	1	20	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1237198 1237199

Parameter	Units	40122310001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Alkalinity, Total as CaCO3, Dissolved	mg/L	632	500	500	1110	1110	95	96	90-110	1	20	

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QUALIFIERS

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.

ND - Not Detected at or above LOD.

J - Estimated concentration at or above the LOD and below the LOQ.

LOD - Limit of Detection adjusted for dilution factor and percent moisture.

LOQ - Limit of Quantitation adjusted for dilution factor and percent moisture.

S - Surrogate

1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected at or above the adjusted LOD.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

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TNI - The NELAC Institute.

ANALYTE QUALIFIERS

H6	Analysis initiated outside of the 15 minute EPA recommended holding time.
P6	Matrix spike recovery was outside laboratory control limits due to a parent sample concentration notably higher than the spike level.
R1	RPD value was outside control limits.

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QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
40122298001	MW-1000R-2015_10	EPA 3010	MPRP/12813	EPA 6020	ICPM/5959
40122298002	MW-1000PR-2015_10	EPA 3010	MPRP/12813	EPA 6020	ICPM/5959
40122298003	MW-1010P-2015_10	EPA 3010	MPRP/12813	EPA 6020	ICPM/5959
40122298004	MW-1013-2015_10	EPA 3010	MPRP/12813	EPA 6020	ICPM/5959
40122298005	MW-1013A-2015_10	EPA 3010	MPRP/12813	EPA 6020	ICPM/5959
40122298006	MW-1013B-2015_10	EPA 3010	MPRP/12813	EPA 6020	ICPM/5959
40122298007	MW-1013C-2015_10	EPA 3010	MPRP/12813	EPA 6020	ICPM/5959
40122298008	MW-1014-2015_10	EPA 3010	MPRP/12813	EPA 6020	ICPM/5959
40122298009	MW-1014A-2015_10	EPA 3010	MPRP/12813	EPA 6020	ICPM/5959
40122298010	MW-1014B-2015_10	EPA 3010	MPRP/12813	EPA 6020	ICPM/5959
40122298011	MW-1014C-2015_10	EPA 3010	MPRP/12813	EPA 6020	ICPM/5959
40122298012	MW-1004-2015_10	EPA 3010	MPRP/12813	EPA 6020	ICPM/5959
40122298013	MW-1004P-2015_10	EPA 3010	MPRP/12813	EPA 6020	ICPM/5959
40122298014	MW-1004S-2015_10	EPA 3010	MPRP/12813	EPA 6020	ICPM/5959
40122298015	MW-1015A-2015_10	EPA 3010	MPRP/12813	EPA 6020	ICPM/5959
40122298016	MW-1015B-2015_10	EPA 3010	MPRP/12813	EPA 6020	ICPM/5959
40122298017	MW-1002-2015_10	EPA 3010	MPRP/12813	EPA 6020	ICPM/5959
40122298018	MW-1002G-2015_10	EPA 3010	MPRP/12813	EPA 6020	ICPM/5959
40122298019	MW-1005-2015_10	EPA 3010	MPRP/12813	EPA 6020	ICPM/5959
40122298020	MW-1005S-2015_10	EPA 3010	MPRP/12813	EPA 6020	ICPM/5959
40122298021	MW-1005P-2015_10	EPA 3010	MPRP/12814	EPA 6020	ICPM/5960
40122298022	MW-DUP-2015_10	EPA 3010	MPRP/12814	EPA 6020	ICPM/5960
40122298023	BACKFILL-DUP-2015_10	EPA 3010	MPRP/12814	EPA 6020	ICPM/5960
40122298001	MW-1000R-2015_10	EPA 120.1	WET/23423		
40122298002	MW-1000PR-2015_10	EPA 120.1	WET/23423		
40122298003	MW-1010P-2015_10	EPA 120.1	WET/23423		
40122298004	MW-1013-2015_10	EPA 120.1	WET/23423		
40122298005	MW-1013A-2015_10	EPA 120.1	WET/23423		
40122298006	MW-1013B-2015_10	EPA 120.1	WET/23423		
40122298007	MW-1013C-2015_10	EPA 120.1	WET/23423		
40122298008	MW-1014-2015_10	EPA 120.1	WET/23423		
40122298009	MW-1014A-2015_10	EPA 120.1	WET/23423		
40122298010	MW-1014B-2015_10	EPA 120.1	WET/23423		
40122298011	MW-1014C-2015_10	EPA 120.1	WET/23423		
40122298012	MW-1004-2015_10	EPA 120.1	WET/23423		
40122298013	MW-1004P-2015_10	EPA 120.1	WET/23423		
40122298014	MW-1004S-2015_10	EPA 120.1	WET/23423		
40122298015	MW-1015A-2015_10	EPA 120.1	WET/23423		
40122298016	MW-1015B-2015_10	EPA 120.1	WET/23423		
40122298017	MW-1002-2015_10	EPA 120.1	WET/23423		
40122298018	MW-1002G-2015_10	EPA 120.1	WET/23423		
40122298019	MW-1005-2015_10	EPA 120.1	WET/23423		
40122298020	MW-1005S-2015_10	EPA 120.1	WET/23425		
40122298021	MW-1005P-2015_10	EPA 120.1	WET/23425		
40122298022	MW-DUP-2015_10	EPA 120.1	WET/23425		
40122298023	BACKFILL-DUP-2015_10	EPA 120.1	WET/23425		
40122298001	MW-1000R-2015_10	SM 2540C	WET/23411		

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QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
40122298002	MW-1000PR-2015_10	SM 2540C	WET/23411		
40122298003	MW-1010P-2015_10	SM 2540C	WET/23411		
40122298004	MW-1013-2015_10	SM 2540C	WET/23411		
40122298005	MW-1013A-2015_10	SM 2540C	WET/23411		
40122298006	MW-1013B-2015_10	SM 2540C	WET/23411		
40122298007	MW-1013C-2015_10	SM 2540C	WET/23411		
40122298008	MW-1014-2015_10	SM 2540C	WET/23411		
40122298009	MW-1014A-2015_10	SM 2540C	WET/23411		
40122298010	MW-1014B-2015_10	SM 2540C	WET/23411		
40122298011	MW-1014C-2015_10	SM 2540C	WET/23411		
40122298012	MW-1004-2015_10	SM 2540C	WET/23411		
40122298013	MW-1004P-2015_10	SM 2540C	WET/23411		
40122298014	MW-1004S-2015_10	SM 2540C	WET/23411		
40122298015	MW-1015A-2015_10	SM 2540C	WET/23411		
40122298016	MW-1015B-2015_10	SM 2540C	WET/23411		
40122298017	MW-1002-2015_10	SM 2540C	WET/23411		
40122298018	MW-1002G-2015_10	SM 2540C	WET/23411		
40122298019	MW-1005-2015_10	SM 2540C	WET/23411		
40122298020	MW-1005S-2015_10	SM 2540C	WET/23411		
40122298021	MW-1005P-2015_10	SM 2540C	WET/23448		
40122298022	MW-DUP-2015_10	SM 2540C	WET/23448		
40122298023	BACKFILL-DUP-2015_10	SM 2540C	WET/23448		
40122298001	MW-1000R-2015_10	SM 4500-H+B	WET/23417		
40122298002	MW-1000PR-2015_10	SM 4500-H+B	WET/23417		
40122298003	MW-1010P-2015_10	SM 4500-H+B	WET/23417		
40122298004	MW-1013-2015_10	SM 4500-H+B	WET/23417		
40122298005	MW-1013A-2015_10	SM 4500-H+B	WET/23417		
40122298006	MW-1013B-2015_10	SM 4500-H+B	WET/23417		
40122298007	MW-1013C-2015_10	SM 4500-H+B	WET/23417		
40122298008	MW-1014-2015_10	SM 4500-H+B	WET/23417		
40122298009	MW-1014A-2015_10	SM 4500-H+B	WET/23417		
40122298010	MW-1014B-2015_10	SM 4500-H+B	WET/23417		
40122298011	MW-1014C-2015_10	SM 4500-H+B	WET/23417		
40122298012	MW-1004-2015_10	SM 4500-H+B	WET/23417		
40122298013	MW-1004P-2015_10	SM 4500-H+B	WET/23417		
40122298014	MW-1004S-2015_10	SM 4500-H+B	WET/23417		
40122298015	MW-1015A-2015_10	SM 4500-H+B	WET/23417		
40122298016	MW-1015B-2015_10	SM 4500-H+B	WET/23417		
40122298017	MW-1002-2015_10	SM 4500-H+B	WET/23417		
40122298018	MW-1002G-2015_10	SM 4500-H+B	WET/23417		
40122298019	MW-1005-2015_10	SM 4500-H+B	WET/23417		
40122298020	MW-1005S-2015_10	SM 4500-H+B	WET/23417		
40122298021	MW-1005P-2015_10	SM 4500-H+B	WET/23418		
40122298022	MW-DUP-2015_10	SM 4500-H+B	WET/23418		
40122298023	BACKFILL-DUP-2015_10	SM 4500-H+B	WET/23418		
40122298001	MW-1000R-2015_10	EPA 300.0	WETA/30663		
40122298002	MW-1000PR-2015_10	EPA 300.0	WETA/30663		

REPORT OF LABORATORY ANALYSIS

Pace Analytical®
www.pacelabs.com

Pace Analytical Services, Inc.
1241 Bellevue Street - Suite 9
Green Bay, WI 54302
(920)469-2436

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: 14F777.14 4Q GROUNDWATER 2015
Pace Project No.: 40122298

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
40122298003	MW-1010P-2015_10	EPA 300.0	WETA/30663		
40122298004	MW-1013-2015_10	EPA 300.0	WETA/30663		
40122298005	MW-1013A-2015_10	EPA 300.0	WETA/30663		
40122298006	MW-1013B-2015_10	EPA 300.0	WETA/30663		
40122298007	MW-1013C-2015_10	EPA 300.0	WETA/30663		
40122298008	MW-1014-2015_10	EPA 300.0	WETA/30663		
40122298009	MW-1014A-2015_10	EPA 300.0	WETA/30663		
40122298010	MW-1014B-2015_10	EPA 300.0	WETA/30663		
40122298011	MW-1014C-2015_10	EPA 300.0	WETA/30663		
40122298012	MW-1004-2015_10	EPA 300.0	WETA/30663		
40122298013	MW-1004P-2015_10	EPA 300.0	WETA/30663		
40122298014	MW-1004S-2015_10	EPA 300.0	WETA/30667		
40122298015	MW-1015A-2015_10	EPA 300.0	WETA/30667		
40122298016	MW-1015B-2015_10	EPA 300.0	WETA/30667		
40122298017	MW-1002-2015_10	EPA 300.0	WETA/30667		
40122298018	MW-1002G-2015_10	EPA 300.0	WETA/30667		
40122298019	MW-1005-2015_10	EPA 300.0	WETA/30667		
40122298020	MW-1005S-2015_10	EPA 300.0	WETA/30667		
40122298021	MW-1005P-2015_10	EPA 300.0	WETA/30667		
40122298022	MW-DUP-2015_10	EPA 300.0	WETA/30667		
40122298023	BACKFILL-DUP-2015_10	EPA 300.0	WETA/30667		
40122298001	MW-1000R-2015_10	EPA 310.2	WETA/30653		
40122298002	MW-1000PR-2015_10	EPA 310.2	WETA/30653		
40122298003	MW-1010P-2015_10	EPA 310.2	WETA/30653		
40122298004	MW-1013-2015_10	EPA 310.2	WETA/30653		
40122298005	MW-1013A-2015_10	EPA 310.2	WETA/30664		
40122298006	MW-1013B-2015_10	EPA 310.2	WETA/30664		
40122298007	MW-1013C-2015_10	EPA 310.2	WETA/30664		
40122298008	MW-1014-2015_10	EPA 310.2	WETA/30664		
40122298009	MW-1014A-2015_10	EPA 310.2	WETA/30664		
40122298010	MW-1014B-2015_10	EPA 310.2	WETA/30664		
40122298011	MW-1014C-2015_10	EPA 310.2	WETA/30664		
40122298012	MW-1004-2015_10	EPA 310.2	WETA/30664		
40122298013	MW-1004P-2015_10	EPA 310.2	WETA/30664		
40122298014	MW-1004S-2015_10	EPA 310.2	WETA/30664		
40122298015	MW-1015A-2015_10	EPA 310.2	WETA/30664		
40122298016	MW-1015B-2015_10	EPA 310.2	WETA/30664		
40122298017	MW-1002-2015_10	EPA 310.2	WETA/30664		
40122298018	MW-1002G-2015_10	EPA 310.2	WETA/30664		
40122298019	MW-1005-2015_10	EPA 310.2	WETA/30664		
40122298020	MW-1005S-2015_10	EPA 310.2	WETA/30664		
40122298021	MW-1005P-2015_10	EPA 310.2	WETA/30664		
40122298022	MW-DUP-2015_10	EPA 310.2	WETA/30664		
40122298023	BACKFILL-DUP-2015_10	EPA 310.2	WETA/30664		

Fourth Quarter 2015
Environmental Monitoring Results

TAD Readable

TAD Exceedances

Chain of Custody Documents

.csv Excel Data File

Facility Name	Location	Well ID	Date	Parameter	Code	Result	Units	QC_I	QC_II	QC_III	LOD	LOQ	RL	no_WL_reason
Flambeau	MW-1000PR	802	151006	Temperature	00010	9.08	deg c							
Flambeau	MW-1000PR	802	151006	Redox Potential	00090	101.2	mV							
Flambeau	MW-1000PR	802	151006	Specific Conductance	00094	822	umhos/cm @25 C	M	M	M	1.5	10	10	
Flambeau	MW-1000PR	802	151006	pH	00400	6.34	s.u.							
Flambeau	MW-1000PR	802	151006	pH	00400	6.4	s.u.	M	F	M	0.01	0.1	0.1	
Flambeau	MW-1000PR	802	151006	Conductivity	00402	671	umhos/cm @25 C							
Flambeau	MW-1000PR	802	151006	Sulfate	00946	68.3	mg/L	M	M	M	20	40	40	
Flambeau	MW-1000PR	802	151006	Arsenic	01000	6.8	ug/L	M	M	M	0.099	1	1	
Flambeau	MW-1000PR	802	151006	Copper	01040	2.7	ug/L	M	M	M	0.26	1	1	
Flambeau	MW-1000PR	802	151006	Iron	01046	0.642	mg/L	M	M	M	0.01	0.25	0.25	
Flambeau	MW-1000PR	802	151006	Manganese	01056	2150	ug/L	M	M	M	0.18	1	1	
Flambeau	MW-1000PR	802	151005	LEVELS	04189	1087.28								
Flambeau	MW-1000PR	802	151006	Hardness	22413	434	mg/L	M	M	M	0.15	5	5	
Flambeau	MW-1000PR	802	151006	Alkalinity as CaCO3	39036	225	mg/L	M	M	M	8.6	20	20	
Flambeau	MW-1000PR	802	151006	Total Dissolved Solids	70295	534	mg/L	M	M	M	8.7	20	20	
Flambeau	MW-1001	803	151005	LEVELS	04189	1119.91								
Flambeau	MW-1001G	804	151005	LEVELS	04189	1118.66								
Flambeau	MW-1001P	805	151005	LEVELS	04189	1119.05								
Flambeau	MW-1002	806	151006	Temperature	00010	12.86	deg c							
Flambeau	MW-1002	806	151006	Redox Potential	00090	87.1	mV							
Flambeau	MW-1002	806	151006	Specific Conductance	00094	156	umhos/cm @25 C	M	M	M	1.5	10	10	
Flambeau	MW-1002	806	151006	Specific Conductance	00094	161	umhos/cm @25 C	M	M	M	1.5	10	10	
Flambeau	MW-1002	806	151006	pH	00400	6.4	s.u.	M	F	M	0.01	0.1	0.1	
Flambeau	MW-1002	806	151006	pH	00400	6.5	s.u.							
Flambeau	MW-1002	806	151006	pH	00400	6.4	s.u.	M	F	M	0.01	0.1	0.1	
Flambeau	MW-1002	806	151006	Conductivity	00402	151	umhos/cm @25 C							
Flambeau	MW-1002	806	151006	Sulfate	00946	4.6	mg/L	M	M	M	2	4	4	
Flambeau	MW-1002	806	151006	Sulfate	00946	4.5	mg/L	M	M	M	2	4	4	
Flambeau	MW-1002	806	151006	Arsenic	01000		ug/L	M	M	M	0.099	1	1	
Flambeau	MW-1002	806	151006	Arsenic	01000	0.1	ug/L	M	M	M	0.099	1	1	
Flambeau	MW-1002	806	151006	Copper	01040	0.67	ug/L	M	M	M	0.26	1	1	
Flambeau	MW-1002	806	151006	Copper	01040	1.1	ug/L	M	M	M	0.26	1	1	
Flambeau	MW-1002	806	151006	Iron	01046		mg/L	M	M	M	0.01	0.25	0.25	
Flambeau	MW-1002	806	151006	Iron	01046	0.0259	mg/L	M	M	M	0.01	0.25	0.25	
Flambeau	MW-1002	806	151006	Manganese	01056		ug/L	M	M	M	0.18	1	1	
Flambeau	MW-1002	806	151006	Manganese	01056	0.37	ug/L	M	M	M	0.18	1	1	
Flambeau	MW-1002	806	151006	LEVELS	04189	1090.92								
Flambeau	MW-1002	806	151006	Hardness	22413	67.8	mg/L	M	M	M	0.15	5	5	

Facility Name	Location	Well ID	Date	Parameter	Code	Result	Units	QC_I	QC_II	QC_III	LOD	LOQ	RL	no_WL_reason
Flambeau	MW-1002	806	151006	Hardness	22413	69	mg/L	M	M	M	0.15	5	5	
Flambeau	MW-1002	806	151006	Alkalinity as CaCO3	39036	61.2	mg/L	M	M	M	8.6	20	20	
Flambeau	MW-1002	806	151006	Alkalinity as CaCO3	39036	58.6	mg/L	M	M	M	8.6	20	20	
Flambeau	MW-1002	806	151006	Total Dissolved Solids	70295	96	mg/L	M	M	M	8.7	20	20	
Flambeau	MW-1002	806	151006	Total Dissolved Solids	70295	104	mg/L	M	M	M	8.7	20	20	
Flambeau	MW-1002G	807	151006	Temperature	00010	10.16	deg c							
Flambeau	MW-1002G	807	151006	Redox Potential	00090	118.5	mV							
Flambeau	MW-1002G	807	151006	Specific Conductance	00094	324	umhos/cm @25 C	M	M	M	1.5	10	10	
Flambeau	MW-1002G	807	151006	pH	00400	6.5	s.u.							
Flambeau	MW-1002G	807	151006	pH	00400	6.5	s.u.	M	F	M	0.01	0.1	0.1	
Flambeau	MW-1002G	807	151006	Conductivity	00402	298	umhos/cm @25 C							
Flambeau	MW-1002G	807	151006	Sulfate	00946	9.2	mg/L	M	M	M	2	4	4	
Flambeau	MW-1002G	807	151006	Arsenic	01000		ug/L	M	M	M	0.099	1	1	
Flambeau	MW-1002G	807	151006	Copper	01040	0.35	ug/L	M	M	M	0.26	1	1	
Flambeau	MW-1002G	807	151006	Iron	01046		mg/L	M	M	M	0.01	0.25	0.25	
Flambeau	MW-1002G	807	151006	Manganese	01056	0.23	ug/L	M	M	M	0.18	1	1	
Flambeau	MW-1002G	807	151006	LEVELS	04189	1090.83								
Flambeau	MW-1002G	807	151006	Hardness	22413	144	mg/L	M	M	M	0.15	5	5	
Flambeau	MW-1002G	807	151006	Alkalinity as CaCO3	39036	98.2	mg/L	M	M	M	8.6	20	20	
Flambeau	MW-1002G	807	151006	Total Dissolved Solids	70295	190	mg/L	M	M	M	8.7	20	20	
Flambeau	MW-1003	808	151005	LEVELS	04189	1110.98								
Flambeau	MW-1003P	809	151005	LEVELS	04189	1111.01								
Flambeau	MW-1004	810	151006	Temperature	00010	12.79	deg c							
Flambeau	MW-1004	810	151006	Redox Potential	00090	110.1	mV							
Flambeau	MW-1004	810	151006	Specific Conductance	00094	145	umhos/cm @25 C	M	M	M	1.5	10	10	
Flambeau	MW-1004	810	151006	pH	00400	6.06	s.u.							
Flambeau	MW-1004	810	151006	pH	00400	6.1	s.u.	M	F	M	0.01	0.1	0.1	
Flambeau	MW-1004	810	151006	Conductivity	00402	136	umhos/cm @25 C							
Flambeau	MW-1004	810	151006	Sulfate	00946	20.5	mg/L	M	M	M	2	4	4	
Flambeau	MW-1004	810	151006	Arsenic	01000		ug/L	M	M	M	0.099	1	1	
Flambeau	MW-1004	810	151006	Copper	01040	4.2	ug/L	M	M	M	0.26	1	1	
Flambeau	MW-1004	810	151006	Iron	01046		mg/L	M	M	M	0.01	0.25	0.25	
Flambeau	MW-1004	810	151006	Manganese	01056	1.4	ug/L	M	M	M	0.18	1	1	
Flambeau	MW-1004	810	151005	LEVELS	04189	1107.07								
Flambeau	MW-1004	810	151006	Hardness	22413	58.9	mg/L	M	M	M	0.15	5	5	
Flambeau	MW-1004	810	151006	Alkalinity as CaCO3	39036	41.3	mg/L	M	M	M	8.6	20	20	
Flambeau	MW-1004	810	151006	Total Dissolved Solids	70295	92	mg/L	M	M	M	8.7	20	20	
Flambeau	MW-1004S	811	151006	Temperature	00010	9.72	deg c							

Facility Name	Location	Well ID	Date	Parameter	Code	Result	Units	QC_I	QC_II	QC_III	LOD	LOQ	RL	no_WL_reason
Flambeau	MW-1004S	811	151006	Redox Potential	00090	118.8	mV							
Flambeau	MW-1004S	811	151006	Specific Conductance	00094	160	umhos/cm @25 C	M	M	M	1.5	10	10	
Flambeau	MW-1004S	811	151006	pH	00400	6.07	s.u.							
Flambeau	MW-1004S	811	151006	pH	00400	6.1	s.u.	M	F	M	0.01	0.1	0.1	
Flambeau	MW-1004S	811	151006	Conductivity	00402	155	umhos/cm @25 C							
Flambeau	MW-1004S	811	151006	Sulfate	00946	24.7	mg/L	M	M	M	2	4	4	
Flambeau	MW-1004S	811	151006	Arsenic	01000	0.13	ug/L	M	M	M	0.099	1	1	
Flambeau	MW-1004S	811	151006	Copper	01040	1.8	ug/L	M	M	M	0.26	1	1	
Flambeau	MW-1004S	811	151006	Iron	01046		mg/L	M	M	M	0.01	0.25	0.25	
Flambeau	MW-1004S	811	151006	Manganese	01056	0.73	ug/L	M	M	M	0.18	1	1	
Flambeau	MW-1004S	811	151005	LEVELS	04189	1107.12								
Flambeau	MW-1004S	811	151006	Hardness	22413	67.2	mg/L	M	M	M	0.15	5	5	
Flambeau	MW-1004S	811	151006	Alkalinity as CaCO3	39036	40.9	mg/L	M	M	M	8.6	20	20	
Flambeau	MW-1004S	811	151006	Total Dissolved Solids	70295	106	mg/L	M	M	M	8.7	20	20	
Flambeau	MW-1004S	811	151006	Comment - Sample Odor	00001	0	None							
Flambeau	MW-1004P	812	151006	Temperature	00010	8.94	deg c							
Flambeau	MW-1004P	812	151006	Redox Potential	00090	-8.4	mV							
Flambeau	MW-1004P	812	151006	Specific Conductance	00094	318	umhos/cm @25 C	M	M	M	1.5	10	10	
Flambeau	MW-1004P	812	151006	pH	00400	7.2	s.u.	M	F	M	0.01	0.1	0.1	
Flambeau	MW-1004P	812	151006	pH	00400	7.23	s.u.							
Flambeau	MW-1004P	812	151006	Conductivity	00402	318	umhos/cm @25 C							
Flambeau	MW-1004P	812	151006	Sulfate	00946	3.6	mg/L	M	M	M	2	4	4	
Flambeau	MW-1004P	812	151006	Arsenic	01000	0.46	ug/L	M	M	M	0.099	1	1	
Flambeau	MW-1004P	812	151006	Copper	01040		ug/L	M	M	M	0.26	1	1	
Flambeau	MW-1004P	812	151006	Iron	01046	0.418	mg/L	M	M	M	0.01	0.25	0.25	
Flambeau	MW-1004P	812	151006	Manganese	01056	149	ug/L	M	M	M	0.18	1	1	
Flambeau	MW-1004P	812	151005	LEVELS	04189	1105.84								
Flambeau	MW-1004P	812	151006	Hardness	22413	156	mg/L	M	M	M	0.15	5	5	
Flambeau	MW-1004P	812	151006	Alkalinity as CaCO3	39036	167	mg/L	M	M	M	8.6	20	20	
Flambeau	MW-1004P	812	151006	Total Dissolved Solids	70295	160	mg/L	M	M	M	8.7	20	20	
Flambeau	MW-1005	813	151006	Comment - Sample Color	00002	0	None							
Flambeau	MW-1005	813	151006	Comment - Sample Turbi	00003	0	None							
Flambeau	MW-1005	813	151006	Temperature	00010	11.49	deg c							
Flambeau	MW-1005	813	151006	Redox Potential	00090	75.7	mV							
Flambeau	MW-1005	813	151006	Specific Conductance	00094	1490	umhos/cm @25 C	M	M	M	1.5	10	10	
Flambeau	MW-1005	813	151006	pH	00400	5.83	s.u.							
Flambeau	MW-1005	813	151006	pH	00400	5.9	s.u.	M	F	M	0.01	0.1	0.1	
Flambeau	MW-1005	813	151006	Conductivity	00402	1319	umhos/cm @25 C							

Facility Name	Location	Well ID	Date	Parameter	Code	Result	Units	QC_I	QC_II	QC_III	LOD	LOQ	RL	no_WL_reason
Flambeau	MW-1005	813	151006	Sulfate	00946	14.9	mg/L	M	M	M	2	4	4	
Flambeau	MW-1005	813	151006	Arsenic	01000	1.2	ug/L	M	M	M	0.099	1	1	
Flambeau	MW-1005	813	151006	Copper	01040	1.6	ug/L	M	M	M	0.26	1	1	
Flambeau	MW-1005	813	151006	Iron	01046	16.2	mg/L	M	M	M	0.01	0.25	0.25	
Flambeau	MW-1005	813	151006	Manganese	01056	540	ug/L	M	M	M	0.18	1	1	
Flambeau	MW-1005	813	151006	LEVELS	04189	1140.26								
Flambeau	MW-1005	813	151006	Hardness	22413	418	mg/L	M	M	M	0.15	5	5	
Flambeau	MW-1005	813	151006	Alkalinity as CaCO3	39036	57.3	mg/L	M	M	M	8.6	20	20	
Flambeau	MW-1005	813	151006	Total Dissolved Solids	70295	1070	mg/L	M	M	M	8.7	20	20	
Flambeau	MW-1005S	814	151006	Comment - Sample Color	00002	0	None							
Flambeau	MW-1005S	814	151006	Temperature	00010	8.65	deg c							
Flambeau	MW-1005S	814	151006	Redox Potential	00090	-41.6	mV							
Flambeau	MW-1005S	814	151006	Specific Conductance	00094	360	umhos/cm @25 C	M	M	M	1.5	10	10	
Flambeau	MW-1005S	814	151006	pH	00400	6.99	s.u.							
Flambeau	MW-1005S	814	151006	pH	00400	7	s.u.	M	F	M	0.01	0.1	0.1	
Flambeau	MW-1005S	814	151006	Conductivity	00402	347	umhos/cm @25 C							
Flambeau	MW-1005S	814	151006	Sulfate	00946	2.3	mg/L	M	M	M	2	4	4	
Flambeau	MW-1005S	814	151006	Arsenic	01000	2.4	ug/L	M	M	M	0.099	1	1	
Flambeau	MW-1005S	814	151006	Copper	01040		ug/L	M	M	M	0.26	1	1	
Flambeau	MW-1005S	814	151006	Iron	01046	4.29	mg/L	M	M	M	0.01	0.25	0.25	
Flambeau	MW-1005S	814	151006	Manganese	01056	237	ug/L	M	M	M	0.18	1	1	
Flambeau	MW-1005S	814	151006	LEVELS	04189	1140.07								
Flambeau	MW-1005S	814	151006	Hardness	22413	177	mg/L	M	M	M	0.15	5	5	
Flambeau	MW-1005S	814	151006	Alkalinity as CaCO3	39036	179	mg/L	M	M	M	17.3	40	40	
Flambeau	MW-1005S	814	151006	Total Dissolved Solids	70295	198	mg/L	M	M	M	8.7	20	20	
Flambeau	MW-1005P	815	151006	Temperature	00010	9.49	deg c							
Flambeau	MW-1005P	815	151006	Redox Potential	00090	11.1	mV							
Flambeau	MW-1005P	815	151006	Specific Conductance	00094	485	umhos/cm @25 C	M	M	M	1.5	10	10	
Flambeau	MW-1005P	815	151006	pH	00400	7.02	s.u.							
Flambeau	MW-1005P	815	151006	pH	00400	7.2	s.u.	M	F	M	0.01	0.1	0.1	
Flambeau	MW-1005P	815	151006	Conductivity	00402	466	umhos/cm @25 C							
Flambeau	MW-1005P	815	151006	Sulfate	00946		mg/L	M	M	M	2	4	4	
Flambeau	MW-1005P	815	151006	Arsenic	01000	0.32	ug/L	M	M	M	0.099	1	1	
Flambeau	MW-1005P	815	151006	Copper	01040	0.32	ug/L	M	M	M	0.26	1	1	
Flambeau	MW-1005P	815	151006	Iron	01046	1.07	mg/L	M	M	M	0.01	0.25	0.25	
Flambeau	MW-1005P	815	151006	Manganese	01056	71.6	ug/L	M	M	M	0.18	1	1	
Flambeau	MW-1005P	815	151006	LEVELS	04189	1139.76								
Flambeau	MW-1005P	815	151006	Hardness	22413	240	mg/L	M	M	M	1.5	50	50	

Facility Name	Location	Well ID	Date	Parameter	Code	Result	Units	QC_I	QC_II	QC_III	LOD	LOQ	RL	no_WL_reason
Flambeau	MW-1005P	815	151006	Alkalinity as CaCO3	39036	251	mg/L	M	M	M	8.6	20	20	
Flambeau	MW-1005P	815	151006	Total Dissolved Solids	70295	234	mg/L	M	M	M	8.7	20	20	
Flambeau	MW-1010P	816	151006	Comment - Sample Odor	00001	0	None							
Flambeau	MW-1010P	816	151006	Temperature	00010	8.67	deg c							
Flambeau	MW-1010P	816	151006	Redox Potential	00090	101.9	mV							
Flambeau	MW-1010P	816	151006	Specific Conductance	00094	367	umhos/cm @25 C	M	M	M	1.5	10	10	
Flambeau	MW-1010P	816	151006	pH	00400	7.3	s.u.	M	F	M	0.01	0.1	0.1	
Flambeau	MW-1010P	816	151006	pH	00400	7.45	s.u.							
Flambeau	MW-1010P	816	151006	Conductivity	00402	351	umhos/cm @25 C							
Flambeau	MW-1010P	816	151006	Sulfate	00946	24.4	mg/L	M	M	M	2	4	4	
Flambeau	MW-1010P	816	151006	Arsenic	01000	23	ug/L	M	M	M	0.099	1	1	
Flambeau	MW-1010P	816	151006	Copper	01040	0.55	ug/L	M	M	M	0.26	1	1	
Flambeau	MW-1010P	816	151006	Iron	01046		mg/L	M	M	M	0.01	0.25	0.25	
Flambeau	MW-1010P	816	151006	Manganese	01056	83.4	ug/L	M	M	M	0.18	1	1	
Flambeau	MW-1010P	816	151005	LEVELS	04189	1087.06								
Flambeau	MW-1010P	816	151006	Hardness	22413	185	mg/L	M	M	M	0.15	5	5	
Flambeau	MW-1010P	816	151006	Alkalinity as CaCO3	39036	161	mg/L	M	M	M	8.6	20	20	
Flambeau	MW-1010P	816	151006	Total Dissolved Solids	70295	188	mg/L	M	M	M	8.7	20	20	
Flambeau	PZ-1006	817	151005	LEVELS	00006	0								Dry
Flambeau	PZ-1006G	818	151005	LEVELS	04189	1137.5								
Flambeau	PZ-1006S	819	151005	LEVELS	04189	1136.34								
Flambeau	PZ-1007S	820	151005	LEVELS	04189	1117.21								
Flambeau	PZ-1008	821	151005	LEVELS	04189	1138.57								
Flambeau	PZ-1008G	822	151005	LEVELS	04189	1138.91								
Flambeau	PZ-1009	823	151005	LEVELS	04189	1143.96								
Flambeau	PZ-1009G	824	151005	LEVELS	04189	1144.08								
Flambeau	PZ-1011	825	151005	LEVELS	04189	1138.68								
Flambeau	PZ-1012	826	151005	LEVELS	04189	1108.62								
Flambeau	PZ-R1	827	151005	LEVELS	04189	1089.25								
Flambeau	PZ-S1	828	151005	LEVELS	04189	1095.92								
Flambeau	PZ-S3	829	151005	LEVELS	04189	1124.95								
Flambeau	SANDPOINT	830	151005	LEVELS	04189	1085.09								
Flambeau	ST-9-23	831	151005	LEVELS	04189	1126.38								
Flambeau	ST-9-23A	832	151005	LEVELS	04189	1126.57								
Flambeau	ST-9-26	833	151005	LEVELS	04189	1117.6								
Flambeau	OW-7	836	151005	LEVELS	04189	1116.29								
Flambeau	OW-10	837	151005	LEVELS	04189	1094.44								
Flambeau	OW-39	838	151005	LEVELS	04189	1100.98								

Facility Name	Location	Well ID	Date	Parameter	Code	Result	Units	QC_I	QC_II	QC_III	LOD	LOQ	RL	no_WL_reason
Flambeau	OW-42	839	151005	LEVELS	04189	1101.62								
Flambeau	OW-43	840	151005	LEVELS	04189	1087.56								
Flambeau	MW-1000R	860	151006	Temperature	00010	10.49	deg c							
Flambeau	MW-1000R	860	151006	Redox Potential	00090	135.9	mV							
Flambeau	MW-1000R	860	151006	Specific Conductance	00094	696	umhos/cm @25 C	M	M	M	1.5	10	10	
Flambeau	MW-1000R	860	151006	pH	00400	6.08	s.u.							
Flambeau	MW-1000R	860	151006	pH	00400	6.1	s.u.	M	F	M	0.01	0.1	0.1	
Flambeau	MW-1000R	860	151006	Conductivity	00402	682	umhos/cm @25 C							
Flambeau	MW-1000R	860	151006	Sulfate	00946	69.2	mg/L	M	M	M	10	20	20	
Flambeau	MW-1000R	860	151006	Arsenic	01000	0.29	ug/L	M	M	M	0.099	1	1	
Flambeau	MW-1000R	860	151006	Copper	01040	89.7	ug/L	M	M	M	0.26	1	1	
Flambeau	MW-1000R	860	151006	Iron	01046	0.0183	mg/L	M	M	M	0.01	0.25	0.25	
Flambeau	MW-1000R	860	151006	Manganese	01056	10600	ug/L	M	M	M	1.8	10	10	
Flambeau	MW-1000R	860	151005	LEVELS	04189	1088.48								
Flambeau	MW-1000R	860	151006	Hardness	22413	336	mg/L	M	M	M	1.5	50	50	
Flambeau	MW-1000R	860	151006	Alkalinity as CaCO3	39036	247	mg/L	M	M	M	8.6	20	20	
Flambeau	MW-1000R	860	151006	Total Dissolved Solids	70295	450	mg/L	M	M	M	8.7	20	20	
Flambeau	MW-1013	861	151006	Temperature	00010	11.95	deg c							
Flambeau	MW-1013	861	151006	Redox Potential	00090	59.4	mV							
Flambeau	MW-1013	861	151006	Specific Conductance	00094	1140	umhos/cm @25 C	M	M	M	1.5	10	10	
Flambeau	MW-1013	861	151006	pH	00400	6.05	s.u.							
Flambeau	MW-1013	861	151006	pH	00400	6.3	s.u.	M	F	M	0.01	0.1	0.1	
Flambeau	MW-1013	861	151006	Conductivity	00402	1106	umhos/cm @25 C							
Flambeau	MW-1013	861	151006	Sulfate	00946	24.9	mg/L	M	M	M	10	20	20	
Flambeau	MW-1013	861	151006	Arsenic	01000	0.63	ug/L	M	M	M	0.099	1	1	
Flambeau	MW-1013	861	151006	Copper	01040	7.6	ug/L	M	M	M	0.26	1	1	
Flambeau	MW-1013	861	151006	Iron	01046	4.57	mg/L	M	M	M	0.01	0.25	0.25	
Flambeau	MW-1013	861	151006	Manganese	01056	26200	ug/L	M	M	M	17.9	100	100	
Flambeau	MW-1013	861	151005	LEVELS	04189	1115.02								
Flambeau	MW-1013	861	151006	Hardness	22413	568	mg/L	M	M	M	0.15	5	5	
Flambeau	MW-1013	861	151006	Alkalinity as CaCO3	39036	630	mg/L	M	M	M	43.2	100	100	
Flambeau	MW-1013	861	151006	Total Dissolved Solids	70295	692	mg/L	M	M	M	8.7	20	20	
Flambeau	MW-1013A	862	151006	Temperature	00010	9.46	deg c							
Flambeau	MW-1013A	862	151006	Redox Potential	00090	47.2	mV							
Flambeau	MW-1013A	862	151006	Specific Conductance	00094	960	umhos/cm @25 C	M	M	M	1.5	10	10	
Flambeau	MW-1013A	862	151006	pH	00400	6.6	s.u.							
Flambeau	MW-1013A	862	151006	pH	00400	6.6	s.u.	M	F	M	0.01	0.1	0.1	
Flambeau	MW-1013A	862	151006	Conductivity	00402	970	umhos/cm @25 C							

Facility Name	Location	Well ID	Date	Parameter	Code	Result	Units	QC_I	QC_II	QC_III	LOD	LOQ	RL	no_WL_reason
Flambeau	MW-1013A	862	151006	Sulfate	00946	163	mg/L	M	M	M	20	40	40	
Flambeau	MW-1013A	862	151006	Arsenic	01000	0.26	ug/L	M	M	M	0.099	1	1	
Flambeau	MW-1013A	862	151006	Copper	01040	0.47	ug/L	M	M	M	0.26	1	1	
Flambeau	MW-1013A	862	151006	Iron	01046	0.0547	mg/L	M	M	M	0.01	0.25	0.25	
Flambeau	MW-1013A	862	151006	Manganese	01056	4330	ug/L	M	M	M	0.18	1	1	
Flambeau	MW-1013A	862	151005	LEVELS	04189	1098.88								
Flambeau	MW-1013A	862	151006	Hardness	22413	468	mg/L	M	M	M	0.15	5	5	
Flambeau	MW-1013A	862	151006	Alkalinity as CaCO3	39036	353	mg/L	M	M	M	8.6	20	20	
Flambeau	MW-1013A	862	151006	Total Dissolved Solids	70295	586	mg/L	M	M	M	8.7	20	20	
Flambeau	MW-1013B	863	151006	Temperature	00010	9.71	deg c							
Flambeau	MW-1013B	863	151006	Redox Potential	00090	135.5	mV							
Flambeau	MW-1013B	863	151006	Specific Conductance	00094	3380	umhos/cm @25 C	M	M	M	1.5	10	10	
Flambeau	MW-1013B	863	151006	pH	00400	6.14	s.u.							
Flambeau	MW-1013B	863	151006	pH	00400	6.3	s.u.	M	F	M	0.01	0.1	0.1	
Flambeau	MW-1013B	863	151006	Conductivity	00402	3197	umhos/cm @25 C							
Flambeau	MW-1013B	863	151006	Sulfate	00946	1600	mg/L	M	M	M	100	200	200	
Flambeau	MW-1013B	863	151006	Arsenic	01000	1	ug/L	M	M	M	0.099	1	1	
Flambeau	MW-1013B	863	151006	Copper	01040	510	ug/L	M	M	M	0.26	1	1	
Flambeau	MW-1013B	863	151006	Iron	01046	0.0632	mg/L	M	M	M	0.01	0.25	0.25	
Flambeau	MW-1013B	863	151006	Manganese	01056	30800	ug/L	M	M	M	17.9	100	100	
Flambeau	MW-1013B	863	151005	LEVELS	04189	1099.29								
Flambeau	MW-1013B	863	151006	Hardness	22413	2030	mg/L	M	M	M	15	500	500	
Flambeau	MW-1013B	863	151006	Alkalinity as CaCO3	39036	523	mg/L	M	M	M	43.2	100	100	
Flambeau	MW-1013B	863	151006	Total Dissolved Solids	70295	2970	mg/L	M	M	M	8.7	20	20	
Flambeau	MW-1013C	864	151006	Temperature	00010	10.28	deg c							
Flambeau	MW-1013C	864	151006	Redox Potential	00090	60.1	mV							
Flambeau	MW-1013C	864	151006	Specific Conductance	00094	3320	umhos/cm @25 C	M	M	M	1.5	10	10	
Flambeau	MW-1013C	864	151006	pH	00400	6.37	s.u.							
Flambeau	MW-1013C	864	151006	pH	00400	6.4	s.u.	M	F	M	0.01	0.1	0.1	
Flambeau	MW-1013C	864	151006	Conductivity	00402	3174	umhos/cm @25 C							
Flambeau	MW-1013C	864	151006	Sulfate	00946	1550	mg/L	M	M	M	200	400	400	
Flambeau	MW-1013C	864	151006	Arsenic	01000	21.2	ug/L	M	M	M	0.099	1	1	
Flambeau	MW-1013C	864	151006	Copper	01040	0.78	ug/L	M	M	M	0.26	1	1	
Flambeau	MW-1013C	864	151006	Iron	01046	13.7	mg/L	M	M	M	0.01	0.25	0.25	
Flambeau	MW-1013C	864	151006	Manganese	01056	9600	ug/L	M	M	M	17.9	100	100	
Flambeau	MW-1013C	864	151005	LEVELS	04189	1101.66								
Flambeau	MW-1013C	864	151006	Hardness	22413	1940	mg/L	M	M	M	15	500	500	
Flambeau	MW-1013C	864	151006	Alkalinity as CaCO3	39036	522	mg/L	M	M	M	17.3	40	40	

Facility Name	Location	Well ID	Date	Parameter	Code	Result	Units	QC_I	QC_II	QC_III	LOD	LOQ	RL	no_WL_reason
Flambeau	MW-1013C	864	151006	Total Dissolved Solids	70295	2840	mg/L	M	M	M	8.7	20	20	
Flambeau	MW-1014	865	151006	Temperature	00010	9.24	deg c							
Flambeau	MW-1014	865	151006	Redox Potential	00090	136.3	mV							
Flambeau	MW-1014	865	151006	Specific Conductance	00094	737	umhos/cm @25 C	M	M	M	1.5	10	10	
Flambeau	MW-1014	865	151006	pH	00400	6.26	s.u.							
Flambeau	MW-1014	865	151006	pH	00400	6.4	s.u.	M	F	M	0.01	0.1	0.1	
Flambeau	MW-1014	865	151006	Conductivity	00402	710	umhos/cm @25 C							
Flambeau	MW-1014	865	151006	Sulfate	00946	128	mg/L	M	M	M	20	40	40	
Flambeau	MW-1014	865	151006	Arsenic	01000		ug/L	M	M	M	0.099	1	1	
Flambeau	MW-1014	865	151006	Copper	01040	5.2	ug/L	M	M	M	0.26	1	1	
Flambeau	MW-1014	865	151006	Iron	01046		mg/L	M	M	M	0.01	0.25	0.25	
Flambeau	MW-1014	865	151006	Manganese	01056	455	ug/L	M	M	M	0.18	1	1	
Flambeau	MW-1014	865	151005	LEVELS	04189	1124.02								
Flambeau	MW-1014	865	151006	Hardness	22413	332	mg/L	M	M	M	0.15	5	5	
Flambeau	MW-1014	865	151006	Alkalinity as CaCO3	39036	194	mg/L	M	M	M	8.6	20	20	
Flambeau	MW-1014	865	151006	Total Dissolved Solids	70295	446	mg/L	M	M	M	8.7	20	20	
Flambeau	MW-1014A	866	151006	Temperature	00010	8.76	deg c							
Flambeau	MW-1014A	866	151006	Redox Potential	00090	152.2	mV							
Flambeau	MW-1014A	866	151006	Specific Conductance	00094	2370	umhos/cm @25 C	M	M	M	1.5	10	10	
Flambeau	MW-1014A	866	151006	pH	00400	6.46	s.u.							
Flambeau	MW-1014A	866	151006	pH	00400	6.6	s.u.	M	F	M	0.01	0.1	0.1	
Flambeau	MW-1014A	866	151006	Conductivity	00402	2190	umhos/cm @25 C							
Flambeau	MW-1014A	866	151006	Sulfate	00946	931	mg/L	M	M	M	40	80	80	
Flambeau	MW-1014A	866	151006	Arsenic	01000	0.81	ug/L	M	M	M	0.099	1	1	
Flambeau	MW-1014A	866	151006	Copper	01040	3.8	ug/L	M	M	M	0.26	1	1	
Flambeau	MW-1014A	866	151006	Iron	01046		mg/L	M	M	M	0.01	0.25	0.25	
Flambeau	MW-1014A	866	151006	Manganese	01056	156	ug/L	M	M	M	0.18	1	1	
Flambeau	MW-1014A	866	151005	LEVELS	04189	1120.98								
Flambeau	MW-1014A	866	151006	Hardness	22413	1400	mg/L	M	M	M	0.15	5	5	
Flambeau	MW-1014A	866	151006	Alkalinity as CaCO3	39036	488	mg/L	M	M	M	43.2	100	100	
Flambeau	MW-1014A	866	151006	Total Dissolved Solids	70295	1790	mg/L	M	M	M	8.7	20	20	
Flambeau	MW-1014B	867	151006	Temperature	00010	8.83	deg c							
Flambeau	MW-1014B	867	151006	Redox Potential	00090	174.4	mV							
Flambeau	MW-1014B	867	151006	Specific Conductance	00094	2970	umhos/cm @25 C	M	M	M	1.5	10	10	
Flambeau	MW-1014B	867	151006	pH	00400	6.25	s.u.							
Flambeau	MW-1014B	867	151006	pH	00400	6.4	s.u.	M	F	M	0.01	0.1	0.1	
Flambeau	MW-1014B	867	151006	Conductivity	00402	2680	umhos/cm @25 C							
Flambeau	MW-1014B	867	151006	Sulfate	00946	1340	mg/L	M	M	M	200	400	400	

Facility Name	Location	Well ID	Date	Parameter	Code	Result	Units	QC_I	QC_II	QC_III	LOD	LOQ	RL	no_WL_reason
Flambeau	MW-1014B	867	151006	Arsenic	01000	1.3	ug/L	M	M	M	0.099	1	1	
Flambeau	MW-1014B	867	151006	Copper	01040	372	ug/L	M	M	M	0.26	1	1	
Flambeau	MW-1014B	867	151006	Iron	01046		mg/L	M	M	M	0.01	0.25	0.25	
Flambeau	MW-1014B	867	151006	Manganese	01056	9970	ug/L	M	M	M	9	50	50	
Flambeau	MW-1014B	867	151005	LEVELS	04189	1117.33								
Flambeau	MW-1014B	867	151006	Hardness	22413	1730	mg/L	M	M	M	7.5	250	250	
Flambeau	MW-1014B	867	151006	Alkalinity as CaCO3	39036	512	mg/L	M	M	M	43.2	100	100	
Flambeau	MW-1014B	867	151006	Total Dissolved Solids	70295	2460	mg/L	M	M	M	8.7	20	20	
Flambeau	MW-1014C	868	151006	Temperature	00010	9.21	deg c							
Flambeau	MW-1014C	868	151006	Redox Potential	00090	57.1	mV							
Flambeau	MW-1014C	868	151006	Specific Conductance	00094	1100	umhos/cm @25 C	M	M	M	1.5	10	10	
Flambeau	MW-1014C	868	151006	Specific Conductance	00094	1070	umhos/cm @25 C	M	M	M	1.5	10	10	
Flambeau	MW-1014C	868	151006	pH	00400	6.56	s.u.							
Flambeau	MW-1014C	868	151006	pH	00400	6.6	s.u.	M	F	M	0.01	0.1	0.1	
Flambeau	MW-1014C	868	151006	pH	00400	6.7	s.u.	M	F	M	0.01	0.1	0.1	
Flambeau	MW-1014C	868	151006	Conductivity	00402	1026	umhos/cm @25 C							
Flambeau	MW-1014C	868	151006	Sulfate	00946	215	mg/L	M	M	M	10	20	20	
Flambeau	MW-1014C	868	151006	Sulfate	00946	214	mg/L	M	M	M	10	20	20	
Flambeau	MW-1014C	868	151006	Arsenic	01000	22.6	ug/L	M	M	M	0.099	1	1	
Flambeau	MW-1014C	868	151006	Arsenic	01000	22.8	ug/L	M	M	M	0.099	1	1	
Flambeau	MW-1014C	868	151006	Copper	01040	0.36	ug/L	M	M	M	0.26	1	1	
Flambeau	MW-1014C	868	151006	Copper	01040		ug/L	M	M	M	0.26	1	1	
Flambeau	MW-1014C	868	151006	Iron	01046	4.64	mg/L	M	M	M	0.01	0.25	0.25	
Flambeau	MW-1014C	868	151006	Iron	01046	4.83	mg/L	M	M	M	0.01	0.25	0.25	
Flambeau	MW-1014C	868	151006	Manganese	01056	1610	ug/L	M	M	M	0.18	1	1	
Flambeau	MW-1014C	868	151006	Manganese	01056	1580	ug/L	M	M	M	0.18	1	1	
Flambeau	MW-1014C	868	151005	LEVELS	04189	1111.82								
Flambeau	MW-1014C	868	151006	Hardness	22413	545	mg/L	M	M	M	0.15	5	5	
Flambeau	MW-1014C	868	151006	Hardness	22413	528	mg/L	M	M	M	0.15	5	5	
Flambeau	MW-1014C	868	151006	Alkalinity as CaCO3	39036	273	mg/L	M	M	M	17.3	40	40	
Flambeau	MW-1014C	868	151006	Alkalinity as CaCO3	39036	274	mg/L	M	M	M	17.3	40	40	
Flambeau	MW-1014C	868	151006	Total Dissolved Solids	70295	676	mg/L	M	M	M	8.7	20	20	
Flambeau	MW-1014C	868	151006	Total Dissolved Solids	70295	670	mg/L	M	M	M	8.7	20	20	
Flambeau	MW-1015A	869	151006	Temperature	00010	8.7	deg c							
Flambeau	MW-1015A	869	151006	Redox Potential	00090	127.7	mV							
Flambeau	MW-1015A	869	151006	Specific Conductance	00094	194	umhos/cm @25 C	M	M	M	1.5	10	10	
Flambeau	MW-1015A	869	151006	pH	00400	6.8	s.u.	M	F	M	0.01	0.1	0.1	
Flambeau	MW-1015A	869	151006	pH	00400	6.98	s.u.							

Facility Name	Location	Well ID	Date	Parameter	Code	Result	Units	QC_I	QC_II	QC_III	LOD	LOQ	RL	no_WL_reason
Flambeau	MW-1015A	869	151006	Conductivity	00402	191	umhos/cm @25 C							
Flambeau	MW-1015A	869	151006	Sulfate	00946	8.7	mg/L	M	M	M	2	4	4	
Flambeau	MW-1015A	869	151006	Arsenic	01000		ug/L	M	M	M	0.099	1	1	
Flambeau	MW-1015A	869	151006	Copper	01040	0.46	ug/L	M	M	M	0.26	1	1	
Flambeau	MW-1015A	869	151006	Iron	01046	0.0101	mg/L	M	M	M	0.01	0.25	0.25	
Flambeau	MW-1015A	869	151006	Manganese	01056	6.8	ug/L	M	M	M	0.18	1	1	
Flambeau	MW-1015A	869	151005	LEVELS	04189	1087.57								
Flambeau	MW-1015A	869	151006	Hardness	22413	96.4	mg/L	M	M	M	0.15	5	5	
Flambeau	MW-1015A	869	151006	Alkalinity as CaCO3	39036	83.5	mg/L	M	M	M	8.6	20	20	
Flambeau	MW-1015A	869	151006	Total Dissolved Solids	70295	120	mg/L	M	M	M	8.7	20	20	
Flambeau	MW-1015B	870	151006	Temperature	00010	8	deg c							
Flambeau	MW-1015B	870	151006	Redox Potential	00090	11.3	mV							
Flambeau	MW-1015B	870	151006	Specific Conductance	00094	508	umhos/cm @25 C	M	M	M	1.5	10	10	
Flambeau	MW-1015B	870	151006	pH	00400	7.55	s.u.							
Flambeau	MW-1015B	870	151006	pH	00400	7.6	s.u.	M	F	M	0.01	0.1	0.1	
Flambeau	MW-1015B	870	151006	Conductivity	00402	621	umhos/cm @25 C							
Flambeau	MW-1015B	870	151006	Sulfate	00946	3.2	mg/L	M	M	M	2	4	4	
Flambeau	MW-1015B	870	151006	Arsenic	01000	0.16	ug/L	M	M	M	0.099	1	1	
Flambeau	MW-1015B	870	151006	Copper	01040		ug/L	M	M	M	0.26	1	1	
Flambeau	MW-1015B	870	151006	Iron	01046	0.138	mg/L	M	M	M	0.01	0.25	0.25	
Flambeau	MW-1015B	870	151006	Manganese	01056	34.3	ug/L	M	M	M	0.18	1	1	
Flambeau	MW-1015B	870	151005	LEVELS	04189	1087.61								
Flambeau	MW-1015B	870	151006	Hardness	22413	161	mg/L	M	M	M	0.15	5	5	
Flambeau	MW-1015B	870	151006	Alkalinity as CaCO3	39036	184	mg/L	M	M	M	8.6	20	20	
Flambeau	MW-1015B	870	151006	Total Dissolved Solids	70295	252	mg/L	M	M	M	8.7	20	20	

Flambeau Mining Company
License: 03180
NR 140 Exceedances
4Q 2015 GW Sampling
10/6/2015

Location	Sample Type	Arsenic ug/L NR 140 PAL 1	Arsenic ug/L NR 140 ES 10	Copper ug/L NR 140 PAL 130	Iron ug/L NR 140 ES 300	Manganese ug/L NR 140 PAL 25	Manganese ug/L NR 140 ES 50	Sulfate mg/L NR 140 PAL 125	Sulfate mg/L NR 140 ES 250
MW-1000PR	N	6.8			642		2150		
MW-1000R	N						10600		
MW-1004P	N				418		149		
MW-1005	N	1.2			16200		540		
MW-1005P	N				1070		71.6		
MW-1005S	N	2.4			4290		237		
MW-1010P	N		23.0				83.4		
MW-1013	N				4570		26200		
MW-1013A	N						4330	163	
MW-1013B	N	1.0		510			30800		1600
MW-1013C	N		21.2		13700		9600		1550
MW-1014	N						455	128	
MW-1014A	N						156		931
MW-1014B	N	1.3		372			9970		1340
MW-1014C	N		22.6		4640		1610	215	
MW-1014C	FD		22.8		4830		1580	214	
MW-1015B	N					34.3			

40122298

CHAIN OF CUSTODY

Pace Analytical® www.pacelabs.com

UPPER MIDWEST REGION
MN: 612-607-1700 WI: 920-469-2436

K8

(Please Print Clearly)

Company Name:	Flambeau Mining Co.
Branch/Location:	Ladysmith, WI
Project Contact:	Sharon Kozicki
Phone:	(920)-496-6737
Project Number:	14F777.14
Project Name:	4Q Groundwater 2015
Project State:	Wisconsin
Sampled By (Print):	Max Malmquist
Sampled By (Sign):	Max Malmquist
PO #:	
Regulatory Program:	

Quote #:	
Mail To Contact:	Sharon Kozicki
Mail To Company:	Foth
Mail To Address:	2121 Innovation Ct. DePere, WI 54115
Invoice To Contact:	Same as above
Invoice To Company:	~~Flambeau Mining Co~~
Invoice To Address:	
Invoice To Phone:	

*Preservation Codes
A=None B=HCL C=H2SO4 D=HNO3 E=DI Water F=Methanol G=NaOH
H=Sodium Bisulfate Solution I=Sodium Thiosulfate J=Other

Data Package Options (billable)
☐ EPA Level III
☐ EPA Level IV

MS/MSD
☐ On your sample (billable)
☐ NOT needed on your sample

Matrix Codes
A = Air, B = Biota, C = Charcoal, O = Oil, S = Soil, Sl = Sludge
W = Water, DW = Drinking Water, GW = Ground Water, SW = Surface Water, WW = Waste Water, WP = Wipe

					As, Mn, Cu, Fe Hardness	pH, Conductivity, TDS	Alkilinity, Sulfate	CLIENT COMMENTS	LAB COMMENTS (Lab Use Only)	Profile #
				FILTERED? (YES/NO)	Y	Y	Y			
				PRESERVATION (CODE)*	D	A	A			
PACE LAB #	CLIENT FIELD ID	COLLECTION DATE	COLLECTION TIME	MATRIX						
001	MW-1000R-2015-10	10/6/15	750	GW	X	X	X		3-250mL, AAD	
002	MW-1000PR-2015-10	↓	800	↓	↓	↓	↓		↓	
003	MW-1010P-2015-10	↓	815	↓	↓	↓	↓		↓	
004	MW-1013-2015-10	↓	1035	↓	↓	↓	↓		↓	
005	MW-1013A-2015-10	↓	1040	↓	↓	↓	↓		↓	
006	MW-1013B-2015-10	↓	1050	↓	↓	↓	↓		↓	
007	MW-1013C-2015-10	↓	1025	↓	↓	↓	↓		↓	
008	MW-1014-2015-10	↓	825	↓	↓	↓	↓		↓	
009	MW-1014A-2015-10	↓	835	↓	↓	↓	↓		↓	
010	MW-1014B-2015-10	↓	845	↓	↓	↓	↓		↓	
011	MW-1014C-2015-10	↓	915	↓	↓	↓	↓		↓	
012	MW-1004-2015-10	↓	1120	↓	↓	↓	↓		↓	
013	MW-1004P-2015-10	↓	1100	↓	↓	↓	↓		↓	

Rush Turnaround Time Requested - Prelims
(Rush TAT subject to approval/surcharge)
Date Needed:

Transmit Prelim Rush Results by (complete what you want):

Email #1:	
Email #2:	
Telephone:	
Fax:	

Samples on HOLD are subject to special pricing and release of liability

Relinquished By:	Date/Time:	Received By:	Date/Time:
[signature]	10/7/15 815	[signature] Pace	10/7/15 0815
[signature] Pace	10/7/15 0905	[signature] PaceGB	10/7/15 0905

PACE Project No. 40122298

Receipt Temp = 2.3 °C

Sample Receipt pH
(OK) / Adjusted

Cooler Custody Seal
Present / Not Present (circled: Not Present)
Intact / Not Intact

Version 6.0 06/14/06

C019a(27Jun2006)

ORIGINAL

(Please Print Clearly)

Company Name:	Flambeau Mining Co.
Branch/Location:	Ladysmith, WI
Project Contact:	Sharon Kozicki
Phone:	(920)-496-6737
Project Number:	14F777.14
Project Name:	4Q Groundwater 2015
Project State:	Wisconsin
Sampled By (Print):	Max Malmquist
Sampled By (Sign):	Max Malmquist
PO #:	
Regulatory Program:	

Pace Analytical® www.pacelabs.com

CHAIN OF CUSTODY

UPPER MIDWEST REGION
MN: 612-607-1700 WI: 920-469-2436

*Preservation Codes
A=None B=HCL C=H2SO4 D=HNO3 E=DI Water F=Methanol G=NaOH
H=Sodium Bisulfate Solution I=Sodium Thiosulfate J=Other

Quote #:	
Mail To Contact:	Sharon Kozicki
Mail To Company:	Foth
Mail To Address:	2121 Innovation Ct. DePere, WI 54115
Invoice To Contact:	Same as above
Invoice To Company:	~~Flambeau Mining Co.~~
Invoice To Address:	
Invoice To Phone:	

Data Package Options (billable)
☐ EPA Level III
☐ EPA Level IV

MS/MSD
☐ On your sample (billable)
☐ NOT needed on your sample

Matrix Codes
A = Air, B = Biota, C = Charcoal, O = Oil, S = Soil, Sl = Sludge
W = Water, DW = Drinking Water, GW = Ground Water, SW = Surface Water, WW = Waste Water, WP = Wipe

FILTERED? (YES/NO): Y | Y | Y
PRESERVATION (CODE)*: D | A | A

Analyses Requested: As, Mn, Cu, Fe Hardness | pH, conductivity TDS | Alkilinity Sulfate

PACE LAB #	CLIENT FIELD ID	COLLECTION DATE	COLLECTION TIME	MATRIX	As, Mn, Cu, Fe Hardness	pH, conductivity TDS	Alkilinity Sulfate	CLIENT COMMENTS	LAB COMMENTS (Lab Use Only)	Profile #
014	MW-1004S-2015_10	10/6/15	1145	GW	X	X	X		3-250mLp AAD	
015	MW-1015A-2015_10	↓	1220	↓	↓	↓	↓		↓	
016	MW-1015B-2015_10	↓	1225	↓	↓	↓	↓		↓	
017	MW-1002-2015_10	↓	1250	↓	↓	↓	↓		↓	
018	MW-1002G-2015_10	↓	1305	↓	↓	↓	↓		↓	
019	MW-1005-2015_10	↓	1410	↓	↓	↓	↓		↓	
020	MW-1005S-2015_10	↓	1340	↓	↓	↓	↓		↓	
021	MW-1003P-2015_10	↓	1425	↓	↓	↓	↓		↓	
022	MW-DUP-2015_10	↓		↓	↓	↓	↓		↓	
023	Backfill-DUP-2015_10	↓		↓	↓	↓	↓		↓	

Rush Turnaround Time Requested - Prelims
(Rush TAT subject to approval/surcharge)
Date Needed:

Transmit Prelim Rush Results by (complete what you want):
Email #1:
Email #2:
Telephone:
Fax:

Samples on HOLD are subject to special pricing and release of liability

Relinquished By:	Date/Time:	Received By:	Date/Time:
[signature]	10/7/15 8:15	[signature] Pace Pace	10/7/15 0815
[signature] Pace Pace	10/7/15 0905	E. Mund Pace GB	10/7/15 0705

PACE Project No. 40122298

Receipt Temp = 2.3 °C

Sample Receipt pH: OK / Adjusted

Cooler Custody Seal: Present / Not Present; Intact / Not Intact

Version 6.0 06/14/06

C019a(27Jun2006)

ORIGINAL

Pace Analytical™

Sample Condition Upon Receipt

Pace Analytical Services, Inc.
1241 Bellevue Street, Suite 9
Green Bay, WI 54302

Project #: **WO# : 40122298**

40122298

Client Name: Flambeau Mining

Courier: ☐ Fed Ex ☐ UPS ☐ Client ☒ Pace Other: ______

Tracking #: ______

Custody Seal on Cooler/Box Present: ☐ yes ☒ no Seals intact: ☐ yes ☐ no

Custody Seal on Samples Present: ☐ yes ☒ no Seals intact: ☐ yes ☐ no

Packing Material: ☐ Bubble Wrap ☐ Bubble Bags ☒ None ☐ Other ______

Thermometer Used N/A **Type of Ice:** (Wet) Blue Dry None ☒ Samples on ice, cooling process has begun

Cooler Temperature Uncorr: ROI /Corr: 2,3 **Biological Tissue is Frozen:** ☐ yes ☐ no

Temp Blank Present: ☒ yes ☐ no

Temp should be above freezing to 6°C for all sample except Biota.
Frozen Biota Samples should be received ≤ 0°C.

Person examining contents:
Date: 10/7/15
Initials: EM

				Comments:
Chain of Custody Present:	☒Yes	☐No	☐N/A	1.
Chain of Custody Filled Out:	☒Yes	☐No	☐N/A	2.
Chain of Custody Relinquished:	☒Yes	☐No	☐N/A	3.
Sampler Name & Signature on COC:	☒Yes	☐No	☐N/A	4.
Samples Arrived within Hold Time:	☒Yes	☐No	☐N/A	5.
- VOA Samples frozen upon receipt	☐Yes	☐No		Date/Time:
Short Hold Time Analysis (<72hr):	☐Yes	☒No	☐N/A	6.
Rush Turn Around Time Requested:	☐Yes	☒No	☐N/A	7.
Sufficient Volume:	☒Yes	☐No	☐N/A	8.
Correct Containers Used:	☒Yes	☐No	☐N/A	9.
-Pace Containers Used:	☒Yes	☐No	☐N/A	
-Pace IR Containers Used:	☐Yes	☐No	☒N/A	
Containers Intact:	☒Yes	☐No	☐N/A	10.
Filtered volume received for Dissolved tests	☒Yes	☐No	☐N/A	11.
Sample Labels match COC:	☒Yes	☐No	☐N/A	12.
-Includes date/time/ID/Analysis Matrix: W				
All containers needing preservation have been checked. (Non-Compliance noted in 13.)	☒Yes	☐No	☐N/A	13. ☒ HNO3 ☐ H2SO4 ☐ NaOH ☐ NaOH +ZnAct
All containers needing preservation are found to be in compliance with EPA recommendation. (HNO3, H2SO4 ≤2; NaOH+ZnAct ≥9, NaOH ≥12)	☒Yes	☐No	☐N/A	
exceptions: VOA, coliform, TOC, TOX, TOH, O&G, WIDROW, Phenolics, OTHER:	☐Yes	☒No		Initial when completed: EM; Lab Std #ID of preservative: ; Date/Time:
Headspace in VOA Vials (>6mm):	☐Yes	☐No	☒N/A	14.
Trip Blank Present:	☐Yes	☐No	☒N/A	15.
Trip Blank Custody Seals Present	☐Yes	☐No	☒N/A	
Pace Trip Blank Lot # (if purchased): ______				

Client Notification/ Resolution: If checked, see attached form for additional comments ☐

Person Contacted: ______ Date/Time: ______

Comments/ Resolution: ______

Project Manager Review: [signature] **Date:** 10-7-15

F-GB-C-031-Rev.03 (9April2015) SCUR Form

Attachment 2

Certification of Fourth Quarter 2015 Environmental Monitoring Results

State of Wisconsin
Department of Natural Resources

Environmental Monitoring Data Certification

Form 4400-231(R 1/04)

Notice: Personally identifiable information collected will be used for program administration and enforcement purposes. The Department may also provide this information to requesters as required under Wisconsin's Open Records law, ss. 19.31 to 19.39, Wis. Stats.
When submitting monitoring data, the owner or operator of the facility, practice or activity is required to notify the Department in writing that a groundwater standard or an explosive gas level has been attained or exceeded, as specified in ss. NR 140.24(1)(a); NR 140.26(1)(a); NR 507.30NR 635.14(9)(a); NR 635.18(20) and NR 507.30, Wis. Adm. Code. Failure to report may result in fines, forfeitures or other penalties resulting from enforcement under ss. 289.97, 291.97 or 299.95, Wis. Stats.

Instructions:

- **Prepare one form for each license or monitoring ID.**
- **Please type or print legibly.**
- Attach a notification of any values that attain or exceed groundwater standards (that is, preventive action limits, enforcement standards or alternative concentration limits). The notification must include a preliminary analysis of the cause and significance of each value.
- Attach a notification of any gas values that attain or exceed explosive gas levels.
- Send the original signed form, any notification, and Electronic Data Deliverable (EDD) to: GEMS Data Submittal Contact - WA/5
  Bureau of Waste Management
  Wisconsin Department of Natural Resources
  101 South Webster Street
  Madison WI 53707-7921

Monitoring Data Submittal Information

Name of entity submitting data (laboratory, consultant, facility owner):

Pace Analytical Services, Inc.

Contact for questions about data formatting. Include data preparer's name, telephone number and E-mail address:

Name: Steve Lehrke Phone: (920) 496-6894

E-mail: Stephen.lehrke@foth.com

Facility name:	License # / Monitoring ID	Facility ID [FID]	Actual sampling dates (e.g., July 2-6, 2003)
Flambeau Mining Company	03180	855034730	Oct. 6, 2015

The enclosed results are for sampling required in the month(s) of: (e.g., June 2003)

Type of Data Submitted (Check all that apply)

- [X] Groundwater monitoring data from monitoring wells
- [ ] Groundwater monitoring data from private water supply wells
- [ ] Leachate monitoring data
- [ ] Gas monitoring data
- [ ] Air monitoring data
- [ ] Other (specify)

Notification attached?

- [X] No. No groundwater standards or explosive gas limits were exceeded.
- [ ] Yes, a notification of values exceeding a groundwater standard is attached. It includes a list of monitoring points, dates, sample values, groundwater standard and preliminary analysis of the cause and significance of any concentration.
- [ ] Yes, a notification of values exceeding an explosive gas limit is attached. It includes the monitoring points, dates, sample values and explosive gas limits.

Certification

To the best of my knowledge, the information reported and statements made on this data submittal and attachments are true and correct. Furthermore, I have attached complete notification of any sampling values meeting or exceeding groundwater standards or explosive gas levels, and a preliminary analysis of the cause and significance of concentrations exceeding groundwater standards.

Facility Representative Name (Print)	Title	(Area Code) Telephone No.
Dave Cline	VP, Flambeau Mining Co.	(801) 204-2526

Signature: [signature] Date: 12/23/15

FOR DNR USE ONLY. Check action taken, and record date and your initials. Describe on back side if necessary.

- [ ] **Found uploading problems on** ____________ **Initials**
- [ ] **Notified contact of problems on** ____________ **Uploaded data successfully on** ____________

EDD format(s): [ ] **Diskette** [ ] **CD (initial submittal and follow-up)** [ ] **E-mail (follow-up only)** [ ] **Other**

September 7, 2017 Public Hearing on SB 395 – Ladysmith, Wisconsin

Testimony of Laura Gauger
1321 E. 1st Street
Duluth, MN 55805
kettu2010@gmail.com

My name is Laura Gauger. I am a Wisconsin native who's been following developments at the Flambeau Mine for about 20 years.

I am here to provide you with information from several different expert reports regarding water contamination at the Flambeau Mine.

1. The first report[1] was authored by Dr. Robert Moran, a hydrogeology consultant from Colorado with over 45 years of domestic and international experience in doing water quality work for the mining industry, private investors, tribal and citizens groups, NGO's, law firms, and governmental agencies, at all levels (abbreviated resume attached).

Dr. Moran reviewed FMC's own water quality data on file with the Wisconsin DNR and concluded the following:

"Roughly 20 years after the cessation of active mining, Flambeau Mine ground waters are contaminated by past Flambeau Mining Company (FMC) activities. FMC data confirm that, as a minimum, dissolved concentrations of the following constituents significantly exceed FMCs baseline concentrations (1987-88): copper, iron, manganese, zinc, sulfate, alkalinity, hardness, total dissolved solids, specific conductance (field)."

2. But if you don't want to take Dr. Moran's word for it, the second report[2] I submit into the record was issued by FMC in December 2015. In this report, the company itself documented **45 Exceedances of Wisconsin water quality standards in 17 different wells** at the Flambeau Mine site.

As Dr. Moran stated, "these waters would require expensive, active water treatment to be made suitable for most foreseeable uses. Historically, most such costs are paid by the taxpayers."

He added: "I know of no metal-sulfide mines anywhere in the world that have met the criteria of Wisconsin's 1998 moratorium on issuance of permits for mining of sulfide ore bodies without degrading the original water quality, long-term."

Dr. Moran also commented on misinformation being circulated by the industry about Flambeau. Here's what he said:

"Flambeau ground and surface water quality is being and has been degraded—despite years of industry public relations statements touting the success of the FMC operation. Rio Tinto said in a 2013 public relations (PR) release regarding the Flambeau Mine: "**Testing shows conclusively that ground water quality surrounding the site is as good as it was before mining.**" In efforts to encourage development of the other metal-sulfide deposits in northern Wisconsin and the Great Lakes region, the industry approach has been to simply repeat this false statement over and over, assuming that repetition will make it believed. **Unfortunately, the FMC data show otherwise.**"

In conclusion, I'd like to leave you with a statement made by Dr. Moran in January 2017: "Wisconsin's "Prove it First" law is the most intelligent and pragmatic legislation intended to protect water quality that I have encountered ANYWHERE in the world, and I have been involved in such activities for more than 45 years in many countries."

Instead of repealing the Mining Moratorium Law, we need to celebrate this landmark legislation and fight hard to preserve it.

---

1. Moran, Robert E., 2017 (April), Summary: Flambeau Mine: Water Contamination and Selective "Alternative Facts"; 4pg. https://remwater.org/projects/flambeau-mine-ladysmith-wisconsin-u-s/

2. Flambeau Mining Company, 2015 (December), Environmental Monitoring (Fourth Quarter 2015); 55pg.

###

Robert E. Moran, Ph.D.
Michael-Moran Assoc., LLC
Water Quality/Hydrogeology/Geochemistry
Golden, Colorado, U.S.A.
remwater@gmail.com
remwater.org

Dr. Robert Moran has more than 45 years of domestic and international experience in conducting and managing water quality, geochemical and hydrogeologic work for private investors, industrial clients, tribal and citizens groups, NGO's, law firms, and governmental agencies at all levels. Much of his technical expertise involves the quality and geochemistry of natural and contaminated waters and sediments as related to mining, nuclear fuel cycle sites, industrial development, geothermal resources, hazardous wastes, and water supply development. In addition, Dr. Moran has significant experience in the application of remote sensing to natural resource issues, development of resource policy, and litigation support. He has often taught courses to technical and general audiences, and has given expert testimony on numerous occasions. Countries worked in include: Australia, Greece, Bulgaria, Mali, Senegal, Guinea, Gambia, Ghana, South Africa, Iraqi Kurdistan, Oman, Pakistan, Kazakhstan, Kyrgyzstan, Mongolia, Romania, Russia, Papua New Guinea, Argentina, Bolivia, Chile, Colombia, Guatemala, Haiti, Honduras, Mexico, Peru, El Salvador, Belgium, France, Canada, Germany, Great Britain, Netherlands, Spain, United States.

EDUCATION

University of Texas, Austin: Ph.D., Geological Sciences, 1974
San Francisco State College: B.A., Zoology, 1966

PROFESSIONAL HISTORY

Michael-Moran Assoc., LLC, Partner, 2003 to present
Moran and Associates, President, 1983 to 1992; 1996 to 2003
Woodward-Clyde Consultants, Senior Consulting Geochemist, 1992 to 1996
Gibbs and Hill, Inc., Senior Hydrogeologist, 1981 to 1983
Envirologic Systems, Inc., Senior Hydrogeologist/Geochemist, 1980 to 1981
Tetra Tech Int'l. / Sultanate of Oman, Senior Hydrogeologist, 1979 to 1980
Science Applications, Inc., Geochemist/Hydrologist, 1978 to 1979
U.S. Geological Survey, Water Resources Division, Hydrologist/Geochemist, 1972 to 1978
Texas Bureau of Economic Geology, Research Scientist Assistant, 1970 to 1971

LANGUAGES

English, Spanish

CITIZENSHIP: United States of America, Ireland

State of Wisconsin
DEPARTMENT OF NATURAL RESOURCES
101 S. Webster Street
Box 7921
Madison WI 53707-7921

Scott Walker, Governor
Kurt Thiede, Interim Secretary
Telephone 608-266-2621
Toll Free 1-888-936-7463
TTY Access via relay - 711

WISCONSIN DEPT. OF NATURAL RESOURCES

Senate Committee on Sporting Heritage, Mining, and Forestry

2017 SB 395

Non-Ferrous Mining

Chairman Tiffany and members of the Committee, my name is Pat Stevens and I am the Administrator for the Environmental Management Division, Wisconsin Department of Natural Resources. I am here today to testify for information only.

In general, this bill makes several changes in the regulation of nonferrous metallic mining. It eliminates the "mining moratorium" on the issuance of permits for the mining of sulfide ore bodies. It adopts provisions like those in the ferrous mining law to allow bulk sampling and to modify the permitting process. It also modifies other requirements for a nonferrous mining permit, including those related to financial assurance and fees for nonferrous metallic mining.

Moratorium on Permits for Mining Sulfide Ore Bodies

Current law prohibits the Department from issuing a permit for mining a sulfide ore body until the applicant submits and the department verifies that a mining operation with the potential to generate acid drainage in the United States or Canada has operated for ten years without a violation of environmental laws and without causing significant environmental pollution of surface or groundwater from acid drainage or from the release of heavy metals. In addition, it must be shown that a mining operation has been closed for ten years without a violation of environmental laws and without causing significant environmental pollution of groundwater or surface water from acid drainage or from the release of heavy metals. The bill repeals this prohibition.

Some observations regarding the moratorium include:

- Current law provisions do not focus on the site-specific characteristics of a proposed mine site in Wisconsin. Each mining proposal and mine site must be evaluated based on site-specific characteristics.
- Because of the differences in geology and hydrogeology in different areas of North America as compared to Wisconsin, it is very difficult to draw conclusions about a proposed mine in Wisconsin based on other mining operations. For example, a mine that has operated in Arizona may not be comparable to a mining operation in Wisconsin.
- In addition, because of the required ten-year look back, it may be difficult to compare the condition of a mining site after practices that occurred in the past with the conditions that would likely occur based on the use of newer technologies or practices that may be used today.

Provisions Similar to Ferrous Mining Law Chapter 295

Bulk Sampling

The bill includes provisions like those for ferrous mining that allow bulk sampling. Bulk sampling is defined as the removal of less than 10,000 tons of material to assess the quality and quantity of a mineral deposit and to collect and analyze data to prepare an application for a prospecting or mining permit.

- The bulk sampling provisions in the bill give applicants *an optional* step between exploration and a prospecting or mining permit application to learn more about an ore body.

- The bill requires an applicant to obtain all necessary approvals (for example, stormwater and wetland permits) and post a bond, conditioned on the successful completion of the requirements for bulk sampling, *before* bulk sampling can take place.

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- After a notice of intent is filed, the bill requires the Department to provide an applicant with information on the data that should be included in an environmental impact report and the requirements for the approvals relating to the proposed project.
- The bill includes deadlines for Department review of a mining permit application. The timeframes in the bill provide *greater time for department review* than the time line under the ferrous mining law.
- Similar to the ferrous mining law, the bill requires the Department to seek to enter an MOU with the US Army Corps of Engineers and the applicant regarding timelines for studies and for review.
- The bill replaces the "master hearing" process (which included a contested case hearing *prior to* the issuance of any permitting decisions) with a public informational hearing. The public informational hearing process is commonly used by the Department for permits, approvals and Environmental Impact Statements (EIS).
- Prior to the public informational hearing, the Department is required to provide public access to the applications, draft permits and the draft EIS for review and comment. The bill includes a 45-day public comment period.
- The bill provides an opportunity for a contested case hearing on the Department's decision related to the EIS or any approval related to the prospecting or mining operation.
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Other Modifications

The bill proposes to modify certain provisions relating to modeling for a waste site, the vertical distance (depth) used to determine compliance with groundwater standards, the conditions for approval of a high capacity well, and the assessment of wetland impacts.

- Modeling time frame: Predictive modeling is commonly used to assess the potential impacts of a mining operation. If the Department requires modeling to assess a mine's waste site's performance, the bill specifies a time period for the modeling. Under the bill, the time period can be no longer than the period in which the mining waste site is proposed to operate plus 250 years after closure of the mining waste site.
- Depth of DMZ for application of groundwater standards: Compliance with groundwater standards is measured at the boundary of a "design management zone" for the mining operation and mining waste facility. Under the bill, the Department is to determine the vertical distance (depth) of the design management zone by determining the depth in the Precambrian bedrock below which the groundwater is not reasonably capable of being used for human consumption and is not hydrologically connected to any groundwater that is capable of being used for human consumption.
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or dewatering will not result in an unreasonable detriment of public or private water supplies or the unreasonable detriment of public rights in waters of the state. The conditions may include a requirement to provide replacement water supply or an increased or temporarily augmented amount of water to the water supply.

- Wetlands: The bill repeals the provisions in the Department's nonferrous mining regulations that relate to wetland impacts (NR 132). As a result of the repeal, the standards applicable to all other wetland permits under s. 281.36 will apply to nonferrous mining activities.

Financial Assurance and Fees

Finally, the bill contains provisions relating to the collection of fees by the Department and the financial assurance the Department may require for mining operations.

- The bill allows the Department to assess a fee *equal to the Department's costs* in reviewing and providing feedback to prospective applicants prior to a Notice of Intent.
- The bill retains other provisions that allow the Department to assess a fee *equal to the Department's costs* in reviewing applications and preparing an EIS for a prospecting or mining operation. The bill *does not cap the amount of fees* the Department can collect [ferrous mining law has a cap – see 295.73]
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  - The Department adopted the trust fund requirement after receiving a petition from a group of legislators in July 1996 requesting that rules be adopted to require mining permit holders to carry insurance adequate to fund any remedial measures in case of environmental contamination caused by the mining operation. Instead of an insurance policy, the rule adopted by the Department specifies that a trust fund be maintained in perpetuity.
  - Other provisions of current law prevent and address potential remedial actions that may be necessary and require financial assurance for reclamation and for long term care of the mining waste site. Current law not impacted by this bill includes provisions that: (1) require a bond conditioned on the performance of all of the requirements of the mining permit, including reclamation of the site; (2) require financial responsibility for the long-term care of the waste site; (3) require annual review of the mining plan and the reclamation plan and allows the Department to request an amendment to the mining plan or reclamation plan based on changed conditions; (4) require a contingency plan to address any potential risks and hazards potentially associated with the mining operation; (5) impose liability for certain damages to persons or property; and (6) impose liability for private well contamination.
  - The remedial action statute, ch. 292, could also apply to impose liability for any unpermitted release of a hazardous substance (292.11) or any remedial action necessary to avert or repair environmental damage (s. 292.31).
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I hope you find this information helpful, and would be happy to address any questions you may have.

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Senate Committee on Sporting Heritage, Mining, and Forestry

2017 SB 395

Non-Ferrous Mining

Chairman Tiffany and members of the Committee, my name is Pat Stevens and I am the Administrator for the Environmental Management Division, Wisconsin Department of Natural Resources. I am here today to testify for information only.

In general, this bill makes several changes in the regulation of nonferrous metallic mining. It eliminates the "mining moratorium" on the issuance of permits for the mining of sulfide ore bodies. It adopts provisions like those in the ferrous mining law to allow bulk sampling and to modify the permitting process. It also modifies other requirements for a nonferrous mining permit, including those related to financial assurance and fees for nonferrous metallic mining.

Moratorium on Permits for Mining Sulfide Ore Bodies

Current law prohibits the Department from issuing a permit for mining a sulfide ore body until the applicant submits and the department verifies that a mining operation with the potential to generate acid drainage in the United States or Canada has operated for ten years without a violation of environmental laws and without causing significant environmental pollution of surface or groundwater from acid drainage or from the release of heavy metals. In addition, it must be shown that a mining operation has been closed for ten years without a violation of environmental laws and without causing significant environmental pollution of groundwater or surface water from acid drainage or from the release of heavy metals. The bill repeals this prohibition.

Some observations regarding the moratorium include:

- Current law provisions do not focus on the site-specific characteristics of a proposed mine site in Wisconsin. Each mining proposal and mine site must be evaluated based on site-specific characteristics.
- Because of the differences in geology and hydrogeology in different areas of North America as compared to Wisconsin, it is very difficult to draw conclusions about a proposed mine in Wisconsin based on other mining operations. For example, a mine that has operated in Arizona may not be comparable to a mining operation in Wisconsin.
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I hope you find this information helpful, and would be happy to address any questions you may have.

Statement by Sister Cecilia Fandel, 1100 Port Arthur Rd #A, Ladysmith, WI 54848

I am not in favor of rescinding Wisconsin's prove-it-first protections against unsafe Mining.

The Mining Give-Away Bill undermines our wetland laws, threatens the water security of the residents of the area, and sidesteps many of our existing safeguards.

There never has been a hard metal (sulfide) mine that didn't damage the environmental area surrounding it, and the water that flows through it and downstream from it. It is said that the Flambeau Mine was a successful operation, but the time test after it left has shown that it has left, and continues to leave, its ugly legacy of contamination.

Mining does damage to the economy, which is one reason why promoters say mining is good, that is, that it will improve the livelihood of the folks who live around there. That is a short term fix that will in the longer term prove more problematic and costly to the people living there for the rest of their lives and their children and grandchildren's lives as well.

Cleaning up after the mining operation is finished, is a job that is never done, and the health risks to an already health-stressed population only adds to the community's burden.

Our local communities in Northern Wisconsin depend on our renewable natural resources for our economies which are fueled by tourism and outdoor sports of all kinds. Surely, Mr. Tom Tiffany who lives in beautiful Hazelhurst, surrounded by beautiful lakes, streams, and outdoor activities knows that. WE NEED CLEAN WATER AND WE NEED CLEAR AIR. WE NEED TO PRESERVE OUR RENEWABLE NATURAL RESOURCES AND SAFEGUARD THEM FROM CORPORATE PREDATORS WHO WANT TO TAKE AND RUN, LEAVING THE LOCAL PEOPLE AND ECONOMY TO DEAL WITH THE AFTERMATH.

I urge this committee and all legislators to listen to the experience and will of the people and vote against this Mining Bill.

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Thank you.

Sept. 7, 2017

Dear Sir,

Please oppose- Do Not Approve—SB 395. Years ago I worked with Roscoe Churchill's group and others to get our current "Prove It First" miming law in force. Please do not weaken or cut it in any way.

Sincerely,

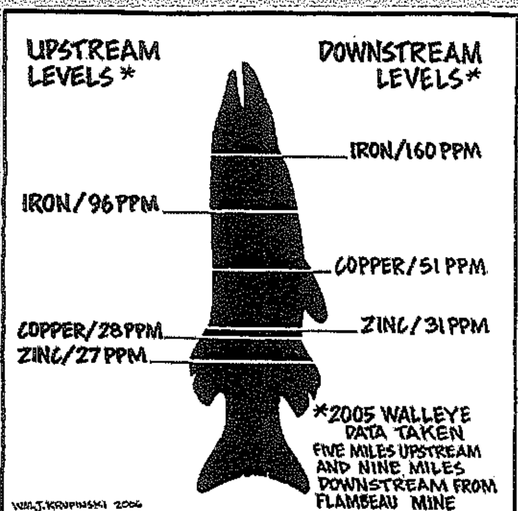
Gayle Johnson

Gayle Johnson
W8644 Deer Lane
Ojibwa. WI 54862

IS THE FLAMBEAU MINE HARMING THE FLAMBEAU RIVER?

Between 1991 and 2011 Kennecott was required to test walleye in the Flambeau River for heavy metal accumulation, both upstream and downstream of the Flambeau Mine site. Before the mine was built in 1993, the **upstream** walleye had **higher** levels of copper and zinc in their liver tissue than the **downstream** fish. That reversed in 1996 (at the height of mining); for the next ten years (1996-2006) higher levels of copper and zinc were measured in the **downstream** fish. A graph of the 2005 data is shown below.

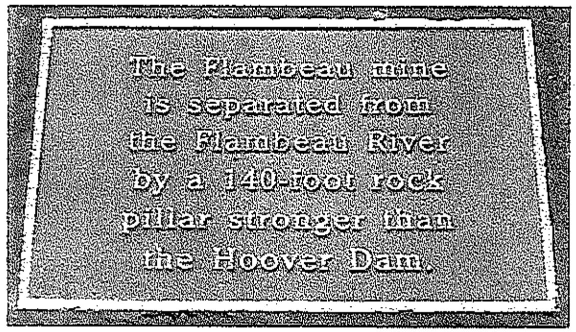
Flambeau Mine Walleye-ometer



What the future holds for the walleye in the Flambeau River is unknown. Polluted groundwater from the Flambeau Mine site continues to enter the river through fractured bedrock, but, with the end of mandatory walleye testing in 2011, Kennecott is now "off the hook."

Kennecott Lied to the People of Wisconsin

The Flambeau Mine pit was dug to within 150 feet of the Flambeau River. During the permitting process, people voiced concern that groundwater polluted with heavy metals would get into the river from the mine site. Kennecott responded by telling the people there was nothing to worry about because the bedrock between the mine pit and Flambeau River was like the "Hoover Dam." The plaque pictured below was actually posted at the mine site:



Only later did the public learn that Kennecott had lied. An open records request of the Wisconsin Department of Natural Resources revealed that Kennecott knew in **1989**, before the mine was built, that the rock between the pit and the river was **"fractured"** and that the contaminated groundwater leaving the mine pit would **"flow directly into the bed of the Flambeau River."**[3] That includes the water contaminated with sulfate and manganese shown in this brochure!

③ Flambeau Mine Permit App, Appendix L, Foth, p. L-32, Dec 1989.

Deer Tail Press
Duluth, MN

For more information go to:
https://FlambeauMineExposed.wordpress.com/

February 2016

Protect the Water!

Expose the Myth of the Flambeau Mine

CHERISH and DEFEND the WATERS of Northern Wisconsin, Minnesota's Arrowhead Region & Michigan's Upper Peninsula

If the mining industry was **not** able to keep the water clean and prevent long-term pollution problems at Wisconsin's Flambeau Mine ("the newest and smallest copper mine in the world") how will the industry will be able to protect Lake Superior, the Menominee River, St. Louis River, Rainy River, Bad River and other public waters at the much larger mines proposed for Wisconsin, Minnesota and Michigan?

Flambeau "Model" Mine Myth

Kennecott Minerals, a wholly owned subsidiary of Rio Tinto, operated the Flambeau Mine near Ladysmith, Wisconsin in the mid-1990s and backfilled the mine pit in 1998. Rio Tinto issued a report in June 2013, claiming the following:

"Testing shows conclusively that groundwater quality surrounding the site is as good as it was before mining."①

Others in the mining industry have echoed the claim, citing the Flambeau Mine as an example of a metallic sulfide mine that operated **"without polluting local waters."**②

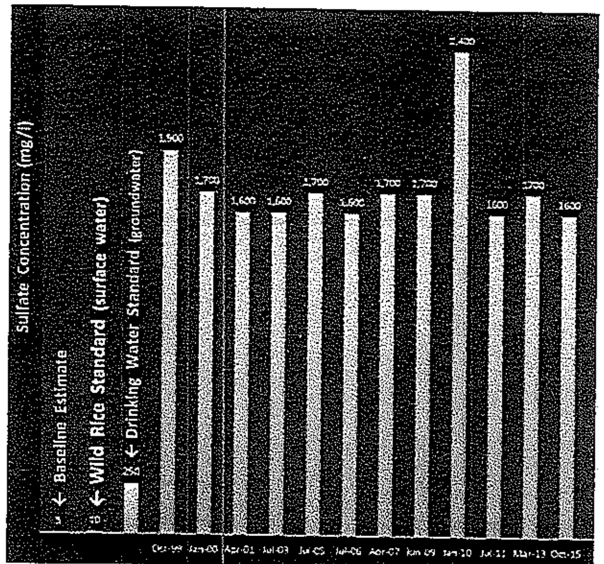
The above statements from the industry are **blatantly false**. The groundwater at the Flambeau Mine site is **highly polluted**, and the company's own data proves it. Take a look!

Sulfate Pollution in the Water at the Flambeau Mine Site

In Minnesota, the sulfate standard set to protect wild rice is 10 mg/l in surface waters.

There is a well at the Flambeau Mine site that has registered sulfate levels as high as 2,400 mg/l – 240 times the wild rice standard.

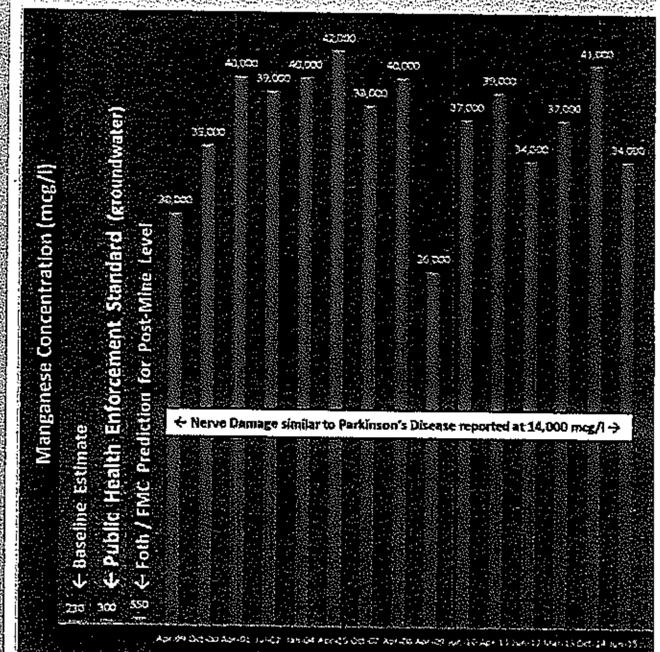
Promises Broken: Sulfate Levels (mg/l) in Well-1013B at Flambeau Mine Site (Well-1013B is 610' from Flambeau River & 86' deep)



According to Kennecott's computer modeling, it's going to take **3,000 - 4,000 years** for sulfate and various metals polluting the groundwater at the Flambeau Mine site to return to normal!

The groundwater has been polluted forever.

Promises Broken: Manganese Levels (mcg/l) in Well-1013B at Flambeau Mine Site (Well-1013B is 610' from Flambeau River & 86' deep)



Kennecott told the people of Wisconsin that manganese levels in the groundwater at the Flambeau Mine site would end up at about **550** mcg/l, but a well just 610 feet from the Flambeau River has registered levels as high as **42,000** mcg/l - **75 times higher** than predicted and **140 times higher** than the public health standard! Elevated manganese levels in drinking water have been associated with causing the kind of nerve damage seen in Parkinson's disease.

① *Flambeau Mine Legacy Management Case Study*, Rio Tinto, June 2013.
② Letter and "Fact Sheet" sent by Mining Minnesota (a mining trade association) to Gov. Mark Dayton, Minnesota Lawmakers and Minnesota Congressional Delegation, Sep 2013.

Water is Life!

If the Flambeau Mine were a pea, the new mines proposed for Northern Wisconsin, Minnesota's Arrowhead Region and Michigan's Upper Peninsula would be watermelons.
The Flambeau Mine pit was 32 acres in size, a half mile long, 550 feet wide and 220 feet deep.

The Non-Effect of the Flambeau Mine on Rusk County's Annual Unemployment Rate

	County[1]								State of Wisconsin
	Rusk		Chippewa		Taylor		Barron		
Year[2]	Rate[3]	County Rank[4]	Rate[3]	County Rank[4]	Rate[3]	County Rank[4]	Rate[3]	County Rank[4]	Rate[3]
1990	8.2%	71	5.8%	48	6.7%	62	6.2%	54	4.4%
1991	10.6%	70	6.2%	33	8.6%	65	6.8%	43	5.5%
1992	10.2%	71	6.4%	39	7.7%	56	6.7%	44	5.2%
1993	11.0%	72	6.5%	49	7.6%	61	7.0%	52	4.7%
1994	9.8%	72	6.1%	42	7.6%	64	6.4%	49	4.7%
1995	7.6%	71	4.6%	39	6.4%	62	4.8%	45	3.7%
1996	7.0%	70	4.4%	38	4.9%	50	4.5%	43	3.5%
1997	7.9%	71	4.2%	32	5.3%	53	4.8%	42	3.7%
1998	6.0%	63	3.8%	30	5.0%	54	4.3%	43	3.4%
1999	4.6%	59	3.7%	38	3.9%	44	3.9%	44	3.0%
2000	6.8%	68	4.4%	42	4.5%	45	4.8%	53	3.5%

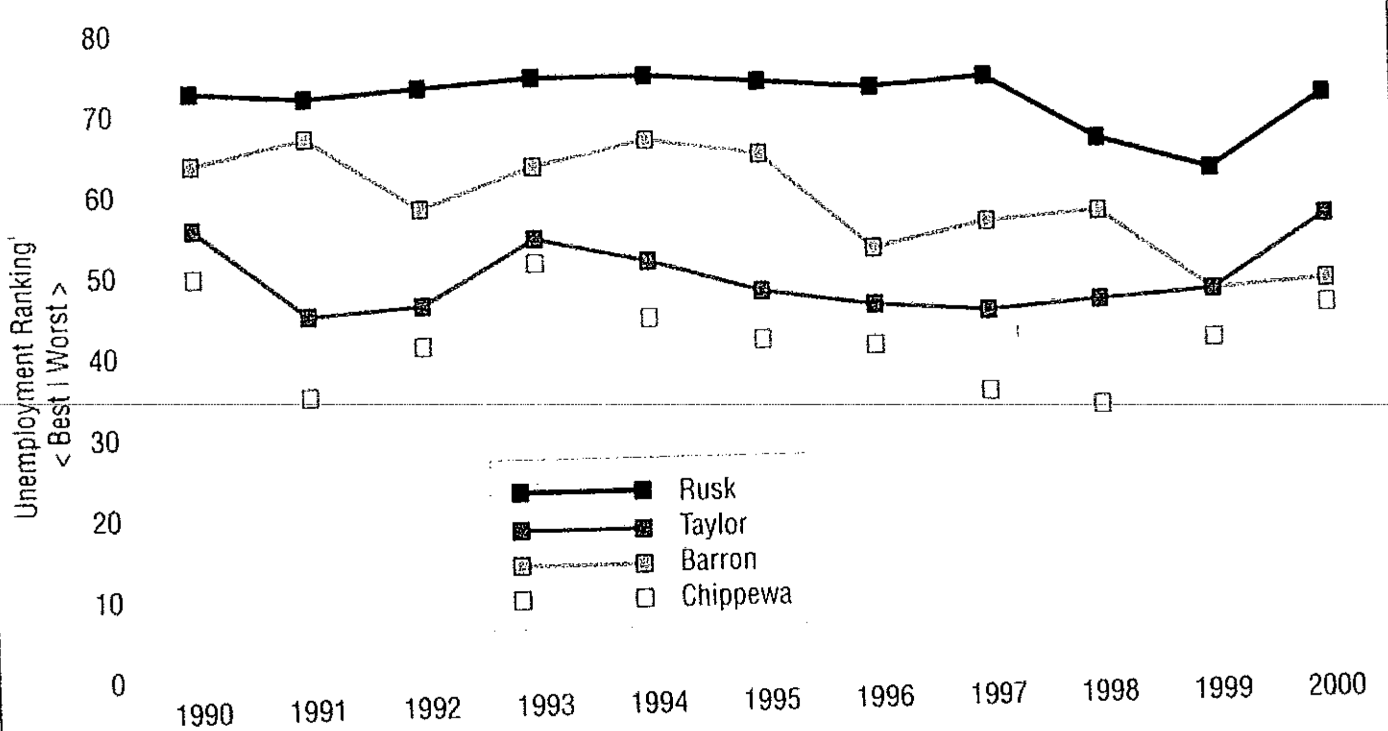
[1] See CD 119-8 for a table including data from three additional Wisconsin counties—Forest, Price and Sawyer.

[2] The Flambeau Mine was in production from 1993 to 1997.

[3] Unemployment rates were obtained from the web page of the Wisconsin Department of Workforce Development (www.dwd.state.wi.us/lmi), January 2002.

[4] County rank indicates the number of counties in the state with *equal or lower* unemployment rates. Since there are 72 counties in the State of Wisconsin, a rank of 72 means the county had the highest unemployment rate in the state.

Table 119-1. Annual unemployment rates and corresponding rankings within the State of Wisconsin for Rusk County and three of its neighboring counties (1990–2000), with special emphasis on the mining years in Rusk County (1993–1997).



[1] Since there are 72 counties in Wisconsin, a rank of 72 indicates the county with the highest unemployment rate in the state.

Graph 119-1. Annual unemployment rate rankings within the State of Wisconsin for Rusk County and three of its neighboring counties (1990–2000).

The Non-Effect of the Flambeau Mine on Rusk County's Annual Per Capita Income

	County[1]								State of Wisconsin
	Rusk		Chippewa		Taylor		Barron		
Year[2]	Per Capita Income[3]	County Rank[4]	Per Capita Income[3]	County Rank[4]	Per Capita Income[3]	County Rank[4]	Per Capita Income[3]	County Rank[4]	Per Capita Income[3]
1990	$7,161	70	$9,186	40	$8,934	47	$9,167	41	$12,686
1991	$7,542	70	$10,002	37	$9,246	48	$9,698	41	$13,043
1992	$7,849	69	$10,240	38	$9,514	45	$9,972	42	$13,287
1993	$8,003	71	$10,349	43	$10,367	41	$10,250	44	$13,840
1994	$8,474	71	$10,906	42	$11,350	37	$10,755	47	$14,534
1995	$8,991	71	$11,581	45	$11,841	40	$11,440	46	$15,324
1996	$9,490	70	$12,299	42	$12,297	43	$11,810	46	$16,118
1997	$10,074	70	$13,156	39	$12,993	41	$12,525	48	$17,437
1998	$11,258	70	$14,263	40	$13,893	41	$13,825	42	$18,655
1999	$11,879	70	$15,461	40	$15,248	42	$15,359	41	$20,116
2000	$12,377	70	$16,178	41	$15,409	47	$15,823	43	$20,503

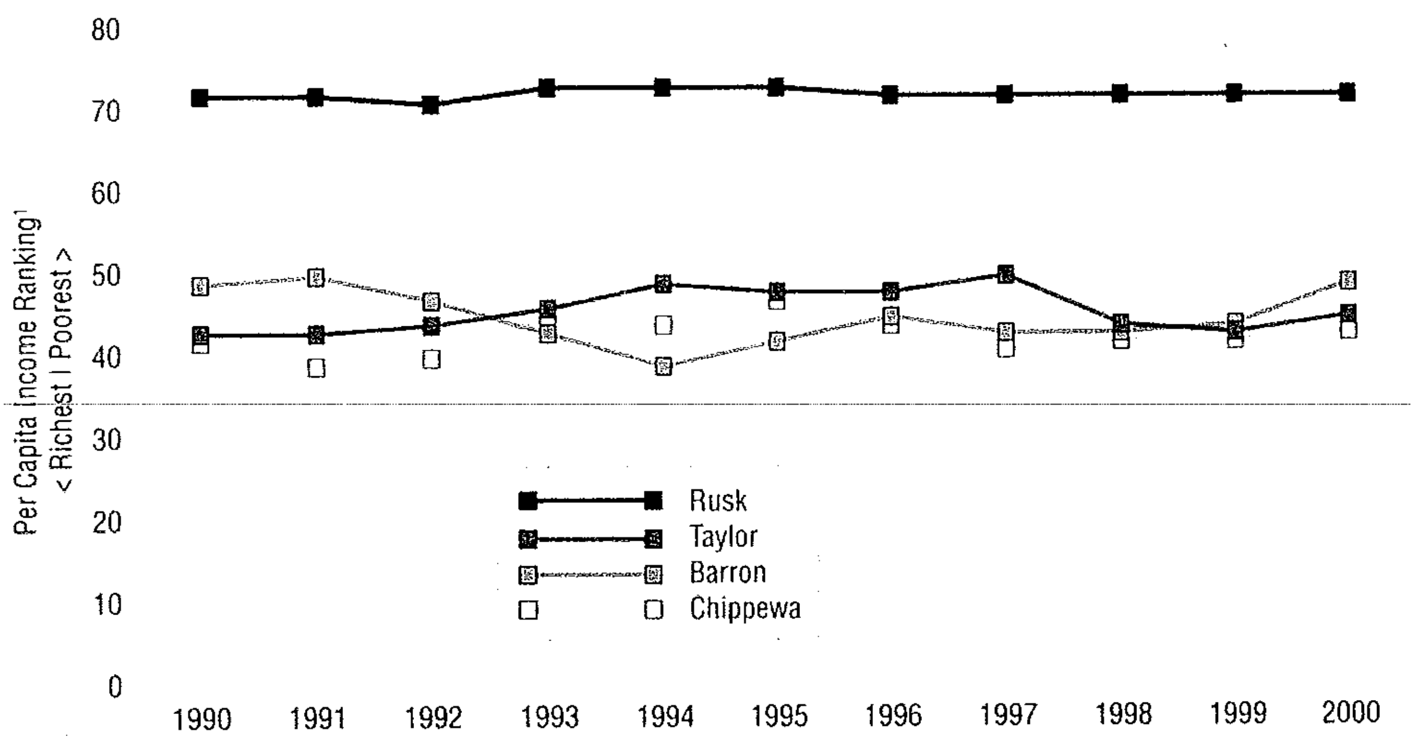
[1] See CD 119-16 for a table including data from three additional Wisconsin counties—Forest, Price and Sawyer.

[2] The Flambeau Mine was in production from 1993 to 1997

[3] Annual per capita adjusted gross incomes were obtained from the 1995–1996, 1997–1998, 1999–2000 and 2001–2002 volumes of the *Wisconsin Blue Book*. Values for 2000 were obtained from the Wisconsin Department of Revenue.

[4] County rank indicates the number of counties in the state with equal or higher per capita incomes. Since there are 72 counties in the State of Wisconsin, a rank of 72 means the county had the lowest per capita income in the state.

Table 119-2. Annual per capita adjusted gross incomes and corresponding rankings within the State of Wisconsin for Rusk County and three of its neighboring counties (1990–2000), with special emphasis on the mining years in Rusk County (1993–1997).



[1] Since there are 72 counties in Wisconsin, a rank of 72 indicates the county with the lowest per capita income in the state.

Graph 119-2. Annual "per capita adjusted gross income" rankings within the State of Wisconsin for Rusk County and three of its neigh-

The Non-Effect of the Flambeau Mine on the Percentage of Rusk County's Children Living in Poverty

	County[1]								State of Wisconsin
	Rusk		Chippewa		Taylor		Barron		
Year[2]	Percent Living in Poverty[3]	County Rank[4]	Percent Living in Poverty[3]	County Rank[4]	Percent Living in Poverty[3]	County Rank[4]	Percent Living in Poverty[3]	County Rank[4]	Percent Living in Poverty[3]
1989	20.8	60	14.0	33	16.0	51	14.4	35	14.9
1993	21.4	66	15.1	42	14.4	36	16.6	51	15.9
1995	20.8	69	13.9	42	13.8	41	14.6	50	13.9
1997	21.9	67	14.4	41	14.5	42	16.1	50	14.3
1998	18.9	66	14.2	45	12.8	34	15.7	51	13.6
1999	15.7	67	11.2	41	11.9	45	12.2	48	10.9

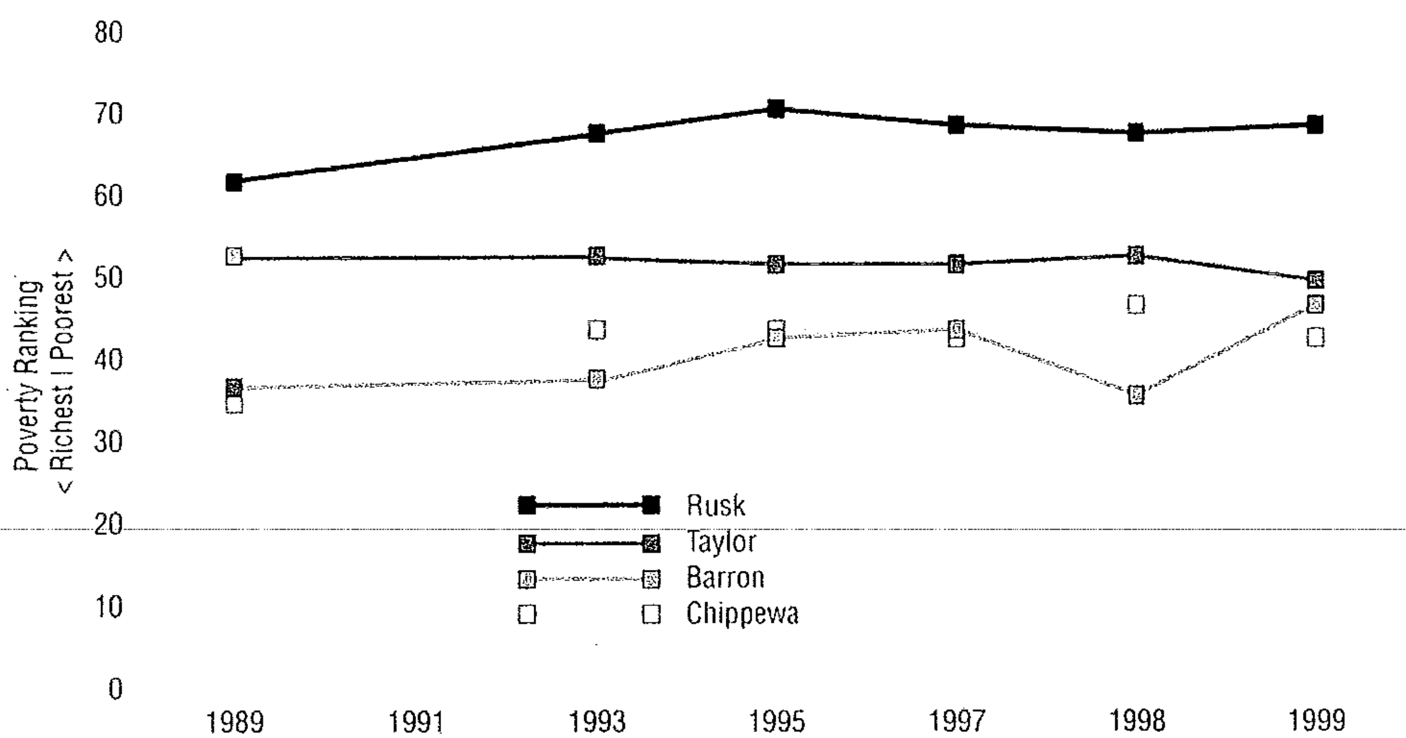
[1] See CD 119-19 for a table including data from three additional Wisconsin counties—Forest, Price and Sawyer.

[2] The Flambeau Mine was in production from 1993 to 1997.

[3] Percentages were obtained from the web page of the United States Census Bureau (www.census.gov/hhes/www/). September 2003. Information was not posted for 1990, 1991, 1992, 1994, 1996 or 2000, so that is why those particular years are not included in the table.

[4] County rank indicates the number of counties in the state with equal or lower percentages of childen living in poverty. Since there are 72 counties in the State of Wisconsin, a rank of 72 means the county had the highest percentage of children living in poverty in the store.

Table 119-4. Percentages of children living below the poverty level and corresponding rankings within the State of Wisconsin for Rusk County and three of its neighboring counties (1989-1999), with special emphasis on the mining years in Rusk County (1993-1997).



[1] Since there are 72 counties in Wisconsin, a ranking of 72 indicates the county with the highest percentage of children living in poverty in the state

Graph 119-4. Poverty rankings within the State of Wisconsin for Rusk County and three of its neighboring counties with respect to percentage of children living in poverty (1989-1999).

Critical Points Extracted from:

SUMMARY - Flambeau Mine: Water Contamination and Selective "Alternative Facts"

Robert E. Moran, Ph.D. / https://remwater.org/ / April 11, 2017

For complete summary report go to: https://remwater.org/projects/flambeau-mine-ladysmith-wisconsin-u-s/

- "Flambeau ground and surface water quality is being and has been degraded—despite years of industry public relations statements touting the success of the FMC operation. Rio Tinto said in a 2013 public relations (PR) release regarding the Flambeau Mine: "Testing shows conclusively that ground water quality surrounding the site is as good as it was before mining." In efforts to encourage development of the other metal-sulfide deposits in northern Wisconsin and the Great Lakes region, the industry approach has been to simply repeat this false statement over and over, assuming that repetition will make it believed. **Unfortunately, the FMC data show otherwise.**"
- "FMC wells within the backfilled pit have median dissolved concentrations as high as the following (2014-16): Copper = 503 μg/L; Iron = 14,000 μg/L; Manganese = 33,500 μg/L; Zinc = 1200 μg/L; Arsenic = 23 μg/L; Sulfate = 1600 mg/L; Alkalinity = 610 mg/L; Hardness = 2150 mg/L; Total Dissolved Solids = 3110 mg/L; Specific Conductance = 3180 μS. **These values greatly exceed baseline data and relevant water quality standards and aquatic life criteria.** FMCs "baseline" ground water data report that uranium was detected in between 64 to 100% of their samples, yet **uranium was not included in the routine monitoring.**"
- "These ground waters are also being contaminated with numerous minor / trace constituents (e.g. aluminum, arsenic, chromium, lead, nickel, uranium, etc.) as a result of FMC operations. Drawing reliable, ***quantitative*** conclusions about these constituents is difficult as ***FMC has been allowed to characterize the water quality using data that are not representative of the actual, <u>chemically-unstable</u> ground waters.***"
- "FMC and their contractors supplied all of the data and interpretations used to compile the permit-related reports and subsequent Annual Reports. Such an approach obviously reflects FMC's interests, but is likely quite different from financially-independent, public-interest science. **In short, the Flambeau Mine is the poster child for a severely-flawed permitting and oversight process, that has likely generated long-term public liabilities.**"
- "FMC has failed to define either the actual flow pathways for ground waters exiting the backfilled pit, or to define the ground water-surface water interactions."
- "Contaminated discharges from the southeast corner of the FMC site have resulted in ... [a tributary of the Flambeau River] being added to the Environmental Protection Agency (EPA) impaired waters list for exceedances of acute aquatic toxicity criteria for copper and zinc. Since 1998, FMC has instituted six different work plans to address this soil and water contamination issue. As of fall 2016, copper levels in the Flambeau River tributary still exceed the acute toxicity criterion [despite passive water treatment], and FMC has not secured a mine reclamation Certificate of Completion (COC) for this portion of the mine site."
- "Backfilled waste rock was mixed with limestone to minimize the formation of acid and release of trace constituents into the pit waters. However, the rise in pH due to the addition of limestone (or especially lime) can also generate conditions that increase the water concentrations of those trace elements that form mobile species ***at elevated pHs, such as aluminum, arsenic, antimony, chromium, manganese, nickel, selenium, molybdenum, uranium, zinc, etc.***"
- "Wastes from the FMC operation will remain onsite ***forever***. While limestone was added to the waste rock as it was backfilled into the pit, the ability of the limestone to neutralize the formation of acid waters is limited and finite. After the limestone has reacted with the waste rock, its neutralizing action will cease and the ***pit waters are likely to become increasingly acidic and the concentrations of potentially-toxic contaminants are likely to increase.*** The deeper pit well waters already show evidence of increased degradation of water quality, in roughly 20 years, post-closure. **It is reasonable to conclude that the Flambeau ground and surface water quality will further degrade in the coming decades if current site maintenance practices continue.**"
- "The narrative "predictions" made by FMC's main Wisconsin consultant in the various permit-related and Annual Reports appear to be largely naïve geochemically and hydrogeologically. It is doubtful that these statements represented the opinions of FMCs technical experts. Such statements are most useful for obtaining permits, less so for generating quantitatively-reliable predictions."
- "I know of no metal-sulfide mines anywhere in the world that have met the criteria of Wisconsin's 1998 moratorium on issuance of permits for mining of sulfide ore bodies without degrading the original water quality, long-term."
- **"Obviously the mining and remediation practices employed at Flambeau do not represent a *sustainable, long-term solution.*** While FMC may have satisfied State oversight and disclosure requirements, the site ground waters are contaminated, and ***these waters would require expensive, active water treatment to be made suitable for most foreseeable uses. Historically, most such costs are paid by the taxpayers.***"

WISCONSIN STATE SENATE

Public Hearing

Written Testimony

Name: TERRY CUMMINGS

Date: 9/7/2017

Street Address or Route Number: 804 BIRCH ST.

Subject: MINING MORATORIUM REPEAL

City/Zip Code: RHINELANDER, WI 54501

Organization (*if applicable*): SELF

Registering: In Favor ☐ Against ☑

Senator Tiffany ~~tonight~~ states that the state can effectively regulate sulfide mining. That was 1997. The current ~~legislation~~ legislature has gutted and weakened the DNR - especially Sen. Tiffany. Sen. Tiffany has been a dogged advocate for violators of all types. If a sulfide mine exceeds environmental standards, can we expect:

Sen. Tiffany to bully, threaten, and intimidate DNR staff.

Sen. Tiffany to impose gag orders on DNR staff

Sen. Tiffany to slip pro-mining exemptions into the budget

Sen. Tiffany to specifically exempt a site from regulation?

— He has done all of the above.

Please return this slip to a messenger promptly.

September 7, 2017

To: Senator Tom Tiffany and the committee reviewing the Mining for America Bill

Our Northern Wisconsin way of life depends on clean water, land and air far more than we depend on jobs from the mining industry. Please do not end the common sense moratorium on metal sulfide mining. The moratorium simply asked the mining industry to prove their claims that this type of mining could be done without harming the groundwater, rivers and streams. The industry has not been able to prove that they can do that. The Flambeau River, streams and groundwater at and near the site have higher levels of many metals and contaminants than were present prior to the mine, based on the flambeau mine's own data.

If the mining cannot be done safely, the people of Wisconsin do not want it done. The citizenry has not changed their mind on this. Recent polls affirm that the people of Wisconsin still value clean water over mining jobs. That is because they know that clean air, land and water are the most important things for our lives and the future of our State.

They have their priorities straight. As a resident of Ladysmith I can tell you that almost 20 years later, the mine has had very little positive impact on our community. We still have higher unemployment and lower per capita income than the state and national averages. Our population is shrinking. I have owned a business here for 25 years and I can tell you that our community's purchase power seems to be at an all time low with wages stagnating and the cost of living and raising families continuing to rise. We have a very high rate of dependency on Medicaid, welfare and food stamps.

Please look at the facts. Don't let the mining lobbyists tell you that the mining is safe, when the data proves it is not. Do your jobs and represent your constituents who value clean water over mining jobs.

I live on the Flambeau River and so I have to live with the mistakes of the Flambeau Mine and I hope your committee will kill this bill to prevent more Wisconsin residents from much larger mining mistakes and their impact on the environment.

Thank you.

Chrysa Ostenso

Ladysmith, WI

4.11.2017

Robert E. Moran, Ph.D.
Michael-Moran Assoc., LLC
Water Quality/Hydrogeology/Geochemistry
Golden, Colorado, U.S.A.
remwater@gmail.com
remwater.org

SUMMARY
Flambeau Mine: Water Contamination and Selective "Alternative Facts"

1-Roughly 20 years after the cessation of active mining, Flambeau Mine *ground waters* are contaminated by past Flambeau Mining Company (FMC) activities. FMC data confirm that, as a minimum, *dissolved* concentrations of the following constituents significantly exceed FMCs baseline concentrations (1987-88): copper, iron, manganese, zinc, sulfate, alkalinity, hardness, total dissolved solids, specific conductance (field). Interestingly, these are practically the only parameters routinely reported by FMC in their quarterly monitoring.

FMC wells within the backfilled pit have *median* dissolved concentrations as high as the following (2014-16): Copper = 503 µg/L; Iron = 14,000 µg/L; Manganese = 33,500 µg/L; Zinc = 1200 µg/L; Arsenic = 23 µg/L; Sulfate = 1600 mg/L; Alkalinity = 610 mg/L; Hardness = 2150 mg/L; Total Dissolved Solids = 3110 mg/L; Specific Conductance = 3180 µS. These values greatly exceed baseline data and relevant water quality standards and aquatic life criteria. FMCs "baseline" ground water data report that uranium was detected in between 64 to 100% of their samples, yet uranium was not included in the routine monitoring.

2-These ground waters are also being contaminated with numerous minor / trace constituents (e.g. aluminum, arsenic, chromium, lead, nickel, uranium, etc.) as a result of FMC operations. Drawing reliable, *quantitative* conclusions about these constituents is difficult as *FMC has been allowed to characterize the water quality using data that are not representative of the actual, chemically-unstable ground waters.*

3-Parameter concentrations from most FMC wells are not quantitatively-reliable due to inadequate well construction, well development and purging, and sampling procedures. Frequently, important chemical constituents were missing from analyses, inappropriate analytical detection limits were employed, and crucial data were not reported. FMC permit reports and subsequent public documents were based on these inadequate data.

4-FMC has constructed dozens of monitoring wells since the early 1970s. Many older wells still exist, but are no longer monitored; several have been replaced, sometimes under questionable circumstances, breaking the historical data continuity.

5-FMC has incorrectly defined baseline conditions, thereby biasing later conclusions. Exploration drilling has been conducted at Flambeau since roughly 1970. Thus, hundreds or more exploration boreholes, together with road and site construction, trenches, dozens of monitoring wells and piezometers, and possibly tunnels have been constructed at the site prior to actual mining of ore. Such activities increase sediment loads and create pathways interconnecting the various horizontal and vertical portions of the local rocks, introducing atmospheric oxygen and other gases, microbes, and surface water, all of which alter the original baseline water quality and geochemical conditions. Hence, FMC's 1987-88 baseline data actually represent water quality that has been altered and somewhat degraded by these pre-mining activities.

6-FMC waste rocks were acidic and releasing contaminated leachates long before they were returned to the pit (both "low" sulfur and "high" sulfur types). Few data have been made public. One sample of water seeping from a "low" sulfur waste rock pile had a dissolved copper concentration = 50,000 μg /L. Other waste rock leachate waters were already mildly acidic by 1994 and became more acidic by the first quarter of 1996 ("low" sulfide pH = 6.3; "high" sulfide pH = 6.3); by the fourth quarter of 1996 the high sulfide waste leachates had pH = 3.1, and copper concentration = 450,000 μg/L. Chromium was reported in low sulfide waste effluents. At a pH of 3.1, it is clear that many other trace and minor elements would also be present in these leachates, but FMC failed to report them, and has failed to identify the results as "Dissolved" or "Total Recoverable".

7-During active mining (1993-97) and immediately after, FMC reported limited water quality data from wells outside the pit on a quarterly basis. A more extensive, but still inadequate list of trace constituents was not reported until 1999, and to the present time is still reported only once per year. Review of company reports revealed no actual water quality data reported for waters being discharged from the exposed pit walls, floor or ore piles.

8-Monitoring wells located outside the pit in the downgradient flow direction show clear evidence of contamination relative to baseline concentrations. For example, a well 175 feet from the Flambeau River shows dissolved manganese concentrations of 13,800 μg/L and a specific conductance of 660 μS (Oct 2016).

9-FMC has failed to define either the actual flow pathways for ground waters exiting the backfilled pit, or to define the ground water-surface water interactions. FMC has not determined whether pit seepage is limited to shallow pathways through alluvium and fractured bedrock into the river, or whether deeper pathways under the bed of the river may be viable. Apparently no recent monitoring of wells on the west side of the river (opposite side from pit) has been conducted by FMC or the State. Thus, it is also not possible to determine whether ground waters west of the Flambeau River have been negatively-impacted by FMC operations.

10-Similar sulfide deposits, worldwide, routinely contain elevated concentrations of: aluminum, antimony, arsenic, barium, cadmium, copper, chromium, cobalt, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, zinc, sulfate, sulfide, nitrate, ammonia, boron, fluoride, chloride, natural radioactive constituents (sometimes uranium, radium, thorium, potassium-40, gross alpha and beta). Flambeau rocks and waters likely contain these constituents, but adequate

analytical results for many of these constituents were never made public. All similar massive sulfide deposits generate degraded water quality in the long-term.

11-The Flambeau River also received contaminants from numerous other sources of FMC property effluents: surface inflows from a tributary of the Flambeau River that crosses the southeast corner of the mine site (Stream C); the Copper Park Lane drainage ditch and other facilities adjacent to the ore crusher and rail spur; wetlands, storm runoff; stockpiled waste rock leachates and seeps; ore stockpiles; releases from the settling ponds; interceptor well discharges; inadequately-treated effluents from the Waste Water Treatment Plant (WWTP); clarifier underflow solids (sludges from WWTP). Several sources are presently contributing contaminants to the Flambeau River via surface water pathways, and possibly also via ground water pathways.

Contaminated discharges from the southeast corner of the FMC site have resulted in Stream C being added to the Environmental Protection Agency (EPA) impaired waters list for exceedances of acute aquatic toxicity criteria for copper and zinc. Since 1998, FMC has instituted six different work plans to address this soil and water contamination issue. As of fall 2016, copper levels in the Flambeau River tributary still exceed the acute toxicity criterion, and FMC has not secured a mine reclamation Certificate of Completion (COC) for this portion of the mine site.

12-Data are inadequate to demonstrate that Flambeau River chemical concentrations have been degraded, but *loads (mass)* of various metals, metalloids, sulfate, sediments, etc. have increased. Increasing the mass of metals in the Flambeau River, either as dissolved or particulate forms (suspended or bedload sediments), has the potential to harm the aquatic biota because these organisms are capable of consuming metal-laden particulates.

13-As the west end of the Flambeau pit is within 140 ft. of the Flambeau River, FMC should have been required to report all water quality constituents that have relevant Standards and Criteria (during both baseline and routine monitoring), to determine whether FMC releases might be damaging to any of the relevant water uses: human consumption; aquatic life; agricultural and irrigation. Such data would have required collection of both *filtered (Dissolved) and unfiltered (Total) samples for analysis of a much wider list of chemical constituents employing appropriate detection limits.* Unfiltered sample data are especially relevant where impacts to aquatic life may be anticipated. *Fish and macroinvertebrates are capable of ingesting both dissolved and particulate forms of chemicals discharged into aquatic environments, aggravating potentially-toxic impacts to the aquatic species and concentration up the food chain.*

14-The narrative "predictions" made by FMC's main Wisconsin consultant in the various permit-related and Annual Reports appear to be largely naïve geochemically and hydrogeologically. It is doubtful that these statements represented the opinions of FMCs technical experts. Such statements are most useful for obtaining permits, less so for generating quantitatively-reliable predictions.

15-Backfilled waste rock was mixed with limestone to minimize the formation of acid and release of trace constituents into the pit waters. However, the rise in pH due to the addition of limestone (or especially lime) can also generate conditions that increase the water concentrations of those trace elements that form mobile species *at elevated pHs, such as aluminum, arsenic, antimony, chromium, manganese, nickel, selenium, molybdenum, uranium, zinc, etc.* The Flambeau Mining Feasibility Study by Pincock Allen & Holt Inc. likely contains data on such testing. *Feasibility studies are required to inform potential investors, but normally are not released to the public.*

16-Wastes from the FMC operation will remain onsite *forever.* While limestone was added to the waste rock as it was backfilled into the pit, the ability of the limestone to neutralize the formation of acid waters is limited and finite. After the limestone has reacted with the waste rock, its neutralizing action will cease and the *pit waters are likely to become increasingly acidic and the concentrations of potentially-toxic contaminants are likely to increase.* The deeper pit well waters already show evidence of increased degradation of water quality, in roughly 20 years, post-closure. It is reasonable to conclude that the Flambeau ground and surface water quality will further degrade in the coming decades if current site maintenance practices continue.

17-I know of no metal-sulfide mines anywhere in the world that have met the criteria of Wisconsin's 1998 moratorium on issuance of permits for mining of sulfide ore bodies without degrading the original water quality, long-term.

18-Obviously the mining and remediation practices employed at Flambeau do not represent a *sustainable, long-term solution.* While FMC may have satisfied State oversight and disclosure requirements, the site ground waters are contaminated, and *these waters would require expensive, active water treatment to be made suitable for most foreseeable uses. Historically, most such costs are paid by the taxpayers.*

19-FMC and their contractors supplied all of the data and interpretations used to compile the permit-related reports and subsequent Annual Reports. Such an approach obviously reflects FMC's interests, but is likely quite different from financially-independent, public-interest science. In short, the Flambeau Mine is the poster child for a severely-flawed permitting and oversight process, that has likely generated long-term public liabilities.

20-Flambeau ground and surface water quality is being and has been degraded—despite years of industry public relations statements touting the success of the FMC operation. Rio Tinto said in a 2013 public relations (PR) release regarding the Flambeau Mine: "Testing shows conclusively that ground water quality surrounding the site is as good as it was before mining." In efforts to encourage development of the other metal-sulfide deposits in northern Wisconsin and the Great Lakes region, the industry approach has been to simply repeat this false statement over and over, assuming that repetition will make it believed. Unfortunately, the FMC data show otherwise.

HARDROCK MINE RECLAMATION AND REGULATION

<u>HOW CHANGING VALUES and CHANGING LAW CAUSED HARDROCK MINES to DESIGN, BUILD, and OPERATE for LONG-TERM CLOSURE and RECLAMATION: A FEDERAL and STATE REGULATORY SUCCESS STORY</u>

prepared for the

AMERICAN EXPLORATION & MINING ASSOCIATION

(Formerly Northwest Mining Association)
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July 2017

TABLE OF CONTENTS

1.0 Executive Summary 1

2.0 Hardrock Mine Regulation Effectiveness – EPA has never determined that any hardrock mine approved by a federal or a Western State agency after 1990 to be among the "top priority among known response targets"............... 3

2.1 EPA's National Priorities List for CERCLA Cleanup 3

2.2 A specific hardrock mine clean-up case study cannot be used to evaluate the effectiveness of current hardrock mine regulation if that specific hardrock mine had not been subjected to regulation prior to its design and construction 4

2.3 Hardrock mines on the National Priorities List must be rationally classified into three (3) major eras based upon applicable regulation or the lack thereof: (1) Pre-Regulatory Era (prior to 1970); (2) Transition Regulatory Era (1970 through 1990); and, (3) the Regulated Hardrock Mine Era (post-1990).. 5

2.4 Northwest Mining Association June 30, 2013 Comments on EPA's Bristol Bay Watershed Assessment determined that current hardrock mining regulations were protective of the environment, citing to specific federal and state government studies that explicitly support this conclusion..7

2.5 The 2015 Enviroscientists Report confirms the NWMA/(AEMA) Comments on EPA's Bristol Bay Watershed Assessment in June 2013 that determined that no Western hardrock mine has been placed on the CERCLA NPL since 1990........... 8

3.0 Current hardrock mine regulation is protective of the environment, as determined by: (1) the United States National Academy of Sciences; (2) the Western Governors Association; and, (3) Senator Murkowski's 2011 Investigation 10

3.1 The National Academy of Sciences/National Research Council has determined that existing hardrock mine regulation on federal land is "complicated but generally effective" in protecting the environment.......10

3.1.1 The NAS/NRC Report determined that "[s]imple 'one-size-fits-all' solutions are impractical because mining confronts too great an assortment of site-specific technical, environmental, and social conditions."............. 10

3.1.2 The NAC/NRC Report correctly characterizes the current hardrock mining industry as having minimal impact on public lands and the NAC/NRC Report also correctly characterizes the importance of the hardrock mining to the US economy and to US manufacturing................ 11

3.2 Current hardrock mine regulation continues to be protective of the environment on federal lands as further evidenced by the United States Forest Service and United States Bureau of Land Management Responses to Senator Murkowski's 2011 Investigation....11

3.3 The Bi-Partisan Western Governors' Association confirms that the Western States "have a proven track record in regulating mine reclamation in the modern era, having developed appropriate statutory and regulatory controls" that are "protective of human health and the environment" as well as being protective of public treasuries....11

3.4 Current hardrock mine regulation is protective of the environment on all federal and state Western lands - A Summary 14

4.0 Changing Societal Values – The Great Depression, World War II, the Cold War, and the Modern Environmental Movement.... 125

4.1 Prior to 1970, there was virtually no direct regulation of municipal sewage, industrial wastes or hardrock mines. 15

4.2 Societal Values of "The Greatest Generation" 15

4.3 Cultural Balance 18

4.4 The Modern Environmental Movement 18

4.5 Cultural and Legal Changes Incorporating Environmental Values.... 18

5.0 Development of Legally-Applicable Hardrock Mine Regulation 19

5.1 Regulation of the Natural Media Receptors – An Overview 19

5.2 Surface Water 20

5.3 Groundwater Protection at Hardrock Mines 21

5.3.1 State Protection of Groundwater at Hardrock Mines.... 21

5.3.2 Federal Protection of Groundwater at Hardrock Mines.... 21

5.4 Hardrock Mine Reclamation, Fincial Assurances and Water Quality Protection .. 22

5.5 The National Environmental Policy Act of 1970 24

5.6 Evaluation of the Effectiveness of Hardrock Mine Regulation based upon the Timing of Regulatory Developments.... 25

6.0 Conclusion 27

1.0 Executive Summary

The federal and state regulation of hardrock mining and milling facilities (collectively, "hardrock mines")[1] is a success story of environmental protection that is well-illustrated by the fact that of the **none** of the Western hardrock mines that were designed, built and/or approved in the last 26 years are on the United States Environmental Protection Agency ("EPA") National Priorities List of environmental cleanup sites. To characterize this another way, there has never been an environmental problem at a hardrock mine approved by a federal or state agency in the West after 1990 that required EPA to make any such hardrock mine a Superfund "top priority among known response targets." Finally, and most succinctly, no hardrock mine permitted/approved in the West after 1990 has ever been placed on EPA's Superfund National Priorities List. This is in stark contrast to Western hardrock mines designed and built prior to 1970 when there were no regulatory approvals for such facilities and no cultural guidelines.

The reasons for this are straightforward and summarized below.

Current hardrock federal and state mine regulation is protecting the environment. This is not just the opinion of the relevant agencies or the hardrock mining industry. It is also the opinion of the federal government's National Academy of Sciences/National Research Council and the bi-partisan Western Governors' Association.

In 1999, the federal government's independent National Academy of Sciences/National Research Council produced a comprehensive report entitled "Hardrock Mining on Federal Lands" regarding then-current hardrock mine regulation on lands managed by the federal government and states agencies and determined:

> The overall structure of the federal and state laws and regulations that provide mining-related environmental protection is complicated but generally effective.
>
> ...
>
> Simple "one-size-fits-all" solutions are impractical because mining confronts too great an assortment of site-specific technical, environmental, and social conditions. Each proposed mining operation should be examined on its own merits. ... **Recommendation: BLM and the Forest Service should continue to base their permitting decisions on the site-specific evaluation process provided by NEPA [National Environmental Policy Act].** ...

[1] For the purposes of this study, "hardrock mine" includes any facilities deemed to be a "mining" or "beneficiation" facility by the EPA. EPA has defined "mining and beneficiation" to include, generally, all metal mines, but EPA's use of the term "hardrock mine" also includes many non-metallic industrial mineral mines, such as phosphate rock, trona, fluorospar, and mica, as well as the mills required to concentrate the target minerals of these ores. See generally 40 C.F.R. 261.4(b)(7)(July 15, 2016). In common usage, EPA's "mining and beneficiation" is more typically referred to as "hardrock mining and milling" or just for the purposes of this Report sometimes "hardrock mine."

"Hardrock Mining on Federal Lands," National Academy of Sciences/National Research Council, Executive Summary, p. 5. Importantly, the bi-partisan Western Governors Association has determined that the Western States, which regulate hardrock mining on state and private lands within their borders, "... impose permit conditions and stringent design and operating standards, to ensure that hardrock mining operations are conducted in a manner that is protective of human health and the environment." WGA, Policy Resolution 10-16, Background (A)(8) ("National Minerals Policy"). Moreover, the states and federal agencies have continued to strengthen their reclamation and financial assurances requirements on an ongoing basis.

The correctness of the 1999 National Academy of Sciences determinations were revalidated and confirmed by Senator Murkowski's 2011 Investigation, when the United States Forest Service ("Forest Service") and the United States Bureau of Land Management ("BLM") reported to the Senator that out of 3,344 mining plans of operations approved by these two agencies since 1990, **none of these 3,344 federal mine plan approvals created an environmental problem that caused EPA to place any of these hardrock mines on EPA's highest priority environmental clean-up sites.** Therefore, Senator Murkowski's study objectively demonstrates the continued correctness of the National Academy/National Resources Council's 1999 determinations.

The development of the effective hardrock mine regulation and reclamation of the Forest Service, the BLM and Western States did not occur overnight. There was a "learning curve" that took a couple of decades. But the single most important factor creating effective hardrock mine regulation has been an American cultural shift since about 1970 with the advent of the modern environmental movement. Prior to 1970, municipal waste, industrial waste and hardrock mines were not regulated to protect the environment. Protecting the environment was not a major societal priority. The US hardrock has incorporated these environmental values into the cultural fabric of the industry.

The absence of environmental protections prior to 1970 was, in significant part, a legacy of the then-dominant American cultural focus from the Great Depression on jobs and the economy, followed immediately by World War II, the Cold War and the Korean War. All of these nation-threatening events caused the federal government to force dramatic and environmentally-harmful national efforts to quickly and heroically increase the chain of industrial and manufacturing production to historic heights. Hardrock mining was (and remains) the first and primary link in much of the manufacturing chain. Much of the CERCLA hardrock mine negative environmental legacy arose during this period or long before. Even in the late 1950s, President Eisenhower's forward-looking "Blueprint for America" did not even mention the environment.

The modern environmental movement, symbolized by the first Earth Day and by the enactment of the National Environmental Policy Act in 1970, evidenced a shift of our society from one that had been almost wholly-focused on industrial and manufacturing production values to a society where environmental values had a role, too. This shift in values was implemented by changes in law and regulation over the next twenty years as the United States adjusted to this more balanced approach to hardrock mining. As

discussed below, these laws, regulations and the collective experience of federal and states agencies, as well as the hardrock mine industry (learning from regulatory omissions along the way) have created a regulatory climate and an operating culture in which current hardrock mine regulation is an effective protector of the environment.

Hardrock mines designed and built prior to 1970 were developed to maximize production and minimize cost with little or no regard for environmental values. Importantly, however, after 1990, all new hardrock mines have been designed, built and operated to integrate long-term environmental closure and reclamation as a primary design standard. This is required by current law, but it is also required by the U.S. culture, generally, and by the U.S. hardrock mining industry, specifically.

Therefore, the EPA cannot rationally use information about environmental closure and reclamation costs from hardrock mines designed and approved prior to 1970 to assess the degree and duration of environmental risk associated with hardrock mines in 2017. Doing so would be as absurd as assuming that the design flaws of the 1964 Chevrolet Corvair, made infamous by Ralph Nader's 1966 book "Unsafe at Any Speed," should be used to assess whether any new National Highway Traffic Safety rules are needed in 2017. In both the hardrock mine and the NHTSA examples, the result of such assessments would be equally hopeless and comically out of date.

The Forest Service, the BLM, and the Western States reclamation agencies, in concert with the hardrock mining industry environmental management, have prevented any hardrock mine, designed and approved after 1990, from being deemed by EPA to be a "top priority" cleanup site.

This achievement is a genuine "success story."

2.0 Hardrock Mining Regulation Effectiveness – EPA has never determined that any hardrock mine approved by a federal or a Western State agency after 1990 to be among the "top priority among known response targets"

2.1 EPA's National Priorities List for CERCLA Cleanup

The federal "Comprehensive Environmental Response Compensation and Liability Act of 1980, as amended (commonly referred to as "CERCLA" or "Superfund"), requires EPA to publish the National Priorities List annually to identify the "national priorities among known releases or threatened releases [of hazardous substances] throughout the United States ...."[2] The National Priorities List identifies "[t]o the extent practicable, ... [EPA's] 'top priority among known response targets'...."[3] The National Priorities List ("NPL") includes over 1100 sites, which includes only about 50 hardrock mining sites, which, in turn are almost all pre-1970 facilities.[4]

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[2] 42 U.S.C. Section 9605(a)(8)(B).

[3] Id.

[4] http://www.epa.gov/superfund/sites/npl (March 30, 2012). Unfortunately, EPA had prepared and electronically-published a Table designated "Summary – Mining Sites on the National Priorities List"

EPA has specifically determined that hardrock mining wastes pose significantly lower environmental risk than "mineral processing" wastes, and so EPA has determined that "high volume" "low hazard" wastes should not be regulated as if they were "hazardous wastes."[5] Therefore, information about environmental problems with inorganic chemical plants and mineral processing facilities that generate actual "hazardous waste" does not provide any useful information to assess the environmental issues associated with hardrock mines. Accordingly, even more importantly, environmental regulatory issues associated with mineral processing facilities and inorganic chemical plants provide no information about the current regulation of hardrock mining. Mineral processing and inorganic chemical plants are subject to substantially different regulatory programs, standards and procedures than hardrock mines. In short, to have an intelligent discussion about the effectiveness of hardrock mine regulation one must evaluate hardrock mining and milling facilities that were actually subject to regulation since 1990. EPA's now-defunct NPL Mining Sites List failed to do this, since almost one-half of the EPA's so-called "Mining Sites" were in fact mineral processing or inorganic chemical plants.

2.2 A specific hardrock mine clean-up case study cannot be used to evaluate the effectiveness of *current* hardrock mine regulation if that specific hardrock mine had not been subjected to regulation prior to its design and construction

One cannot evaluate the effectiveness of hardrock mine regulation if one does not first consider whether or not a case study hardrock mine had been subject to regulation, and then second, if applicable, one must consider the nature of the specific regulation to which a hardrock mine had been subject to regulation *prior to its design and construction*. Obviously, it is utterly pointless, absurd, and deliberately misleading, to pretend to "evaluate" the effectiveness of hardrock mine regulation with reference to any hardrock mine that has never been subject to regulation! Nevertheless, nongovernmental organizations (NGO's) that seek their funding by opposing hardrock mines inevitably use

("EPA's Mining Site List," May 2013, www.epa.gov/aml), but EPA's Mining Site List was highly misleading because it did not include only hardrock mines, nor even just "hardrock mining and milling sites." Unfortunately, EPA's "Mining Sites List" included large numbers of downstream inorganic chemical plants and "mineral processing" sites that are not hardrock mines. This critical substantive distinction seems to have given rise to multiple legal actions filed by non-governmental organizations ("NGO") against the hardrock mining industry and against EPA speciously seeking regulation of hardrock pursuant CERCLA 108(b). Fortunately, after the NWMA/AEMA provided its public comments regarding EPA's fatally-flawed "Summary – Mining Sites on the National Priorities List" and other closely-related issues in EPA's "Bristol Bay" public docket (see discussion in Section 2.4 below), EPA terminated its dissemination of this particular grossly misleading information by removing it from EPA's website. Nonetheless, the NGO legal challenges against the mining industry that were apparently supported, in part, by EPA's years of misinformation regarding the hardrock mining industry, continue to this day.

[5] See 50 Fed. Reg. 40,292 (Oct. 2, 1985); EPA, "Report to Congress, Wastes from the Extraction and Beneficiation of Metallic Ores, Phosphate Rock, Asbestos, Overburden from Uranium Mining, and Oil Shale," (Dec. 31, 1985); 55 Fed. Reg. 32,135 (Aug. 7, 1990); and EPA, "Report to Congress on Special Wastes from Mineral Processing" (July 1990).

historical and factually irrelevant examples to suggest there are current problems with hardrock mines in both regulatory and litigation settings.[6]

Hardrock mines designed and built prior to 1970 were developed to maximize production and minimize cost, but after 1990, all new hardrock mines have been designed, built and operated to integrate long-term environmental closure and reclamation as a primary design standard, as required by current law and culture. Therefore, the success of hardrock mining regulation must be evaluated by using reasonably current applicable rules.

No one would suggest that General Motors (GM) should be prohibited from producing cars in 2017 or subject to new regulation because, in 1965, GM produced the Corvair (deemed "unsafe at any speed" by Ralph Nader[7]) which does not meet 2017 standards. Yet, critics of the hardrock mining industry repeatedly and constantly describe environmental problems at hardrock mines that were designed and operated prior to 1970 as illustrative of current hardrock mine.[8] This is absurd.

Hardrock mines designed and operated prior to 1970 were in place long before hardrock mines were subject to any regulation whatsoever. Thus, it is critical to determine, even if only generally, the extent to which any hardrock mine used as an example or case study to evaluate the effectiveness of hardrock mine regulatory programs has actually been subject to relevant regulatory programs.

2.3 Hardrock mines on the National Priorities List must be rationally classified into three (3) major eras based upon applicable regulation or the lack thereof: (1) Pre-Regulatory Era (prior to 1970); (2) Transition Regulatory Era (1970 through 1990); and, (3) the Regulated Hardrock Mine Era (post-1990).

Hardrock mine regulation must be classified into 3 major eras based upon the extent of applicable regulation or the lack thereof: (1) Pre-Regulatory Era (prior to 1970); (2) Transition Regulatory Era (1970 through 1990); and, (3) Regulated Hardrock Mine Era (Post-1990). Below, Section 4.0 ("Changing Societal Values – The Great Depression, World War II, the Cold War, and the Advent of the Modern Environmental Movement") provides some of the policy history supporting use of these three temporal classifications. Further below, Section 5.0 ("Development of Legally-Applicable Hardrock Mine

[6] Maest, A.S., Kuipers, J.R., Travers, C.L. and Atkins, D.A., 2005, "Predicting Water Quality at Hardrock Mines: Methods and Models, Uncertainties, and State-of-the Art." But importantly also see, Schlumberger Water Services, 2013, "Technical Review of the Kuipers Maest, 2006, 'Comparison of predicted and actual water quality at hardrock mines: The reliability of predictions in Environmental Impact Statements,'" p. 1, that determined *inter alia* that "The conclusions contained in the [Maest Kuipers, 2006] report are not relevant to any current mines that are being permitted, or to any future mines ...[because] [m]odern-day characterization and analysis techniques have changed so radically from virtually all of the studies cited by the report that it is meaningless to draw any comparison to modern-day conditions." Emphasis added.

[7] Nader, Ralph, Unsafe at any speed: The Designed in Dangers of the American Automobile, Grossman Publishers, 1965.

[8] See footnote 6, supra.

Regulation") provides a summary of the primary legal support for using these three (3) temporal classifications.

Facilities designed and constructed in the Pre-Regulatory Era (prior to 1970) provide no useful information about the effectiveness of current hardrock mine regulation "predictions" since Pre-Regulatory Era Hardrock Mines were designed, constructed and operated to maximize production and minimize cost. Pre-Regulatory Era Hardrock mines did not even consider long-term environmental closure and reclamation. In stark contrast, long-term environmental closure and reclamation are required by current federal and state law, while Pre-1970 hardrock mines were never subject to any regulation whatsoever. Even worse, Pre-Regulatory Era facilities were conceived, designed and operated even before environmental values were imbedded in the American culture. Thus, when subsequently enacted laws and regulations were applied to these facilities after-the-fact, such regulatory efforts could not influence the facility design and construction. Thus, such regulation could never hope to prevent *all* releases to the environment from facilities. For example, tailings facilities from the Pre-Regulatory Era were often designed to release to the ground water for reasons of structural safety, while even simple release-reporting to ground water was only required starting in the 1980s, and even then, only under certain limited circumstances. In short, pre-1970 Pre-Regulatory Era facilities were not conceived, designed or operated with significant concern for the environment.

Importantly, even hardrock mines designed and constructed during the Transition Regulatory Era were often not subject to direct regulatory approvals. But at least there was an increasing cultural awareness of the regulated community and the government that environmental values needed to be considered, even if imperfectly. However, *those Transition Regulatory Era Mines that were actually subject to regulation* were never subject to full control of surface and ground water regulation and geochemical predictive modeling that characterizes current hardrock mine permitting.

For example, in 1985, it was EPA's assessment was that "EPA data on management methods at mining facilities indicate that only a small percentage of mines currently [i.e., 1985] monitor their ground water, use run-on/run-off controls or liner, or employ leachate collection, detection, and removal systems." 50 Fed. Reg. 40,292 (Oct. 2, 1985); EPA, "Report to Congress, Wastes from the Extraction and Beneficiation of Metallic Ores, Phosphate Rock, Asbestos, Overburden from Uranium Mining, and Oil Shale," (Dec. 31, 1985) ("RTC I," p. ES-10.) Therefore, as a practical matter, according to EPA, any discussion of the effectiveness of "environmental predictions" at facilities designed and approved prior to 1985 is utterly meaningless. To restate this point, hardrock mining facilities designed and approved prior to 1985 do not provide any useful information about current regulation of hardrock mines because pre-1985 hardrock mines were not designed, built and operated to integrate long-term environmental closure and reclamation. This is in sharp contrast to current law and regulation.

Therefore, per EPA, there was almost no comprehensive regulation of ground water discharges prior to 1985. Of course, such programs were not created overnight. Even in

1990, programs specifically designed to preclude groundwater releases from mining facilities were in their infancy and geochemical "predictive" modeling was largely conceptual at that time. Modern geochemical predictive modeling really did not begin practical application as a regulatory tool in the mid-1990s. For example, Earthworks, a group that opposes the hardrock mining industry, contracted for a report "Predicting Water Quality at Hardrock Mines: Methods and Models, Uncertainties, and State-of-the Art" in which of 202 references cited to, only 28 dated from before 1990, and most of the directly pertinent geochemical references have been published since 2000.[9] Nevertheless, if one evaluates and then assigns each hardrock mine that EPA has deemed to be among its "top priority among known response targets" (i.e., the NPL) to the major regulatory era when it was designed, constructed and approved, then a very clear and incontestable picture develops, as discussed immediately below.

2.4 Northwest Mining Association June 30, 2013 Comments on EPA's Bristol Bay Watershed Assessment determined that current hardrock mining regulations were protective of the environment, citing to specific federal and state government studies that explicitly support this conclusion.

The American Exploration & Mining Association (AEMA) (formerly Northwest Mining Association or "NWMA") provided comments to EPA's Bristol Bay Watershed Assessment concerning the Alaskan Pebble Project on June 30, 2013 regarding the effectiveness of existing hardrock mine regulation. Baird, 2013, "Hardrock Mining Reclamation and Reclamation – Developing Sustainable Environmental Protection through Changing Values, Changing Laws and Experience: A Federal State Success Story" (the "NWMA 2013 Study"). The NWMA 2013 Study provides detailed support to arrive at its conclusions that:

> Current Hardrock Mining regulation is protecting the environment. However, this is not just the opinion of the relevant agencies or the Hardrock Mining industry; it is the opinion of the National Academy of Sciences and the bi-partisan Western Governors' Association.

Unfortunately, EPA apparently wholly-ignored the NWMA 2013 Study with regard to the "Bristol Bay Watershed Assessment," except that the NWMA 2013 Study may have caused EPA's to terminate use of its so-called "NPL Mining Site List." Nevertheless, to date, EPA has never referenced the NWMA/AEMA's 2013 Study.

AEMA must assume EPA's failure to acknowledge the relevant indisputable facts described in NWMA's 2013 Report has something to do with the bias that occurred within EPA regarding the "Bristol Bay Watershed Assessment." More specifically, the respected Cato Institute "think tank" has stated:

> Because there was never a mining permit application [submitted for the Pebble Project], EPA charged a senior biologist (not a mining engineer)

[9] See footnote 6, <u>supra</u>.

> named Phillip North to design a worst case scenario open-pit 'hypothetical mine' that could never be approved. ... North then proceeded to 'model' the maximum deleterious impact of the nonexistent, unplanned, and imaginary mine ...
>
> EPA and North simply ignored ... [a $150,000,000 in scientific study of the] biology, ecology, and dynamics of the Bristol Bay watershed. EPA and North simply ignored this remarkable repository of information before admitting, during the entire time that the Bristol Bay Watershed Assessment was written (2011-2014), that it was never really intended to provide a scientific foundation for regulatory decision-making, after all.
>
> ...
>
> While he was creating his hypothetical mine, Mr. North also coached anti-Pebble activists on how to petition his own Agency to stop the real permit application. It appears he even wrote petitions. ...

Mamula, Ned and Michaels, Patrick J., 2016, "A Green Mess: Is EPA in Hot Water over Alaska's Bristol Bay?" http://www.cato.org/publications/commentary/green-mess-epa-hot-water. Importantly, when the House Oversight Committee sought to bring Mr. North before a Committee Hearing in 2013:

> ... he delayed, bobbed and weave, and suddenly pulled his children out of school and fled the country.

Id. Therefore, the AEMA/NWMA must assume that the important information that it has previously presented to EPA regarding the adequacy of existing hardrock mine reclamation has been lost to EPA's unethical Bristol Bay Watershed Assessment sideshow.

Accordingly, the AEMA has developed this document in 2017 to further support its and refine the NWMA's original demonstration that currently, federal and state hardrock mine reclamation programs and financial assurance mechanism are protective of the environment. Therefore, the AEMA commissioned the independent expertise of Enviroscientists, Inc. to review and assess NWMA's 2013 Report to be sure that its information is fully considered by future EPA actions.

2.5 The 2015 Enviroscientists Report confirms the AEMA/NWMA Comments on the Bristol Bay Watershed Assessment in June 2013 that determined that no Western hardrock mine has been placed on the CERCLA NPL since 1990

Dr. Richard DeLong of Enviroscientists, Reno, Nevada, has completed an assessment of U.S. Environmental Protection Agency's National Priorities List ("NPL") for Mining and Milling Sites. Please see attached "Memorandum" from Richard DeLong to Joe Baird,

Baird Hanson LLP, dated, May 15, 2015, "Assessment of Mining and Milling Sites on the National Priorities List" ("Enviroscientists Memo"). Dr. DeLong's analysis states:

> There are over 1,100 sites on the NPL. Of those, there are 100 that the EPA has classified as MMS [i.e., "Mining and Milling Sites"]. However, only 55 of those sites are actual mining operations where mineral resources were extracted from the earth. The other 45 are mineral processing facilities where a mineral product is delivered to the operation for further processing. The 55 "hardrock" MMS on the NPL fall into the following temporal classifications: 49 are prior to 1970; five are from 1970 through 1990; and one is post-1990 and it is the Barite Hill property in South Carolina.

Therefore, per the Enviroscientists' Memorandum, the 55 Mining and Milling sites on the NPL fall into the following temporal classifications:

Pre-Regulatory Era (prior to 1970)	49
Transition Regulatory Era (1970 through 1990)	5
Regulated Hardrock Mine Era (post-1990)	1[10]

By eliminating the "red herring" mineral processing and inorganic chemical plants from the EPA's so-called "Mining" Sites List of 100 sites, the EPA List can be corrected to include about 55 sites that are hardrock mining sites, but **only if** one includes hardrock mining sites from ***all*** eras, including many historic facilities dating back to the 1800s, which obviously provided no information about 20th century mine design, construction, operation and reclamation/closure practices, let alone 21st century practices.

Obviously, and most importantly from the perspective of evaluating the success of current hardrock mine regulation, *none* of the hardrock mines on the National Priorities List were approved after 1990 in the West.[11] Moreover, this is validated and updated regarding federal lands by the Forest Service and the BLM, as discussed immediately below.

[10] Barite Hill, McCormick County, South Carolina, EPA Facility ID SCN000407714. According to EPA, from 1991 to 1995, gold and silver mining was conducted at the site.

[11] It is important to note that eliminating mineral processing and inorganic chemical plant sites almost certainly does not affect the number of regulated facilities from EPA's so-called Mining Site List that would be deemed to be located on the NPL since 1990. In fact, there have been very few new mineral processing facilities constructed since 1990, other than updating of existing facilities (e.g., Rio Tinto's Utah Copper Division) or use of small "mineral processing" facilities such as the dore furnaces commonly located at gold mines. Very few, if any, new large regional mineral processing facilities have been constructed since 1990. Nevertheless, one cannot have an intelligent discussion about the efficacy of or even enumerate the issues related to regulating hardrock mines and mills if the data includes information about mineral processing and inorganic chemical plants.

3.0 Current hardrock mine regulation is protective of the environment, as determined by: (1) the United States National Academy of Sciences; (2) the Western Governors Association; and, (3) Senator Murkowski's 2011 Investigation.

3.1 The National Academy of Sciences/National Research Council has determined that existing hardrock mine regulation on federal land is "complicated but generally effective" in protecting the environment.

In 1999, the federal government's independent National Academy of Sciences/National Research Council ("NAS/NRC"), including several-related organizations,[12] produced a comprehensive report entitled "Hardrock Mining on Federal Lands" regarding then-current hardrock mine regulation on lands managed by the Forest Service and the Bureau of Land Management and determined:

> The overall structure of the federal and state laws and regulations that provide mining-related environmental protection is complicated but generally effective.
>
> ...

NAS/NRC, 1999, "Hardrock Mining on Federal Lands," p.5. Importantly, the NAS/NRC also identified a number of areas where implementation of existing laws could be improved, Id., pp. 6 – 9, and all of the NAS/NRC recommendations that increased the protection of the environment have since been adopted into current federal law.

Importantly, the Forest Service and the BLM continue to improve their programs. Since the 1999 NAS/NRS determination, for example, the Forest Service developed a new "Training Guide for Reclamation Bond Estimation and Administration – For Mineral Plans of Operation authorized and administered under 36 CFR 228A" in 2004, which considered the decades of experience that had developed concerning creating financial assurances and distilled much of this practical knowledge into the Forest Service manual. Additionally, in 2001, the BLM expanded its program to provide for financial assurances on all surface disturbing activities, including notice-level exploration projects affecting fewer than five acres. Thus, the hardrock mining regulation protecting federal land is continually improving and adjusting to take into account the lessons learned from experience, as is required pursuant to NEPA "adaptive management" strictures. These existing regulatory programs already substantially limit or eliminate the degree and duration of environmental risk associated with the current hardrock mining industry.

3.1.1 The NAS/NRC Report determined that "[s]imple 'one-size-fits-all' solutions are impractical because mining confronts too great an assortment of site-specific technical, environmental, and social conditions."

[12] "Committee on Hardrock Mining on Federal Lands," "Committee on Earth Resources," "Board on Earth Sciences and Resources," "Commission on Geosciences, Environment, and Resources."

Over the last 40 years, the Forest Service and the BLM have developed complicated, but nonetheless workable and environmentally protective programs under the auspices of their own authorities comprehensively coordinated by the National Environmental Policy Act ("NEPA") to properly evaluate and take into account site-specific conditions. The NAS/NRC properly characterizes the situation.

> Conclusion: Federal land management agencies' regulatory standards for mining should continue to focus on the clear statement of management goals rather than on defining inflexible, technically prescriptive standards. Simple 'one-size-fits-all' solutions are impractical because mining confronts too great an assortment of site-specific technical, environmental, and social conditions. Each proposed mining operation should be examined on its own merits. … Recommendation: BLM and the Forest Service should continue to base their permitting decisions on the **site-specific evaluation** [emphasis added] process provided by NEPA. The two land management agencies should continue to use comprehensive performance-based standards rather than rigid, technically prescriptive standards. …

"Hardrock Mining on Federal Lands," Executive Summary, p.5. The NAC/NRC emphasis on the criticality of site-specific evaluation is emphasized by NEPA, CERCLA's ARARs process and state permitting for determining rational standards that are protective of the environment and create realistic mechanism for reclamation guarantees.

3.1.2 The NAC/NRC Report correctly characterizes current hardrock mining industry as having minimal impact on public lands and NAC/NRC Report also correctly characterizes the importance of hardrock mining to the US economy and to US manufacturing

The NAC/NRC Report "… respond[ed] to a request by Congress that the National Research Council assess the adequacy of the regulatory framework for hardrock mining on federal lands." "Hardrock Mining on Federal Lands," Executive Summary, p. 1. Importantly, the Report states that "[t]he area of federal land available to hardrock mining in the Western states is enormous, but the surface area actually physically disturbed by active mining is small in comparison … [a]pproximately 0.06% of BLM lands are affected by active mining and mineral exploration operations." Id. And, "while society requires a healthy environment, it also requires sources of materials, many of which can be supplied only by mining." Id. Importantly:

> Regulations intended to control and manage the alteration of the landscape and the environment in an acceptable way are generally in place and are updated as new technologies are developed to improve mineral extraction, to reclaim mined lands, and to limit environmental impacts.

Thus, the NAC/NRC Hardrock Mining Report correctly notes that hardrock mining has a minor surface area "footprint" relative to total federal lands, and that society requires mining for survival.

3.2 Current hardrock mine regulation continues to be protective of the environment on federal lands as further evidenced by the United States Forest Service and the United States Bureau of Land Management Responses to Senator Murkowski's 2011 Investigation

By letter dated, March 8, 2011, Senator Murkowski's (R-AK) asked the Forest Service and the BLM how many mine plans of operations ("MPOs") the agencies had approved since 1990 and asked how many of those approved MPO facilities subsequently were listed by EPA on the NPL? The Forest Service responded to Senator Murkowski by stating that they had approved 2,685 MPOs since 1990 and stated that none of these required EPA to place them on the NPL. The BLM responded to Senator Murkowski by stating that they had approved 659 MPOs after 1990 and stated that none of these required EPA to place them on the NPL.

Thus, the 1999 NAS/NRC determination that current hardrock mine regulation was protective of federal lands was additionally confirmed and updated by Senator Murkowski's 2011 Investigation.

3.3 The Bi-Partisan Western Governors' Association confirms that the Western States "have a proven track record in regulating mine reclamation in the modern era, having developed appropriate statutory and regulatory controls" that are "protective of human health and the environment" as well as being protective of public treasuries

The Western Governors' Association has repeatedly determined that current Western States' hardrock mine regulation is protective of human health and the environment. The Western States have agencies and staffs that have been exclusively dedicated to prospective mine regulation and to prospectively requiring mine operating and mine reclamation plans. Additionally, good regulatory work and correct mine financial assurances have not only protected public health and the environment, but these regulatory programs have also protected state and federal public treasuries. Importantly, these WGA determinations have been Bi-Partisan. Even more importantly, these determinations regarding the quality of Western states mine regulation and reclamation have been on-going, made year-after-year, by an ever-changing group of Bi-Partisan Western Governors. Please note that WGA policy statements are either, renewed, updated or "sun-setted" every three (3) years, but it is also important to see the evolution of these policy statements.

In 2010, the Western Governors' Association ("WGA") stated:

> The Western States ... extensively regulate hardrock mining operations on both public and private lands, and uniformly impose permit conditions and

> stringent design and operating standards, to ensure that hardrock mining operations are conducted in a manner that is protective of human health and the environment, and that, at closure, the mined lands are returned to a safe, stable condition for productive post-mining use.

WGA, Policy Resolution 2010-16, Background (A)(8) ("National Minerals Policy"). More recently, in 2011, the Western Governors Association "Policy Statement" further emphasized the above points stating simply:

> The member states have a proven track record in regulating mine reclamation in the modern era, having developed appropriate statutory and regulatory controls, and are dedicating resources and staff to ensure responsible industry oversight.

WGA, Policy Resolution 2011-4 ("Bonding for Mine Reclamation"). Previous WGA policy determinations provided foundation for the correctness of the above determinations, stating that:

> All Western states … have staff dedicated to ensuring that ongoing mine operations develop and follow appropriate reclamation plans.
>
> …
>
> Western states have a proven track record in regulating mine reclamation in the modern era – including for hard rock mines – having developed appropriate statutory and regulatory controls, and are dedicating resources and staff to ensure responsible industry oversight.

WGA, Policy Resolution 2014-07 ("Bonding for Mine Reclamation"). Thus, while the National Academy of Science/NRC confirms that hardrock mine regulation on federal lands is "generally effective," the Western Governors' Association confirms that the Western States' hardrock mine regulation is also "protective of human health and the environment." Collectively, this means that all Western lands, federal and state (including private) lands are covered by adequate regulations regarding hard rock mining.

Thus, since it has been well-established that state regulatory and policy regulation of hardrock mining protects human health and the environment, it is important to also ensure that such regulation is protective of the state public finances, as well.

In 2014, the WGA correctly determined regarding the Western mining states that:

> An important component of a state's oversight of mine reclamation is the requirement that mining companies provide financial assurances in a form and sufficient to fund required reclamation if, for some reason, the company itself fails to do so [often referred to generically as "Bonding"].
>
> …

> All Western states have developed regulatory bonding programs to evaluate and approve the financial assurances required of mining companies. The states have developed the staff and expertise necessary to calculate the appropriate amount of the bonds, based upon the unique circumstances of each mining operation, as well as to make informed predictions of how the real value of current financial assurance may change over the life of mine, even post-closure.

WGA, Policy Resolution 2014-07 ("Bonding for Mine Reclamation"). These are powerful Bi-Partisan collective gubernatorial determinations made over a period of recent years. Importantly, these statements by Western State political leaders are well-supported by the independent factual record.

3.4 Current hardrock mine regulation is protective of the environment on all federal and state Western lands – A Summary

In 1999, federal hardrock mine regulation programs of the USFS and the BLM were deemed to be "generally effective" in protecting the environment by the National Academy of Science/National Research Council. In 2011, Senator Murkowski's investigation of the BLM and Forest Service mine regulation experience verified and updated the 1999 NAS/NRC determination. And the Bipartisan Western Governors' Association has determined that the state hardrock mine regulatory programs were both "protective of human health and the environment" and protective of public treasuries.

Importantly, such regulatory "treasury protection" does not even consider the major additional public benefit of mining revenue from state revenue from taxes, severances taxes, and employee income taxes, among other sources, which are substantial since <u>mining jobs</u> (i) are traditionally <u>some of the highest paying hourly wages</u> in any state (ii) like any industrial enterprise, <u>have substantial job multiplier effects on supporting business and employment</u> and (iii) typically <u>produce products that are the necessary in-puts for US manufacturing</u>.

Nevertheless, it is reasonable to ask, "Why is hardrock mine regulation so effective now, when historic operations created significant problems?" Obviously, as discussed above, part of the answer is simply that prior to 1970 (i.e., the Pre-Regulatory Era) there was no significant environmental regulation of hardrock mines. However, it is also important to recognize that prior to 1970 there was also no significant environmental regulation of municipal waste or municipal sewage, nor was there any significant regulation of manufacturing environmental impacts. The "bottom line" is that the American culture has now made environmental protection a priority value – not only for the hardrock mining industry, but also for local communities, industry, the regulatory community, and the public. Therefore, unlike in decades gone-by, public, private and NGO managers are now paying close attention to hardrock mining environmental issues that did not even show up on the policy "radar screen" prior to 1970.

4.0 Changing Societal Values – The Great Depression, World War II, the Cold War, and the the Modern Environmental Movement

4.1 Prior to 1970, there was virtually no direct regulation of municipal sewage, industrial wastes or hardrock mines.

Prior to 1970, there was no significant regulation of hardrock mines at either the federal or state level. Mining was not an exceptional activity in this regard. Prior to 1970 there was very little direct regulation of municipal sewage or industrial waste discharges. The early federal water pollution control laws were primarily construction grants programs that were public works projects subsidizing certain activities, but these were not regulatory prohibitions. Rivers, lakes and other water bodies were deliberately used to dispose of all types of septic, chemical and industrial wastes.

Prior to 1970, government and industrial managers did not "see" environmental pollution as a problem or they simply did not know what to do about it. In 2017, this may seem incomprehensible. However, if one briefly reviews our history leading up to this point, one can quickly understand how the culture reached this point. More importantly, for the purpose of this report, in part, it explains why the regulatory omissions of the past will not be repeated, even without specific regulatory prohibitions.

4.2 Societal Values of "The Greatest Generation"

Tom Brokaw's iconic 1998 book *The Greatest Generation*[13] describes the generation of American who came of age in the poverty of the Great Depression and went on to fight World War II, the Korean War, the Cold War, and then participated in generating an era of comparative affluence in the 1950s and 1960s. The deprivation of the Great Depression created a culture in which jobs and manufacturing production were the primary concerns. Belching industrial smokestacks symbolized prosperity in one town, while clean air in the next town symbolized factory closure and unemployment. For example, in 2016, it is now ironic to note with regard to a historic smokestack at a Hoover vacuum manufacturing facility that:

> … the Hoover Co. understood the value of the tall chimney promoting the burgeoning company at a time when companies took pride in the height of their smokestacks. While today they may represent industrial pollution, in that era, the image of the black billowing smoke from a tall chimney stack represented prosperity. 'They wanted it to be a symbol of their company by putting their name on it,' Fernandez said. 'Every time somebody would take a picture of North Canton [Ohio], that chimney is in the picture.' 'It's certainly symbolic.'

"Iconic Hoover Smoke Stack to be Restacked," Robert, Wang, The Canton Repository, December 4, 2014. Obviously, this describes a very different set of values from the environmental values that are foundational to the US in 2017.

[13] Brokaw, Thomas, The Greatest Generation, Random House, New York, 1998.

The economic desperation of the Great Depression focused both public and private values upon the primary mission of finding ways to generate employment, manufacturing production and material prosperity to the exclusion of almost all other societal values. Thus, for example, when President Roosevelt's New Deal promoted multiple massive government dams on the Columbia River and Tennessee River systems progressive folk hero Woody Guthrie celebrated these achievements with songs like "Roll On, Columbia, Roll On" and "Grand Coulee Dam" unabashedly supporting such projects without any apparent concern about the associated major environmental, social or First Nation impacts. "Environmental concerns," as we now understand them were not part of the mainstream culture. The American culture of the Great Depression was one that necessarily worshiped jobs, production and material prosperity above all other values. These traits became even more deeply embedded into the American cultural fabric by the advent of World War II ("WWII") and its precursor events.

Strategically, WWII was to be won or lost based not just upon the bravery and sacrifice of soldiers, sailors and airmen, but also by delivering a crushing weight of one nation's gross national product ("GNP") onto the enemy nation. At the time, the United States excelled at this form of industrial warfare. At the time, the US could generate GNP quickly and in vast quantities of material, and the US did exactly that. Idled factories were brought back to smoking productively, while liquid (and solid) industrial wastes were conveniently disposed in the waterways behind these same plants.[14] Massive new industrial production facilities were conceived of and brought into production within months, not years. Enormous new manufacturing plants were constructed to build aircraft, ships, tanks, trucks, weapons and munitions, to name just a very few of the critical implements of war. Whole new cities were constructed, seemingly overnight, to meet various production goals, and indeed, the "Manhattan Project" developing atomic weapons built new towns and industrial facilities like Oak Ridge, Tennessee and Los Alamos, New Mexico in secret, without any oversight other than that that ensured production was achieve ASAP. There was no "permitting" of any of these great public works, and little or no consideration of environmental values.

Critically, all manufacturing requires mineral inputs as primary material ingredients and the wartime plants consumed the products of hardrock mines voraciously, demanding immediate expansion of the hardrock mining industry during WWII without regard to environmental impacts.

The federal government's direct orders and subsidies spurred the hardrock mining industry into what was the greatest periods of the industry's expansion in the shortest possible time. Providing immediate production, and lots of it, was the driving societal value. Generating GNP to deliver its brutal impact upon enemy nations was imperative. Indeed, *everyone* knew that American lives depended upon this industrial production, including the primary contribution of the hardrock mining industry. (Mining is referred to as being a "primary industry" for good reason!) Environmental values, as we now

[14] Obviously, the US could not duplicate these same achievements at this time.

understand them, were pushed to an obscure corner, or more typically, such values simply did not influence federal decision-making whatsoever.

Perhaps, no single visual image captures the difference in attitudes between this period and the present than the 1943 Pennsylvania Railroad calendar art by Dean Cornwell showing a PRR steam locomotive highballing past a massive steel mill belching fire and smoke, a munitions train on the foreground track, full coal hopper cars in the background and a pile of iron ore set to be charged into the steel production furnaces. Uncle Sam looms huge in the background, rolling up his sleeve to get down to work. There is no mistaking the message, even in 2017. In 1943, the Pennsylvania Railroad was proudly displaying the pollution it generated to help win World War II.

Nor did the post-WWII culture quickly change from its intense wartime focus on material production to the exclusion of other values. The Union of Soviet Socialist Republics (USSR), a World War II ally, immediately became the new "Cold War" enemy. Additionally, Communist China, also a then-recent WW II ally became a frightening new enemy in very real "hot" war in Korea in 1950. The Soviet Union's surprisingly swift development of nuclear weapons only exacerbated US concerns. Not only were many WWII attitudes of the USA about the production ethos maintained, but indeed many of the WWII industrial and mineral production subsidies were maintained through the Korean War, and for some time thereafter. Indeed, the most far-reaching federal statute explicitly supporting U.S. mineral production was passed during this period, i.e., the U.S. Defense Production Act of 1950.

If a town was in the way of the growth of mine production, then the town had to move, in whole or in part, as witnessed, e.g., at Butte, Montana or at Bingham Canyon Utah. Other values, be they cultural or environmental, were secondary to overall societal production needs. And, indeed, the core values of production, employment and prosperity continued well into the 1960s.

> In the 1960s, before the crises of energy shortages, sprawl, air and water pollution, and post-industrial economic restructuring gripped urban and rural places across America, unlimited growth was a primary goal of many communities. Growth, both economic and demographic, was a mark of progress, a source of pride, and a centerpiece of many communities' identifies.

Greenow, Linda, 2004, "When Growth was Good: Images of Prosperity in Mid-Twentieth Century America, Middle States Geographer, 2004, 37:pp. 53-61, p. 53.

In short, the current culture of the USA has embedded environmental values into all aspects of policy-making. In contrast, "The Greatest Generation" had no such luxury in the 1930s, 1940s or 1950s. The 1960s reaction to such attitudes is understandable. However, it is not only the hardrock mining industry that had to change and incorporate such values, it was society as a whole that had to make these changes. And, such

changes, did in fact occur, in the public, the government, and the hardrock mining industry.

4.3 Cultural Balance

Fear of unemployment, fear of war, and fear of losing wars were all factors that pushed the United States far into the public policy mode of production-at-all-costs during most of the Twentieth Century. Environmental values were almost entirely ignored regarding industrial production until 1970. Indeed, such values were rarely even articulated. At the time, the pendulum had swung too far in the direction of industrial production at all cost, which led to unnecessarily high costs to natural and environmental values. However, times *were* changing in the 1960s and 1970s. With the prosperity of the 1950's and 1960's, other values could and did enter or re-enter the American culture ... including environmental values.

4.4 The Modern Environmental Movement

There is no single event that marks the beginning of the environmental movement, but there are a series of events that collectively altered the mix of cultural norms regarding jobs, production, pollution, and the environment. Concerns about nuclear arms and the effects from nuclear fallout (e.g., strontium 90) from bomb testing raised consciousness about the "environment" in the 1950s. The controversy surrounding the proposal of several major dams on the Colorado River system provided a focus for environmental values in the late 1950s, perhaps most notably the work of the Sierra Club and David Brower to help thwart the building of the Echo Park Dam in Dinosaur National Monument. The 1962 publication of Rachel Carson's controversial book *Silent Spring* provided a counterpoint to the widespread use of chemicals in the U.S. and Dupont's "better living through chemistry" message. Shortly thereafter, changing values and changing politics allowed the passage of the landmark Wilderness Act of 1964. All of these and many other factors brought changes to America's culture and values.

America reached a symbolic turning-point on April 22, 1970, celebrated by the first Earth Day. The advent of the modern environmental movement was to generate major changes for the U.S. hardrock mining industry, and indeed, all of US industry, manufacturing, state and municipal government pollution. However, these changes were certainly not immediate, and many of the changes most applicable to hardrock mining, reclamation, environmental protection and financial assurances would take decades to develop and implement.

4.5 Cultural and Legal Changes Incorporating Environmental Values

The above discussion is provided to emphasize the extent and rapidity of the change in societal values that caught both government and industry off-guard in the 1970s. Prior to 1970, there was very little regulation of government or industrial pollution. Often, there was no regulation of pollution whatsoever. Even worse, the USA's pre-1970 values and norms were such that environmental values were not significantly impacting societal

decision-making in any way, because much of society did not even understand there was another way of conceiving of the world. In fact, it was only late in 1969 that the US enacted the National Environmental Policy Act of 1969 (NEPA), which was the forerunner of most modern federal environmental statutes.

Accordingly, there is nothing that can be learned about the effectiveness of current hardrock mine regulation by studying facilities that were designed or constructed prior to 1970. These facilities were designed, built and operated to maximize production and minimize cost, but hardrock mines permitted/approved after 1990 have been designed, built and operated to integrate long-term environmental closure and reclamation as a primary design standard, as required by current law and mining industry attitudes.

Importantly, as discussed immediately below, even though laws and attitudes were changing rapidly starting in the 1970s, there was certainly a very steep "learning curve" as both government and industry tried to cope with challenges of a sort that never had had to be addressed previously. This transition was hard for all concerned, and mistakes were made. For example, the infamous "Syringe Tide" of raw garbage and medical waste washed up onto New Jersey and Long Island beaches as late as 1988-1989 highlighted on-going municipal waste disposal practices, and indeed, well into the 1990s, New York City and various New Jersey communities were still ocean-dumping sewage sludge in the New York Bight and raw sewage via storm water overflow.

Fortunately, the Hardrock Mining Industry's transition problems was largely complete by 1990, and since 1990 environmental problems associated Hardrock Mining have been generally modest and manageable, as benchmarked, in part, by the lack of any new Western hardrock mines appearing on the CERCLA National Priorities List in the last 26 years.

Section 5.0, immediately below, provides a summary of the major environmental regulatory programs that have created the regulated hardrock mine era.

5.0 Development of Legally-Applicable Hardrock Mine Regulation

5.1 Regulation of the Natural Media Receptors – An Overview

Fundamentally, there are four major categories natural media that the environmental laws protect: (1) air; (2) surface water; (3) groundwater, and (4) land. As a practical matter, hardrock mining has not typically triggered significant scientific, policy or regulatory questions regarding air quality; therefore, this study does not evaluate hardrock mine regulation regarding protection of air quality.[16] Surface water quality protection has been

[16] For example, the only significant air quality policy issue that has arisen from hardrock mining concerns the emissions of mercury from gold mining operations in Nevada impacting Idaho dam-impounded reservoirs. However, these allegations were effectively discredited by the White Paper developed by the Idaho Association of Commerce and Industry/Idaho Council for Industry and the Environment Report "Sources and Receptors of Mercury in Idaho," January 28, 2009 ("Idaho Mercury Report"). Mercury in Idaho's waterways is primarily a result of geologic source mercury or legacy mining (i.e., historic mining

dominated by promulgation of federal statutory and regulatory programs, which then have typically been implemented by state agencies. On the other hand, ground water quality protection has been the province of State government with some specific notable exceptions.

Regulation of direct impacts to land (i.e., "reclamation") has been almost exclusively the province of the relevant land management authorities. The regulation of hardrock mine reclamation on National Forest System lands has been administered by the USFS since 1974, the regulation of hardrock mining on Department of Interior managed public domain lands has been administered by the BLM since 1981, and the regulation of state and private lands within a state are administered by the relevant state agency. Additionally, the integration of post-mining land use, continued protection of water quality and post-mining land uses following hardrock mine closure and reclamation, as well as bonding for these purposes, has been the unique province and expertise of the State and Federal Land management agencies. A brief history of these programs is provided below.

5.2 Surface Water

The Clean Water Act[17] was passed in 1972 and, among other things, created a requirement for a discharger of a "pollutant" to "navigable waters" (which later came to be more broadly defined as "waters of the United States") from a "point source" to obtain an NPDES permit.[18] In theory, the Clean Water Act, most particularly the NPDES permit system was one of the first federal laws potentially directly implementing regulation of hardrock mines. However, implementation was slow as EPA and the mining industry grappled with new concepts, new operational issues, and new regulatory concepts, including but not limited to programmatic litigation (see e.g., *U.S. Steel Corp. v. Train*, 556 F. 2d. 822 (7th Cir. 1977), and major statutory amendments[19] to address these issues. Thus, EPA did not promulgate 40 C.F.R. 440, Subpart J, concerning "Copper, Lead, Zinc, Gold, Silver, and Molybdenum Ores Subcategory," some of the most common Hardrock Mines, until December 1982. 47 FR 54609, Dec. 3, 1982.

Therefore, prior to 1982, EPA and delegated State programs had attempted to enforce on a case-by-case basis an inflexible and absolute "no discharge" requirement that did not take into account net contributions of rain and snow which contributed to unrealistic environmental evaluations that significantly contributed to environmental problems at early Transition Era hardrock mines. Thus, the very first practical federal regulatory scheme specifically regulating hardrock mine surface discharges did not even exist until the very end of 1982. Not surprisingly, sorting out the implementation of the NPDES program did not occur overnight.

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using historic mineral extraction technologies and practices long abandoned). Neither the EPA, nor the NGO's, have ever responded to the Idaho Mercury Report in writing.

[17] Technically, the Clean Water Act is the Federal Water Pollution Control Act Amendments of 1972, Pub. L. No. 92-500 (codified as amended at 33 U.S.C. Section 1251-1387.

[18] 33 U.S.C. Sections 1311(a), 1362(6), (7), (12), (14).

[19] 1977 Clean Water Act Amendments, Pub. L. No. 95-217, 91 Stat. 1581 (codified as amended in scattered sections of 33 U.S.C.)

5.3 Groundwater Protection at Hardrock Mines

5.3.1 State Protection of Groundwater at Hardrock Mines

Groundwater regulation is generally held to be the unique province of state government. Groundwater, unlike surface water, does not readily migrate across State borders. Thus, while the federal definition of "waters of the United States" has been construed broadly, it has not generally been construed to regulate groundwater. As the American Law of Mining states, "[t]he Clean Water Act makes a clear distinction between navigable waters on the one hand and groundwater on the other."[25]

Therefore, state hardrock mine regulation has emerged as the primary regulatory tool for preventing or otherwise regulating potential hardrock mining impacts to groundwater. However, these programs have been relatively recent developments (i.e., since 1990). For example, the Nevada "Mining Facilities" regulation explicitly protects against and regulates discharges to groundwater from mining facilities were promulgated on September 1, 1990.[26] And although Idaho's Ground Water Quality Plan became law in 1992,[27] it was not until 1997 that a detailed and comprehensive enforcement mechanism was promulgated. See IDAPA 58.01.11, 3-20-1997 ("Ground Water Quality Rule"). Alaska's Hardrock mine reclamation was codified and promulgated in 1991. Washington's Metal Mining and Milling Act protects against potential discharges to groundwater and was passed in 1994.[28]

Thus, comprehensive direct preventative regulation of potential groundwater impacts of hardrock mine regulation was only initiated in the 1990s.

5.3.2 Federal Protection of Groundwater at Hardrock Mines

The Clean Water Act regulates discharges from hardrock mines, to "waters of the United States," and as discussed above, this is generally limited exclusively to surface water discharges. Certain Federal programs, including the Safe Drinking Water Act,[29] the federal Resource Conservation and Recovery Act[30] and Uranium Mill Tailings Radiation Control Act of 1978[31] regulate specific, narrowly defined activities potentially relevant to hardrock mines. The federal public lands agencies (i.e., the Forest Service and the BLM) incorporate state groundwater standards into NEPA compliance and mitigation. Nevertheless, as discussed below, since these state programs were devised in the 1990s, even explicit federal incorporation of state groundwater standards did not provide significant preventative groundwater regulation until, at least 1990. EPA has confirmed this to be true.

[25] 5 Am. L. of Mining Section 169.02[2][c] (2d ed.)
[26] NAC 445A.350 et seq.
[27] See Idaho Groundwater Plan, Section II-C, Senate Bill 1321 (1992).
[28] Wash.Rev.Code 43.21.
[29] Safe Drinking Water Act, 42 U.S.C Sections 300 et seq.
[30] Resource Conservation and Recovery Act, 42 U.S.C. Sections 6901 et seq.
[31] Uranium Mill Tailings Radiation Control Act of 1978, 42 U.S.C. Section 7901 et seq.

EPA's assessment of groundwater protection at hardrock mine in 1985 was as follows:

> Ground-water monitoring is difficult, expensive, and has seldom been conducted at mine sites on a comprehensive basis. Because of complex geologic strata (presence of an ore body) and the extensive size of many mine properties, proper ground-water monitoring is technically difficult and costly. Historical practice in the mining industry has not required such monitoring. As a result, there is very little available information in the literature, and almost none on a complete or comprehensive basis. Most mines have no historical or contemporary ground-water monitoring information.

RTC I, p. 6-7 (emphasis in original). In short, as late as 1985 EPA asserts that groundwater protection at hardrock mine sites was virtually nonexistent. Thus, per EPA's own study of the hardrock mining industry, one cannot rationally gauge the current effectiveness of hardrock mine regulation regarding groundwater protection with reference to sites designed and approved before 1985.

Accordingly, in the 1980s, federal regulation hardrock mining for protection of groundwater was limited, and virtually non-existent. This left the subject of groundwater regulation at hardrock mines to the state governments. The Western States stepped-up to manage this area in the 1990s, generally as part of mining specific statutes or regulations, and eventually tied directly to hardrock mine reclamation programs and financial assurance requirements.

5.4 Hardrock Mine Reclamation, Financial Assurances and Water Quality Protection

In 1974, the Forest Service promulgated regulations governing reclamation and performance bonding of hardrock mines on National Forest System Lands.[32] These were some of the first regulations governing Hardrock Mine reclamation promulgated by any agency, federal or state. In 1981, the BLM promulgated the surface management regulations applicable to Mine Plans of Operations ("MPOs") similar in concept to those of the Forest Service. The history of the impact and evolution of these programs is described in greater detail by Northwest Mining Association's "The Evolution of Federal and Nevada State Reclamation Bonding Requirements from Hardrock Exploration and Mining Projects: A Case History Documenting How Federal and State Regulators Used Existing Regulatory Authorities to Respond to Shortcomings in the Reclamation Bonding Program," prepared by Jeffrey V. Parshley and Debra W. Struhsacker, January 2008. That study documents federal and state interagency and industry cooperation by which hardrock mine regulation worked to create the currently effective hardrock mine regulation in Nevada; however, a similar history is reflected in most of the western mining states, as discussed above.

[32] 36 CFR Part 228 (2016).

However, hardrock mine regulation is certainly not only about the Forest Service and the BLM. The Western States have regulated hardrock mining for decades. For example, both Idaho and Colorado had mined land reclamation programs that dated back to the 1970s. Initially these programs, like those of the Forest Service and the BLM focused on regrading and revegetation of mined lands, and not on surface water quality and certainly not ground water protection. Indeed, initially, the Forest Service deferred protection of surface water to EPA enforcement of the Clean Water Act and EPA oversight of delegated state Clean Water Act programs, which gave rise to two of the most notorious hardrock mine regulatory failures during the Transition Era (1970-1990), specifically Summitville, Colorado and Zortman, Montana. Thus, it became clear to the BLM, the Forest Service and the Western States that closure, reclamation, post-mining land uses and water quality had to be integrally-related and "bonds" posted.

Accordingly, the current reclamation bonding programs are working very well. Not only are Regulated Hardrock Mines (i.e., post-1990) avoiding EPA CERCLA National Priorities List, but even more importantly, existing financial assurances (federal and state) are avoiding public liability, even when defaults have occurred. For example, in the co-authors' home states of Idaho and Nevada, there has never been a Hardrock Mine that was approved and for which financial assurances were posted that defaulted on the financial assurances such that the Mine was not closed and reclaimed in accordance with: (1) the reclamation/closure plan approved by the relevant federal and/or state agencies; and (2) the financial assurances retained by the agencies. This is discussed in greater detail below.

In Idaho, two relatively large hardrock mines in Idaho defaulted on their bonds in the 1990s such that the public agencies had to rely on financial assurance monies to close and reclaim the properties. Even though both mines dated from the Transition Era (i.e., pre-1990), in both situations (specifically, Dakota Mines-Stibnite and Black Pine), the bond amounts proved to be adequate. Interestingly, these two mines had been identified by Earthworks' (one of the CERCLA 108(b) plaintiffs) as being insufficiently bonded.[33] Earthworks was wrong, by a factor of ten. More specifically, Earthworks' stated that adequate bonding for each of these mines would be about $50,000 per acre; in fact, Dakota Stibnite and Black Pine were closed and reclaimed for $2,710 per acre and $7,383 per acre respectively.[34] In short, it is objectively demonstrable that any factual assertions by Earthworks are insufficiently grounded to be given serious consideration in any EPA rulemaking.

Nevada has the nation's largest and arguably the most successful state hardrock mine environmental closure and reclamation program. In part because it started later, Nevada developed water quality protection and land reclamation into an integrated and "bonded" hardrock mine program, essentially from the beginning. Nevada's "Mining Facilities" regulations protecting waters of the state (surface and groundwater) were promulgated in 1989, and then in 1990 the Nevada legislature passed the Nevada Reclamation Act. In

[33] Letter, Baird Hanson William LLP to USFS Salmon-Challis Nation Forest, May 24, 2007

[34] Thus, Earthworks and their NGO colleagues have been are fully informed of the adequacy of existing hardrock mine financial assurances for 20 years.

the mid-to-late 1990s, two permitted mines (Goldfields and Mt. Hamilton) defaulted on their "bonds," which were adequate but not immediately available for necessary water system management. This prompted voluntary efforts on the part of the Nevada mining industry to act to prevent any interim spills and this caused the Nevada Mining Association to seek a change in Nevada law to allow for immediate NDEP access to "fluid management bonding." This problem has never recurred.

Thus, every Idaho and Nevada hardrock mine (including those that have been in default) that was approved and subject to financial assurances has been closed and reclaimed in accordance with: (1) the reclamation/closure plan approved by the relevant federal and/or state agencies; and (2) the financial assurances retained by the federal and/or state agencies.

Once states and/or federal land management agencies (i.e., the Forest Service and the BLM) integrated mine reclamation with surface water and ground water protection, geochemical prediction and financial assurance for such activities and related predictions, the chances of such facilities replicating the problems that arose in the Pre-Regulatory Era (Per-1970) became essentially impossible to duplicate ... and, indeed, such problems have not been recreated to date.

Thus, certain Transition Era (1970 through about 1990) hardrock mines created problems. There is no question there has been a "learning curve." State agencies began to create active groundwater management programs regulating hardrock mines that might impact ground water. And, the Forest Service and the BLM began to work in concert with the relevant states, as all parties sought to incorporate comprehensive surface and groundwater protection into NEPA planning, Mine Plan of Operation approvals and reclamation bonding programs to create regulatory programs that prevented the creation of water pollution in the first place and bonded for such protection from the outset of mining operations. This took time, but it was achieved. And, the most important single element is that since 1990, design, permitting, construction, operation, closure and reclamation of hardrock mines are integrated.

Initially, Western States hardrock mine regulation was limited to regrading and re-vegetation, similar to the early Forest Service and BLM programs. However, after water quality impacts were identified famously at hardrock mines at Zortman and Summitville, then the primary federal land management agencies (i.e., the Forest Service and BLM) shifted from reclamation as a merely regrading and revegetation exercise to comprehensive sustainable surface and ground water quality protection.

5.5 The National Environmental Policy Act of 1970

Nominally, the passage of the National Environmental Policy Act of 1969 (NEPA) was potentially applicable to hardrock mines and therefore could have heralded an immediate major shift in hardrock mine regulatory policy. In fact, initially, it did not. NEPA requires a "proposal" of a "major federal action" (including potentially approval of a

Mine Plan of Operation) "significantly affecting the environment."[35] Thus, NEPA regulation of hardrock mining typically is triggered by the filing of a request for an MPO with the Forest Service, the BLM or the EPA (for an NPDES permit). In fact, in the 1970's and 1980's there was significant state-by-state debate regarding whether the approval of a single hardrock mine constituted a "major" Federal action that was subject to NEPA, but it was not until 1995 that the first hardrock mine Environmental Impact Statement was issued in Nevada. Nevertheless, when it became clear that EPA and state NPDES jurisdiction could not adequately manage surface discharges as stand-alone issues at Zortman and Summitville, the Forest Service and the BLM used their Mine Plan of Operation approval processes to create comprehensive and integrated water quality protection for hardrock mines. Clearly, there were regulatory gaps that had to be addressed. This was part of the learning curve that delayed effective hardrock mine regulation until the 1990s. In fact, regarding current hardrock mine regulation, NEPA EIS evaluation of the environmental impacts and mitigation measures has become a major aspect of any hardrock mine approval with a federal nexus.

Nevertheless, prior to 1990, NEPA had little relevance to hardrock mine regulation.

5.6 Evaluation of the Effectiveness of Hardrock Mine Regulation based upon the Timing of Regulatory Developments

The above discussion provides a short jurisdictional history of the regulation of hardrock mining. To briefly summarize, there was literally no regulation and therefore no regulatory consideration of the environmental impacts of hardrock mining prior to 1970, so any site designed and constructed prior to this date provides no information about the effectiveness of hardrock mine regulation. NEPA was signed into law in 1970, but NEPA required other federal authorities and case law to be interpreted before NEPA could be implemented at hardrock mines. Accordingly, it is misleading, disingenuous, and certainly "arbitrary and capricious" to evaluate environmental issues associated with hardrock mines designed and operated prior to 1970 as examples of current hardrock mine regulation.

EPA's hardrock mine NPDES program was not published until 1982, and took years after that to properly implement the program. As discussed above, federal agencies were generally precluded from infringing upon state control of groundwater, and groundwater programs regulating hardrock mines were largely the product of the 1990s. Thus, it was not until the 1990s that federal and state agencies began to comprehensively address the water quality issues associated with hardrock mining.

EPA confirms this state of affairs when it stated in 1985 that:

> During active site life, during closure, and in the post-closure period, facilities could employ engineering controls to prevent erosion, to keep leachate out of the ground water, or to remove contaminants introduced into ground water. However, EPA data on management methods at mining

[35] American Law of Mining, Section 167.02.

> facilities indicate that only a small percentage of mines currently monitor their ground water, use run-on/runoff controls or liners, or employ leachate collection, detection, and removal systems. EPA has not determined the circumstances under which these waste measures would be appropriate at mine waste and mill tailing disposal sites.

RTC I, p. ES-10. It is only after 1990 that the lessons learned from the 1970 to 1990 Transition Era began to be more fully incorporated in the mine regulatory processes. Thus, it has only been in the last 20 years that hardrock mine permitting has first begun to more fully evaluate, predict and regulate long term water quality impacts.

The bi-partisan Western Governors' Association has characterized the situation as follows:

> ...
>
> 3. While older mines in western states have sometimes had harmful impacts on adjacent waters, the mining industry has improved its operation and reclamation track record in recent decades, to avoid or minimize such impacts.
> 4. Recent decades have also brought heightened attention to the importance of mine reclamation from state regulators across the west. All western states that host hardrock mining industries now have staff dedicated to ensuring that on-going mine operations develop and follow appropriate reclamation plans.

WGA, Policy Resolution 2011-4 (A)(3) and (4).

> All Western states have developed regulatory bonding programs to evaluate and approve the financial assurances required of mining companies. The states have developed the staff and expertise necessary to calculate the appropriate amount of the bonds, based upon the unique circumstances of each mining operation, as well as to make informed predictions of how the real value of current financial assurance may change over the life of mine, even post-closure.

WGA, Policy Resolution 2014-07 ("Bonding for Mine Reclamation"). In fact, the "bottom line" on the adequacy of hardrock mine regulation is fairly simple. Until changing societal cultural norms regarding environmental protection and Hardrock Mine regulation began to be implemented by federal and state regulatory agencies environmental problems arose. Since 1990 after federal and state agencies began paying attention with a degree of technical experience, the EPA has yet to designate even a single Western hardrock mine site to the National Priorities List.

The key to effective hardrock mine regulation is that there is *some* form of evaluation and planning. Neither the goals, nor the science, are that difficult to implement. It takes planning and application of existing knowledge. Almost all of the hardrock mines giving rise environmental problems on the CERCLA NPL arose when environmental goals and planning were nonexistent in the Pre-Regulatory Era (Pre-1970). And, while a few CERCLA NPL problems arose in the Transition Era (1970 through 1990) when practical experience was wholly-lacking, in the Regulatory Era (Post-1990) there have been no

Western hardrock mine sites that EPA has deemed to be a sufficient problem to require nomination to the National Priorities List.

6.0 Conclusion

The federal and state regulation of hardrock mining and milling facilities is a remarkable success story of changing law and policy environmental protection that is well-illustrated by the vintage of hardrock mines on the United States Environmental Protection Agency ("EPA") National Priorities List of environmental cleanup sites. To briefly summarize, there has never been an environmental problem at a Western hardrock mine that was approved by a federal or state agency in the West after 1990 that has required EPA to make such hardrock mine a Superfund "top priority among known response targets." To reiterate, no hardrock mine permitted in the West after 1990 has ever been placed on EPA's Superfund National Priorities List.

Current hardrock mine regulation on federal lands managed by the United States Forest Service and the Bureau of Land Management has been determined to be "complicated, but generally effective" by the federal government's independent National Academy of Sciences National Research Council in 1999. In 2011, Senator Murkoswki's investigation of the BLM and Forest Service mine regulation experience verified and updated the 1999 NAS/NRC determination. And, the Bi-partisan Western Governors' Association has stated that the Western states, which regulate Hardrock Mining on state and private lands within their borders "... impose permit conditions and stringent design and operating standards, to ensure that hardrock mining operations are conducted in a manner that is protective of human health and the environment" and that Western "... states have developed the staff and expertise necessary to calculate the appropriate amount of the bonds, based upon the unique circumstances of each mining operation, as well as to make informed predictions of how the real value of current financial assurance may change over the life of mine, even post-closure." WGA, Policy Resolution 10-16, Background (A)(8) ("National Minerals Policy"). Moreover, all programs of the federal and state agencies have continued to strengthen their reclamation and bonding programs on an ongoing basis.

The above-described regulatory success story is a direct result of society's change in values both outside of, and within, the hardrock mining industry to seek protection of the environment, not just to creates jobs, industrial production and tax revenue. Hardrock mines designed and built prior to 1970 were developed to maximize production and minimize cost with little or no regard for environmental values. After 1990, new hardrock mines have been designed, built and operated to integrate long-term environmental closure and reclamation as a primary design standard, as required by current law.

The above-described changes in values, law, design, permitting, operation closure and reclamation have had a major impact on the adequacy of financial assurances posted pursuant to routine individual financial assurances on a mine by mine basis. Using the co-authors' home states as examples, there has never been an Idaho or Nevada hardrock

mine for which financial assurances were posted that defaulted on the bonding such that the hardrock mine was not closed and reclaimed in accordance with: (1) the reclamation/closure plan approved by the relevant federal and/or state agencies; and (2) the financial assurances retained by the agencies. Thus, objectively, the existing regulation of hardrock mines is protecting the environment from releases and protecting public treasuries through posting of adequate financial assurances.

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MEMORANDUM

TO: Mr. Joe Baird – Baird Hanson LLP

FROM: Mr. Richard DeLong *RFD*

DATE: May 15, 2015

SUBJECT: Assessment of Mining and Milling Site on the National Priorities List

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At your request, Enviroscientists, Inc. (Enviroscientists) completed an assessment of the United States Environmental Protection Agency's (EPA's) National Priorities List (NPL) for Mining and Milling Sites (MMS). A search of the NPL was completed on April 21, 2015. See Attachment A for a printout of the list. In addition, a compact disk (CD) with the searchable excel version of the printout is included with is memorandum.

There are over 1,100 sites on the NPL. Of those, there are 100 that the EPA has classified as MMS. However, only 55 of those sites are actual mining operations where mineral resources were extracted from the earth. The other 45 are mineral processing facilities where a mineral product is delivered to the operation for further processing. The 55 "Hardrock Rock" MMS on the NPL fall into the following temporal classifications: 49 are prior to 1970; five are from 1970 through 1990; and one is post-1990. The one operation that was permitted and began operations post-1990 is the Barite Hill property in South Carolina. The operation was an open pit heap leach mine that ceased operation in 1995 and reclamation was completed in 1995 to 1999.

ATTACHMENT A

MAY 2013 VERSION OF THE MINING AND MILLING SITES ON THE NATIONAL PRIORITY LIST

Table 1

Summary - Mining and Milling Sites on the National Priorities L
Source: EPA AML - Status = "Final" as of May 2013 Update (list check April 21, 2

The EPA AML program defines AMLs as:

"Those lands, waters, and surrounding watersheds contaminated or scarred by extraction, beneficiation or processing of ores and minerals, including phosphate but not coal". Abandoned mine lands include areas where mining or processing activity is temporarily inactive."

	Site Name	EPA Region	State	Year Start	Year End	Year End	Design/Approval 1 - pre 1970 2 1970 - 1989 3 - 19 and later	Mining/Milling or Other Processing	Type of Activity	Minerals	NPL Status	Site/CERCLIS ID Number
1	CALLAHAN MINING CORP	1	ME	1880's	1972	1972	1	M	Mining/milling (Open pit mine)	Zinc/copper	Final	MED980524128
2	ELIZABETH MINE	1	VT	early 1800s	1958	1958	1	M/O	Mining; copper smelting	Copper	Final	VTD988366621
3	ELY COPPER MINE	1	VT	1821	1920	1920	1	M/O	Mining/cobbing/roasting/smelting; (removal of ore)	Copper	Final	VTD988366571
4	PIKE HILL COPPER MINE	1	VT	1847	1919	1919	1	M	Mining	Copper	Final	VTD988366720
5	LI TUNGSTEN CORP.	2	NY	1940's	1984	1984	1	O	Processing (Received tungsten ore's for processing).	Tungsten	Final	NYD986882660
6	MAYWOOD CHEMICAL CO.	2	NJ	1916	1955	1955	1	O	Processing (radioactive thorium ore).	Thorium	Final	NJD980529762
7	SHIELDALLOY CORP.	2	NJ	1955	2006	2006	1	O	Processing (discharge to unlined pits prior to 1970 enforcment actions).	Chromium alloy	Final	NJD002365930
8	U.S. RADIUM CORP.	2	NJ	1915	1926	1926	1	O	Processing/Tailings	Radium	Final	NJD980654172
9	W.R. GRACE & CO., INC./WAYNE INTERIM STORAGE SITE (USDO	2	NJ	1948	1971	1971	1	O	Processing/extraction	Monazite ore (thorium/rare earths)	Final	NJ1891837980
10	FOOTE MINERAL CO.	3	PA	1942	1991	1991	1	O	Processing/Manufacture of metal products	Lithium	Final	PAD077087989

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11	FRANKLIN SLAG PILE (MDC)	3	PA	1950's	1999	1999	1	O	MDC Industries sold the processing slag as sand blasting grit for 40 years. MDL Abandoned site 12/30/1999. Franklin Smelting and Refining Co smelting the ore. (lead contamination)	Copper	Final	PASFN0305549
12	JACKS CREEK/SITKIN SMELTING & REFINING, IN	3	PA	1958	1977	1977	1	O	Smelting processing and precious metals reclamation	Precious metals	Final	PAD980829493
13	PALMERTON ZINC PILE	3	PA	~1912	1982	1982	1	O	Smelting processing (NJ Zinc Co.)	Zinc	Final	PAD002395887
14	U.S. TITANIUM	3	VA	1931	1971	1971	1	O	Refining processing titanium ore/Titanium dioxide manufacturing	Titanium	Final	VAD980705404
15	BARITE HILL/NEVADA GOLDFIELDS	4	SC	1991	1995	1995	3	M	Mining (gold plant, heap leach)	Gold, Silver	Final	SCN000407714
16	BREWER GOLD MINE	4	SC	1828	1995	1995	1,2	M	Mining - CN heap leach pad 1987 - 1995.	Gold	Final	SCD987577913
17	MACALLOY CORPORATION	4	SC	1941	1998	1998	1	O	Ferrochromium alloy processing plant	Ferrochromium	Final	SCD003360476
18	NATIONAL SOUTHWIRE ALUMINUM CO.	4	KY	1969	active	active	1	O	Aluminum processing (north pond)	Aluminum	Final	KYD049062375
19	ORE KNOB MINE	4	NC	1850s	1962	1962	1	M	Mining, roasting, smelting	Copper	Final	NCN000409895
20	STAUFFER CHEMICAL CO. (TARPON SPRINGS)	4	FL	1950	1981	1981	1	O	Processed elemental phosphorous from phosphate ore.	Phosphate	Final	FLD010596013

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21	ASARCO TAYLOR SPRINGS	5	IL	1911	active	active	1	O	Zinc smelting/Processing zinc oxide	Zinc	Final	ILN000508170
22	DEPUE/NEW JERSEY ZINC/MOBIL CHEMICAL CORP	5	IL	1903	1990	1990	1	O	Zinc smelting/Processing/Phosphate fertilizer	Zinc	Final	ILD062340641
23	EAGLE ZINC CO DIV T L DIAMOND	5	IL	1923	2003	2003	1	O	Processing/zinc smelting	Zinc/Cadmium	Final	ILD980606941
24	HEGELER ZINC	5	IL	1906	1954	1954	1	O	Zinc smelter/Processing	Zinc	Final	ILN000508134
25	MATTHIESSEN AND HEGELER ZINC COMPANY	5	IL	1858	1978	1978	1	O	Zinc Smelter (smelter closed 1961)/ Processing	Zinc	Final	IL0000064782
26	ORMET CORP.	5	OH	1956	2005	2005	1	O	Aluminum reduction (unlined pits closed 1981)/ Processing	Aluminum	Final	OHD004379970
27	TORCH LAKE	5	MI	1890	1969	1969	1	M	Mining (copper mines dumped tailings into lake).	Copper	Final	MID980901946
28	U.S. SMELTER AND LEAD REFINERY, INC	5	IN	1920	1985	1985	1	O	Smelter/Processing	Lead	Final	IND047030226
29	CHEVRON QUESTA MINE (MOLYCORP)	6	NM	1920	Active (underground blockcave 1983 to present)	active	1,2	M/O	Mining/Milling	Molybdenum	Final	NMD002899094
30	CIMARRON MINING CORP.	6	NM	1960	1982	1982	1,2	O	Milling	Iron; Precious metals	Final	NMD980749378
31	HOMESTAKE MINING CO.	6	NM	1958	1990	1990	1	O	Milling	Uranium	Final	NMD007860935

The EPA AML program defines AMLs as:

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	Site Name	EPA Region	State	Year Start	Year End	Year End	Design/Approval 1 - pre 1970 2 1970 - 1989 3 - 19 and later	Mining/Milling or Other Processing	Type of Activity	Minerals	NPL Status	Site/CERCLIS ID Number
32	TAR CREEK (OTTAWA COUNTY)	6	OK	1850	1970s	1970	1	M	Mining district	Iron, Zinc	Final	OKD980629844
33	TEX-TIN CORP.	6	TX	1941	1989	1989	1	O	Smelter/Processing	Tin, Copper	Final	TXD062113329
34	TULSA FUEL AND MANUFACTURING	6	OK	1914	1925	1925	1	O	Smelter/Roaster/Processing	Zinc/lead	Final	OKD987096195
35	UNITED NUCLEAR CORP.	6	NM	1967	1986	1986	1,2	M/O	Mining/Processing/milling	Uranium	Final	NMD030443303
36	ANNAPOLIS LEAD MINE	7	MO	1920	1940	1940	1	M	Mining	Lead	Final	MO0000958611
37	BIG RIVER MINE TAILINGS/ST. JOE MINERALS CORP.	7	MO	1700's	1972	1972	1	O	Tailings disposal for lead mining	Lead	Final	MOD981126899
38	CHEROKEE COUNTY	7	KS	~1870	1970	1970	1	M	Mining (a/k/a Tri-State mining district)	Lead, zinc	Final	KSD980741862
39	MADISON COUNTY MINES	7	MO	1700's	1970s	1970	1	M	Mining (mining district)	Lead	Final	MOD098633415
40	NEWTON COUNTY MINE TAILINGS	7	MO	~1850s	1950	1950	1	M	Mining (Tri-State Mining District)	Lead, cadmium, zinc	Final	MOD981507585
41	OMAHA LEAD	7	NE	1870s	1996	1996	1	O	Smelting/Processing	Lead	Final	NESFN0703481

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42	ORONOGO-DUENWEG MINING BELT	7	MO	1848	late 1960s	1967	1	M	Mining (Tri-State Mining District)	Lead, cadmium, zinc	Final	MOD980686281
43	SOUTHWEST JEFFERSON COUNTY MINING	7	MO	early 1800s		1975	1	M/O	Historic mining district, smelting	Lead, zinc, barium	Final	MON000705443
44	WASHINGTON COUNTY LEAD DISTRICT - FURNACE CREEK	7	MO	1799	1980s (historic)	1980	1	M/O	Mining, milling, smelting	Lead, barite (barite 1926 - 1980s)	Final	MON000705842
45	WASHINGTON COUNTY LEAD DISTRICT - OLD MINES	7	MO	1700s		1980	1	M/O	Mining, milling, smelting			MON000705027
46	WASHINGTON COUNTY LEAD DISTRICT - POTOSI	7	MO	1700s		1980	1	M/O	Mining, milling, smelting			MON000705023
47	WASHINGTON COUNTY LEAD DISTRICT - RICHWOODS	7	MO	1700s		1980	1	M/O	Mining, milling, smelting			MON000705032
48	ACM SMELTER AND REFINERY	8	MT	1892	1972	1972	1	O	Smelting, refiningProcessing	Copper, zinc	Final	MTD093291599
49	ANACONDA CO. SMELTER	8	MT	late 1800s	1980	1980	1	O	SmeltingProcessing	Copper	Final	MTD093291656
50	BARKER HUGHESVILLE MINING DISTRICT	8	MT	1879	1970s	1970	1	M	Mining (only brief activity in 1940s, 1920s, and 1960s)	Silver, lead	Final	MT6122307485
51	BASIN MINING AREA	8	MT	late 1800s	1960s	1960	1	M	Mining (intermittent into 1960s)	Precious metals	Final	MTD982572562

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	Site Name	EPA Region	State	Year Start	Year End	Year End	Design/Approval 1 - pre 1970 2 1970 - 1989 3 - 19 and later	Mining/Milling or Other Processing	Type of Activity	Minerals	NPL Status	Site/CERCLIS ID Number
52	CALIFORNIA GULCH	8	CO	1895 (Yak Tunnel	Early 1980s	1980	1	M	Mining, processing, smelting	Gold, silver, lead, zinc	Final	COD980717938
53	CAPTAIN JACK MILL	8	CO	1860	1992	1992	1	M	Mining, milling	Gold, silver	Final	COD981551427
54	CARPENTER SNOW CREEK MINING DISTRICT	8	MT	1880s	1931	1931	1	M	Mining (last mine closed 1931 with intermittant mining after that)	Silver, lead, zinc	Final	MT0001096353
55	CENTRAL CITY, CLEAR CREEK	8	CO	1880s	active (limited)	2011	1	M	Mining District, any current operations small) (includes Argo Tunnel draining 30+ inactive mines)	Gold	Final	COD980717557
56	DAVENPORT AND FLAGSTAFF SMELTER:	8	UT	1870	1875	1875	1	O	SmeltingProcessing	Lead, silver	Final	UTD988075719
57	DENVER RADIUM SITE	8	CO	1915	1920s	1920	1	O	Processing (35 sites of Ra disposal)	Radium	Final	COD980716955
58	EAGLE MINE	8	CO	1880s	1984	1984	1	M	Mining	Gold, silver	Final	COD081961518
59	EAST HELENA SIT	8	MT	1888	2001	2001	1	O	SmelterProcessing	Lead, zinc	Final	MTD006230346
60	EUREKA MILLS	8	UT	1870	1958	1958	1	M/O	Mining and Milling	Gold, silver, lead, copper, arsenic	Final	UT0002240158
61	FLAT CREEK IMM	8	MT	1909	1953	1953	1	M/O	Mining and Milling	Silver, gold, copper, zinc, iron	Final	MT0012694970

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62	GILT EDGE MINE	8	SD	1876	1998	1998	1,2	M	Mining (1986 DENR permit for open pit with CN heap leach operations).	Gold, copper, tungsten	Final	SDD987673985
63	INTERNATIONAL SMELTING AND REFINING	8	UT	1910	1972	1972	1,2	O	Smelter/Processing	Copper, lead, zinc	Deleted (10/11/2011	UTD093120921
64	JACOBS SMELTER	8	UT	1870s	1970	1970	1	O	Smelting/Processing	Silver	Final	UT0002391472
65	LIBBY ASBESTOS SITE	8	MT	1920 - start of large scale minin	1990	1990	1	M	Mining	Vermiculite	Final	MT0009083840
66	LINCOLN PARK (Cotter Mill, Canyon City, Colorado)	8	CO	1958		1979	1	O	Milling	Uranium, vandadium	Final	COD042167858
67	MIDVALE SLAG	8	UT	1871	1971	1971	1	O	Smelting/MillingProcessing	Lead, copper	Final	UTD081834277
68	MILLTOWN RESERVOIR SEDIMENTS/Clark Fork	8	MT	1870s	1980	1980	1,2	M	Mining and Smelter (possible source of As also could be landfill as source) (120 miles of sediments above reservoir)	Copper	Final	MTD980717565
69	MONTICELLO MILL TAILINGS (USDOE)	8	UT	1942	1960	1960	1	M	Milling	Vanadium, uranium	Final	UT3890090035
70	MOUAT INDUSTRIES	8	MT	late 1950s	1973	1973	1	O	Processing	Chromium	Final	MTD021997689

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71	NELSON TUNNEL/COMMODORE WASTE ROCK	8	CO	1889	1985 (historic hard rock mine)	1985	1,2	M	Mining	Silver, lead, zinc	Final	CON000802630
72	SILVER BOW CREEK/BUTTE AREA	8	MT	~1870s	1963	1963	1	M	Mining, milling and smelting (contamination of 24 stream miles by industrial, ag, and municipal)	Copper	Final	MTD980502777
73	STANDARD MINE	8	CO	1874	1974	1974	1	M	Mining	Silver	Final	CO0002378230
74	SUMMITVILLE MINE	8	CO	1870	1992	1992	1,2	M	Mining (1984 - CN Heap Leach)	Gold, silver	Final	COD983778432
75	U.S. MAGNESIUM	8	UT	1972	Active	2013	1,2	O	Processing	Magnesium (from brine)	Final	UTN000802704
76	UPPER TENMILE CREEK MINING AREA	8	MT	1870	1930s	1930	1	M	Mining district	Gold, lead, zinc, copper	Final	MTSFN7578012
77	URAVAN URANIUM PROJECT (UNION CARBIDE CORP.)	8	CO	1912	1984	1984	1,2	O	Processing	Radium, uranium, vandaium	Final	COD007063274
78	VASQUEZ BOULEVARD AND I-70	8	CO	1870s	1950s	1950	1	O	Smelting (smelting center for Rocky Mountain west)/ Processing	Gold, silver, copper, lead, zinc	Final	CO0002259588
79	ATLAS ASBESTOS MINE	9	CA	1963	1979	1979	1	M/O	Mining/Mill	Asbestos	Final	CAD980496863

Table 1

Summary - Mining and Milling Sites on the National Priorities L
Source: EPA AML - Status = "Final" as of May 2013 Update (list check April 21, 2

The EPA AML program defines AMLs as:

"Those lands, waters, and surrounding watersheds contaminated or scarred by extraction, beneficiation or processing of ores and minerals, including phosphate but not coal". Abandoned mine lands include areas where mining or processing activity is temporarily inactive."

	Site Name	EPA Region	State	Year Start	Year End	Year End	Design/Approval 1 - pre 1970 2 1970 - 1989 3 - 19 and later	Mining/Milling or Other Processing	Type of Activity	Minerals	NPL Status	Site/CERCLIS ID Number
80	CARSON RIVER MERCURY SITE	9	NV	late 1800s	~1950s (sporadic small mining after this)	1950	1	O	Milling(multiple mills (75) along Carson River; used Hg amalgam reactions)	Gold, Silver	Final	NVD980813646
81	IRON KING MINE - HUMBOLDT SMELTER	9	AZ	late 1800s, 1906	1969 (mining, 1960s (smelter)	1969	1	M/O	Mining, smelter/Processing	Lead, gold, silver, zinc, copper	Final	AZ0000309013
82	IRON MOUNTAIN MINE	9	CA	1860s	1963	1963	1	M	Mining	Silver, gold, coper, zinc, iron	Final	CAD980498612
83	KLAU/BUENA VISTA MINE	9	CA	1868	1970	1970	1	M/O	Mining, milling	Mercury	Final	CA1141190578
84	LAVA CAP MINE	9	CA	1861	1943	1943	1	M	Mining (historical CN plant)	Gold, silver	Final	CAD983618893
85	LEVIATHAN MINE	9	CA	1860s	1962	1962	1	M	Mining	Sulfur	Final	CAD980673685
86	SULPHUR BANK MERCURY MINE	9	CA	1865	1957	1957	1	M	Mining	Sulfur, mercury	Final	CAD980893275
87	BLACK BUTTE MINE	10	OR	1890	1960s	1960	1	M	Mining	Mercury	Final	OR0000515759
88	BUNKER HILL MINING & METALLURGICAL COMPLEX	10	ID	1880s	1981	1981	1	M/O	Mining, milling, smeltingProcessing	Lead, zinc	Final	IDD048340921
89	COMMENCEMENT BAY, NEAR SHORE/TIDE FLATS	10	WA	1890s	1985 (smelter closed)	1985	1	O	Smelter (also pulp mill, and chemical industries)/ Processing	Lead, copper	Final	WAD980726368

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	Site Name	EPA Region	State	Year Start	Year End	Year End	Design/Approval 1 - pre 1970 2 1970 - 1989 3 - 19 and later	Mining/Milling or Other Processing	Type of Activity	Minerals	NPL Status	Site/CERCLIS ID Number
90	EASTERN MICHAUD FLATS CONTAMINATION	10	ID	1944	Active	2013	1	O	Processing	Phosphate	Final	IDD984666610
91	FORMOSA MINE	10	OR	1910	1937	1993	1	M	Mining	Copper, zinc, thorium	Final	ORN001002616
92	FREMONT NATIONAL FOREST/WHITE KING AND LUCKY LASS URANIUM MINES (USDA)	10	OR	1955	mid-1960's	1960	1	M	Mining	Uranium	Final	OR7122307658
93	KAISER ALUMINUM (MEAD WORKS	10	WA	1942	Active?	2013	1	O	Processing (Aluminum Reduction) (1942 - 1978 on site disposal of pot linings)	Aluminum	Final	WAD000065508
94	MIDNITE MINE	10	WA	1955	1981	1981	1	M	Mining	Uranium	Final	WAD980978753
95	MONSANTO CHEMICAL CO. (SODA SPRINGS PLANT	10	ID	1952	Active	2013	1	O	Processing	Phosphate	Final	IDD081830994
96	REYNOLDS METALS COMPANY	10	OR	1941	2000	2000	1	O	Processing (Primary Aluminum Reduction Plant)	Aluminum	Final	ORD009412677
97	SALT CHUCK MINE	10	AK	1915	1941	1941	1	M/O	Mining/Milling	Gold, silver, copper	Final	AK0001897602
98	TELEDYNE WAH CHANG	10	OR	1957	Active as of 2010	2013	1	O	Processing	Zirconium, rare earths	Final	ORD050955848
99	BLUE LEDGE MINE	9	CA	1904		1930	1	M	Mining	Copper/Zinc	Final	CAN000906063
100	NEW IDRIA MERCURY MINE	9	CA	1854	1970s	1970	1	M/O	Mining/Processing	Mercury	Final	CA0001900463

Oppose the Industrial Acid Mining Bill SB 395

Statement of Matt Dannenberg, Field Director
Wisconsin League of Conservation Voters
September 7, 2017

Good morning. I am Matt Dannenberg, Field Director for Wisconsin League of Conservation Voters. Thank you for this opportunity to testify on SB 395.

Wisconsin League of Conservation Voters is not opposed to mining. Rather, we are concerned about the considerations and guidelines that will be used by the state when evaluating future mine site proposals. Does the legislation protect public health and natural resources to at least current standards? Does the legislation give citizens and the general public the opportunity to be adequately informed and engaged in decisions that affect their community? In the case of SB 395, the answer is 'no' to both of these questions.

No mining company sets out to pollute. However, the very nature of the toxins used and produced in the process of metallic sulfide mining makes it almost impossible not to. The U.S. EPA has called sulfide mining the most toxic industry in America and estimates that the headwaters of 40% of watersheds in the western United States are contaminated by pollution from hard rock mining. Sulfide mining poisons rivers, disrupts eco-systems, and taints groundwater with heavy metals and carcinogens like lead, arsenic, and cyanide.

Given that metallic sulfide mining is the most toxic industry in America, it is essential for Wisconsin to maintain strong clean water protections and the Prove It First provision of our mining statutes. Unfortunately, SB 395 undermines many of Wisconsin's important mining provisions.

SB 395 repeals the Prove It First provision of our mining law (Page 32, Section 37). For 20 years, Wisconsin's waters, public lands, and wildlife have been protected by the "Prove It First" mining law. That provision requires mining companies to provide specific proof a sulfide mine can run for 10 years and be closed for 10 years without polluting groundwater and surface waters with acid drainage.

SB 395 repeals Natural Resources Rule 132.06, which is the special designation for wetlands specifically under the mining code (Page 37, Section 48). The mining code outlines detailed wetland protections because, when sulfides in waste rock are exposed to water, they become incredibly toxic. The current law focuses on avoiding mining in sensitive wetlands where sulfuric acid could be produced. SB 395 would allow mining to occur in more wetlands in exchange for wetland mitigation anywhere else in the state. This increases the likelihood we will have more acid drainage problems and increases the destruction of wetlands needed for clean groundwater and clean lakes and rivers.

SB 395 eliminates a permit for "bulk sampling" activities defined as 10,000 tons (Page 9, Sections 6 & 7). Metallic sulfide mining by its very nature causes acid drainage when the sulfides in the ore come into contact with water. The bill requires the mining company to develop a plan for their bulk sampling activities rather than having those actions covered by a permit. By eliminating the need for a permit for bulk sampling, you are eliminating all the enforceable water standards that come with a permit. Digging a 10,000 ton hole that would be exposed to weather and other elements is creating the potential for acid pollution.

SB 395 undermines protections for local communities (Page 35 Section 47). The bill as drafted removes critical opportunities to challenge accuracy of mining company information and allows mining companies to begin construction even as their permits are being challenged. SB 395 would eliminate the Master Hearing in the mining permitting process. The Master Hearing is where the mining company can be questioned about accuracy of the information that they are submitting to the DNR, which is the basis for their permits. The bill also prohibits a judge from blocking a mining company from proceeding with construction of a mine while they are reviewing the legality of their permits. By allowing construction while a permit is being reviewed, they are allowing environmental damage that cannot be undone if it is later found that the permit conditions were not adequate (Page 36, Lines 18-21).

Finally, SB 395 allows mining companies to walk away from financial responsibility for any damage that occurs after the mine has been closed (Page 32, Section 41). SB 395 eliminates the requirement for a mining company to establish and maintain an irrevocable trust in perpetuity to ensure the availability of funds for preventive and remedial activities, such as responding to a spill of a hazardous substance at the mining site. If we don't require mining companies to have an irrevocable trust in place, and there is a hazardous spill, taxpayers and local communities will be on the hook for dealing with this pollution.

We ask that you oppose SB 395, which fails the citizens of Wisconsin by removing protections for human health and our natural resources for the benefit of the most toxic industry in America. Thank you.