2020 Flambeau Mine Snapshot

Overview
History
Pollution
Reclamation
Economic Impact
Federal Clean Water Act Lawsuit
Photo and Document Archive

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\(^1\) Deer Tail Scientific is a 501(c)3 nonprofit organization founded in 2017. As stated in its bylaws: The mission of Deer Tail Scientific is to educate the public, government officials and tribal sovereign nations with fact-based information on: (1) the permitting, development, reclamation, environmental performance and economics of Wisconsin's Flambeau Mine; and (2) how the Flambeau Mine compares to other mines (closed, currently operating or proposed) in the Great Lakes region and beyond.
Overview

The Flambeau Mine was an open pit copper-sulfide mine constructed on the banks of the Flambeau River near Ladysmith, Wisconsin in the mid-1990s (Figure 1). It was owned by Rio Tinto/Kennecott and operated by their subsidiary, Flambeau Mining Company (FMC). When production ceased in 1997, the 32-acre Flambeau pit was backfilled with waste rock, some of it amended with limestone. No tailings are stored at the site, since all ore was shipped by rail to Canada for processing. Environmental monitoring, included as part of the owner’s long-term care responsibilities under Wisconsin law, is expected to continue through at least 2047 (40 years following the 2007 certification of the completion of pit reclamation activities), but state regulations also include a provision allowing for potential early termination of the responsibility.

Figure 1. The Flambeau Mine operated on the banks of the Flambeau River near Ladysmith, Wisconsin in the mid-1990s. This photo was taken in 1994 when the river flooded during heavy rains and came within 20 horizontal feet and 4 vertical feet of spilling into the mine pit (Photo by Bob Olsgard of Sarona, WI, September 17, 1994).

For a schematic of the Flambeau Mine project site, see Figure 2. For a summary of the mine’s key characteristics compared to other metal-sulfide mines proposed in the Great Lakes region, see Table 1.
Figure 2. Flambeau Mine Schematic (Source: Figure 2 in: Flambeau Mine: Water Contamination and Selective “Alternative Facts”, Dr. Robert E. Moran, May 2019 (posthumous). NB: This figure was adapted by Dr. Moran from Figure 1-3 in: Final Environmental Impact Statement for Flambeau Mining Co. Copper Mine, Wisconsin Department of Natural Resources, 1990.)
Table 1. Flambeau Mine Key Characteristics Compared to Other Metal-Sulfide Mines Proposed in the Great Lakes Region

<table>
<thead>
<tr>
<th></th>
<th>Flambeau Mine (Operational 1993-97)</th>
<th>Back Forty Project (as proposed in 2015)</th>
<th>PolyMet Project (as proposed in 2015)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wisconsin: Flambeau River</td>
<td>Michigan/Wisconsin border: Menominee River</td>
<td>Minnesota: Superior National Forest</td>
</tr>
<tr>
<td>Life of Mine (yr)</td>
<td>4</td>
<td>7</td>
<td>20</td>
</tr>
<tr>
<td>Footprint (acres)</td>
<td>181</td>
<td>860</td>
<td>7,650</td>
</tr>
<tr>
<td>Distance to River (ft)</td>
<td>140</td>
<td>~140</td>
<td>-</td>
</tr>
<tr>
<td>Open Pit</td>
<td>32 acres Max Depth = 225 ft</td>
<td>83 acres Max depth = 750 ft</td>
<td>3 pits totaling 528 acres Max depth = 700 ft</td>
</tr>
<tr>
<td>Ore (tons)</td>
<td>1.9 million</td>
<td>12.5 million</td>
<td>225 million</td>
</tr>
<tr>
<td>Metals</td>
<td>Copper, Silver, Gold, Zinc</td>
<td>Gold, Zinc, Copper, Silver, Lead</td>
<td>Copper, Nickel, Cobalt, Gold, Platinum, Palladium, Zinc</td>
</tr>
<tr>
<td>Wetlands Destroyed</td>
<td>8 acres</td>
<td>?</td>
<td>913 acres</td>
</tr>
<tr>
<td>Additional Wetlands</td>
<td>11 acres</td>
<td>?</td>
<td>6,569 – 7,694 acres</td>
</tr>
<tr>
<td>or Potentially</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Impacted</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Sulfide Waste Rock</td>
<td>8.6 million</td>
<td>54 million</td>
<td>308 million</td>
</tr>
<tr>
<td>(tons)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Tailings (tons)</td>
<td>0*</td>
<td>12 million</td>
<td>225 million</td>
</tr>
<tr>
<td>Engineering Consultant(s)</td>
<td>Foth (Green Bay, WI)</td>
<td>Foth (Green Bay, WI)</td>
<td>Barr (Minneapolis, MN) &amp; Foth (Green Bay, WI)</td>
</tr>
</tbody>
</table>

*Flambeau ore was shipped by rail to Canada for processing, so there is no tailings storage at Flambeau.

- Data Source: Final Environmental Impact Statement for Flambeau Mining Co. Copper Mine, Wisconsin DNR, 1990 (1); 1997 Backfilling Plan for Stockpiled Type II Material, Flambeau Mining Company / Foth & Van Dyke, March 1997 (2); and Surface Water Quality Assessment of the Flambeau Mine Site, Wisconsin DNR, April 2012 (3).
- Data Source: The Back Forty figures shown here are from Aquila Resources’ 2015 Mining Permit Application (4), in which the company claims a 7-year life for the mine. According to information retrieved from Aquila’s website in November 2020, however, the company is now envisioning a 12-year life for the mine (5 years of open pit mining, followed by 7 years of underground mining and processing), which means more ore and more waste rock and tailings than reported in the 2015 Mining Permit Application (http://www.aquilaresources.com/projects/back-fourty-project/).

Table 1. Flambeau Mine key characteristics compared to other metal-sulfide mines proposed in the Great Lakes region.
History

The Flambeau Mine was a controversial project due to public concern over the close proximity of the proposed mine pit to the Flambeau River (140-foot separation) and the fact that the Flambeau Deposit contained high percentages of sulfides, the culprit associated with generating acid mine drainage. Stories of the grassroots resistance movement to the project, protests, arrests, state and local governmental actions, mining company maneuvers, lawsuits, and legislative battles (including the enactment of Wisconsin’s landmark Mining Moratorium Law in 1998 and the debate over how to tax the mining industry and regulate groundwater pollution) are chronicled in a book about the Flambeau Mine that was published in 2007, available online as a free download (6). Included are numerous charts and graphs showing the impact of the mine on the local economy and the extent of surface and groundwater pollution linked to the operation. In terms of how the Flambeau project was regulated by the State of Wisconsin, the book also includes an easy-to-navigate table of the state’s mining regulations that were in force at the time, many of which are still on the books today, and some that have since been revised, repealed or renumbered (7).

According to Flambeau Mining Company (FMC), the Flambeau Mine produced 181,000 tons of copper, 334,000 ounces of gold and 3.3 million ounces of silver (8-10). The combined gross value of the three metals, based on average metal prices from the 1990s, has been estimated at roughly $584 million (11). A report issued by the Wisconsin Department of Natural Resources (DNR) also mentions that 900 tons of zinc were produced (3), although this does not appear in the FMC literature. Figures from the Wisconsin Department of Revenue show the company paid a total of $14.3 million in mining taxes to the State of Wisconsin for the produced ore (11). In terms of jobs, FMC claimed that, during the active mining period, about 60 people were employed at the mine, 80% of them local residents, although independent verification of the company’s employment figures is lacking (12).

Per the terms of its mining permit (13), FMC treated contaminated pit water and runoff from the project site in a wastewater treatment plant (WWTP) that used lime neutralization, sulfide precipitation and filtration technologies. Over the years, more than 600 million gallons of effluent were discharged from the WWTP to the Flambeau River (8). The company also conducted analyses of Flambeau River water quality, sediments, crayfish, walleye and insects upstream and downstream of the mine site to monitor for potential impacts (14).

More than 100,000 people were said to have visited the mine during operations, taking in the view from a small Visitor Center and observation platform constructed near the mine pit. As noted above, the mine operated on the shores of the Flambeau River, a popular paddling and fishing destination. The river provides habitat for a variety of aquatic species, including a number of endangered or threatened mussel and dragonfly species discovered near the mine site in 1991, shortly before construction of the open pit was set to begin (15). The discovery was considered significant enough by the courts to impose a temporary injunction on mine construction while a supplemental Environmental Impact Statement regarding the species was prepared by the Wisconsin DNR (16-17). No post-mining studies have been conducted to determine the fate of these species.

Reclamation of the project site began in late 1996 and included backfilling the mine pit with stockpiled waste rock (some of it amended with limestone), recontouring the surface, adding topsoil and establishing plant communities. In 2007, the State of Wisconsin awarded FMC a partial “Certificate of Completion” (COC) for its reclamation efforts, focusing on the pit area (18). Certification was denied for the adjacent 32-acre industrial outlot, where the ore crusher, rail spur, high-sulfur waste rock stockpile and water detention ponds were located during mine operations. At issue was ongoing surface water contamination in a Flambeau River tributary (known as Stream C on company drawings) that crosses the industrial outlot and historically has been used by FMC as a conduit for conveying contaminated stormwater runoff from the outlot to the Flambeau River (19). As discussed in greater detail below, the Wisconsin DNR and United States Environmental Protection Agency (EPA) added Stream C to their official list of “impaired waters” in 2012 because of elevated copper concentrations linked to the mine operation (20-21). As of 2020, Stream C remains impaired, despite several attempts by FMC over the years to mitigate the problem by installing different types of passive water treatment systems (22-23). As a result of these failed efforts, FMC has yet to receive certification from the state for successful reclamation of this portion of the mine site.

1 A number of changes have been made to Wisconsin’s mining regulations since 2007 (when the book and table cited here were published). Most notably, the Wisconsin Legislature repealed the state’s Mining Moratorium Law and made other significant changes to the state’s nonferrous metallic mining laws in 2017 with the passage of Wisconsin Act 134. In addition, the regulations found in Chapters NR 130, NR 131, NR 132 and NR 182 of the Wisconsin Administrative Code were revised and/or renumbered in late 2020. For a copy of the most current laws and rules, go to the following State of Wisconsin web pages: https://docs.legis.wisconsin.gov/statutes and https://docs.legis.wisconsin.gov/code.
Pollution

There are 51 observation wells and piezometers at the Flambeau Mine site to measure groundwater depth and quality, and there are 2 surface water monitoring stations in the Flambeau River, one upstream and one downstream of the mine site. Location details and specifications for individual monitoring wells are posted to the Wisconsin DNR’s website, as are some of the results of FMC’s surface and groundwater monitoring program (24). In addition, hydrogeologist Robert E. Moran did an outside review of FMC’s technical reports and environmental monitoring data for the time period of 1987 (baseline) through 2016 and authored a report (25) that includes several instructive tables and figures with: (a) Flambeau Mine monitoring well specifications (Moran, Table 3); (b) Flambeau Mine groundwater quality data and graphs (Moran, Table 6 and Figure 9); (c) Flambeau River surface water quality data (Moran, Table 4); (d) Stream C surface water quality data (Moran, Table 7 and p. 45); and (e) for comparative purposes, Water Quality Standards established by the EPA, the Great Lakes Initiative, the State of Wisconsin and Canada (Moran, Table 2).

Pollution of the surface and ground water at Flambeau was predicted to occur by FMC, but the company also predicted that contaminant concentrations would be so low that the nearby Flambeau River would be protected (26). While FMC continues to claim they are in “full compliance” with permit standards and the river “remains fully protected” (27), and while industry representatives who are promoting new mining projects in the Great Lakes region (PolyMet, Twin Metals, Back Forty, etc.) point to Flambeau as a model mine (28), outside analyses of FMC’s own monitoring data suggest otherwise (29-38). As stated by Dr. Moran:

“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” (30).

For example, in a report submitted by FMC to the Wisconsin DNR in December 2015, the company itself acknowledged 45 exceedances of groundwater quality standards in 17 different wells at the Flambeau site, including wells located directly between the backfilled pit and Flambeau River (39). These violations cannot be prosecuted in court, however, because, as discussed below in greater detail, Wisconsin’s mining laws have legalized groundwater pollution within a mine’s project boundary (40).

Groundwater Contamination

Predictive Modeling: When FMC was seeking its permits to mine, the company’s primary engineering consultant for the project, Foth of Green Bay WI, offered modeling that predicted relatively low concentrations of copper (14 µg/L), iron (320 µg/L) and manganese (550 µg/L) in contact water leaving the backfilled pit (26). In addition, sulfate concentrations were predicted to reach 1,100 mg/L, markedly higher than baseline and the 10 mg/L surface water quality standard approved by the EPA to protect wild rice (41).

Now that actual levels of contaminants are being measured in the wells at Flambeau, individual FMC wells within the backfilled pit have registered median dissolved concentrations as high as the following (30):

- Copper = 503 µg/L (35 times higher than predicted)
- Iron = 14,000 µg/L (43 times higher than predicted)
- Manganese = 33,500 µg/L (60 times higher than predicted)
- Sulfate = 1,600 mg/L (1.5 times higher than predicted)

Sulfides: In addition to the flaws in Foth’s predictive modeling regarding the extent of groundwater contamination within the backfilled pit, another issue of concern at Flambeau is the presence of sulfides in the backfilled waste rock. Geological reports issued in the 1970s state that the Flambeau ore deposit was high in sulfides, with portions containing more than 50 percent sulfide by weight, and others greater than 20 percent sulfide (42-43).
In the 1990 Environmental Impact Statement (EIS) for the Flambeau project however, FMC chose not to present actual sulfide percentages in the specific rock types and zones to be mined – unlike most comparable metal-sulfide mine EISs in the U.S. and Canada at that time. Instead they chose to define only two categories of waste rock: “Type-I” with sulfur contents less than 1%; and “Type-II” with sulfur greater than 1% (1, 30).

Because of concerns over the potential for the sulfides in the Flambeau waste rock to generate acid mine drainage, FMC added limestone to the waste rock during backfill operations. 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, was meant to slow the generation of acid and dissolution of metals to an acceptable amount (18). According to company reports, FMC added over 30,000 tons of limestone to the sulfide-bearing waste rock at Flambeau, although the exact distribution between the Type-I (“low” sulfur) and Type II (“high” sulfur) waste was not disclosed. While the company had claimed in the EIS that the Type-I waste would require no limestone amendment, this did not turn out to be the case (2, 44-45).

FMC’s groundwater monitoring results, as published in the company’s annual reports, show that, as of 2016, the water within the backfilled pit has not gone acidic but is nevertheless highly contaminated. Specifically, 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/cm (27, 30).

The above reported values greatly exceed baseline data and relevant water quality standards and aquatic life criteria, but, as noted earlier, Wisconsin law has legalized groundwater pollution within a mine’s boundaries, so no such violations can be prosecuted in court. If, however, sufficiently high concentrations of contaminants are measured in monitoring wells located at or beyond what is known in state regulations as the mine’s “compliance boundary,” citations can be issued by the Wisconsin DNR. The boundary is set, by law, at 1200 feet from the outer edge of the mine’s waste disposal site, or at the boundary of the property owned or leased by the company, whichever distance is less (19, 40). In addition, the law calls for establishing a so-called “intervention boundary” somewhere between the waste disposal site and compliance boundary in order to help identify emerging pollution problems before they have a chance to reach the compliance boundary or, in the case of the Flambeau Mine, before they reach the Flambeau River.

Water quality standards for the Flambeau Mine compliance boundary and intervention boundary were established in the Flambeau Mine Permit (13), and some of those standards were based on what we now know to be Foth’s inaccurate predictions regarding the extent of groundwater contamination expected within the backfilled pit (26). A series of tables summarizing what appear to be the applicable standards for the various wells at the Flambeau site can be accessed online at: https://flambeaumineexposed.wordpress.com/groundwater-permit-standards/.

The compliance boundary for the Flambeau project, as established by the Wisconsin DNR, is roughly 3.5 miles long, encircles the entire mine site and crosses the Flambeau River southwest of the backfilled pit, disregarding possible impacts to the water quality of the river (Figure 3). This was a notable point of contention during the permitting process, when officials within the state’s Department of Justice argued, unsuccessfully, that the compliance boundary west of the pit should be the Flambeau River (46).

A second point of contention regarding Flambeau’s compliance boundary is that FMC was required to install only one nested monitoring well (MW-1015A/B) along the entire 3.5-mile-long boundary (see Figure 3 for location), and the well appears to be positioned outside the main groundwater flow path identified by FMC and their consultants (southwesterly, toward the river) (30, 47). In addition, no monitoring wells at all were installed by FMC across the river from the backfilled pit.

A third point of contention is that FMC routinely filters all Flambeau groundwater samples before running them in the lab instead of following best practices and reporting both filtered (dissolved) and unfiltered (total) concentrations. The latter, of course, undoubtedly would expose additional contamination. Reporting total concentrations is also important because most families using private wells or springs and all farms, livestock, wildlife, fish and vegetation, etc. use and consume unfiltered water (30).
Figure 3. State of Wisconsin-established Compliance Boundary for enforcement of groundwater quality standards at Flambeau Mine plus monitoring well (MW) locations (Source: Figure 7 in: Flambeau Mine: Water Contamination and Selective “Alternative Facts”, Dr. Robert E. Moran, May 2019 (posthumous). NB: This figure was adapted by Dr. Moran from Figure 1 in: Groundwater Monitoring Well Nest Installation at Compliance Boundary, FMC, 2000; https://deertailscientific.files.wordpress.com/2019/03/fmc_2000.pdf).
What the future holds for the groundwater at Flambeau is uncertain, as monitoring results show pit reactions have not stabilized (19). Hydrogeologist Robert E. Moran assessed the situation as follows:

“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 or buffer the formation of acid waters is limited and finite. After the limestone has reacted with the waste rock, its neutralizing action will diminish and the pit waters will become increasingly acidic and the concentrations of potentially-toxic contaminants are likely to increase, assuming representative data are obtained. As the limestone becomes coated with other chemical reaction products, the buffering action ceases. Roughly 20 years, post-closure, the deeper pit well waters at Flambeau show evidence of water quality degradation relative to baseline data and relevant standards and criteria, in spite of FMC’s limestone amendment program. 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”.

He added: “Obviously the mining and remediation practices employed at Flambeau do not represent a sustainable, long-term solution. While FMC may have satisfied the 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. The operating and maintenance costs for such plants are extremely high. I have worked on several projects where the present water treatment costs have been hundreds of millions of dollars, and in some cases the costs must be paid by the taxpayers” (30-31).

Despite the precarious groundwater situation at Flambeau, FMC petitioned the Wisconsin DNR in late 2018 to scale back environmental monitoring requirements at the project site. Among other things, they sought permission to: (1) decrease the number of constituents tested in groundwater samples and the frequency of testing; and (2) eliminate all earlier requirements for monitoring Flambeau River surface water, sediments, macroinvertebrates and fish (48). Despite detailed citizen comments and expert reports submitted in opposition to FMC’s petition (29, 49), the DNR granted the company’s request in 2019 with little modification (50).

Surface Water Contamination –Stream C and Flambeau River

Stream C:

Stream C is a small tributary of the Flambeau River that crosses the southeast corner of the Flambeau project site, where the mine’s industrial outlot is located. That’s where the ore crusher, rail spur, Type-II (“high” sulfur) waste rock stockpile and water detention ponds were located during mine operations and where, as part of site reclamation, a “biofilter” was constructed in 1998 to handle contaminated stormwater runoff. Historically, Stream C has been used by FMC as a conduit for conveying contaminated runoff from the industrial outlot to the Flambeau River, where dilution by the large volume of water in the river occurs (19). See Figure 4 for a map showing the location of Stream C relative to the mine site and Flambeau River. See Figures 5-6 for photos of the stream.

Over the years, stormwater runoff entering Stream C from Flambeau’s industrial outlot has registered high concentrations of copper, apparently due to the presence of contaminated soils and dust in the area from the 4-year blasting, bulldozing, truck loading/unloading, ore crushing (up to 250 tons per hour) and railcar loading operation (3, 19, 51). Ever since 2002, when FMC first started reporting Stream C water quality data, water samples collected downstream of the outlot’s biofilter and other runoff entry points have consistently and significantly exceeded the copper standard set to protect fish and other aquatic species (19, 51-55). In 2008, for example, the copper concentration measured in Stream C just downstream of the biofilter outlet was approximately 10 times the acute water quality standard, and the zinc concentration was approximately twice the standard. Since copper and zinc are synergistic metals, their combined impact on aquatic organisms is greater than that of either by itself (19).

A 2005 FMC study concluded that Stream C was almost devoid of life, including vegetation, insects and fish (56). As noted by geophysicist David M. Chambers in a 2009 review of Flambeau Mine water quality data: “With copper levels [in Stream C] 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” (19).
Figure 4. Location of Flambeau River and Stream C relative to backfilled Flambeau Mine pit and other mine features (Source: Figure 1 in: Flambeau Mine: Water Contamination and Selective “Alternative Facts”, Dr. Robert E. Moran, May 2019 (posthumous). NB: This figure was adapted by Dr. Moran from Figure 6 in: Flambeau Certificate of Completion Stipulation Monitoring Plan, Foth, 2007).
Figure 5. Stream C, downstream of Flambeau Mine site (Photo Credit: Great Lakes Indian Fish & Wildlife Commission, Apr 2004).

Figure 6. Stream C on its final approach to Flambeau River (Photo Credit: Wisconsin DNR, circa 2011).
The Wisconsin DNR did a surface water assessment of Stream C in 2010-11 and concluded that copper contamination was significant enough to warrant placing the stream on the EPA’s list of “impaired waters” (3, 20-21). As of 2020, Stream C remains on the list despite several different attempts by FMC over the years to mitigate the problem using various types of passive water treatment systems (biofilters, infiltration basins, etc.) (22-23, 54). The most recent copper levels measured in the stream, immediately downstream of the newest passive water treatment system employed by FMC, still ranged from 10-22 mcg/L (Fall 2018), roughly 2-4 times higher than the upper limit allowed under Wisconsin law (41, 57). No citations have been issued.

Despite the ongoing problems with Stream C contamination and a request from citizens for the Wisconsin DNR to beef up monitoring requirements (49), the Department moved in the opposite direction in 2019 and is no longer requiring FMC to report any surface water quality data for the stream.

**Flambeau River:**

As noted above, the Flambeau River has received and continues to receive contaminated surface water inflows from Stream C. Other sources of contamination linked to the mine also exist. For example, as part of his review of FMC’s environmental monitoring data for the Flambeau project, Dr. Robert E. Moran examined FMC’s waste water treatment plant (WWTP) permits and concluded that millions of gallons of inadequately-treated effluents were discharged to the river during mine operations (30).

Groundwater pathways are also a factor at Flambeau, as suggested by FMC’s mine design plans that called for the construction of an underground “cutoff wall” between the pit and Flambeau River to limit movement of river water into the pit during mine operations (58). Now that the pit has been backfilled, contaminated water from the pit may be moving around, under or through the cutoff wall and into the river, with flow directions changing seasonally as the respective water levels (head relationships) vary. Another possibility is that the bedrock itself is permeable and contaminated water is moving through fractures (19, 30, 47). Here is what FMC predicted would happen with regard to groundwater flow at the reclaimed mine site:

“... all of the groundwater flowing through the Type-II [“high” sulfur] waste rock in the reclaimed pit will exit the pit 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, there will be little if any dispersion or retardation of the dissolved constituents in the groundwater... 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.” (26).

Indeed, FMC’s monitoring data shows that contaminants are moving out of the pit and toward the Flambeau River (19, 30). In particular, two monitoring wells located directly between the backfilled mine pit and river (MW-1000PR and MW-1000R) have shown marked increases in manganese and sulfate concentrations over baseline, with manganese levels so high that both wells have been in violation of Flambeau Mine permit standards ever since post-reclamation monitoring began in 1998 (see Figure 7 for sample graph and References 59-60 for additional graphs) No citations have been issued.

Whether or not the Flambeau River was or is being adversely affected by contaminated ground and surface waters emanating from the mine site cannot be fully ascertained at this time. While FMC claims that sediment, macroinvertebrate, crayfish and walleye studies conducted by the company between 1991 and 2011 showed no adverse impact to the river, an outside review of their studies revealed numerous flaws in study design, execution and reporting (34-38). Plus, no new data has been reported by the company since 2011.

FMC’s Flambeau River surface water monitoring program is also suspect, this due to the fact that the company has failed to report any surface water quality data from the stretch of the Flambeau River immediately adjacent to the backfilled pit. Rather, the location selected by the company for “downstream” reporting (SW-2 on company diagrams) is a full 500 feet downstream of the backfilled pit and upstream of the discharge point of Stream C (see Figure 4). As of 2017, surface water quality data reported by FMC for the SW-2 sampling site has met standards (61).
Figure 7. Manganese concentrations reported by Flambeau Mining Company in MW-1000PR (intervention boundary well) at the Flambeau Mine site before, during and after completion of mine operations (Source: Graphs of Flambeau Mine Surface and Groundwater Quality Data (Time Period 1987-2020), Deer Tail Scientific (Duluth, MN), September 2020).
Reclamation

Reclamation plans for the 225-foot-deep Flambeau Mine pit – a half mile long and 32 acres in size – were approved by the Wisconsin DNR as part of the permitting process (62-63), and the Department also supervised elements of the field work (9). According to FMC, the unlined pit was backfilled with: (a) roughly 4.0 million tons of Type-I (“low” sulfur) waste rock; (b) 4.6 million tons of Type-II (“high” sulfur) waste rock; and (c) all of the “metal and sulfur enriched sludge” from the mine’s waste water treatment plant (exact volume not disclosed) (1-2, 44-45). As discussed earlier, FMC also added limestone to some of the waste during backfill operations in an attempt to slow the development of acid mine drainage.

Backfill operations were completed in 1997, and FMC installed monitoring wells within the backfilled pit in September 1998 (64). It took several years for the groundwater table to re-establish at the project site. While the deeper monitoring wells within the backfill could be sampled as early as February 1999, the shallowest remained dry until late 2005. Some of the monitoring wells located outside the pit took a while to rebound, too. The last to come online was MW-1000R, about 24 feet deep and located directly between the backfilled pit and Flambeau River. It was dry until late 2010, when the first samples were collected for analysis (27).

Reclamation activities at the Flambeau Mine site also included recontouring the surface of the backfilled pit, adding topsoil and establishing plant communities (9). By 2001, FMC claimed all necessary vegetation performance standards had been met (65). According to promotional materials circulated by the company, “the area now serves as a year-round community resource. The site is home to prairie and woodland habitat along with 10 acres of wetlands which support hundreds of plant and wildlife species. Visitors enjoy free access to ten miles of hiking trails and five miles of equestrian trails, as well as bird watching, fishing and a variety of other activities” (8). Aerial views of the reclaimed site have also been circulated widely by mine proponents, drawing attention to the outward appearance of the property rather than the beneath-the-surface problems that Flambeau is experiencing with ground and surface water contamination (28).

Partial Certification for Completion of Mine Reclamation Activities

As part of the State of Wisconsin’s mine closure process, an operator is required to demonstrate successful reclamation of the mine site, and, if the Wisconsin DNR agrees that standards have been met, the company is awarded a “Certificate of Completion” (COC) for their reclamation efforts. In the case of Flambeau, FMC received a partial COC in May 2007. Certification was granted for the 149-acre portion of the mine site where the open pit and several other mine features were located during operations, with the decision based on FMC’s completion of backfill operations according to plan and successful revegetation of the surface. However, due to ongoing problems with contaminated stormwater runoff draining into Stream C from the mine’s 32-acre industrial outlot, certification was denied for that portion of the property (18). As noted earlier, over the years FMC has tried to clean up the problem by constructing several different kinds of passive water treatment systems in the industrial outlot (22). As of 2020, however, Stream C remains on the EPA’s list of “impaired waters” for copper toxicity linked to the Flambeau Mine operation (54), and, as a result, FMC has yet to receive a COC from the State of Wisconsin for successful reclamation of this portion of the mine site.

All is not clear with the portion of the mine site that received the partial COC in 2007 either. As noted above, certification of the pit area was based on FMC’s completion of backfill operations according to plan and successful revegetation of the surface. Through legal maneuvering, the company succeeded in securing a ruling from the State of Wisconsin Division of Hearings and Appeals that eliminated consideration of the following factors in the certification process: (a) groundwater contamination within the mine’s backfilled pit that significantly exceeded levels predicted by FMC; (b) documented violations of Flambeau Mine Permit standards in monitoring wells located between the backfilled pit and Flambeau River; and (c) data regarding potential adverse impacts of the mine on fish and other aquatic life in the Flambeau River (66).
Economic Impact

The impact of the Flambeau Mine on the local Rusk County economy has been described by some as an “economic miracle” and others as negligible (12). Here are the facts:

Information regarding Rusk County’s annual unemployment rate, annual per capita income and percentages of total population and children living in poverty is on file with the Wisconsin Department of Workforce Development, Wisconsin Department of Revenue and U.S. Census Bureau. When that data is reviewed and analyzed for the time period of 1990 (pre-mining) to 2000 (post-reclamation), it appears the Flambeau Mine had little or no impact on Rusk County’s overall economic health (12). In fact, in 1995, at the height of mining, Rusk County continued to rank at or near the bottom of the barrel among Wisconsin’s 72 counties in terms of its unemployment rate and other important economic indicators (see Table 2). When the data is graphed, the flat-line effect of the mine on the local economy becomes even more apparent (see Figure 8 for graph with unemployment data and Reference 67 for additional graphs).

<table>
<thead>
<tr>
<th>Economic Indicator</th>
<th>Rusk County’s Ranking Among Wisconsin’s 72 Counties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Unemployment Rate (2nd to the worst unemployment rate of all 72 Wisconsin counties)</td>
<td>71st</td>
</tr>
<tr>
<td>Annual Per Capita Income (2nd to the lowest annual per capita income of all 72 Wisconsin counties)</td>
<td>71st</td>
</tr>
<tr>
<td>Percentage of Total Population Living in Poverty (3rd highest percentage of people living in poverty of all 72 Wisconsin counties)</td>
<td>70th</td>
</tr>
<tr>
<td>Percentage of Children Living in Poverty (4th highest percentage of children living in poverty of all 72 Wisconsin counties)</td>
<td>69th</td>
</tr>
</tbody>
</table>

* Data compiled by Deer Tail Scientific (Duluth, MN) for educational purposes, using statistics provided by the Wisconsin Department of Workforce Development, United States Census Bureau, Wisconsin Blue Book, and Wisconsin Department of Revenue. For more information go to: https://deertailscientific.wordpress.com/flambeau-economics/

Table 2. Rusk County’s poverty ranking, relative to all 72 Wisconsin counties, for the year 1995 (at the height of Flambeau Mine operations); Source: Economic Indicators for Rusk County and Its Neighboring Counties, Before, During and After Flambeau Mine Operations, Deer Tail Scientific, 2017.

In terms of tax payments to the State of Wisconsin for the Flambeau ore, the copper, gold and silver produced by the Flambeau Mine had an estimated value of about $584 million (based on production figures provided by FMC and average metal prices from the 1990s), and FMC paid $14.3 million in state mining taxes (11). According to the Wisconsin Department of Revenue, roughly $8.6 million of the total amount paid was returned to the local municipalities directly impacted by the mine (Rusk County, the Town of Grant and City of Ladysmith): $3 million per the terms of the mining tax law and $5.6 million in discretionary grants (11, 68). The remaining $5.7 million was deposited into the state’s “Badger Fund” 2. The three local municipalities also received about $2.7 million in direct payments from FMC per the terms of a locally-negotiated agreement (11).

2 The Wisconsin Legislature revamped the state’s mining tax law in 1981 and included provisions to funnel a portion of any future mining tax revenues into a newly-created fund known as the “Badger Fund” (69). Lawmakers specified that half of the interest accrued on the fund would be distributed as grants to help Wisconsin communities develop recreational facilities, and the other half was to be used by the state to help cover its financial commitment to the public school system. After money started to accumulate in the fund from mining taxes paid by FMC in the mid-90s, the fund was raided by the Wisconsin Legislature to help balance the state budget in 1996, and the fund was totally eliminated in 1997 (11, 69).
Figure 8. Rusk County’s poverty ranking relative to all 72 Wisconsin counties (as reflected by Annual Unemployment Rate) for the time period immediately before, during and after Flambeau Mine operations (Source: Economic Indicators for Rusk County and Its Neighboring Counties, Before, During and After Flambeau Mine Operations, Deer Tail Scientific, 2017).

The Wisconsin Resources Protection Council (Tomahawk, WI), Center for Biological Diversity (Tucson, AZ) and Laura Gauger (Duluth, MN) filed a complaint against Flambeau Mining Company in the U.S. District Court for the Western District of Wisconsin in early 2011, alleging ongoing violations of the federal Clean Water Act at the Flambeau Mine site (70). The plaintiffs’ legal argument was that FMC was in violation of the Act because it had never obtained a federally-mandated National Pollution Discharge Elimination System (NPDES) permit to regulate the discharge of contaminated stormwater runoff from a man-made detention basin or “biofilter” in the southeast corner of the mine site (point source) to Stream C (a water of the U.S.), and now the stream was impaired (20). FMC, on the other hand, sought to convince the court that the company’s mining permit issued by the State of Wisconsin fulfilled the requirements of the Act, even though the permit had placed no restrictions on the amount of copper, zinc, iron and other pollutants discharged to Stream C from the detention basin.

In April 2012, U.S. District Judge Barbara Crabb handed down an opinion and order regarding various motions for summary judgment filed by the two parties (71). The ruling was overwhelmingly in the plaintiffs’ favor, including Judge Crabb’s conclusion that FMC’s state-issued mining permit did not qualify as a permit under the federal Clean Water Act.

A week-long trial was held in Madison, Wisconsin in May 2012. Key evidence submitted by the plaintiffs included a recently-completed study by the Wisconsin DNR entitled: Surface Water Quality Assessment of the Flambeau Mine Site (3). In it, the Department assessed, among other things, copper and zinc concentrations in Stream C and the stormwater detention basin at issue. They looked at old data, collected new data and found that toxicity standards set to protect fish and other aquatic species were routinely exceeded in the stream. As a result, the DNR recommended to the EPA in late 2011 that Stream C be added to the Agency’s 2012 list of “Impaired Waters” for copper and zinc toxicity linked to the Flambeau Mine operation (20).

FMC, too, had key evidence for the judge to consider. After the lawsuit was filed by the plaintiffs, but before it went to trial, the company implemented a new work plan at the mine site that involved converting the biofilter (the source of the pollution at the heart of the plaintiffs’ complaint) into an infiltration basin with no outlet to Stream C (72). The idea was that the contaminated water would now seep into the earth instead of discharging to Stream C. FMC presented this information to the court as part of their defense, seeming to suggest that any problems that might have existed at the mine site were already fixed. A representative of Foth Engineering (Green Bay, WI), FMC’s consultant for the work plan, also assured the Judge, under oath, that the new infiltration basin would withstand a 100-year flood event.

Judge Crabb issued her final opinion and order in July 2012 and ruled in the plaintiffs’ favor (73). She wrote:

Judgment is GRANTED in favor of plaintiffs on their claim that defendant discharged a pollutant from a point source that entered a water of the United States and that it did not have a permit issued under the Clean Water Act when it did so.

She also noted that the Clean Water Act “does not recognize good faith or lack of knowledge as defense; civil liability is strict.”

In her ruling, Judge Crabb also opined on the seriousness of the FMC violation. Despite the Wisconsin DNR report submitted into evidence that showed Stream C to be impaired, she characterized the pollution of the stream as “de minimis”. She also approvingly noted of various efforts undertaken by FMC over the years to remediate the mine site, including the company’s recent conversion of the biofilter at issue to an infiltration basin. With regard to the new infiltration basin, she wrote: “it is reasonable to expect that [it] will improve on the efficiency of the biofilter.” Taking all of these factors into account, Judge Crabb concluded that any penalties assessed to FMC for their violation of the Act should be minimal and fined the company only $275. In an unusual move, she also denied the prevailing party (the plaintiffs) an award of their attorney fees.

Elements of Judge Crabb’s decision were appealed by both parties, sending the case to the U.S. Court of Appeals for the Seventh Circuit. Oral arguments were heard by the three-judge panel in Chicago, Illinois on April 23, 2013, and the court handed down a final decision a few months later (74). In its ruling, the higher court did not dispute the plaintiffs’
claim that FMC had discharged contaminated stormwater runoff from a point source at the Flambeau Mine site to a water of the United States and that the tributary was now impaired. Rather, the panel focused on the Wisconsin DNR’s regulatory authority as the administrator of the Clean Water Act in Wisconsin. Contrary to Judge Crabb’s opinion, they ruled that the mining permit issued by the State of Wisconsin to FMC shielded the company from prosecution under the federal Clean Water Act, this despite the fact that the state-issued permit had included no provisions for regulating the discharge of pollutants to Stream C. Since FMC was now the prevailing party in the case, the plaintiffs were also ordered to reimburse the company a portion of its legal expenses (75).

For online access to many of the legal briefs and expert reports filed in the Flambeau Mine Clean Water Act lawsuit, go to: https://flambeaumineexposed.wordpress.com/legal-actions/clean-water-act-case-2012-3/.

Shortly after the Flambeau Mine Clean Water Act lawsuit was decided, the plaintiffs learned that Judge Crabb’s faith in FMC’s newly-constructed infiltration basin to “improve on the efficiency of the biofilter” had been misplaced. The basin replacing the biofilter in the Flambeau Mine industrial outlot malfunctioned (Figure 9), as did a second infiltration basin constructed nearby as part of the same work plan. Instead of being able to withstand a 100-year flood event as claimed by their designer (Foth of Green Bay, WI), the infiltration basins could not even withstand the Spring melt. Here is how the Wisconsin DNR described the situation in a 2014 memo (76):

“In brief, we have been monitoring the situation with the basins and have noted that the basins were nearly filled to capacity during the Spring 2013/14 melts and exceptionally large rainfall events. When that happens, FMC is required to activate pumps to lower the water level in the basins. We have shared our concerns with FMC that periodic pumping is not a long-term solution to the problem. It is our understanding that FMC is working on a solution and will be submitting something for our review in the near future.”

In 2015, FMC decided to scrap the infiltration basins altogether and revert to an engineered biofilter-like wetland with a drainage channel and culvert connecting it to Stream C (77). As before, the Wisconsin DNR placed no limits on the amounts of contaminants discharged to Stream C, and the stream remains on the EPA’s list of impaired waters to this day (54).

![Figure 9. This photo of the infiltration basin in the Flambeau Mine industrial outlot was taken in Spring 2013, when the basin nearly overtopped and had to be pumped. For more information and photos, go to: https://flambeaumineexposed.wordpress.com/infiltration-basin-malfunction/ (Photo Credit: Wisconsin DNR, April 12, 2013).]
As I get older in life, I realize that I am not always going to be here!

Many hours have been spent over the years tracking down technical reports and environmental monitoring data for the Flambeau Mine near Ladysmith, Wisconsin – the industry’s so-called “Model Mine” and calling card. Why? As you might suspect, the Flambeau Mine is not all it’s cracked up to be, and I wanted to set the record straight (be it in court or at public hearings) as my way of trying to protect our precious water resources for future generations.

Not everyone can drive over to Ladysmith or Madison like I have over the years to dig through the records of state and local agencies to uncover the real story of what happened at Flambeau – nor should they have to, especially since the work has already been done!

The lengthy spreadsheet assembled for your use lists all of the documents in my files, is organized by topic and electronically searchable. Information regarding where to find original copies of all listed documents is also provided, as are live links to many of them. In addition, self-produced scans of all the documents can be found on a series of DVDs inside the back cover of the printed spreadsheet, available in the archives of the Wisconsin Historical Society in Madison, Wisconsin and the Kathryn A. Martin Library at the University of Minnesota-Duluth. If you would like your own copy of the spreadsheet and DVDs, please contact Deer Tail Scientific.

Putting together this spreadsheet was more than just about Flambeau! The data clearly shows that, even at a very small and state-of-the-art copper-sulfide mine with no tailings pond (all of the Flambeau ore was shipped by rail to Canada for processing, so that is where the tailings were generated and disposed), strategies designed to protect ground and surface water quality failed. Specifically: (1) limestone amendment of the Flambeau waste rock failed to prevent significant groundwater contamination within the backfilled pit; and (2) passive treatment of stormwater runoff failed to protect a nearby Flambeau River tributary from becoming polluted (the tributary is now on the United States Environmental Protection Agency’s official list of impaired waters). What's to happen at even larger metal-sulfide mines with tailings ponds?*

May the documents herein cataloged and provided for review be helpful to you, my partners in this struggle, and the next generation of fighters!

Laura Gauger, Chair
Deer Tail Scientific

*As stated by hydrogeologist Robert E. Moran: “I know of no metal-sulfide mines anywhere in the world that have operated without degrading the original water quality, long-term – even those employing modern technologies” (30).
References


8. Rio Tinto Website: Flambeau Mine, retrieved 2020 (Nov); http://flambeaumine.com/

9. Wisconsin DNR Website: Reclaimed Flambeau Mine, retrieved 2020 (Nov); https://dnr.wisconsin.gov/topic/Mines/Flambeau.html


76. **Wisconsin DNR (Philip Fauble), 2014 (Oct)**, Email correspondence with Laura Gauger (Duluth, MN); https://flambeaumineexposed.files.wordpress.com/2015/01/flambeau-mine-update_oct-2014.pdf


78. **Digital Collection of Historical Flambeau Mine Technical Reports, Environmental Monitoring Data, Correspondence, Diagrams and Photos (1969 – 2020)**, compiled by Deer Tail Scientific (Duluth, MN) for educational purposes, March 2020 (updated August 2020); https://deertailscientific.wordpress.com/historic-documents/

**Website Resources**

- **Wisconsin Historical Society – Roscoe and Evelyn Churchill Papers (Flambeau Mine)**; https://search.library.wisc.edu/catalog/9912201460002121
- **Wisconsin DNR – Flambeau Reclaimed Mine**; https://dnr.wisconsin.gov/topic/Mines/Flambeau.html
- **Deer Tail Scientific**; https://deertailscientific.wordpress.com/
- **Deer Tail Press**; https://deertailpress.wordpress.com/
- **Flambeau Mine Exposed-I**; https://flambeaumineexposed.wordpress.com/
- **Flambeau Mine Exposed-II**; https://flambeaumineexposed2.wordpress.com/