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Memorandum

Date: May 2, 2022

Report for 401(a)(2) Public Hearing

To: US Army Corps of Engineers, St. Paul District
File No. MVP-1999-05528-TJH

From: Cliff Twaroski (resume provided in Attachment 1)

RE: 401(a)(2) Public Hearing on PolyMet's NorthMet Project Section 404 Permit
NorthMet Project Supplemental Evaluation of Baseline Wetland Water Levels, Water Chemistry (Sulfate, Total Mercury, and Methylmercury), and Export to Downstream Waters

Summary

In the attached report, we document our review of claims by the Fond du Lac Band of Lake Superior Chippewa (Band) that the NorthMet Project (Project) by Poly Met Mining, Inc. (PolyMet) will affect the Band's water quality on its Reservation located 116 miles downstream from the Project. Major conclusions from evaluating the Band's claims against Project information include:

- The Band mischaracterizes and misrepresents the Project, leading to faulty claims.
- The net cumulative effect of the Project's operations (potential loading from air emissions plus required water management and treatment) will reduce sulfate and mercury loading to the lower St. Louis River near the Fond du Lac Reservation by approximately 1,380,000 kilograms per year and 5.2 grams per year, respectively.
- The Project will reduce mercury and methylmercury loading from the Project area to downstream waters on short-term (days) and longer-term (annual) time scales.
- The Project's water management requirements and limited mine pit dewatering effects are expected to maintain wetland water level fluctuations within the naturally occurring range. Therefore, flushing of sulfate, mercury, and methylmercury from wetlands is reasonably expected to also remain within the range of naturally occurring loading.
- A reduction in sulfate loading is not reasonably expected to increase methylmercury formation or export from Project watersheds or concentrations in downstream waters.

The weight-of-evidence clearly indicates the Project cannot increase sulfate, mercury, or methylmercury loading to the lower St. Louis River above that occurring under existing conditions. There are adequate controls in place, both in Project design and in permit requirements, to verify the Project will not violate water quality standards for sulfate or mercury at the Fond du Lac Reservation on the lower St. Louis River, 116 river miles downstream.

NorthMet Project Supplemental Evaluation of Baseline Wetland Water Levels, Water Chemistry (Sulfate, Total Mercury, and Methylmercury), and Export to Downstream Waters Conducted in Support of 401(a)(2) Permitting Process to Address Comments on Potential Effects to Downstream Water Quality

Prepared for
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May 2022

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NorthMet Project Supplemental Evaluation of Baseline Wetland Water Levels, Water Chemistry (Sulfate, Total Mercury, and Methylmercury), and Export to Downstream Waters

May 2022

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Abbreviations

Band	The Fond du Lac Band of Lake Superior Chippewa
BMPs	Best Management Practices
cfs	cubic feet per second
DNR	Minnesota Department of Natural Resources
FEIS	Final Environmental Impact Statement
F-MeHg	filtered methylmercury
FTB	Flotation Tailing Basin
g/yr	grams per year
$g/m^2/yr$	grams per square meter per year
gpm	gallons per minute
16 years	2005 through 2020
kg/day	kilograms per day
kg/ha/yr	kilograms per hectare per year
kg/yr	kilograms per year
$\mu g/m^2/yr$	microgram per square meter per year
mg/L	milligrams per liter
ng/L	nanogram(s) per liter
MeHg	methylmercury
MPCA	Minnesota Pollution Control Agency
NPDES	National Pollutant Discharge Elimination System
Project area	Plant Site and Mine Site
PolyMet	Poly Met Mining, Inc.
Project	NorthMet Project
ROD	Record of Decision
SDS	State Disposal System
USACE	U.S. Army Corps of Engineers
"will affect" letter	The Band's August 3, 2021 letter to the U.S. Environmental Protection Agency
WWTS	Waste Water Treatment System

1 Introduction

The Fond du Lac Band of Lake Superior Chippewa (Band) has objected to the 404 permit issued for the NorthMet Project (Project) based on its determination that Project discharges "will affect" the quality of the Band's waters more than 110 river miles downstream in the lower St. Louis River. The Band's August 3, 2021 letter to the U.S. Environmental Protection Agency ("will affect" Letter) presents the Band's claims of potential Project effects on waters of the Fond du Lac Reservation. Poly Met Mining, Inc. (PolyMet) has asked Barr Engineering Co. (Barr) to address the Band's claims related to Project effects on wetlands and the downstream effects on concentrations of sulfate, mercury,[1] and methylmercury in waters of the Fond du Lac Reservation. It is Barr's understanding that a separate document is being developed to address the Band's concerns in its "will affect" Letter about specific conductance.

PolyMet's analyses were conducted in support of the Final Environmental Impact Statement (FEIS), National Pollutant Discharge Elimination System (NPDES) permitting, and the 401 water quality certification (e.g., Appendix A of Reference (1); References (2); (3)) demonstrate the Project will **decrease** sulfate and mercury loading to the lower St. Louis River near the Fond du Lac Reservation by approximately 1,380,000 kilograms per year (kg/yr) and 5.2 grams per year (g/yr), respectively (Reference (3)). Therefore, a reduction in sulfate loading will reduce the potential for methylmercury formation and will not increase loading to these downstream waters.

Both PolyMet's analyses and evaluations and the Minnesota Department of Natural Resources (DNR)'s extensive assessment of the St. Louis River watershed conclude that mine water discharges are not the primary source of mercury or methylmercury but are a dominant source of sulfate to the lower St. Louis River. The DNR studies also determined that the vast majority of mercury and methylmercury in the lower St. Louis River originates from non-mining areas, including the large wetland-dominated watersheds of the Whiteface, Floodwood, and Cloquet Rivers. The Band disagrees with these conclusions, and its opinion is the Project will increase the loading of sulfate and inorganic mercury, and various processes will increase the formation and concentration of methylmercury in the waters and fish of the Fond du Lac Reservation. However, this is in direct conflict with FEIS conclusions and permit documentation issued for the NorthMet Project by the U.S. Army Corps of Engineers (USACE), Minnesota Pollution Control Agency (MPCA), and the Minnesota Court of Appeals, as follows:

- The FEIS states, "[t]he net effect of these [Project] changes would be an overall reduction in mercury loadings to the downstream St. Louis River upstream of the Fond du Lac Reservation boundary. Therefore, the NorthMet Project Proposed Action would not add to any potential exceedance of the Fond du Lac mercury water quality standard of 0.77 ng/L within the Reservation." (Reference (4), p. 5-10)
- The USACE Record of Decision (ROD; Reference (5)) states, "[t]he net effect…would be an overall reduction in mercury loadings to the downstream St. Louis River upstream of the Fond du Lac

[1] References to mercury in this memo refer to total mercury unless otherwise noted.

Reservation Boundary. The Project is not expected to add to any potential exceedance of the Fond du Lac mercury water quality standard of 0.77 ng/L within the Reservation" (p. 42), and "there is no expected change in fish mercury concentrations and no substantial change in human health risks related to fish consumption" (p. 74).

- The MPCA's Section 401 Water Quality Certification Program Fact Sheet (Reference (6)) states, "[b]ased on its review of Cross-Media analysis, the MPCA concluded:

    1. The analysis developed a reasonable and protective scenario that showed no measurable changes of mercury in water or fish from Project-related deposition of sulfur.

    2. There will be no exceedances of copper, cobalt, and arsenic Class 2D water quality standards or to any other numeric water quality criteria from Project-related air emissions or the cumulative impact of Project-related air emissions.

    3. The Project will not result in any measurable changes to water quality downstream of the Project in the St. Louis River, including downstream locations at Forbes (upper St. Louis River)" (p. 14).

- The Minnesota Court of Appeals, in the NorthMet Project NPDES/SDS Permit case,[2] states "the PCA did not err by issuing a permit that does not ensure compliance with the Band's water-quality standards" (p. 33) and "[t]he permit ensures compliance with the Band's water-quality standards" (p. 39). In this case, the Band did appeal other decisions unrelated to the Band's water quality standards; however, they did not appeal the court decision that the permit would not comply with the Band's water-quality standards.

The objectives of this report are to address the Band's August 3, 2021, claims specifically by:

- Providing context to the Band's claims of a direct nexus between the Project and the waters of the Fond du Lac Reservation

- Providing monitoring data to further characterize existing conditions at the Plant Site and Mine Site with regard to wetland water level fluctuation, wetland water and surface water quality, and the range (variability) of existing conditions for sulfate, mercury, and methylmercury concentrations and loading to the Embarrass River, Partridge River, and St. Louis River

- Assessing potential Project contributions to the lower St. Louis River during a high-flow and high-concentration flushing scenario and determining if Project contributions are outside the range of existing conditions using supplemental screening calculations for mercury and methylmercury, reflecting Project water management and treatment requirements.

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[2] In the Matter of the Denial of Contested Case Hearing Requests and Issuance of National Pollutant Discharge Elimination System / State Disposal System Permit No. MN0071013 for the Proposed NorthMet Project St. Louis County Hoyt Lakes and Babbitt Minnesota.

2 Project Water Management Not Accounted for in Band's Claims

The Band's August 3, 2021, claims do not reflect the Project's water management requirements. Information in the FEIS, NPDES permit applications and NPDES Permit documentation, and 401 Certification application and documentation are summarized here, along with some additional support information, to provide context for the Band's mischaracterization of the Project, as discussed in Section 3.

Water management (collecting, storing, and treating Tailings Basin seepage and waters that have contacted mining features and using Colby Lake water for make-up) and treatment are key components of the Project's compliance with water quality standards and antidegradation requirements. The FEIS (Reference (4)), PolyMet's Water Management Plans (References (7); (8)), and antidegradation analyses (Appendix A of Reference (1)); Reference (2)) all describe the Project's water management and treatment requirements. These requirements include collecting waters that have contacted mining features at the Mine Site, including construction dewatering water and runoff from the Overburden Storage and Laydown Area, which is then sent to the Tailings Basin for project use and treatment. These are areas that the Band continues to identify as releasing "*repeated flushes*" of methylmercury and mercury (e.g., Band's "will affect" Letter p. 18). Yet, the Band's forecast that the Project will adversely impact the water quality and increase fish mercury concentrations in the waters of the Fond du Lac Reservation ignores the permit requirements for PolyMet to manage water at both the Mine Site and Plant Site.

Important features of PolyMet's water management and treatment are highlighted below.

- Plant Site
    - Flotation Tailing Basin (FTB) seepage capture systems will collect water with sulfate concentration that averages 200 to 300 milligrams/liter (mg/L) around the toe of the Tailings Basin that currently flows to headwater wetlands to Unnamed (Mud Lake) Creek, Trimble Creek, and Unnamed Creek, all of which are tributaries to the Embarrass River and Second Creek, a tributary to the Partridge River. Captured water will be routed to the Waste Water Treatment System (WWTS) and treated to remove sulfate and other constituents. The treated water will have a maximum of 10 mg/L sulfate concentration and will be routed to the headwater wetlands for stream augmentation.
        - The primary effect of seepage collection is to reduce sulfate loading (replacing 200-300 mg/L seepage with 10 mg/L treated water) to these headwater wetlands around the Tailings Basin and these tributaries to the Embarrass River and Partridge River.
        - Based on a concentration range of 200 to 300 mg/L and 2,400 gallons per minute (gpm) flow, sulfate load leaving the LTVSMC tailings basin toward the Embarrass River ranges from 2,600 to 3,900 kilograms per day (kg/day), average of about 3,300 kg/day. In the FEIS (p. 5-217), under existing conditions, approximately

3,000 kg/day of sulfate was estimated to leave the LTVSMC tailings basin toward the Embarrass River.

        - By capturing the seepage around the north and west portions of the Tailings Basin, treating it at the WWTS, and discharging the treated water at 10 mg/L sulfate, the sulfate load discharged is estimated to range from about 82 kg/day (-20% flow) to 158 kg/day (+20% flow); some 20 to 40 times less loading per day to the headwater wetlands, tributaries to the Embarrass River, and downstream waters than occurs in existing conditions.

        - Capturing the seepage to the south of the Tailings Basin, treating it at the WWTS, and discharging the treated water at 10 mg/L sulfate to Second Creek, the sulfate load discharged is reduced by about 231 kg/day (~84,300 kg/yr) from existing Second Creek, the Partridge River, and downstream waters conditions.

    - The combined effect of the FTB seepage capture systems and treated water discharge at the Plant Site, using average values, and including treated water discharge to Second Creek, will result in an approximately 3,100 kg/day loading decrease (a decrease of approximately 1,131,000 kg/yr).

- Mine Site

    - There will be no direct discharge of treated water from the Mine Site to waters of the United States or waters of the state.

    - Water management includes collecting water that has contacted mining features and activities such as mine pits, stockpiles, haul roads, Overburden Storage and Laydown Area, and construction dewatering. This water is sent to the Plant Site for use and treatment. Additionally, natural runoff and stormwater that has not been exposed to mining activities will be routed to stormwater ponds around the perimeter of the Mine Site to control storm event flow off site and to have total suspended solids removed from the water.

    - Water management actions, primarily collecting waters that have contacted mining features and activities, are estimated to reduce flows from the Mine Site by about 48% (from 3.9 cubic feet per second (cfs) in existing conditions to approximately 2.1 cfs) (Attachment F of Appendix A of Reference (1)). Note that this reduction in flow from the Mine Site is estimated to result in less than a 5% change in annual daily mean flow to the upper Partridge River (Reference (4), p. 5-139).

    - Under existing conditions, the Mine Site mercury loading is from the atmosphere (wet and dry deposition), while almost all methylmercury is formed in wetlands. The primary effect of water management at the Mine Site is to remove mercury and methylmercury load from this portion of the Partridge River watershed that would otherwise continue to be added under a continuation of existing conditions.

    - Mercury annual loading is estimated to be reduced by about 6 g/yr under average flow and concentration conditions (Section 5 of Reference (3)); Attachment E of Appendix A of Reference (1)). Supplemental calculations indicate water management could reduce mercury loading on an event basis by about 1 g/day under high-flow and high-mercury-concentration conditions (e.g., snowmelt or large storm) (Section 3.4).

    - Methylmercury loading to the Partridge River is estimated to be reduced by about 0.5 g/yr under average flow and concentration conditions (Section 3.4). The supplemental calculations also indicate the Project could reduce methylmercury loading by about 0.13 g/day under high-flow with high-methylmercury-concentration conditions (e.g., snowmelt or large storm).

- Under existing conditions, the Mine Site sulfate loading is from the atmosphere with a background estimated at about 4.8 kilograms per hectare per year (kg/ha/yr). For the two streams on the south side of the Mine Site (e.g., Unnamed Creek, former sampling location WP-1, and the intermittent outlet stream from the Wetland of Interest evaluated in the Cross-media Analysis that does not connect to the Partridge River), the average sulfate concentrations range from 2 to 5 mg/L, typical of background conditions (concentrations ranging from 1 to 6 mg/L in non-mining wetland areas (Reference (9)). Wetlands in the middle of the Mine Site, within and adjacent to the proposed mine pits, have no channelized flow connection to the Partridge River. On the southern edge of the Mine Site, south of the proposed mine pits, some intermittent wetland water is routed under Dunka Road via culverts, but the channeled flow at Dunka Road then disperses out into downgradient wetlands.

  Surface water sulfate concentrations and exporting sulfate to the upper Partridge River during Project operations are not expected to increase above those in existing conditions because even though additional atmospheric sulfate load from the Project was estimated to be centered just southeast of the West Pit (1.55 kg/ha/yr additional sulfate to the Wetland of Interest), all other areas of the Mine Site and the upper Partridge River were estimated to receive very little additional sulfate from the Project (1 to 2% of background) (Section 4 and Large Figure 10 of Reference (3)). Further, only one stream at the Mine Site directly connects to the Partridge River: Unnamed Creek (former monitoring location WP-1), which starts in a wetland on the north side of Dunka Road in the southwest portion of the Mine Site. Estimated sulfate loading from the Project in that portion of the Mine Site area was ~0.06 kg/ha/yr, 1% of background (Large Figure 10 of Reference (3)). Overall, Mine Site operations result in a reduction of about 9,020 kg/yr in sulfate loading to the Partridge River at SW004a (Table 5-6 of Reference (3)).

- Colby Lake
    - Colby Lake water will be used as make-up water in the processing plant. As documented in previous loading analyses (e.g., antidegradation analyses for the NPDES Permit and 401 Certification), pumping water from Colby Lake to the Plant Site removes surface water and the associated loads of sulfate, mercury, and methylmercury from the lower Partridge River. Using Colby Lake water also reduces loading to the Embarrass River because after the Colby Lake water is used as process water at the Plant Site, it is sent to the FTB and eventually treated at the WWTS as Tailings Basin seepage prior to discharge. Therefore, using Colby Lake water at the Plant Site and treating it prior to discharge also reduces overall sulfate, mercury, and methylmercury loading in downstream waters in the St. Louis River.
- NorthMet Project in total
    - On an annual basis, the NorthMet Project water management and treatment at the Plant Site and Mine Site and using Colby Lake water is estimated to reduce overall sulfate and mercury loading to the lower St. Louis River near the Fond du Lac Reservation by approximately 1,380,000 kg/yr and 5.2 g/yr, respectively, compared to existing conditions (Reference (3)).

Engineering controls and overall Project water management result in reduced loadings of sulfate, mercury, and methylmercury from both the Mine Site and Plant Site to downstream waters in the Partridge River, Embarrass River, and St. Louis River, including the lower St. Louis River adjacent to the Fond du Lac Reservation, compared to existing conditions (Reference (3)). The Band dismisses or fails to acknowledge the required water management and treatment for the Project and therefore has erroneously concluded the Project will affect downstream waters, including the Fond du Lac Reservation waters in the lower St. Louis River more than 110 river miles from the Project.

3 Assessment and Evaluation

Previous assessments have used representative average flow and concentration conditions to estimate potential Project sulfate and mercury loading to evaluation points on the Embarrass River, Partridge River, and St. Louis River. This supplemental evaluation assesses potential Project contributions for high-flow and high-concentration (flushing) events that the Band raised as a concern in its August 3, 2021, letter.

This supplemental evaluation demonstrates Project operations at the Mine Site will not increase sulfate, mercury, or methylmercury loading to the Partridge River (Section 3.2) or other downstream waters. In addition, because the Band's objections are founded on conclusions regarding the net effect of the Project on water quality in the lower St. Louis River at the Fond du Lac Reservation, more than 110 river miles from the Project, this section also provides background information needed to place its claims in context (Section 3.1) and reviews the evidence that the Project's direct discharges will not increase the sulfate, mercury, or methylmercury loading to the Embarrass River, Partridge River, or downstream waters (Section 3.3). As done in PolyMet's previous assessments, this evaluation summarizes how the overall Project will not increase loads or concentrations of sulfate, mercury, or methylmercury in downstream waters at the Fond du Lac Reservation (Section 3.4).

3.1 Context for Sub-Watershed Contributions to the Lower St. Louis River

The potential for the Project to adversely affect water quality and fish tissue mercury concentrations in the St. Louis River at the Fond du Lac Reservation is limited by several fundamental factors:

- the distance between the nearest Project discharge point and the Fond du Lac Reservation is more than 110 river miles
- the Project area contributes less than 1% of the flow in the St. Louis River at the Fond du Lac Reservation
- vast wetlands in watersheds contributing to flow and loadings downstream of the Project control mercury and methylmercury concentrations in surface water in the lower St. Louis River and, therefore; fish mercury concentrations in the St. Louis River at the Fond du Lac Reservation

3.1.1 Fond du Lac Reservation is more than 110 river miles downstream of the Project

The Project area is located in the headwaters of the Partridge and Embarrass Rivers, and the Fond du Lac Reservation is more than 110 river miles downstream of the Project.

River miles are measured along the St. Louis River, starting where the river flows into Lake Superior (River Mile 0). The DNR's State Water Trail Maps for the upper St. Louis River and lower St. Louis River were referenced for the River Miles identified in this section. The Highway 33 bridge in Cloquet is at River Mile 37, the Fond du Lac Reservation borders the river between River Miles 38 and 60 (with several tributaries flowing through tribal lands entering the river in this stretch), and the St. Louis River originates at Seven Beavers Lake at River Mile 200, upstream of the Project.

Large Figure 1 shows the St. Louis River watershed and the locations of the Project and the Fond du Lac Reservation. Major sub-watersheds are identified, including the Embarrass River (confluence at River Mile 141.1) and Partridge River (confluence at River Mile 164.6) sub-watersheds near the headwaters of the St. Louis River. The Embarrass River and Partridge River sub-watersheds are further discussed in Section 3.1.3. Table 1 summarizes the area of the sub-watersheds and the area of wetlands within each.

Table 1 Selected sub-watersheds in the St. Louis River basin

Sub-watershed	Watershed area (mi^2)	Wetland area (mi^2)	Percent Wetland Area (%)
Cloquet River	793.5	103.4	13.0
Whiteface River	535.8	165.3	30.9
Upper St. Louis River (headwaters)[1]	135.6	73.3	54.1
Mud Hen Creek	99.3	13.1	13.2
Stony Creek	88.4	47.0	53.4
Floodwood River	231.1	108.4	46.9
Swan River[2]	241.4	61.6	25.5
West Two River[2]	81.3	6.4	7.9
East Two River[2]	52.1	2.6	5.0
Long Lake Creek[2]	21.5	1.5	7.0
Elbow Creek[2]	19.9	1.5	7.5
Embarrass River[2]	180.8	19.3	10.7
Partridge River[2]	161.8	20.3	12.5

Adapted from Table 1 of Reference (9)
mi^2 = square miles
[1] Estimated watershed area and wetland area from GIS mapping tools for the Upper St. Louis River sub-watershed by Barr Engineering Co. All other area estimates from (Reference (9)).
[2] The DNR identified these watersheds to contain active mines and/or mining features (stockpiles, tailings basins, etc.); a "Mining Watershed."

3.1.2 The Project Area Contributes less than 1% of the Flow in the St. Louis River at the Fond du Lac Reservation

Figure 1 illustrates the magnitude of flows in the St. Louis River, near the Project areas in the Embarrass and Partridge Rivers, and downstream from the Project to the Fond du Lac Reservation and Cloquet. Flow increases with distance downstream, with about 75% of the St. Louis River flow at Cloquet entering between Forbes and Cloquet (calculated from flows in Figure 2). As shown in Figure 2, as tributaries join the river downstream of Forbes, the annual average flow increases by more than a factor of 4 between Forbes and Cloquet. In addition to a number of smaller tributaries, two major tributaries (the Whiteface

River and the Cloquet River) enter the St. Louis River downstream of Forbes. The flow in the Whiteface River is about 50% of the St. Louis River flow where it enters the St. Louis River (Reference (10)). The flow in the Cloquet River is about 33% to 50% of the St. Louis River flow where it enters the St. Louis River (References (10); (11)). In addition, the Whiteface, Floodwood, and Cloquet Rivers combined account for about 46% of the watershed area of the St. Louis River basin, further emphasizing their importance to flow and water chemistry in the lower St. Louis River. In comparison, under both existing conditions (i.e., without the NorthMet Project) and with the Project fully operating, the Project area (Plant Site and Mine Site) contributes about 2% of the St. Louis River flow at Forbes, and 0.5% of the St. Louis River flow at Cloquet, just downstream of the Fond du Lac Reservation. In other words, the flow contribution from the Project area to the lower St. Louis River is so small that the Project in operation is not discernible from existing conditions.

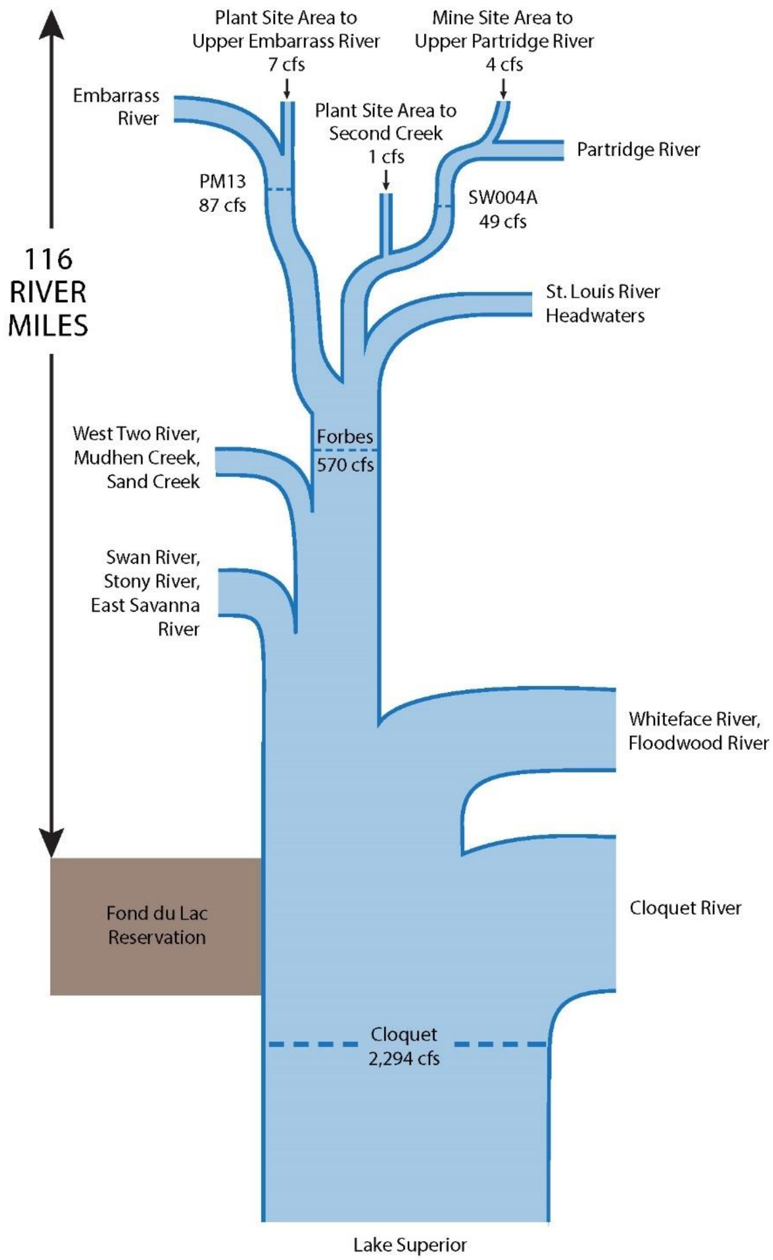


Figure 1 Overview of St. Louis River Flows

Even at evaluation points on the Embarrass and Partridge Rivers, close to the Project, the respective Project areas are a small contributor to existing conditions flows. For example, the Plant Site is estimated to currently contribute about 8% of the flow (~7 cfs) to the upper Embarrass River at monitoring location SW005 (formerly PM-13), just downstream of the Plant Site. The Mine Site is estimated to currently contribute about 8% of the flow (~4 cfs) to the upper Partridge River at monitoring site SW413 (formerly SW004a), just downstream from the Mine Site. The previous identifiers for the monitoring sites (e.g., PM-13 and SW004a) are used hereafter to maintain naming consistency with previous submittals to the state agencies.

The flow rates are an important context for the Band's claims because the small flow contributions from each Project area inherently limit the mass of sulfate, mercury, and methylmercury that can be exported to downstream waters, whether under existing conditions or with the Project in operation. The Project in operation will have flows to both the Embarrass River and Partridge River similar to existing conditions flows due to water management requirements and NPDES permit discharge limits. As identified in previous loading calculations submitted to state agencies (including the antidegradation analyses for 401 Certification and NPDES permitting and the Cross-media Analysis), the small changes in flows, primarily reduction in flows to the Embarrass and Partridge Rivers, result in reduced sulfate and mercury loads, primarily due to the water management requirements (collecting Tailings Basin seepage and water that contacts mining features and using Colby Lake water) and discharge of treated water. New calculations under high-flow and high-concentration conditions (results summarized in Section 3.4) further demonstrate the estimated reduced sulfate, mercury, and methylmercury loads to the Embarrass, Partridge, and lower St. Louis Rivers associated with the Project in operation and the Band's continued misinterpretation and mischaracterization of the Project.

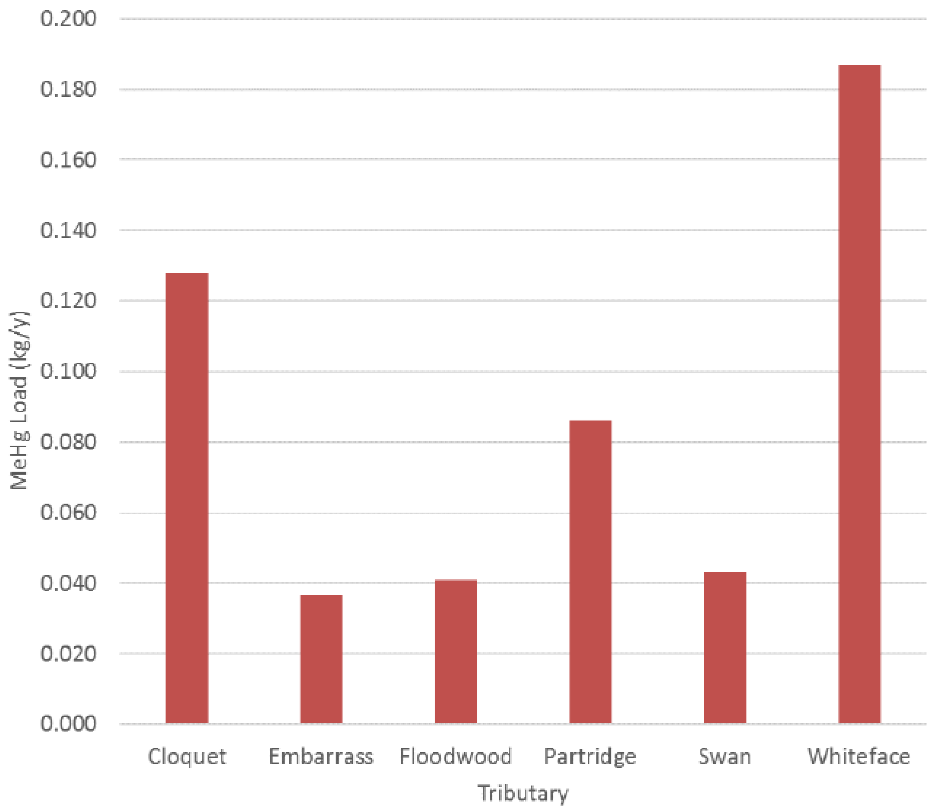
3.1.3 Non-mining Areas Contribute Most of the Mercury and Methylmercury in the lower St. Louis River

The DNR initiated a study of the St. Louis River watershed in the mid-2000s to investigate the role of sulfate releases from mining operations on mercury speciation in the river. Sampling was conducted over a range of hydrologic conditions to identify primary source regions and transport mechanisms for mercury species (Reference (11)). The DNR's extensive evaluation of the St. Louis River watershed included a number of linked studies to identify the sources of sulfate, mercury, and methylmercury in the St. Louis River and has led to the following conclusions (References (9); (11); (12)):

- The source of sulfate in the lower St. Louis River is primarily from mining operations (average load of 35 metric tons per day), although non-mining areas also contribute sulfate (average load of about 15 metric tons per day) (Reference (9))

- Conversely, the source of mercury and methylmercury in the lower St. Louis River is primarily from non-mining areas, with the Whiteface River and Cloquet River providing significantly more methylmercury load to the St. Louis River than watersheds with mining features (Figure 2) (Reference (13))

- Riparian wetlands immediately adjacent to rivers were identified as the dominant source of the mercury and methylmercury found at the various sampling locations, including the lower St. Louis River



Source: Reference (13)

Figure 2 Estimated Annual Loads of Methylmercury from Selected Tributaries in the St. Louis River Watershed

DNR assessment reports (e.g., Reference (11)) and published literature (References (9); (12)) and MPCA's mercury loading study (Reference (13)) have demonstrated the overriding influence on mercury and methylmercury concentrations and loading in the lower St. Louis River are from low-sulfate non-mining areas. While the Partridge River watershed is identified as mining-influenced, it has a large non-mining area that includes the South Branch that originates in extensive headwater wetlands. The non-mining portion of the Partridge River watershed is likely contributing to the higher estimated loading compared to other mining-influenced watersheds such as the Embarrass River and Swan River. One of the early studies (Reference (10)) noted the Whiteface River and Cloquet River drain a significant part of the St. Louis River basin. The flow in the Whiteface River is about 50% of the St. Louis River flow where it enters the St. Louis River (Reference (10)). The flow in the Cloquet River is about 33% to 50% of the St. Louis River flow where it enters the St. Louis River (References (10)); (11)).

To date, the Band has not accounted for the significance of mercury and methylmercury flows and loading from non-mining watersheds in its assessment of potential impacts on waters of the lower St. Louis River. This is a serious omission and contributes to the Band's mischaracterization of the Project's potential to affect water quality in the lower St. Louis River.

3.2 Project Operations Will Not Increase the Export of Sulfate, Mercury, or Methylmercury from Mine Site Wetlands

PolyMet measured wetland water levels in the Project area (Mine Site, Transportation and Utility Corridors, and Plant Site) from 2005 through 2020 (i.e., 16 years). Wetlands in the Project area function similarly to other wetlands in northern Minnesota. Data for the Project area wetlands show they experience seasonal water level fluctuations as well as notable water level drawdown during drought conditions, with water levels increasing again as precipitation and snowmelt add more water to the system. However, even during weeks to months of very dry conditions, none of the wetlands dried up, and water levels rebounded when precipitation events resumed.

The following are general characterizations of Project area wetlands based on monitoring data:

- All wetlands experience water level fluctuations
- Ombrotrophic bogs (Sphagnum dominated) tend to have water levels at or below the ground surface; occasionally experiencing water levels above the ground surface
- Alder thicket wetlands experience water levels at and above the ground surface and can experience deep water level drawdown (more than 24 inches below ground surface)
- Swamps and marsh-type wetlands typically have less water level fluctuation in any given year compared to other wetland types

3.2.1 Wetland Water Level Impacts from Mine Pit Development are Expected to be Limited as Described in the FEIS

DNR and the USACE assessed potential indirect effects of pit dewatering on Mine Site wetlands using a field-based method known as the analog method. The analog method was developed based on data from northern Minnesota for actual mining operations and adjacent wetlands (Section 5.2.2.3.2 of Reference (4)). The analog method concluded that measurable wetland water level drawdown from mine pit dewatering (distinguishable from natural variation) is possible within 1,000 feet from the pit rim. The FEIS conclusions about the effects of mine pit dewatering on the ~5,800 acres of wetlands within 10,000 feet of the pit rim include (Table 5.2.3-4 of Reference (4)):

- 5,094 acres would see no effect (87%)
- 568 acres have a low likelihood of water level drawdown (10%)
- 120 acres have a moderate likelihood of water level drawdown (2%)
- 46 acres have a high likelihood of water level drawdown (<1%)

Band's Claims from Band "will affect" Letter:

- *"PolyMet has previously argued that site conditions preclude the application of the numerical model used to determine pit dewatering requirements to explicitly identify the extent of wetland impact,* *and as such only apply knowledge from analog sites. This argument has been dismissed by another expert Opinion (J.S. Price, 2017). Despite the clear potential for impacts on surface water and wetland function, in the absence of a model, PolyMet asks that it be taken on faith that wetlands in the zones of impact would be largely unaffected by aquifer depressurization because they are hydrologically 'disconnected' from underlying groundwater systems. This unsubstantiated contention was consistently challenged in prior opinions (Branfireun, 2014; 2019), as it is neither supported by best available science, nor PolyMet's own data (or lack thereof) and expert opinions."* (pp. 11-12)

- *"Maps developed by GLIFWC…show the approximate area of groundwater drawdown in four zones, which have ranges of potential surface dewatering effects ranging from severe (Zone 1 – closest to the mine pit) to modest-minimal (Zone 4, farthest)…Zone 1: 5 to 10 feet of drawdown [0-1,000 feet based on figure]…Zone 2: 3 to 5 feet of drawdown [1,000-2,000 feet based on figure]…Zone 3: 1 to 3.5 feet of drawdown [2,000-5,000 feet based on figure]…Zone 4: 0-1 foot of drawdown [5,000-10,000 feet based on figure]"* (pp. 12-14)
- *"[T]he development and de-watering of the open pit will lower groundwater and surface water levels around the mine directly affecting an area that contains over 6000 acres of wetlands"* (p. 11)
- *"…the substantial changes in surface water hydrology…will be the direct result of pit dewatering and wetland under-drain…"* (p. 17)

FEIS and USACE ROD Findings and Protective Permit Conditions

The FEIS addressed potential wetland hydrology impacts. The USACE ROD describes the process used to assess indirect effects on wetlands and the reasoning behind their process:

> "Indirect effects caused by the discharge of dredged and fill material into wetlands, including changes to wetland hydrology, are difficult to model and accurately predict because of the complex mixes of bedrock, surficial deposits, and wetland soils at the Mine Site" (USACE ROD, p. 7).
>
> "As discussed in an ERM/MDNR memorandum, the Co-Lead Agencies determined site conditions at the Mine Site preclude the use of computer modeling to predict the groundwater cone of depression and identify specific resultant wetland impacts around the mine pit. Unconsolidated surficial deposits observed at the Mine Site are relatively heterogeneous and range from very dense clay to well-sorted sand. The hydraulic conductivity of these surficial deposits ranges from 0.012 to 31 feet per day, and bedrock outcrops are present across the area which may hydraulically separate or isolate different areas of the surficial deposits. Based on observations at other Mine Sites located on the Minnesota Iron Range, the lead agencies developed the analog approach described in the referenced ERM/MDNR memo, in which the degree of effect was correlated to the distance from the open mine pit. Analog data were used instead of a model such as MODFLOW. While the heterogeneous nature of the surficial deposits and undulating topography of bed rock makes precise predictions of impacts to a specific wetland and the extent of the cone of groundwater depression problematic, impact would be generally expected to be greatest close to the mine pits with impacts reducing as a function of distance from the mine pits.

A range of potential indirect impacts has been estimated in the FEIS (Section 5.2.3.2.2 and Figure 5.2.3-6 and Figure 5.2.3-11) using the Analog Method developed by the Co-lead Agencies. Wetlands were identified within four analog impact zones (Figure 12):

- 0-1,000 ft from the pits: significant surficial groundwater drawdown in this zone is most likely to occur. Impacts are most likely to be measurable, but there may also be areas of perched surficial water table that will be unaffected by pit dewatering.
- >1,000-2,000 ft: surficial groundwater drawdown may occur but will likely be much less than within the 1000 ft zone and may be discernable from natural variation.
- >2,000-3,500 ft: surficial groundwater drawdown is unlikely, except under unique hydrogeologic conditions, e.g., where elongated bedrock valleys of coarse glacial material are severed by the pit. Impacts may not be discernable from natural variation.
- >3,500-10,000 ft: impacts unlikely." (USACE ROD, pp. 35-36)

While the Band claims that "*PolyMet…argued that site conditions preclude application of the numerical model*," the FEIS clearly stated that when MODFLOW was previously used to estimate drawdown impacts at another mine site, it was found to be inaccurate (Reference (4), p. 5-112) and the USACE ROD makes it clear that the Co-Lead Agencies developed the analog method, which was based on "observations at other mine sites located on the Minnesota Iron Range." The Band's experts may disagree with this approach and the characterization of the impact zones, which are very different than what the Band's expert GLIFWC developed in 2013 and submitted to the USACE ahead of the FEIS. The Co-Lead Agencies did consider GLIFWC's submittal, as detailed in the FEIS (Reference (4), pp. 8-13 and 8-14), which describes this as a difference of opinion between the Co-Lead Agencies and the Tribal Cooperating Agencies. The Band contends this is in error, but the fact is, the agencies' experts didn't agree with the Band's experts. The USACE ROD also states that "[u]ltimately regardless of the method used to identify potential areas of impact, implementation of a monitoring plan will provide definitive information to the extent and nature of indirect wetland impacts" (Reference (5), p. 24).

The FEIS uses the analog method to "inform where monitoring should take place for those areas that were identified as having a potential for indirect wetland effects" (FEIS p. 5-259). The USACE ROD states, "[b]ecause there is considerable uncertainty regarding the extent of indirect effects that may occur due to groundwater drawdown, indirect effects cannot be definitively determined in advance of direct impacts." (Reference (5), p. 36). Therefore, USACE "developed a protocol for utilizing well data to determine indirect impacts to wetlands due to groundwater drawdown." Compliance with the monitoring plan developed from this USACE protocol is incorporated in Special Conditions 16-18 of the NorthMet Project USACE Section 404 Wetland Permit (Reference (5), pp. 37 and 80).

The NorthMet Project permits have many protective conditions to verify that wetland drawdown does not result in further indirect effects without action being required and that pit dewatering does not result in "*substantial changes in surface water hydrology*," as follows:

NorthMet Project USACE Section 404 Wetland Permit:

- Special condition 14-15 requires PolyMet to use erosion control measures along the perimeter of all work areas and to maintain stream flows within the Embarrass River at +/- 20% of historic average annual flow. The USACE ROD states that the rationale for these conditions is to "ensure indirect effects associated with regulated activities in wetlands are minimized" (p. 80).

- Special conditions 16-28 require PolyMet to monitor for potential indirect effects on wetlands, to evaluate wetland hydrology data (43 wetland wells in the Mine Site area, including three wells in reference wetlands (Reference (14)), wetland vegetation data, and wetland boundaries in accordance with specific protocols in comparison with baseline data for the annual, biennial, and every five year reporting to the USACE for review and approval. If USACE determines that additional wetlands have been adversely impacted, PolyMet must provide a plan within 60 days for increasing monitoring, implementing adaptive management, and/or providing compensatory mitigation, all of which must be reviewed and approved by USACE. (Note that special condition 31 already requires PolyMet to retain an option on up to 529 additional credits in the event they are needed for indirect impacts.) The USACE ROD states the rationale for these conditions is to "ensure adequate monitoring and reporting of data and information to inform the Corps' determinations of indirect effects on wetlands associated with authorized activities" (p. 82).

- Special condition 29 requires additional hydrology monitoring in specific wells around the east and west pits with quarterly reporting after overburden removal occurs on each pit to assess potential impacts from pit dewatering. The USACE ROD states that this condition is required to "ensure adequate monitoring and reporting of data and information to inform the Corps' determinations of indirect effects on wetlands in areas of the Project site that may have a higher likelihood for indirect effects" (p. 82).

- Special conditions 31-33 set the requirements for compensatory mitigation if required. The USACE ROD states that these conditions are required to "ensure appropriate compensation to offset any indirect effects to wetlands caused by permitted activities" (p. 83).

NorthMet Project 401 Water Quality Certification, with compliance required under the 404 Permit:

- Conditions 2 and 3 include wetland hydrology monitoring (43 wetland wells in the Mine Site area, including three wells in reference wetlands (Reference (14)) and wetland vegetation monitoring, which is characterized in the 401 Certification Fact Sheet to "help the agency ensure that wetland functions and values are adequately protected and/or replaced where necessary."

- Condition 4 requires an evaluation of annual monitoring data to see if there are any deviations from baseline conditions to determine whether adaptive management measures need to be triggered.

- Condition 6 requires compensatory mitigation "for all permanent direct and indirect surface water impacts."

NorthMet Project Minnesota Wetland Conservation Act Approval:

- Conditions 9-11 detail the requirements for the monitoring plan for potential indirect wetland impacts, which is to be reviewed and approved by the DNR, the requirements to be followed if indirect wetland impacts are likely to occur (adaptive management and mitigation), and the length of time monitoring for indirect wetland impacts are required (until the DNR determines that no possibility exists for indirect impacts to occur).

NorthMet Project DNR Water Appropriation Permits:

- Maintain Partridge River Streamflow: This condition requires PolyMet to maintain mean annual streamflow in the Partridge River within +/-20% of the existing hydrograph.
- Stream Augmentation: This condition requires PolyMet to augment streamflow in Trimble Creek, Unnamed Creek, Second Creek, and Unnamed (Mud Lake) Creek to maintain the mean annual streamflow in each stream within +/-20% of the existing conditions hydrograph.
- Model Updates and Assessments: This condition requires PolyMet to develop a modeling work plan to be approved by the DNR to incorporate monitoring results into surface and groundwater modeling to evaluate the suitability of the monitoring data based on predicted impacts.
- Adaptive Management: This condition requires PolyMet to work with the DNR to develop an approved plan for implementing adaptive management or mitigation strategies if monitoring or modeling results show unacceptable impacts to lands or waters caused by the permitted water appropriations, which includes pit dewatering.
- In addition to the permit conditions listed above, PolyMet's water appropriation permits require PolyMet to monitor:
    - Groundwater levels in 22 wells in the surficial aquifer and 24 wells in the bedrock around the Mine Site to evaluate changes in groundwater levels due to the Project. Note that these are in addition to the 43 wetland hydrology monitoring wells.
    - Groundwater levels in 26 wells/piezometers in the surficial aquifer around the Tailings Basin to evaluate changes in groundwater levels as a result of the Project.
    - Surface water flows immediately upstream and downstream of the Mine Site and Tailings Basin to evaluate changes in streamflow as a result of the Project.

PolyMet's Additional Evaluation and Findings

The Band's conclusions seem to rest on the premise that mine pit dewatering will drawdown water levels in *all* the wetlands evaluated for the FEIS. This premise is inconsistent with accepted wetland hydrology principles and the known characteristics of wetlands at the Mine Site discussed in the FEIS. When considering the Mine Site landscape and wetland hydrologic functioning, conclusions from the FEIS were as follows (Reference (4), pp. 4-173 to 4-174)):

- There is a general lack of interaction between the surficial and bedrock aquifers. The hydrology of many wetlands at the Mine Site is primarily supported by direct precipitation with some variable surficial groundwater components from the uplands (water infiltrating upland soils and some amount of that water contributing to the wetland).

- Organic and mineral soils at the Mine Site are typically perched over the dense till or a local sandy textured surficial aquifer, resulting in perched wetlands. The primary method for water to move across the landscape towards the Partridge River is by lateral flow either at/near the soil surface or within the subsurface soil. Surface flow laterally across the wetland complexes (i.e., flow from one wetland to the next) is negligible because of flat slopes and surface roughness.

- Lateral flow within the wetland soils is typically very slow. Fibric peat at the surface allows infiltration of surficial water; however, the deeper, more highly decomposed, sapric peat has greatly reduced lateral and vertical hydraulic conductivity compared to the fibric peat. Therefore, water tends to stay perched and stored within the wetland, typically exhibiting only subtle variations in the water tables over time in those deeper peat soils. The silty sand or clay typically underlying the organic soil also has low hydraulic conductivity and, therefore, contributes to maintaining the wetlands' hydrology.

The Mine Site wetland characteristics are consistent with the characteristics of other wetland / peatlands in northern Minnesota (Reference (15)). As further discussed by Boelter and Verry (Reference (15)), wetland waters in ombrotrophic peatlands essentially have no mixing with groundwater (either surficial or regional groundwater). Wetland characteristics limit the vertical flow of water (Reference (16)), thus limiting the potential effects of mine pit dewatering on wetland water levels. Even in more permeable glacial till areas such as the Marcell Experimental Forest, where wetlands are perched above the groundwater table, water is only very slowly released vertically (References (15); (16)), and water is retained in the wetland even during extended dry/drought conditions. Wetland formation characteristics that include compacted bottom layers and associated negligibly small hydraulic conductivity (Reference (16)) effectively limit the downward movement of water and retain water within the wetland.

In addition, the Mine Site landscape (e.g., general disconnection of wetlands at the Mine Site to groundwater) limits the potential effect of mine pit development on wetlands relatively close, or well beyond, 1,000 feet from the pit rims.

- Monitoring data indicate the majority of Mine Site wetlands are primarily supported by precipitation inputs and local surface runoff, with hydrology closely mirroring weather patterns (References (4), p. 4-175); (14)). This means any effects on the surficial aquifer or groundwater at depth should minimally affect wetland hydrology

- The Mine Site bedrock does not have a smooth surface; rather, it has mini hills and depressions that either shed or collect water (i.e., water collected in the depressional areas). This means the wetlands have short flow paths due to the characteristics of the bedrock and are considered to be separate from the shallow aquifer. Additionally, typical wetland characteristics, such as very slowly permeable bottom layers that severely limit the extent of vertical seepage, further limit potential effects from mine pit dewatering.

- The Mine Site is a local topographic high on the landscape, with a surface drainage divide oriented generally from southwest to northeast near the northern border of the Mine Site. Water to the north of the divide drains to 100 Mile Swamp, with the majority of the Mine Site (approximately 80%) draining south towards Dunka Road and eventually to the Partridge River through extensive wetland complexes (Reference (4), p. 4-175)). Surveys of the wetlands at the Mine Site, with oversight and results reviewed by the DNR and USACE, indicate the bedrock is generally sloping away from the mine pits, which means surficial water in soils and at the soil-bedrock interface moves away from the mine pits. Therefore, the Mine Site landscape will drain water away from the mine pits and towards downgradient wetlands (e.g., wetlands located to the south of Dunka Road).

This site-specific information, in addition to general peatland characteristics that sequester water (Reference (15)), indicates that pit construction and dewatering should minimally affect Mine Site wetlands, as identified by the FEIS analog method and associated results (Section 5.2.3.1.2of Reference (4), pp. 5-279 to 5-309). The Band and its consultants do not account for the Mine Site landscape, thus misrepresenting the potential effect of mine pit dewatering on Mine Site wetlands. Thus, the Band's worst-case mine dewatering scenario that assumes water will be pulled from wetlands, including wetlands more than a mile from the mine pits, should not occur.

Information from two other mining operations, the Victor Mine in northern Ontario, Canada, and the nearby Peter Mitchell Mine, located just north of the NorthMet Mine Site, provide additional support to the DNR's findings from their analog method that minimal potential impacts to wetland water levels are expected from the NorthMet mine pit dewatering.

Alternative Mining and Wetland Impact Analog #1

The Victor Mine, an open-pit mine located in the Hudson-James Bay Lowland of northern Ontario (Figure 3), which is the second-largest peatland complex in the world, was identified as an analog system to compare to the NorthMet Mine Site (Reference (17)). Before mining began, dewatering of the Victor Mine was predicted to create a large cone of depression due to the porous limestone aquifers underlying the project area. The Victor Mine environmental setting has characteristics that make nearby wetlands potentially highly vulnerable to mine dewatering: e.g., very slowly permeable marine sediments overlying porous limestone bedrock; extensive wetlands adjacent to the mine site; an extensive water table essentially at the ground surface adjacent to the mining operation. Wetland impacts were predicted to be focused on areas with thin overburden and a small watershed near the center of the dewatering (Reference (18)). Because of the porous limestone aquifers, wetland water levels around the Victor Mine were predicted by several researchers to be severely affected by an expanding cone of depression from mine pit dewatering, causing water to be drained downward through the bottom of the wetlands (i.e., increased vertical groundwater flux) (Reference (17)).

However, once mining actually began, while there were local effects within 30 meters of bioherms (raised rock features with a direct connection to regional groundwater (Reference (19)), and drawdown of water levels in some wetlands occurred, most wetland areas experienced water table drawdown similar to a background wetland not affected by mining. It was also identified that water levels in an area of high concern were found to be more influenced by evapotranspiration and not from mine pit dewatering (Reference (20)). Overall, there was no, or very limited, measurable impact on nearby creeks and rivers and only isolated effects on the peatlands and ponds in areas of thin overburden (Reference (18)). In other words, the worst-case predictions of wetland impacts did not occur at the Victor Mine (Reference (18)).

(from: https://www.bing.com/images/)

Figure 3 Location of the Victor Mine in Northern Ontario, Canada

Even though significant impacts to wetland water levels were predicted for the Victor Mine, where a porous limestone aquifer underlies extensive interconnected wetlands, the actual impacts on wetland water levels were isolated and occurred within the estimated impact zone (Reference (18)). Predicted worst-case impacts of severe water level decline and desiccation of extensive wetland areas around the Victor Mine did not occur. Because wetland water levels were only minimally affected by mine pit dewatering, excessive sulfate, mercury, and methylmercury flushing to downstream waters have not occurred (Reference (21)).

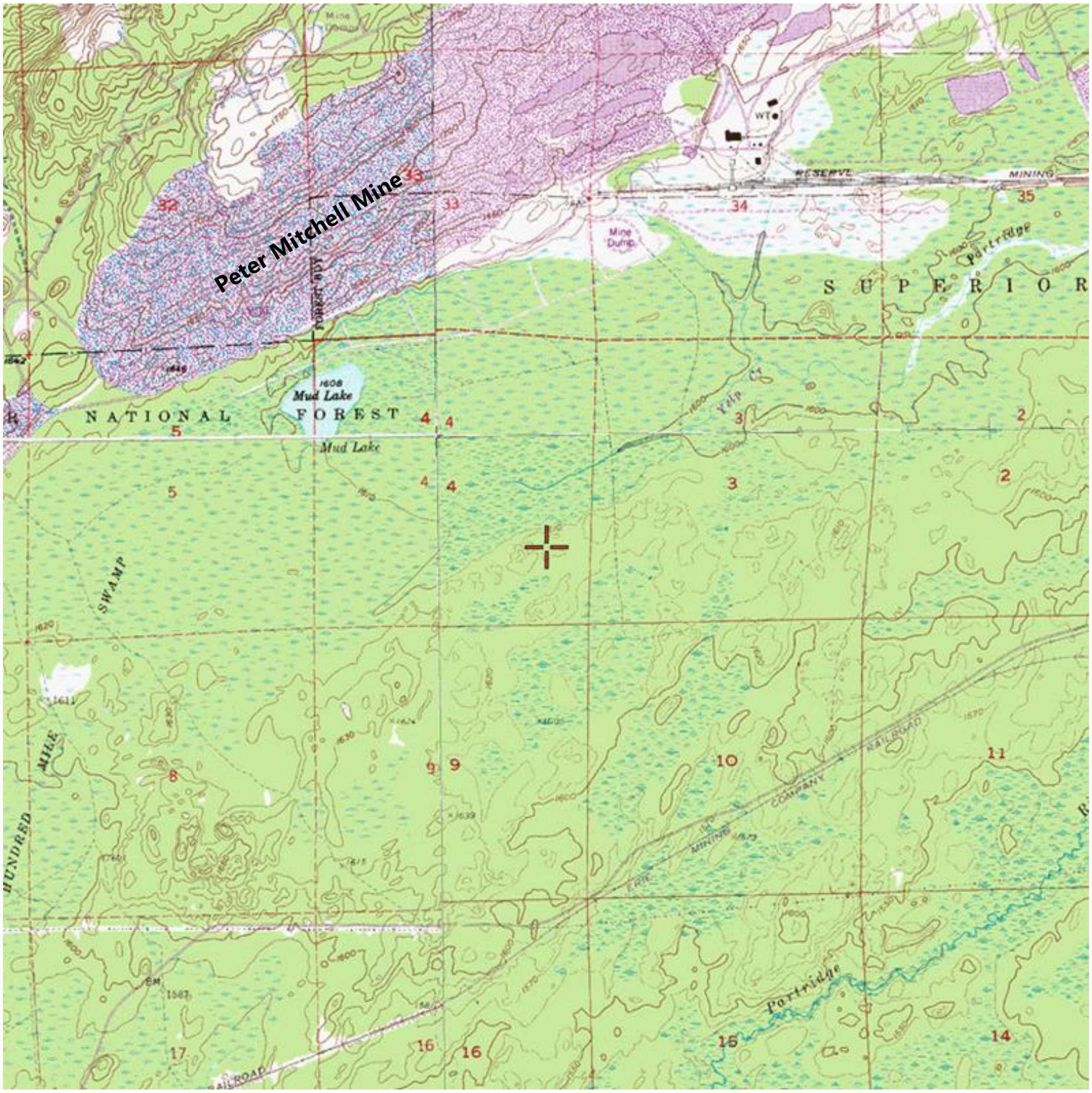
If extensive and severe impacts to wetlands did not occur at the Victor Mine, it is highly unlikely the Band's predictions would occur for extensive and severe wetland impacts at the NorthMet Mine Site. Unlike the very sensitive landscape for wetland impacts from mine pit dewatering at the Victor Mine (due to the porous limestone bedrock and extensive area of interconnected wetlands), the landscape at the NorthMet Mine Site is less vulnerable (due to low permeability gabbro bedrock, short water flow paths, and general lack of direct channel flow connections between wetlands). This also means it is unlikely for the Band's predictions that the NorthMet Project will cause drastic water level fluctuations at the Mine Site resulting in sulfate, mercury, and methylmercury flushing in amounts greater than what occurs in existing conditions.

Alternative Mining and Wetland Impact Analog #2

Further support of the DNR and USACE's use of an analog method to estimate potential impacts is also provided by publicly available environmental review documents for the Northshore Mining Company's Peter Mitchell Mine, located just north of PolyMet's proposed Mine Site (Reference (22)). As stated in the EAW for the Peter Mitchel Mine, "Wetlands are located near the current southern pit wall in the area of the proposed Project (Figure 11-1) [Langley Creek/Dunka River watershed] and are at elevations similar to pre-mining conditions (Figure 11-4), indicating that either the zone of influence does not extend a significant distance from the pit or the surficial aquifer system is perched above the bedrock aquifer system by low-permeability sediments and/or low- permeability bedrock and is not adversely affected by pit dewatering." Figure 4 identifies the location of the 100 Mile Swamp immediately adjacent to the southwest portion of the Peter Mitchell Mine. Dewatering of the mine pits has been occurring since the mid-1950s. No known impacts have been identified to the 100 Mile Swamp due to dewatering these mine pits. Pit dewatering water can be discharged to a portion of 100 Mile Swamp, from "Unnamed Creek to One Hundred Mile Swamp to Mud Lake" and from "Unnamed Creek to One Hundred Mile Swamp to Yelp Creek to Partridge River" (Reference (23)). However, receipt of mine dewatering discharge at its northern edge does not account for the persistence of the 100 Mile Swamp adjacent to the Peter Mitchell during the decades of dewatering that have occurred. As noted above, there are other wetlands adjacent to the Peter Mitchell Mine that do not receive mine dewatering discharge and they have been present since mining was initiated in the 1950s.

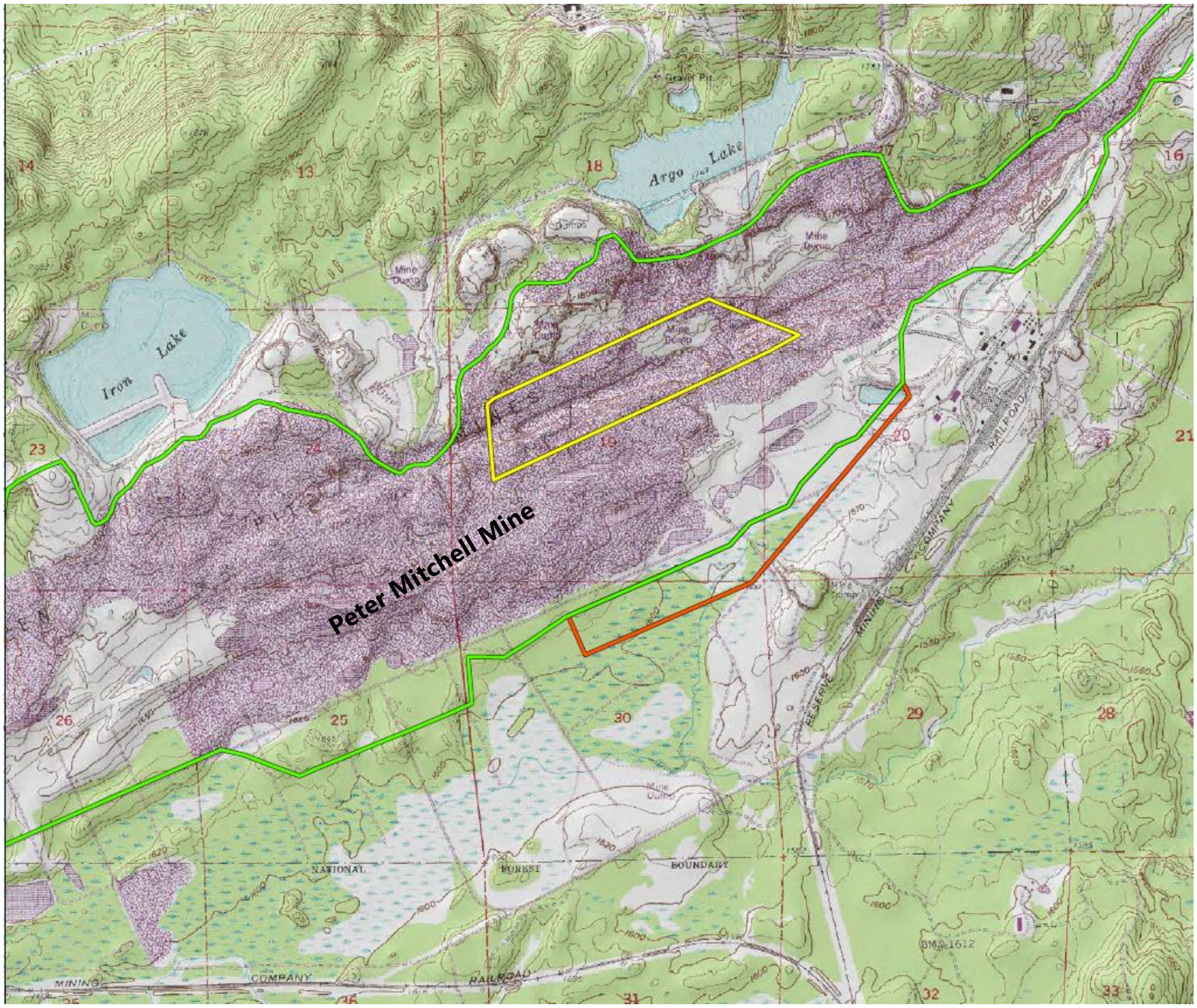
In addition, several wetlands and lakes are present immediately north of the Peter Mitchell Mine (Figure 5). The available schematic of topographic relief indicates these lakes and wetlands are notably higher in elevation than the mine pits. No known hydrologic effects have been identified to these systems and their presence on the landscape adjacent to actively dewatered pits several hundred feet below the normal ground surface indicates mine pit dewatering has not had an adverse impact on their continued functions.

The Peter Mitchell Mine provides another example of lakes and wetlands present on the landscape immediately adjacent to the mining area for decades during active pit dewatering. This alternative analog tempers the Band's worst-case scenario of extensive and catastrophic water level drawdown from mine pit dewatering and further supports the DNR and USACE conclusions that PolyMet's mine pit development will have little effect on wetlands and, more specifically, no expected effect on the wetlands at the large distances (1 to 2 miles from the mine pits) being predicted by the Band.



From: 100 Mile Swamp (https://www.topoquest.com/map.php?lat=47.61928&lon=-91.95099&datum=nad83&zoom=8&map=auto&coord=d&mode=zoomout&size=m&cross=on)

Figure 4 Location of the Peter Mitchell Mine in Relation to the 100 Mile Swamp; Headwaters of the Partridge River



Source: Reference (22)

Green line = current ultimate pit limit; Red line = proposed ultimate pit limit; Yellow line = proposed Type II VF stockpile

Figure 5 Location of Argo Lake, Iron Lake, and Wetlands Immediately Adjacent to the Peter Mitchell Mine

3.2.2 The Project is Not Expected to Materially Affect the Magnitude of Water Level Fluctuations in Most Mine Site Wetlands

In Mine Site wetlands, substantial water level fluctuations occur naturally. This means that the methylmercury formed and mobilized during natural water level fluctuations is present in baseline water quality. Based on the 16 years of wetland hydrology monitoring completed to date, Mine Site wetlands experience periodic water level fluctuations ranging from about 2 inches to more than 20 to 30 inches (Reference (14)), with seasonal or drought-induced drawdown sometimes resulting in water levels declining more than 24 to 29 inches below the ground surface. Water level declines of more than 29 inches have occurred but could not be measured because the water levels recede below the bottom of the well; this is shown on the plotted data as a flat line (Figure 6). As noted in Figure 6, water level decline continued even after precipitation events during the growing season (a high rate of evapotranspiration limits the amount of precipitation that can move downward in the peat profile to replenish the water level (Reference (15)).

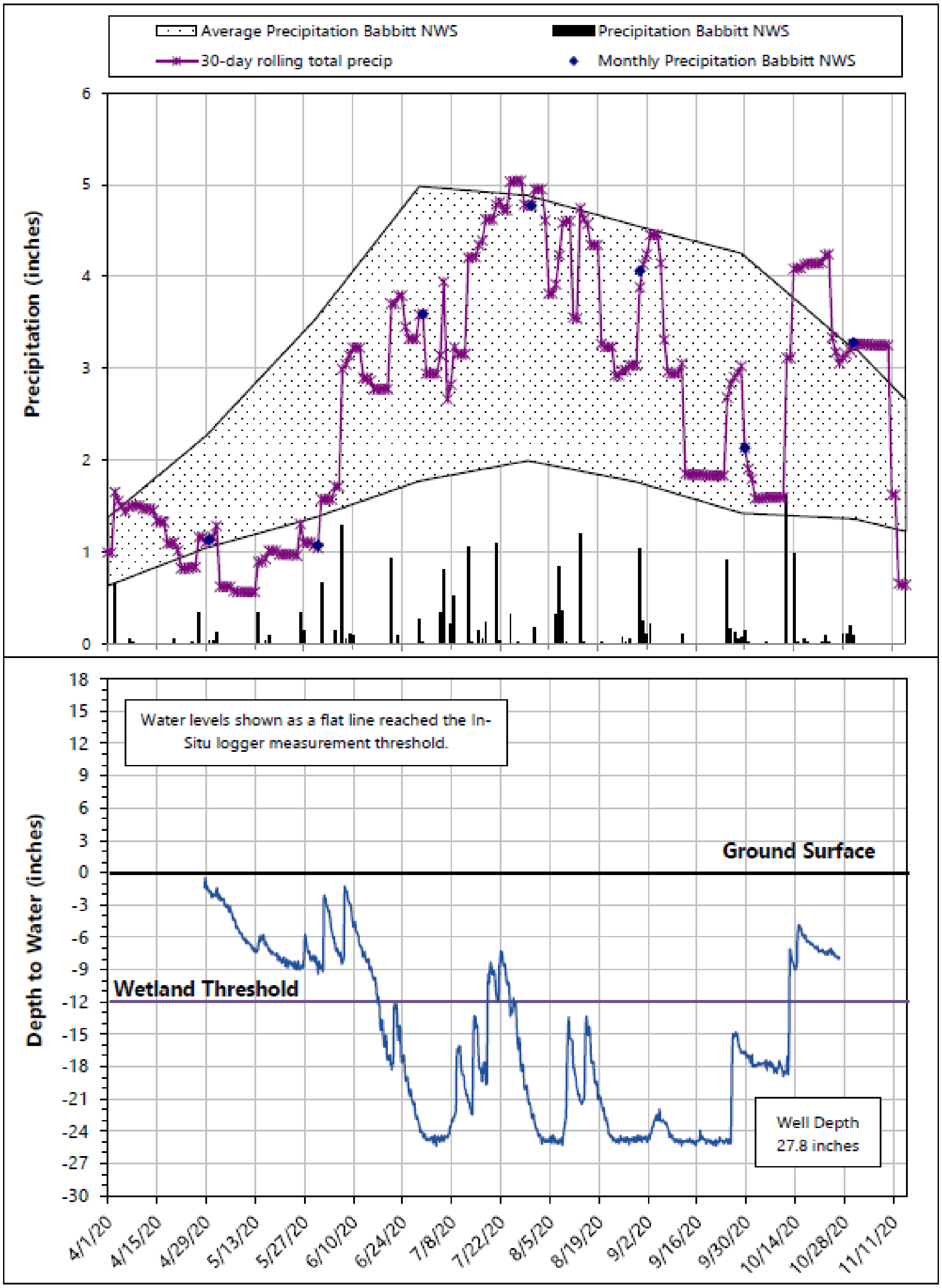
Water levels are dependent on the wetting and drying cycle from the previous year but typically start at, or slightly above, the soil surface in early April, increase in April/May/early June following snowmelt and spring rains, declining from late June through late August/early September, then increasing in mid-September to early November after fall rains. Since monitoring was initiated in 2005, Mine Site wetlands have exhibited water level increases and decreases corresponding with above-normal snow depths, large precipitation events, abnormally wet conditions, normal conditions, and abnormally dry conditions.

In 2020, a year with below-average precipitation, the average water level fluctuations during the growing season were 13.0 inches for the Mine Site wetland wells. However, the minimum measured water levels (i.e., the largest declines in the water level below ground surface) recorded in Mine Site wetlands in 2020 were -29.3 inches (Well 25) and -29.2 inches (Well 48) (Reference (14)).

The large water-level declines experienced by Well 25 and 48 were similar to other wetland water level declines, across many wetland types, around the Mine Site; for example:

- Within the central portion of the Mine Site (e.g., coniferous bog Well 22 with a decline of 14.7 inches, alder thicket Well 28 with a decline of 23.6 inches),
- In the northeast part of the Mine Site (e.g., coniferous bog Well 29 with a decline of 17.4 inches),
- In the southwest part of the Mine Site (coniferous swamp Well 31 with a decline of 9.7 inches), and

The extensive alder thicket wetland types south of Dunka Road (e.g., wetland Well 36 with a decline of 25.4 inches shown on Figure 6).



(Source: Reference (14))

Figure 6 Water Level Fluctuations for Wetland Well 36 (alder thicket wetland type) (April to November 2020)

Some of the Mine Site wetlands experience more than 2 feet of water level drawdown under existing conditions, as shown in Figure 6 for Well 36 and as previously mentioned for Well 48. Water level declines of this magnitude are similar to water-level declines identified in other wetlands during dry/drought conditions (Reference (16)). These water-level declines indicate wetlands that are precipitation-dominated with limited input from groundwater (Reference (15)). With a limited connection to surficial groundwater, mine pit development is not expected to have an effect on water level fluctuations in most wetlands at the Mine Site and, in particular, those wetlands south of Dunka Road.

The literature also identifies a limit, about 30 inches, to the water level declines that can occur in wetlands if there is no actual physical disturbance within a wetland, such as ditching or mining (Reference (16)). The limit of water level decline is defined by the lower layer of peat called the catotelm that "has a [non-drought] water content invariable with time, possesses a negligibly small hydraulic conductivity [very slow movement of water through this layer], and is not subject to air entry" (Reference (16)). In other words, the lower part of the peat soil retains water despite drought conditions. Because of its negligible hydraulic conductivity, it holds water tightly and severely limits water leaving through the bottom of the wetland. Peat mining operations further illustrate this point where intensive ditching is needed to obtain a relatively small drawdown in water level to allow the surface peat soil to dry for harvesting. Yet only a small amount of water is drained from the lower part of the peat soil profile. A study of water levels was conducted on a peatland where mining occurred in a portion of a raised peat bog while the adjacent portion was left in its original condition (Reference (24)). Water level data indicated the dense drainage network (15 to 25 meter spacing of ditches) constructed for mining had a maximum water level drawdown of 10 cm (4 inches), had a maximum impact extent from 30 to 60 meters (~100 to 200 feet) from the mine border (main canals and ditches), but had no effect on the water levels in the immediately adjacent non-mining portion of the raised bog (Reference (24)). At 30 to 40 meters (~98 to 131 feet) from the drainage ditches, the water level was at the ground surface.

Additionally, water tables in wetlands fluctuate in more or less annual cycles, where 12 to 18 inches of fluctuations is typical for northern wetlands or peatlands (References (25); (26); (16)), consistent with the average fluctuation at the Mine Site area wetlands based on the 16 years of wetland hydrology monitoring for the Project. The environment below the water table is anaerobic with lower redox (Eh) values. A capillary fringe is commonly present in peatlands and can extend 12 to 16 inches above the free water table surface (References (16); (27)). The capillary fringe is a zone of saturation or near saturation, is usually anaerobic, particularly during warmer parts of the year when biological activity is moderate to high and is often oxygen depleted. Even during water level declines, the capillary fringe can maintain moist and anaerobic conditions, such that surface soil oxygenation and drying do not occur or are limited. If water level drawdown of 1 foot (12 inches) or more occurs (as typically occurs under existing conditions), moist and anaerobic conditions can be maintained due to the capillary fringe. During severe drought, the water level in a wetland can drop sufficiently to prevent the capillary action from reaching the upper layer of the soil, meaning the upper soil layer becomes an oxygen-rich zone and organic matter decomposition can occur more rapidly until water levels rebound and anaerobic conditions are restored.

Based on the characteristics of Mine Site wetlands, including the limited vertical water movement as described for wetlands in northern Minnesota (References (15); (28)) and the limited distance water level drawdown occurs even in drained wetlands (Reference (29)), dewatering of the mine pits is not expected to have the widespread effect portrayed by the Band. Mine Site wetland characteristics, limited water movement through compacted deeper layers of the peat soil, and the underlying silty sands and clays strongly indicate pit construction and dewatering are unlikely to affect the wetlands at a distance from the mine pits.

The Band's claims of potential effects from mine pit development on wetland water levels have not accounted for the Mine Site landscape or specific details on wetland hydrology from the Mine Site or the best available and applicable wetland science.

Regardless of the difference of opinion between the Band, the FEIS Co-Lead Agencies, and this documentation of the best available wetland science, the regulatory agencies have already added many protective conditions in the NorthMet Project permits to verify that if there are changes in wetland hydrology as a result of pit dewatering drawdown, they would be recognized in the extensive monitoring program required of wetland water levels, surficial aquifer groundwater levels, and bedrock water levels. This would allow PolyMet and the regulatory agencies to employ adaptive management and mitigation measures, as required in the NorthMet Project permits, to address the issue long before it becomes as extensive as the Band has predicted in its "will affect" Letter.

3.2.3 Mine Site Wetland Characteristics and Use of Stormwater Retention Ponds Contradict Band's Worst-Case Projections of Methylmercury Formation and Flushing from Mine Site Wetlands to Downstream Waters

Because the area likely to be affected by mine dewatering is local, rather than regional (within 1,000 feet of the pit rim), and because wetland water-level declines are estimated to remain largely within the naturally occurring range (from several inches to more than 30 inches as currently occurs in existing conditions), Project operation is not expected to cause a substantial change from existing conditions, in methylmercury formation and flushing from Mine Site wetlands. Wetland characteristics and landscape features further limit the potential for methylmercury formation and flushing from Mine Site wetlands.

- Methylmercury in the St. Louis River comes primarily from wetlands that are adjacent to a river, referred to as riparian wetlands (Reference (30)). These wetlands have direct hydrologic connections to the river. Methylmercury that forms in riparian wetlands can be flushed directly into the river. In contrast, large flushing events are generally required for more distant wetlands to contribute methylmercury to a river - those wetlands that do not have direct channel flow connections to the St. Louis River or a tributary. Wetlands within the Mine Site, and those remaining intact during operations within 1,000 feet of the Mine Pits, are not riparian wetlands, and thus may not export methylmercury in any appreciable amount to downstream waters under average and low flow conditions.

- Impoundments within a watershed are known to sequester methylmercury (Reference (31)). The stormwater ponds around the perimeter of the Mine Site will limit the amount of methylmercury from the Mine Site that can be transported to downstream waters.

Band's Claims from Band "will affect" Letter:

- *Changes in regional wetland hydrology in the area of groundwater impact in the vicinity of the Project will have indirect effects that will enhance mercury, sulfate, and methylmercury release in an area that data clearly indicate is already naturally susceptible to enhanced methylmercury production* (p. 5)

- *GLIFWC's Zone 4 with water level declines of 0-1 feet "could have greater impacts on exports of sulfate, inorganic mercury and methylmercury than the zones with more significant de-watering…uncertainty concerning potential hydrological impacts in this zone combined with the substantial wetland area and pool of mercury presents substantial risk of downstream impacts. A lack of monitoring of wetland chemistry under baseline conditions, and no requirement for monitoring during operations means that none of these impacts would be captured"* (p. 16)

401 Water Certification, NPDES/SDS Permit, and USACE ROD Findings and Requirements

While the Band contends there is no wetland chemistry monitoring under baseline conditions or requirement for monitoring during operations, the MPCA's Section 401 water quality certification clearly lists these requirements in the following conditions:

- Condition 1.A requires monthly wetland water quality monitoring in 22 wetland hydrology monitoring locations for not less than two years under baseline conditions (from permit issuance until commencing project mining operations) for mercury, methylmercury, sulfate, and 10 other water quality parameters. This baseline monitoring began in 2019 and is about to start its fourth year.

- Condition 2 requires quarterly stream monitoring for mercury and methylmercury immediately upstream and downstream of the Mine Site and Plant Site upon issuance of all state permits and continues through one year after project mining operations end.

- Condition 4.A requires an annual review of monitoring results and evaluation of any adaptive management required, including potential expansion of monitoring locations.

- Condition 4.B requires evaluation of surface water conditions compared to baseline conditions. If deviations occur that are attributable to the Project, MPCA and USACE may require adaptive management measures.

As detailed in the USACE ROD, "[c]ompliance with the Section 401 WQC is a special condition of the DA permit" (p. 84). The NorthMet Project USACE Section 404 Wetland Permit requires compliance with the 401 Water Quality Certification as general condition 5 and special condition 11.

The NorthMet Project NPDES/SDS Permit also has conditions requiring monitoring for mercury and sulfate in the WWTS discharge and in surface water monitoring locations immediately upstream and downstream of the Mine Site, Plant Site, and Transportation and Utility Corridor. This permit also requires PolyMet to develop and submit annually a mercury minimization plan to evaluate potential sources of mercury and mercury reduction opportunities for the Project.

PolyMet's Additional Evaluation and Findings

The Band's "will affect" Letter identifies water level drawdown from mine pit development will most affect wetlands within 1,000 feet of the mine pits. As discussed in Sections 3.2.1 and 3.2.2, the Mine Site landscape and wetland characteristics should limit the extent of any water level effects from the mine pits and the extensive monitoring network for wetland and groundwater hydrology and wetland vegetation monitoring will evaluate and verify that mine pit drawdown is not occurring.

In the St. Louis River watershed, riparian wetlands have been identified as having the most influence on surface water concentrations of mercury and methylmercury (Reference (30)). As discussed by Berndt et al. (Reference (12)), "…Under conditions of high flow the stream chemistry more closely mimics [wetland] pore water chemistry that evolves in upper riparian [wetland] soils. Conversely, stream chemistry under lower flow conditions mimics that of pore fluids that evolve in deeper sediments underlying the riparian [wetland] soils. …".

Most wetlands within 1,000 feet of the proposed mine pits are not riparian wetlands and have no direct channel connection to the Partridge River. Only one stream that originates in the Mine Site directly connects to the Partridge River: Unnamed Creek (former monitoring location WP-1), which starts in a wetland on the north side of Dunka Road in the southwest portion of the Mine Site. Even the wetland studied for the Cross-media Analysis (Wetland of Interest), to the south of Dunka Road, which has an intermittent outlet stream, does not directly connect to the Partridge River. This stream only exists for about 300 feet before it becomes diffuse flow in the large downgradient wetland. Monitoring in 2021 identified that the short section of the stream did not have flow for several months due to dry conditions, further limiting its contribution to the downgradient wetland complex. With very limited connectivity to the Partridge River, methylmercury currently produced in the Mine Site wetlands has an uncertain contribution to the Partridge River under most hydrologic conditions.

The location of the Mine Site wetlands at the outer fringe of the watershed and the general lack of streams flowing from the Mine Site wetlands to the Partridge River limits the ability of the Mine Site wetlands to have the significant effect on downstream waters envisioned by the Band. Therefore, the worst-case flushing events carrying sulfate, mercury, and methylmercury from these wetlands to downstream waters, as hypothesized by the Band, are severely limited due to the actual features of the Mine Site wetlands and the lack of direct connection between these wetlands and the Partridge River.

Impoundments present in a watershed further limit the methylmercury export to the lower St. Louis. The peer-reviewed literature identifies impoundments in a watershed limit the amount of methylmercury carried to downstream waters. For example, the USGS (Reference (31)) studied the Edisto River watershed in South Carolina and the Hudson River watershed in New York and stated, "… Out-of-channel wetland/floodplain environments were primary sources of filtered methylmercury (F-MeHg) to the stream habitat in both systems. Shallow, open-water areas in both basins exhibited low F-MeHg concentrations and decreasing F-MeHg mass flux. Downstream increases in out-of-channel wetlands/floodplains and the absence of impoundments result in high methylmercury (MeHg) throughout the Edisto. Despite substantial wetlands coverage and elevated F-MeHg concentrations at the headwater margins, numerous impoundments on primary stream channels favor spatial variability and lower F-MeHg concentrations in the Upper Hudson. The results indicated that, even in geographically, climatically, and ecologically diverse streams, production in wetland/floodplain areas, hydrologic transport to the stream aquatic environment, and conservative/nonconservative attenuation processes in open water areas are fundamental controls on dissolved MeHg concentrations and, by extension, MeHg availability for potential biotic uptake…".

Natural runoff and stormwater that has not been exposed to mining activities from the Mine Site will be routed to stormwater retention ponds prior to discharging to downstream wetlands. Retention ponds are shown on Figure 7.

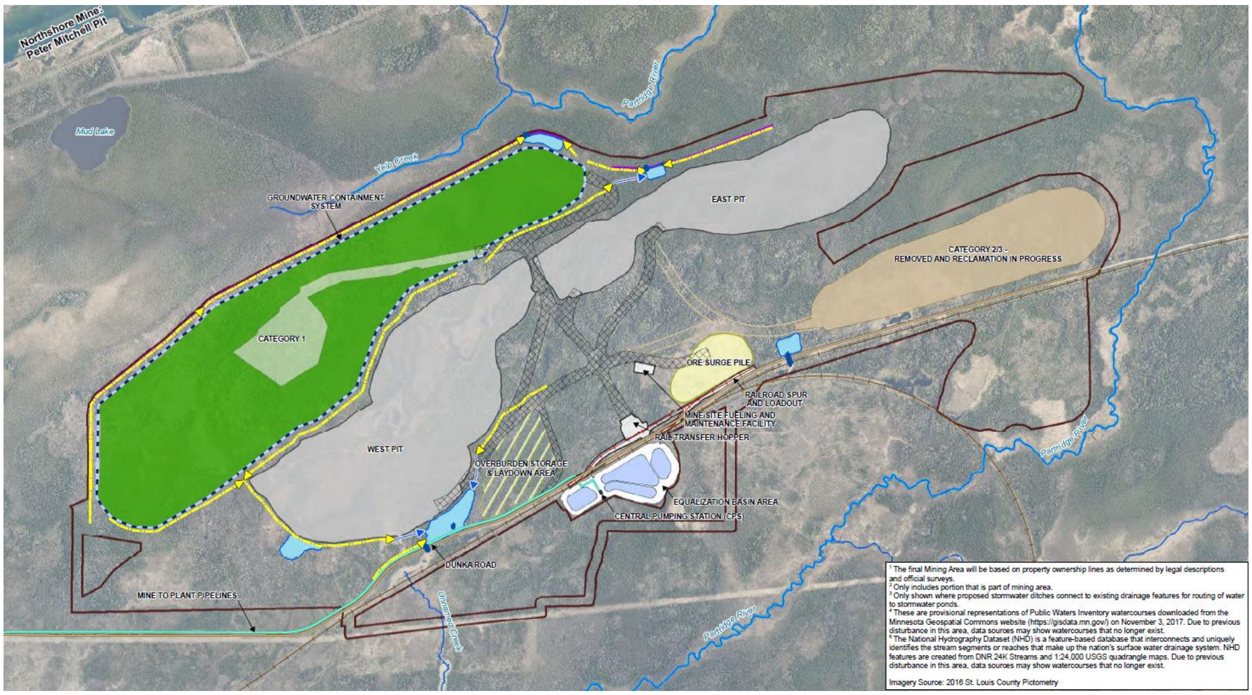


Figure 7 Stormwater Ponds (in Blue) Around the Perimeter of the Mine Site

Best Management Practices (BMPs) will be used to manage stormwater. These BMPs include erosion prevention practices and sediment control practices. The BMPs are based on the practices the MPCA has specifically determined will reduce mercury loading to water bodies (Reference (32)). These retention ponds will slow and settle any suspended solids from the runoff and stormwater. Stormwater ponds tend to accumulate mercury when present in runoff and stormwater, with noted retention of particle-bound mercury (Reference (5)). Outflow water from the retention ponds may start as channel flow but eventually will move via diffuse flow through wetlands, where numerous loss mechanisms are known to occur (e.g., volatilization, adsorption of mercury to organic matter; (Reference (33)). Studies in the St. Louis River watershed have shown that mixing a smaller volume of stormwater with a larger volume of background wetland water results in water leaving the wetland with mercury concentrations similar to background wetlands not affected by mining-related activities (Reference (34)). The same outcomes are expected for the retention ponds at the Mine Site.

Additionally, there are impoundments downstream of the Plant Site (Embarrass River chain-of-lakes; a series of five lakes) and the Mine Site (Colby Lake). A prior evaluation completed in support of the FEIS

(Reference (35)) identified that mercury and methylmercury concentrations declined after entering the Embarrass chain-of-lakes, where the upper two lakes (both Sabin Lake and Wynne Lake) acted as sinks for mercury and methylmercury. The Barr evaluation (Reference (35)) also identified that while Sabin Lake was acting as a sink for mercury and methylmercury, there was no increase in mercury methylation in the water column and no increase in methylmercury export to downstream water. This finding is similar to findings from the DNR's work in other parts of the St. Louis River watershed, where lakes receiving mine water do not have increased export of methylmercury and, in some cases, have very low export of mercury and methylmercury as compared to other water bodies from the region (Reference (36)).

The sequestering of mercury and methylmercury by lakes in the Embarrass River and Partridge River watersheds has not been accounted for in the mass balance calculations PolyMet has conducted to date for the lower St. Louis River. While the Band has trivialized the role of sequestering mercury and methylmercury within watershed features, the available literature indicates such sequestering is an important consideration when evaluating the loading and bioavailability of methylmercury in downstream waters. This is yet another factor that tempers the Band's claims of unlimited methylmercury export from the Project area to the lower St. Louis River and the effect on waters on the Fond du Lac Reservation more than 110 river miles downstream.

3.3 Direct Discharges from the Project Will Not Increase Loading of Sulfate, Mercury, or Methylmercury to the St. Louis River

Wetlands adjacent to the former LTVSMC tailings basin, including the headwater wetlands of Unnamed Creek, Trimble Creek, and Unnamed (Mud Lake) Creek, have been receiving tailings basin seepage for more than 60 years, with average sulfate concentrations of 200 to 300 mg/L. The Project in operation will discharge treated water from the WWTS to wetlands that are the headwaters of Trimble Creek and Unnamed Creek – tributaries of the Embarrass River. It will also discharge treated water to the headwaters of Second Creek – a tributary of the Partridge River. But the direct discharges are not the only Project activities that will affect the flow and loading to the Embarrass River and the Partridge River. Related activities that affect the quality and quantity of water downstream from the Project include the FTB seepage capture systems, watershed changes at the Mine Site and Plant Site, and water withdrawal from Colby Lake. These activities will reduce sulfate, mercury, and methylmercury loading so that the net Project effect from direct discharges and related activities will be to reduce overall loading.

3.3.1 Direct discharges and related activities will not increase loading of sulfate or mercury to the Embarrass River, and will not increase methylmercury concentrations in downstream waters

Downgradient to the north and northwest of the former LTVSMC tailings basin lies a large wetland complex, including wetlands that form the headwaters of Trimble Creek, Unnamed Creek, and Unnamed (Mud Lake) Creek. These creeks are tributaries to the Embarrass River. LTVSMC operations started in 1957, so these wetlands have received seepage with elevated sulfate concentrations (20 to >500 mg/L; average of 200 to 300 mg/L) from the former LTVSMC tailings basin for more than 60 years. Background atmospheric deposition of sulfate (historically about 14 kg/ha/yr and currently about 4.8 kg/ha/yr, wet + dry) provides additional loading. These headwater wetlands currently receive sufficient inputs of sulfate and mercury to generate methylmercury and have sufficient stream flow to export methylmercury to downgradient wetlands and downstream waters, similar to non-mining wetlands in the Embarrass River watershed (Reference (35)).

Current seepage towards the Embarrass River from the former LTVSMC tailings basin is estimated at 2,400 gpm (5.3 cfs), which converts to approximately 1,261,440,000 gallons per year (~1.3 billion gallons per year). Concentrations of sulfate in this seepage average about 200 to 300 mg/L. Sulfate loading from the northern and western portions of the former LTVSMC tailings basin towards the Embarrass River is estimated to range from about 2,600 to 3,900 kg/yr. In the FEIS, a flow of 2,400 gpm and sulfate concentration of 230 mg/L sulfate were used to estimate approximately 3,000 kg/day (Reference (4), p. 5-217) or about 1,100,000 kg/yr, loading towards the Embarrass River.

PolyMet will construct the FTB seepage Containment System to cut off the flow of high-sulfate seepage from the Tailings Basin prior to the start of operations. PolyMet will replace the captured seepage with water treated to a sulfate concentration of 10 mg/L and a mercury concentration of no more than 1.3 nanograms per liter (ng/L) to prevent the wetlands from drying out. This wetland augmentation is the direct discharge to the wetlands with the Project in operation.

Discharge water quality will be controlled by the NorthMet Project NPDES/SDS Permit conditions. Enforceable conditions of this permit require that the discharge sulfate concentration be no more than 10 mg/L. With the Project in operation, seepage captured and treated at the WWTS will be discharged towards the Embarrass River via the headwaters to Unnamed Creek and Trimble Creek at a rate ranging from approximately 1,514 gpm (-20% flow) to 2,900 gpm (+20% flow). These flows convert to approximately 795,758,400 gallons per year to 1,524,240,000 gallons per year, respectively. Sulfate loading towards the Embarrass River, with sulfate concentrations of 10 mg/L associated with the treated water, ranges from about 82 kg/day to 158 kg/day, respectively. Even at the higher flow rate (+20%), there is a reduction in sulfate loading from the 3,000 kg/day that is currently estimated to occur toward Unnamed and Trimble Creeks (Reference (4), p. 5-217). Future sulfate loading towards the Embarrass River is estimated to decrease by 20 to 40 times compared to existing conditions with seepage capture, treatment, and flow augmentation. Overall, the sulfate loading to the Embarrass River at PM-13 is estimated to be reduced by approximately 1,280,000 kg/yr (Table 5-6 of Reference (3)).

Band's Claims from Band "will affect" Letter:

- *The Project will result in seven direct wastewater outfalls to the headwater wetlands of Trimble Creek, increasing water loading by several million gallons per day that will supply hundreds of pounds of sulfate per year* (p. 3)

- *The direct effect of loading water, sulfate and (inorganic) mercury to headwater wetlands and surface waters will increase net methylmercury production resulting in a measurable contribution to the cumulative loading of methylmercury to the St. Louis River. Increasing methylmercury concentrations are expected to result in increases in exposure of fish and wildlife, as well as Band member consumers…* (pp. 3 - 4)

- *For the Trimble Creek headwater wetlands, the additional water loading from the Mine processing operation alone will further contribute to the export of inorganic mercury and methylmercury…* (p. 20)

USACE ROD Findings and Protective Permit Conditions

In making these claims, the Band only explains part of the story. The Band is leaving out an explanation of the system as a whole, why PolyMet is discharging water to Trimble Creek and other tributaries to the Embarrass River, Partridge River, and ultimately, the St. Louis River. This is explained well in the USACE ROD:

> "As a result of the Tailings Basin groundwater containment system, flows would be reduced to tributaries of the Embarrass River that extend from the Tailings Basin. These impacts would be minimized with the use of flow augmentation [i.e., WWTS discharge], which would maintain flows to within ± 20% of existing flows. Flow augmentation would occur throughout Project operations, reclamation, and long term closure, and monitoring would be required in order to ensure that the flow quantity would be within the natural variability of the streams. This maintenance of the hydrologic regime of receiving streams will ensure impacts to aquatic species are minimized. A special condition requiring flow monitoring and maintenance of flows within ± 20% of existing flows would maintain the natural variability of the streams and ensure impacts to aquatic species are minimized." (USACE ROD, p. 66)

The USACE further explains in their ROD that these discharges are not expected to exceed water quality standards and that there is no expected change in fish mercury concentrations as a result of the Project:

> "Overall, impacts to water quality and chemistry are not expected to exceed regulatory limits. Discharges at the Plant Site from the WWTS would be subject to the MPCA NPDES permit that was issued on December 20, 2018. The MPCA NPDES permit contains Operating Limits for sulfate and copper in the permit that are enforceable. Given the treatment technology required by the permit, compliance with the Operating Limits will ensure the discharge does not exceed water quality standards for other parameters. MPCA added a prohibition against discharges from the treatment facility that violate water quality standards." (USACE ROD, p. 71)

> "Members of the Grand Portage and Fond du Lac Bands are known to consume substantially more fish than the assumed statewide average. As described in Section 5.2.9.2.2 of the FEIS, bioaccumulation of mercury in fish could affect Band members' willingness to rely on subsistence fishing as a contribution to household economies, as well as affect continuation of traditional fishing practices, but there is no evidence that this availability would significantly affect subsistence use given the lack of information showing recent or historic fishing activity in the Project area. The Air Emissions Risk Analysis assessed health effects for recreational and tribal fishermen and their families consuming fish that could potentially contain elevated bioaccumulated levels of methylmercury. A potential small change in fish mercury concentration was estimated based on modeled emissions and deposition. The potential change in methylmercury concentration was not statistically measurable given variability in background

concentrations and current laboratory analytical methods (Barr 2013j [Supplemental Air Emissions Risk Analysis (AERA) – Plant Site]). Therefore, there is no expected change in fish mercury concentrations, and no subsequent change in human health risks related to fish consumption (see FEIS Section 5.2.7.2.5)." (USACE ROD, p.74)

In addition to the analysis completed in the FEIS and permitting, the NorthMet Project permits have many protective conditions to verify that water quality and quantity downstream of the Tailings Basin do not result in a net increase in water, sulfate, or mercury. These conditions include:

- Maintaining stream flows in the tributaries to the Embarrass River at +/- 20% of the historic average annual flow is required by the NorthMet Project 404 Wetland Permit, 401 Water Quality Certification, and Water Appropriation Permits.
- Monitoring for sulfate, mercury, and methylmercury immediately upstream and downstream of the Project is required in the NorthMet Project NPDES/SDS Permit and 401 Water Quality Certification.
- Evaluating annual monitoring data to see if there are any deviations from baseline conditions to determine whether adaptive management measures need to be triggered are required by the 401 Water Quality Certification, NorthMet Project NPDES/SDS Permit, Water Appropriation Permits, and Permit to Mine.

PolyMet's Additional Evaluation and Findings

The Band fundamentally mischaracterizes the Project by considering only half of the Project's effects on the wetlands. The Project will add water to the wetlands by direct discharge, but it will also subtract water by seepage capture. The water balance cannot be accurately analyzed unless it considers additions and subtractions. PolyMet will add and subtract roughly equal amounts of water, so the flow and water levels in the wetlands will be maintained within +/- 20% of existing conditions, as required by the 404 Wetland Permit, 401 Water Quality Certification, and Water Appropriation Permits. Likewise, the net loading of sulfate and mercury to the wetlands must consider both additions and subtractions. PolyMet will add a volume of water back to the wetlands to the north and northwest of the Tailings Basin with sulfate at concentrations no greater than 10 mg/L but will subtract a much larger amount of sulfate at concentrations averaging 200 to 300 mg/L by seepage capture, resulting in a large net reduction in sulfate loading to the Embarrass River wetlands. The Project will also have the net effect of slightly reducing the load of mercury to the Embarrass River wetlands.

Table 2 summarizes the net Project effect on Embarrass River headwaters wetlands and demonstrates the Band's conclusion is incorrect that the discharge will add "*over 100 kg of sulfate and nearly 5 g of mercury per year… to the headwaters wetland of Trimble Creek*" (p. 19 of the Band "will affect" Letter). The Band's conclusion is incorrect because the Band considers only half of the water balance and loading equation. Rather than seeing increased loads of sulfate and mercury, the wetlands will see reductions due to treated water having lower concentrations of sulfate and mercury than currently being received by those same wetlands.

Table 2 Net Project Effects on Trimble Creek and Unnamed Creek Headwaters Wetlands

	Project additions (direct discharge)	Project subtractions (seepage containment)	Net Project effect[4]
Trimble Creek Wetlands			
Water[1]	4.2 cfs	3.6 cfs	0.6 cfs increase (within ±20%)
Sulfate[2]	37,000 kg/yr	163,000 kg/yr	126,000 kg/yr decrease
Mercury[3]	7.7 g/yr	9.3 g/yr	1.6 g/yr decrease
Unnamed Creek Wetlands			
Water[1]	1.2 cfs	1.5 cfs	0.3 cfs decrease (within ±20%)
Sulfate[2]	11,000 kg/yr	150,000 kg/yr	139,000 kg/yr decrease
Mercury[3]	5 g/yr	5.3 g/yr	0.3 g/yr decrease
Total to Wetlands tributary to Embarrass River			
Water[1]	5.4 cfs	5.1 cfs	0.3 cfs increase (within ±20%)
Sulfate[2]	48,000 kg/yr	313,000 kg/yr	265,000 kg/yr decrease
Mercury[3]	12.7 g/yr	14.6 g/yr	1.9 g/yr decrease

Values are from detailed calculation spreadsheets and rounded for use in this table. Values may not sum due to independent rounding.

[1] From Table 5-2 of Reference (3)

[2] From Table 5-6 of Reference (3)

[3] From Table 5 of Attachment F of Appendix A of Reference (1)

[4] Flow to headwater wetlands adjacent to the Flotation Tailings Basin required to be within ±20% of existing conditions flow

The Band's conclusion regarding the Project adding millions of gallons of new water to the wetlands north and northwest of the Tailings Basin is incorrect. The Tailings Basin seepage currently contributes about 1.3 billion gallons per year to those wetlands. Seepage collected and treated to remove sulfate will be returned to Trimble Creek and Unnamed Creek headwater wetlands at a similar rate (~2,400 gpm) during Project operations. The treated water will have a concentration of no more than 10 mg/L of sulfate.

The Band's claims that the Project's direct discharges will cause increased methylmercury concentrations in downstream waters are based on its erroneous assessment that the Project will increase water, sulfate, and mercury loading to the wetlands. Project water management and water treatment requirements mean the Project's direct discharges will decrease the sulfate and mercury loading and, therefore, should not result in increased methylmercury formation in the wetlands or increased export to downstream waters greater than those already occurring under existing conditions.

Discharge flow rates to Trimble Creek and Unnamed Creek headwater wetlands will be controlled by the conditions of the 404 Wetland Permit, 401 Water Quality Certification, and Water Appropriation Permit 2016-1369. These permits require PolyMet to augment the flow to Unnamed Creek and Trimble Creek to replace the seepage that the FTB seepage containment system will cut off. Specifically, the permits require that the discharge rate be controlled to maintain the streamflow within ±20% of existing conditions. The

Water Appropriation Permit 2016-1369 has a condition that requires the stream augmentation flow to be distributed to the headwater wetlands in proportion to the amount of seepage captured from their sub-watersheds ("Stream Augmentation" requirement in the Permit). Continuous flow monitors will measure the amount of seepage collected by the FTB seepage containment system from each sub-watershed. The discharge system is designed with multiple discharge locations to evenly distribute augmentation flow to the wetlands. Because the discharge flow will match the seepage flow (±20%), flow through the wetlands and wetland water levels will be maintained within the range of existing conditions. Therefore, there is no increase in water loading to the headwater wetlands at rates exceeding existing conditions.

Discharge water quality will be controlled by the NorthMet Project NPDES/SDS Permit conditions. Enforceable conditions of this permit require that the discharge sulfate concentration be no more than 10 mg/L and the mercury concentration be no more than 1.3 ng/L. Required water capture and treatment for the Project result in a net reduction in sulfate and mercury loading to the headwater wetlands and downstream waters, including the lower St. Louis River (Table 5-5 and Table 5-6 of Reference (3)).

In addition, the information provided by the DNR assessments (e.g., Reference (12)) of the St. Louis River and watershed as a whole contradicts the Band's continued statements about sulfate in discharge water from the Project producing high levels of mercury and methylmercury in the Embarrass River and Partridge River watersheds and even further downstream in the lower St. Louis River that will adversely affect downstream waters and fish, including tribal waters tributary to the St. Louis River. As stated by Berndt et al. (Reference (12)), "… Two factors make it difficult for sulfate from the mines to impact MeHg in the rivers. First, the sulfate from mines is introduced largely as point sources at the ends of a relatively few tributaries and, thus, is limited geographically from interacting with riparian sediments in the great majority of the region. Second, even in the streams it flows through, it may be hydrologically excluded from reacting with riparian sediments that have the reduced conditions needed to promote methylation. The St. Louis River watershed receives, on average, approximately 8 inches more precipitation than is evaporated or transpired, and thus stream segments along the flow path mostly gain water from the surrounding landscape. The hydraulic gradient, is therefore, well poised to produce and transport chemicals like DOC and MeHg to the river, but water derived from mines is not well poised hydrologically to interact with riparian sediments where DOC and MeHg are likely to be produced…". Therefore, based on the DNR's assessment of the St. Louis River watershed, the Project's reduction in sulfate loading to the lower St. Louis River will not increase methylmercury concentrations in water or fish in the St. Louis River.

3.3.2 Direct Discharge and Related Activities Will Not Increase Loading of Sulfate or Mercury to the Partridge River, and Will Not Increase Methylmercury Concentrations in Downstream Waters

Currently, background atmospheric deposition of sulfate and mercury to the Mine Site and upper Partridge River watershed results in the export of sulfate, mercury, and methylmercury to downstream waters. However, during Project operations the required water capture at the Mine Site will reduce sulfate loading to the Partridge River at SW004a by about 9,000 kg/yr (Table 5-6 of Reference (3)) and mercury loading at SW004a by about 6.3 g/yr (Table 5-5 of Reference (3)). Water capture will also reduce methylmercury loading to downstream waters and those results are presented in Section 3.4.2.

Direct discharge of water from the project to the Partridge River watershed will occur at Second Creek. Second Creek originates near the southern toe of the former LTVSMC tailings basin and has received seepage with elevated sulfate concentrations from the LTVSMC tailings basin for several decades. Prior to the start of operations, PolyMet will construct the FTB South Seepage Management System to cut off seepage flow from the Tailings Basin to Second Creek. PolyMet will replace the captured seepage with water treated to sulfate and mercury concentrations of no more than 10 mg/L and 1.3 ng/L, respectively, while the Project is in operation to prevent hydrologic impacts in Second Creek.

The change in loading from existing conditions to Project operations has been described in previous loading evaluations (e.g., Antidegradation Evaluation for the NPDES Permit application (Attachment A of Reference (1)). Related activities that affect flow and loading to the Partridge River that further reduce mercury and sulfate include collecting water at the Mine Site and withdrawing and using Colby Lake waters. These reductions in flow and load have also been identified in previous evaluations submitted to the DNR and MPCA in support of the FEIS and the 401 Certification and NPDES/SDS permitting processes. Table 3 summarizes the net changes in flow and loading estimates for mercury and sulfate.

Table 3 Net Project Effects on the Lower Partridge River at USGS 04016000

Flow (cfs)[1]	Mercury (g/yr)[2]	Sulfate (kg/yr)[1]	Notes
0.14	0.5	-84,300	Net change at the headwaters of Second Creek, calculated by subtracting load removed by seepage capture from load added by direct discharge
-1.9	-6.4	-9,960	Load removed by collecting waters that have contacted mining features from the Mine Site
-0.58	-2.8	-14,800	Load removed by using and treating Colby Lake water
-2.33	-8.7	-109,000	Net flow and loading in the Partridge River at MNSW12 (downstream of the confluence with Second Creek)

Values are from detailed calculation spreadsheets and are rounded for use in this table. Values may not sum due to independent rounding.
[1] Source: Table 1 of Attachment E of Appendix A of Reference (1)
[2] Source: Table 5 of Attachment F of Appendix A of Reference (1)

Band's Claims from Band "will affect" Letter:

- *Project discharges will increase the loading of sulfates, mercury, [and] methylmercury… to the Embarrass and Partridge Rivers* (p. 28)

PolyMet's Additional Evaluation and Findings

The Band's claims regarding the Project's water management and potential impacts to the Partridge River have the same flaw as for the Embarrass River (Section 3.3.1). Again, the Band fundamentally mischaracterizes the Project by considering only half of the Project's effects on the Partridge River and not accounting for the Project's subtractions of sulfate and mercury from the watershed.

The Project is required to maintain flows in Second Creek at +20% of existing conditions, in accordance with the 404 Wetland Permit, 401 Water Quality Certification, and Water Appropriation Permits, so they will be similar to current conditions. Removal (subtraction) of sulfate and mercury will be associated with the operation of the FTB South Seepage Management System, the collection and use of water that has contacted mining features from the Mine Site, and the use of Colby Lake water, which is relatively high in mercury. Table 3 summarizes the net Project effect of direct discharge and related activities on the lower Partridge River at monitoring station USGS 04016000, downstream of all PolyMet's combined activities in the Partridge River watershed.

The summaries of the loading assessments (e.g., Table 3) demonstrate that the Band's claim is incorrect that the Project discharge will increase sulfate and mercury loading to the Partridge River because the Band only accounts for half of the loading equation in its review and comments. Rather than seeing increased loads of sulfate and mercury with the Project in operation, the Partridge River as a whole will experience reductions of both parameters. Project direct discharges and related activities should not result in increased sulfate and mercury loading and, therefore, should not result in increased methylmercury concentrations in downstream waters.

3.4 The Project as a Whole Will Reduce Loading of Sulfate, Mercury and Methylmercury to Downstream Waters, Including the Fond du Lac Reservation

Not only will direct discharges and related activities reduce loading to the St. Louis River (as described in Section 3.3), the cumulative effect of the Project, including consideration of air emissions deposition and associated loading, is estimated to reduce the total sulfate and mercury loading to the St. Louis River compared to existing conditions.

- Cumulative Project loading will be reduced on an annual basis, as demonstrated by the Cross-Media Analysis (Reference (3)) and as summarized in Section 3.4.1.
- Cumulative Project loading will be reduced on a daily basis, including during high-flow conditions, as demonstrated by supplemental calculations presented in Section 3.4.2.

3.4.1 Cumulative Loading Will be Reduced on an Annual Basis

The Cross-Media Analysis estimated the potential cumulative change in load and concentration for sulfate and mercury in receiving and downstream waters due to the Project. It included potential effects from atmospheric loading from air emissions, which are not usually accounted for in this type of analysis, plus the flow and load changes associated with the WWTS discharge and other Project actions that will affect downstream water quality and quantity. Other Project actions include operating the FTB seepage capture systems, the effects of watershed changes at the Mine Site and Plant Site, and the effects of withdrawing make-up water from Colby Lake (collectively referred to as Cumulative Project Effects).

Specifically, the Cross-Media Analysis estimated sulfate and mercury loading from air emissions (fugitive dust, stacks, vents, and tailpipes) to the Project watersheds and out to a distance of 50 km, and for the

Project watersheds added air emission loading to the loading from direct discharges and related activities. Adding atmospheric loading from the Project's air emissions addressed previous concerns from the Band that cumulative Project effects should be accounted for when estimating potential effects to downstream waters. The cumulative analysis, presented in Section 5 of the Cross Media analysis (Reference (3)), identified that, on an annual basis, sulfate and mercury loading to watersheds from Project air emissions would be small, and the net effect of the Project as a whole would be to reduce sulfate loading to downstream waters.

The estimate of cumulative Project loading of sulfate summed the contributions of two factors:

1) sulfate removal by water management and treatment
2) sulfate loading from Project air emissions

The estimate of cumulative Project loading of mercury summed the contributions of four factors:

1) mercury removal by water management and treatment
2) mercury loading from Project air emissions
3) potential mercury release from sulfide mineral dust deposition
4) potential increase in methylmercury export from watersheds receiving sulfate loading from the Project's air emissions

Results, presented in Section 5 of Reference (3), show that the cumulative Project effect on the lower St. Louis River will be:

- Overall sulfate load reduction of,1,380,000 kg/yr
- Overall mercury load reduction of 5.2 g/yr

Results also clearly demonstrate that Project atmospheric loading is negligible compared to background atmospheric loading. For sulfate, Project atmospheric loading is only 1% to 1.5% of background loading, and for mercury, Project atmospheric loading is only 0.1% to 1% of background loading (Table 4).

Table 4 Atmospheric Loading of Sulfate and Mercury

Watershed	Embarrass River	Partridge River
Monitoring location	PM-13	SW004a
Sulfate atmospheric loading[1]		
Background (g/m^2/yr)	0.482	0.482
Project (g/m^2/yr)	0.006	0.007
Project % of total	1.2%	1.5%
Mercury atmospheric loading[2]		
Background (µg/m^2/yr)	12.5	12.5
Project (µg/m^2/yr)	0.03 to 0.1	0.01 to 0.06
Project % of total	0.2% to 1%	0.1% to 0.5%

[1] All estimates include loading from precipitation (wet deposition) and dust (dry deposition). From Table 4-3 of Reference (3); loading units, g/m^2/yr = grams per square meter per year

[2] Table 5-3 of Reference (3); loading units, µg/m2/yr = micrograms per square meter per year

While the Band claims that the Project's air emissions of sulfate and mercury will result in excessive amounts of methylmercury being formed in Plant Site and Mine Site wetlands and be flushed to downstream waters, the Project's estimated atmospheric loading of sulfate and mercury to the Embarrass and Partridge River watersheds is negligible compared to background. Therefore, no changes in the mercury methylating environment of wetlands are reasonably expected from the estimated potential small additions of sulfate and mercury from the Project's air emissions.

Band's Claims from Band "will affect" Letter

The Band disagrees with the results of the Cross-Media Analysis. They state that the Cross-Media Analysis underestimated mercury and methylmercury loading from the Project because calculations did not account for pulses of high concentrations of sulfate and organic mercury due to wetting and drying cycles in wetlands (Reference (37), p. 3). They, therefore, conclude that:

- *The Project's discharges will add to the existing loads of … sulfate and methylmercury* (p. 17)
- *The releases of mercury, methylmercury and sulfate from the headwater region of the St. Louis River will be cumulatively impacted by the Project, and the releases of total mercury and sulfate will far exceed estimates provided by PolyMet in support of the Project's 401 Certification. Further, methylmercury loading to surface water will be increased due to direct and indirect effects of the Project.* (p. 24)
- *[I}t is expected that discharged waters from the Project containing elevated levels of sulfates and mercury will interact with dissolved organic matter to generate additional methylmercury that will be transported downriver to the Band's Reservation waters and wetlands, especially in the event of high flows.* (p. 32)

PolyMet's Additional Evaluation and Findings

With regard to the Band's claim that elevated levels of sulfate will result in more methylmercury being generated and transported downstream, there will be a net reduction in sulfate loading to Tailings Basin headwater wetlands (Table 2) and to the headwaters of Second Creek at SD026 (Table 3). Therefore, the Band's claim about elevated levels of sulfate does not account for the Project's required water capture and treatment.

To address Band comments on higher potential loading from the Project area due to wetland water level fluctuations followed by episodic high-flow and high-concentration flushing events (lasting days to possibly weeks), Barr conducted supplemental loading calculations for mercury and methylmercury on a daily basis, presented in Section 3.4.2. These supplemental daily loading calculations confirm the conclusions of the Cross-Media Analysis - that the Project will reduce mercury and methylmercury loading to the lower St. Louis River.

3.4.2 Mercury and Methylmercury Loading Will be Reduced by the Project in Operation on a Daily Basis During High-Flow Flushing Events

Barr conducted supplemental loading calculations to assess potential Project water discharges and water management effects on mercury and methylmercury loading to the lower St. Louis River on a daily basis under conditions representative of episodic flushing events (high concentrations and high flows).[3]

DNR studies have documented the relationship between high flow and high mercury concentrations in the St. Louis River watershed (Reference (9)), as have other researchers (e.g., Reference (38)). Those studies have found that high-flow and high-concentration conditions are important in understanding the resultant loading to downstream waters. Flushing events within the St. Louis River basin take place under existing conditions, with storm events increasing flows in the lower St. Louis River by 10 to 30 times the flow under dry conditions (Reference (9)). Flushing events are short-term increases in loading, and the Band suggests that because flushing events occur, and calculations to date have not included such flushing events, the Project will increase loading to the St. Louis River. This supplemental evaluation compares loading from flushing events with the Project in operation to loading from flushing events under existing conditions to address this claim. This supplemental evaluation shows the Project's water management and treatment requirements (Section 2) result in less loading than is estimated to occur in existing conditions.

Loading estimates for existing conditions and with the Project in operation were estimated on a daily basis for the high-flow and high-concentration flushing scenario. Flushing event concentration data for

[3] The high-flow and high-concentration flushing event analysis focuses on PolyMet's water capture, treatment, and management, assuming that the existing conditions mercury methylating environment in the Plant Site and Mine Site wetlands will be maintained, as well as the mercury methylating environment in the non-Project areas of the Embarrass River and Partridge River watersheds and the other watersheds contributing flow and load to the lower St. Louis River. The estimated atmospheric loading of sulfate and mercury to watersheds is minor compared to background (Table 4) and no changes in the mercury methylating environment are expected from the estimated potential small additions of sulfate and mercury from the Project's air emissions. Therefore, no changes in the existing conditions mercury methylating environment are made for this high-flow and high-concentration scenario.

existing conditions (background) were obtained from Project documents and data collection efforts (including PolyMet's baseline data collection efforts in support of the FEIS and the 401 Certification), MPCA and DNR data from their collective studies in the St. Louis River watershed, and peer-reviewed literature pertinent to the St. Louis River watershed. Based on the reports and literature reviewed, the data included in Table 5 and Table 6 are the highest reported values for the Project area and St. Louis River watershed. Background data are summarized for mercury in Table 5 and methylmercury in Table 6.

The high-concentration values for the Embarrass River and Partridge River watersheds are consistent with other northern/boreal streams, reflecting wetland influences on mercury and methylmercury concentrations. For example, mercury concentrations of 12.4 and 12.5 ng/L, respectively, for the Embarrass River and Partridge River are similar to high concentrations reported for wetland waters and streams in the St. Louis River watershed (11.8 ng/L, headwaters area upstream of mining; Reference (30)), northwest Minnesota (Reference (39)), and north-central Minnesota at the Marcell Experimental Forest on the west end of the Mesabi Range near Grand Rapids (16 to 18 ng/L, Reference (40)). To represent the high-flow high-concentration flushing scenario described by the Band, representative high concentrations were assigned to the respective locations and used in estimating loading for existing conditions and the Project in operation.

Table 5 Summary of Input Data for Supplemental Mercury Loading Estimates for a High-Flow and High-Concentration Scenario

	Existing Conditions			Project in Operation	
Source Area or Evaluation Point	Flow, High (cfs)	Concentration, High (ng/L)	Project Flow Changes (cfs)[9]	Flow, High (cfs)	Concentration, High (ng/L)
Plant Site [1]	24.4	6	Seepage capture +20% for stream augmentation	7.646	6
Embarrass River, PM-13 [2]	673	12.4	-17	656	12.9
Mine Site [3]	27.9	12.5	-26	2.1	12.5
Partridge River, SW004a [4]	150.5	12.5	-26	124.6	12.5
SD026 (Second Creek) (net increase) [5]	n/a	n/a	0.14 (WWTS discharge)	0.14	1.3
Colby Lake (withdrawal) [6]	n/a	n/a	-0.58	-0.58	8.7
Non-Project Areas (contributing to St. Louis River at Forbes)	4,748	8.9	0	4,748	8.9
St. Louis River, Forbes [7]	4,800	8.9	- 43	4,757	8.9
Non-Project Areas (Basin-wide contribution)	14,565	9.4	0	14,565	9.4
St. Louis River, Cloquet [8]	14,617	9.4	- 43	14,574	9.4

cfs = cubic feet per second ng/L= nanogram per liter n/a = not available

[1] Plant Site

a) High flow in existing conditions is estimated at 24.4 cfs and is based on the annual maximum 7-day mean flow of 6.02 cfs per square mile (Table 4-5 of Reference (41) applied to the Tailings Basin area of 4.06 square miles (2,600 acres). This estimate assumes increased flow from the Tailings Basin during snowmelt and large storm events similar to non-project areas.
b) Flow with Project in operation includes stream augmentation flow of 6.466 cfs plus 1.18 cfs from other parts of the Plant Site = 7.646 cfs
c) Concentration reflects the highest available monitored value in the streams draining wetlands to the north and west of the Tailings Basin (i.e., water flowing towards the Embarrass River); concentration of 6 ng/L measured at monitoring location PM-11 (Unnamed Creek); Table 6 of Attachment F to Appendix A (Reference (1)).

No change in the high mercury concentration for future conditions as no change in the flushing environment is expected; atmospheric deposition of mercury from Project air emissions to the watershed was estimated to be small (Reference (3)), and water level fluctuations in wetlands will be similar to existing conditions due to augmentation water supplied to wetlands north of the former LTVSMC tailings basin.

[2] Embarrass River at PM-13

a) High flow in existing conditions was estimated at 673 cfs based on the annual maximum 7-day mean flow of 6.02 cfs per square mile (Table 4-5 of Reference (41); yield rate of 6.02 cfs per square mile applied to the 111.8 square mile watershed of PM-13.
b) Concentration reflects the highest available value from monitoring data in Project reports, the Final EIS, or pertinent data from the watershed; the value of 12.4 ng/L is from Table 6 of Attachment F to Appendix A (Reference (1)). Non-Project areas contribute most of the flow and mercury load at PM-13 versus a smaller contribution from the Plant Site.

No change in the high mercury concentration for future conditions as no change in the flushing environment is expected; atmospheric deposition of mercury from Project air emissions to the watershed was estimated to be small (Reference (3)) and water level fluctuations in wetlands will be similar to existing conditions due to augmentation water supplied to wetlands north of the former LTVSMC tailings basin. While there is no change in the wetland flushing environment in the watershed, there is a small increase in mercury concentration estimated for PM-13 with the Project in operation. Even though loading from the Plant Site is reduced with the Project in operation, there is less flow at PM-13, which results in the small increase in mercury concentration.

[3] Mine Site

a) Flow of 27.9 cfs from the Mine Site is based on the estimated yield rate of 5.87 cfs per square mile derived from the average annual 30-day maximum flow for SW004a of 150.46 cfs found in Table 4.2.2-8 of (Reference (4) divided by the watershed area of SW00a (25.65 square miles); yield rate of 5.87 cfs per square mile applied to the Mine Site area of 4.77 square mile area (3,015 acres).
b) Concentration reflects highest value available from monitoring data in Project reports, the Final EIS, or pertinent data from the watershed; concentration of 12.5 ng/L measured at SW004a was applied to the water exported from the entire SW004a watershed, including the Mine Site. Concentration of 12.5 ng/L (Table 6 of Attachment F to Appendix A (Reference (1)).

No change in the high mercury concentration for future conditions as no change in the flushing environment is expected; atmospheric deposition of mercury from Project air emissions are estimated to be small (<0.5% of background) (Reference (3)) and water level fluctuations expected to remain within the range of those occurring in existing conditions.

[4] Partridge River as SW004a

a) Flow of 150.5 cfs is from Table 4.2.2-8 of Reference (4).
b) Concentration reflects the highest value available from monitoring data in Project reports, the Final EIS, or pertinent data from the watershed. For SW004a, a value of 12.5 ng/L is from Table 6 of Attachment F of Appendix A of Reference (1).

No change in the high mercury concentration for future conditions as no change in the flushing environment is expected; atmospheric deposition of mercury from Project air emissions are estimated to be small (<0.5% of background) (Reference (Barr 2017, Cross-Media Report)) and water level fluctuations expected to remain within the range of those occurring in existing conditions.

[5] Outfall SD026 (headwater of Second Creek)

a) Net change in flow is the value used in the Antidegradation Evaluation; (Attachment F of Appendix A of Reference (1)). Net increase in flow (0.14 cfs) is the increase from existing conditions flow of 0.51 cfs and estimated future flow of 0.66 cfs (values rounded).
b) Concentration in the future during Project operations reflects constant discharge of treated water to SD026; calculations show SD026 load as an incremental addition to downstream waters.

[6] Colby Lake

a) Flow is the value used for the Antidegradation Evaluation (Attachment F of Appendix A of Reference (1)).
b) Concentrations reflect the highest value available from the available reports. Value of 8.7 ng/L is from Table 4.2.2-18 of Reference (4)).

[7] St. Louis at Forbes

a) Flow estimate was obtained from DNR assessment reports for the St. Louis River (Reference (30)).

b) Concentration reflects the highest value available reports for the St. Louis River watershed; value of 8.9 ng/L used in the antidegradation assessment ((Attachment F of Appendix A of Reference (1)).

[8] St. Louis River at Cloquet

a) Flow estimate was obtained from DNR and MPCA summary reports on the St. Louis River watershed; value of 14,617 cfs is an average high flow (Reference (10)).

b) Concentration is from studies conducted for the St. Louis River watershed; value used in the Antidegradation Evaluation (Attachment F of Appendix A of Reference (1)).

[9] Flow reductions and increases reflect the Project's required water management. During high flow scenario, water capture at the Plant Site and Mine Site will be greater than during average flow conditions. Average conditions were assessed in the Antidegradation Evaluation for the NPDES Permit Application; Attachment F of Appendix A of Reference (1).

For the Plant Site, concentrations in existing conditions are also used to estimate potential loading from the Project in operation. The available data for the streams draining the headwater wetlands to the north of the former LTVSMC tailings basin indicate they do not have elevated concentrations of either mercury or methylmercury compared to non-mining influenced watersheds (Reference (35)). Data collected by the DNR (Reference (36)) from surface waters also indicates lower than expected concentrations of mercury and methylmercury in streams draining wetlands and lakes receiving sulfate from mining operations. As discussed by the DNR (Reference (36)), "… Thus, while other studies have demonstrated that the addition of SO4 produces an increase in mercury methylation in peatlands (Åkerblom et al., 2013; Bergman et al., 2012; Coleman Wasik et al., 2012; Jeremiason et al., 2006), SO4 concentration appears, for the most part, unrelated to MeHg concentration in the St. Louis River. Other studies have identified instances where methylation rates are inversely related to the SO4 at relatively high concentrations in the range of those measured downstream from the mining region (Gilmour et al., 1998). Proposed mechanisms for an inverse relationship between SO4 and MeHg production include formation of charged sulfide complexes and the formation of HgS nanocolloidal and aggregated particulates (Benoit et al., 1999; Gerbig et al., 2011) that make oxidized Hg unavailable for methylation. However, MeHg concentrations in the present study are not either positively or negatively correlated to total SO4 concentrations measured in the streams…". Therefore, based on specific assessments of mine water effects on mercury and methylmercury concentrations in wetlands and lakes (References (35); (36)), the Project's treated water with sulfate concentration of 10 mg/L or less is not expected to affect mercury methylation in headwater wetlands to the north and west of the Tailings Basin.

In addition, the Band's claims don't consider that high flushing events affect most or all of the St. Louis River watershed, as previous DNR studies indicate that large storm events and snowmelt typically affect the entire watershed, not just a small part of a sub-watershed or only one sub-watershed such as the Mine Site or Plant Site. The DNR studies identify that flushing events typically affect all parts of the St. Louis River watershed (e.g., snowmelt), but some large storm events may only affect a portion of the watershed, with a demonstrated lag time for waters from the upper reaches of the basin to contribute to the lower part of the river (Reference (9)). However, the supplemental calculations included in this evaluation assume all parts of the watershed deliver their load to the lower St. Louis River at the same time, something that cannot occur in reality due to the distances between tributary entrances to the river and the time it takes for water to travel from an upper reach of a sub-watershed to the confluence with the St. Louis River and then time to travel down to the lower part of the river. Assuming all tributary water is delivered to the lower St. Louis River at the same is an oversimplification and overly protective (it overestimates load); however, even assuming all loading from a flushing event occurs at the same time, a flushing event is still estimated to result in less loading during Project operations than under existing conditions, primarily due to the Project's water management and treatment requirements (Section 2).

Table 6 Summary of Input Data for Supplemental Methylmercury Loading Estimates for High-Flow and High-Concentration Scenario

	Existing Conditions			Project in Operation	
Source Area or Evaluation Point	Flow, High (cfs)	Concentration, High (ng/L)	Project Flow Changes (cfs)[9]	Flow, High (cfs)	Concentration, High (ng/L)
Plant Site [1]	24.4	0.67	Seepage capture; +20% for stream augmentation	7.646	0.67
Embarrass River, PM-13 [2]	673	2.6	-17	656	2.7
Mine Site [3]	27.9	1.6	-26	2.1	1.6
Partridge River, SW004a [4]	150.5	1.6	-26	124.6	1.6
SD026 (Second Creek) (net increase) [5]	n/a	n/a	0.14 (WWTS discharge)	0.05	0.05
Colby Lake (withdrawal) [6]	n/a	n/a	-0.58	-0.58	0.58
Non-Project Areas (contribute to Forbes)	4,748	1.14	0	4,748	1.14
St. Louis River, Forbes [7]	4,800	1.14	-43	4,757	1.14
Non-Project Areas (Basin-wide contribution)	14,565	0.72	0	14,565	0.72
St. Louis River, Cloquet [8]	14,617	0.72	-43	14,574	0.72

cfs = cubic feet per second ng/L= nanogram per liter

[1] Plant Site

a) High flow in existing conditions is estimated at 24.4 cfs and is based on the annual maximum 7-day mean flow of 6.02 cfs per square mile (Table 4-5 of Reference (41) applied to the Tailings Basin area of 4.06 square miles (2,600 acres). This estimate assumes increased flow from the Tailings Basin during snowmelt and large storm events similar to non-project area export of water.

b) Flow with Project in operation includes stream augmentation flow of 6.466 cfs plus 1.18 cfs from other parts of the Plant Site = 7.646 cfs.

c)) Concentration reflects the highest available monitored value in the streams draining wetlands to the north and west of the Tailings Basin (i.e., water flowing towards the Embarrass River); concentration is from Trimble Creek (PM-19); Table 3 of Reference (35).

No change in the high methylmercury concentration for future conditions as no change in methylating or flushing environment is expected; atmospheric sulfate and mercury deposition from Project air emissions to the watershed were estimated to be small (Reference (3)) and water level fluctuations in wetlands will be similar to existing conditions due to augmentation water supplied to wetlands north of the former LTVSMC tailings basin.

[2] Embarrass River at PM-13

a) High flow in existing conditions was estimated at 673 cfs based on the annual maximum 7-day mean flow of 6.02 cfs per square mile (Table 4-5 of Reference (41); yield rate of 6.02 cfs per square mile applied to the 111.8 square mile watershed of PM-13.

b) Concentration reflects the highest available value from monitoring data in Project reports, the Final EIS, or pertinent data from the watershed; a surface water concentration of 2.6 ng/L was calculated for PM-13 based on predominance of contribution from non-Project areas with a methylmercury concentration of 2.7 ng/L (Reference (35)). Non-Project areas contribute most of the flow and methylmercury load at PM-13 versus a smaller contribution from the Plant Site.

No change in the high methylmercury concentration for future conditions as no change in methylating or flushing environment is expected; atmospheric deposition of sulfate and mercury from Project air emissions to the watershed was estimated to be small (Reference (3)) and water level fluctuations in wetlands will be similar to existing conditions due to augmentation water supplied to wetlands north of the former LTVSMC tailings basin. While there is no change in the wetland methylating or flushing environment in the watershed, there is a small increase in methylmercury concentration estimated for PM-13 with the Project in operation. Even though loading from the Plant Site is reduced with the Project in operation, there is less flow at PM-13, which results in the small increase in methylmercury concentration.

[3] Mine Site

a) Flow of 27.9 cfs from the Mine Site is based on the estimated yield rate of 5.87 cfs per square mile derived from the average annual 30-day maximum flow for SW004a of 150.46 cfs (from Table 4.2.2-8 of Reference (4)) divided by the watershed area of SW00a (25.65 square miles); yield rate of 5.87 cfs per square mile applied to the Mine Site area of 4.77 square mile area (3,015 acres).

b) Concentration of 1.6 ng/L reflects the highest value from the Wetland of Interest outlet stream (2019-2020 401 monitoring data). A concentration of 1.6 ng/L was applied to the entire watershed of SW004a as a potential methylmercury concentration during high-flow flushing events.

No change in the high methylmercury concentration for future conditions as no change to methylating or flushing environment is expected for the Mine Site Area; overall, atmospheric deposition of mercury and sulfate from Project emissions to the Mine Site area were estimated to be small even though a small area (Wetland of Interest; ~3.5% of the Mine Site area) was estimated to receive more sulfate deposition (32% of background) while the remaining 96.5% of the Mine Site area was estimated to receive 10% or less of background sulfate deposition with very little change in methylmercury export estimated to occur (Reference (3)). In addition, water level fluctuations are expected to remain within the range of those occurring in existing conditions.

[4] Partridge River at SW004a

a) Flow of 150.5 cfs (from Table 4.2.2-8 of Reference (4)).

b) Concentration is from highest available value from monitoring data: 0.89 ng/L from MPCA 2017 dataset (Reference (42))
No change in the high methylmercury concentration for future conditions as no change to methylating or flushing environment within the SW004a watershed as a whole is expected; overall, atmospheric deposition of mercury and sulfate from Project emissions to the SW004a watershed were estimated to be small even though a small area (Wetland of Interest; 0.3% of the watershed) was estimated to receive more sulfate deposition (32% of background) while the remaining 99.7% of the SW004a watershed was estimated to receive 1% or less of background deposition with very little change in methylmercury export estimated to occur (Reference (3)). In addition, water level fluctuations are expected to remain within the range of those occurring in existing conditions.

[5] Outfall SD026 (headwater of Second Creek)

a) Net change in flow is the value used in the Antidegradation Evaluation (Attachment F of Appendix A of Reference (1)). Net increase in flow (0.14 cfs) is the increase from existing conditions flow of 0.51 cfs and estimated future flow of 0.66 cfs (values rounded).

b) Concentration reflects constant discharge of treated water to SD026

[6] Colby Lake

a) Flow is the value used for the Antidegradation Evaluation (Attachment F of Appendix A of Reference (1)).

b) Concentrations reflect the highest value available from available monitoring data. Concentration of 0.58 ng/L is from the cumulative loading analysis conducted for the Cross-Media Analysis (Section 5 of Reference (3)).

[7] St. Louis River at Forbes

a) Flow estimate of 4,880 cfs was obtained from DNR assessment reports for the St. Louis River (Reference (30)).

b) Concentration reflects highest value from available reports for the St. Louis River watershed; value of 1.14 ng/L for the Forbes reach of the river (from Reference (30)).

[8] St. Louis River at Cloquet

a) Flow estimate obtained from DNR and MPCA summary reports on the St. Louis River watershed; value of 14,617 cfs is average high flow (Reference (10)).

b) Concentration of 0.72 ng/L is from DNR studies conducted within the St. Louis River watershed (Reference (9)).

[9] Flow reductions and increases reflect the Project's required water management. During high flow scenario, water capture at the Plant Site and Mine Site will be greater than during average flow conditions. Average conditions were assessed in the Antidegradation Evaluation for the NPDES Permit Application. Barr 2017. Attachment F of Appendix A of Reference (1)

Supplemental loading calculations used methodology consistent with loading analyses previously submitted to the DNR and MPCA in support of the NorthMet 401 water quality certification water permitting (References (3); (Attachment F of Appendix A of Reference (1)). Consistent with the previous loading estimates, Project-area flows, and load are assumed to be delivered immediately to the lower St. Louis River with no water mixing in the upper part of the watershed; this is a conservative assumption that overestimates potential Project contributions to the lower St. Louis River.

Table 7 provides the estimated Project area mercury loading for existing conditions and with the Project in operation under the high-flow and high-concentration scenario. Table 7 shows that during a flushing event:

- the Project in operation is estimated to decrease mercury loading by about one gram per day (an estimated decrease of 1.048 g/day) compared to a flushing event during existing conditions.
- the Project area is estimated to contribute 0.05% of the loading to the lower St. Louis River with the Project in operation, compared to 0.36% from a flushing event in existing conditions.
- loading from non-Project Areas, which includes non-mining watersheds, contributes more than 99.5% of the mercury load to the lower St. Louis River during flushing events under existing conditions and with the Project in operation.

Table 8 provides the estimated Project area methylmercury loading for existing conditions and with the Project in operation under the high-flow and high-concentration scenario. Results are similar to those for mercury loading. Table 8 shows that during a flushing event:

- the Project in operation is estimated to decrease loading by about 0.13 grams per day compared to a flushing event during existing conditions.
- the Project area is estimated to contribute 0.07% of the loading to the lower St. Louis River with the Project in operation, compared to 0.58% from a flushing event during existing conditions.
- loading from non-Project Areas, which includes non-mining watersheds, contributes more than 99% of the mercury load to the lower St. Louis River during flushing events under existing conditions and with the Project in operation.

The results from the supplemental calculations provided here further indicate the Project water management and treatment requirements remove water with high mercury concentrations and replaces it with lower mercury concentrations, thereby reducing the loading from the Project area to the lower St. Louis River on both short-term (days) and longer (annual) time scales. These supplemental calculations confirm that the Project will not increase loading in the St. Louis River from existing conditions, even under conditions of high flow and high concentrations. On the contrary, the Project will decrease mercury and methylmercury loading in the St. Louis River compared to existing conditions.

Table 7 Estimates of Mercury Loading for a High-Flow and High-Concentration Scenario

Calculation Component	Existing Conditions (g/day)	Project in Operation[1] (g/day)	Net Change[2] (g/day)	Comment
Project Area: Plant Site Load to Embarrass River	0.359	0.112	-0.247	Project in operation includes Project water management and +20% for stream augmentation
Embarrass River, PM-13[3]	20.910	20.664	-0.247	Reduced loading to PM-13 reflects Project water capture and treatment.
Project Area: Mine Site Load to Partridge River	0.854	0.064	-0.790	Project in operation includes Project water management and treatment.
Partridge River, SW004a[3]	4.601	3.812	-0.790	Reduced loading to SW004a reflects Project water capture.
Project Effect: Removal of Colby Lake Water	0	-0.012	-0.012	This loss only occurs with Project in operation.
Project Effect: Additional Flow/Load from SD026	0	0.0004	0.0004	This net addition only occurs with Project in operation.
Net Loading for Project Area and Project Effects	1.213	0.164	-1.048	Values in this row reflect Plant Site load, Mine Site load, Colby Lake load, SD026 load
Load from Non-Project Areas to St. Louis River at Forbes[3]	103.494	103.494	0.0	Contributions from non-Project areas within the St. Louis River watershed upstream of Forbes
Load in St. Louis River at Forbes	104.707	103.658	-1.048	Load estimated for St. Louis River = Net Load from Project Area + Load from Non-Project Areas
Load from Non-Project Areas to the St. Louis River at Cloquet[3]	335.127	335.127	0.0	Contributions from non-Project areas within the entire St. Louis River watershed upstream of Cloquet
Total Load in St. Louis River at Cloquet	336.340	335.291	-1.048	Load estimated for St. Louis River = Net Load from Project Area + Load from Non-Project Areas
Project Area Contribution as a % of Load at Cloquet	0.36%	0.05%		This analysis assumes Project load delivered directly to the Forbes and Cloquet evaluation points

g/day = gram per day

[1] Flows with the Project in operation account for the following:
Plant Site: Requirement is for flow from the Plant Site to be at +20% of average annual flow: flow from basin = 6.466 cfs + 1.18 cfs from other parts of the Plant Site = 7.646 cfs
Mine Site: Reduction in flow from the Mine Site due to water capture (-26 cfs in high flow conditions); flow from the Mine Site with the Project in operation that was used in the loading calculations = 2.1 cfs
Colby Lake: Withdrawing water from Colby Lake for process water assumed to be constant (a loss of flow, -0.58 cfs,) (Attachment E of Appendix A of Reference (1))
SD026: Net increase in flow (0.14 cfs) from SD026 at the headwaters of Second Creek; increase from 0.51 cfs in existing conditions to 0.66 cfs with the Project in operation (Attachment F of Appendix A of Reference (1))

[2] All values are rounded and may not sum exactly.

[3] Flow conditions for the non-Project areas of the watershed are the same for Existing Conditions and Project in operation; the only change in flow and loading is due to the Project.

Table 8 Estimates of Methylmercury Loading for a High-Flow and High-Concentration Scenario

Calculation Component	Existing Conditions (g/day)	Project in Operation[1] (g/day)	Net Change[2] (g/day)	Comment
Project Area: Plant Site Load to Embarrass River	0.040	0.013	-0.028	Project in operation includes Project water management and +20% for stream augmentation
Embarrass River, PM-13[3]	4.325	4.297	-0.028	Reduced loading to PM-13 reflects Project water capture and treatment
Project Area: Mine Site Load to Partridge River	0.109	0.008	-0.101	Project in operation includes Project water management and treatment
Partridge River, SW004a[3]	0.589	0.488	-0.101	Reduced loading to SW004a reflects Project water capture
Project Effect: Removal of Colby Lake Water	0	-0.002	-0.002	This loss only occurs with Project in operation
Project Effect: Additional Flow/Load from SD026	0	0.00002	0.00002	This net addition only occurs with Project in operation
Net Loading for Project Area and Project Effects	0.149	0.019	-0.131	Values in this row reflect Plant Site load, Mine Site load, Colby Lake load, SD026 load
Load from Non-Project Areas to the St. Louis River at Forbes[3]	13.271	13.271	0.0	Contributions from non-Project areas within the St. Louis River watershed upstream of Forbes
Load in St. Louis River at Forbes	13.420	13.289	-0.131	Load estimated for St. Louis River = Net Load from Project Area + Load from Non-Project Areas
Load from Non-Project Areas to the St. Louis River at Cloquet[3]	25.607	25.607	0.0	Contributions from non-Project areas within the St. Louis River watershed upstream of Cloquet
Total Load in St. Louis River at Cloquet	25.756	25.625	-0.131	Load estimated for St. Louis River = Net Load from Project Area + Load from Non-Project Areas
Project Area Contribution as a % of Load at Cloquet	0.58%	0.07%		This analysis assumes Project load delivered directly to the Forbes and Cloquet evaluation points

g/day = gram per day

[1] Flows with the Project in operation account for the following:
Requirement for flow from the Plant Site to be at +20% of average annual flow: flow from basin = 6.466 cfs + 1.18 cfs from other parts of the Plant Site = 7.646 cfs
Mine Site: Reduction in flow from the Mine Site due to water capture (-26 cfs in high flow conditions); flow from the Mine Site with the Project in operation that was used in loading calculations = 2.1 cfs
Colby Lake: Withdrawing water from Colby Lake for process water assumed to be constant (a loss of flow, -0.58 cfs) (Attachment E of Appendix A of Reference (1))
SD026: Net increase in flow (0.14 cfs) from SD026 at the headwaters of Second Creek, from 0.51 cfs in existing conditions to 0.66 cfs with the Project in operation (Attachment F of Appendix A of Reference (1))

[2] Values are rounded and may not sum exactly.

[3] Flow conditions for the non-Project areas of the watershed are the same for Existing Conditions and Project in operation; the only change in flow and loading is due to the Project.

The results of the supplemental loading calculations are consistent with the DNR studies of the St. Louis River watershed. The DNR studies conclude that the St. Louis River receives a relatively small percentage of its water from the mining industry. Small existing conditions contributions of mercury and methylmercury from the Partridge River and Embarrass River watersheds to the lower St. Louis River, relative to contributions from non-mining watersheds, have also been identified (References (9); (11); (12)). The DNR studies have clearly identified the overriding influence of the non-mining areas on mercury and methylmercury contributions to the lower St. Louis River, further emphasizing the de minimis potential for the Project area to affect surface water or fish tissue mercury concentrations in the lower St. Louis River. Those overriding influences from non-Project areas (i.e., non-mining areas) are evident in Table 7 and Table 8.

4 Conclusion

Major conclusions from evaluating the Band's "will affect" Letter and re-assessing Project information leads to the following summation:

- The Band mischaracterizes and misrepresents the Project, leading to faulty claims.
- Water loading from the Project to the headwater wetlands north and west of the Tailings Basin will be similar to existing conditions as required stream augmentation is ±20% of average annual flows. Therefore water flow through the wetlands with the Project in operation will be within the range of flows occurring in existing conditions and will not create excessive flushing conditions and will not increase loading of sulfate, mercury, methylmercury, or organic matter above those levels occurring in existing conditions.
- Atmospheric loading from the Project's air emissions of sulfate and mercury to the Embarrass River watershed at PM-13 and Partridge River watershed at SW004a is small, for sulfate about 1% of background and for mercury <1% of background (Table 4). This potential incremental change in atmospheric loading to the Embarrass River and Partridge River watersheds is not reasonably expected to change the methylating environment in wetlands compared to their methylating potential in existing conditions (Table 4). Any small potential increase in methylmercury in export waters is more than offset by the Project's required water capture and treatment (Table 5-5 and Table 5-6 of Reference (3)); Table 8).
- During Project operations, Mine Site wetland water level fluctuations are expected to remain within the naturally occurring range (e.g., some wetlands currently experience water level declines of 30 inches or more). This means that the amount of methylmercury formed and mobilized due to wetland water level fluctuations will be similar to that occurring in existing conditions. In fact, the amount of methylmercury leaving the Mine Site will decrease, compared to existing conditions, due to capture of waters contacting mine features (including their load from background and Project atmospheric deposition of mercury and sulfate), and the installation of stormwater ponds. Therefore, the Project in operation is not reasonably expected to increase methylmercury loading to downstream waters above that already occurring in existing conditions.
- The cumulative effect of the Project, which is the sum of air deposition plus water management and treatment requirements for the Plant Site and Mine Site, is estimated to reduce sulfate and mercury loading to the lower St. Louis River near the Fond du Lac Reservation by approximately 1,380,000 kg/yr and 5.2 g/yr, respectively.
- Because the Project reduces sulfate loading it is not reasonably expected to increase methylmercury formation or export from watersheds.
- The Project will reduce mercury and methylmercury loading from the Project area to downstream waters on short-term (days) and longer-term (annual) time scales.

The weight-of-evidence clearly indicates the Project cannot increase sulfate, mercury, or methylmercury loading to the lower St. Louis River above the loading occurring in existing conditions. On the contrary, the Project was designed to clean up the brownfield Plant Site, which is why there will be such a large reduction in sulfate and mercury from the Project. Therefore, the worst-case scenarios envisioned by the Band for the Project to flush excess sulfate, mercury, and methylmercury to the lower St. Louis River will **NOT** occur.

These conclusions have been echoed in the FEIS, the NorthMet permit documentation, including the USACE ROD, and in the Minnesota Court of Appeals, as follows:

- The FEIS states, "[t]he net effect of these [Project] changes would be an overall reduction in mercury loadings to the downstream St. Louis River upstream of the Fond du Lac Reservation boundary. Therefore, the NorthMet Project Proposed Action would not add to any potential exceedance of the Fond du Lac mercury water quality standard of 0.77 ng/L within the Reservation." (Reference (4), p. 5-10)
- The MPCA's Section 401 Water Quality Certification Program Fact Sheet (Reference (6)) states, "[b]ased on its review of Cross-Media analysis, the MPCA concluded:
  - 1. The analysis developed a reasonable and protective scenario that showed no measurable changes of mercury in water or fish from Project-related deposition of sulfur.
  - 2. There will be no exceedances of copper, cobalt, and arsenic Class 2D water quality standards or to any other numeric water quality criteria from Project-related air emissions or the cumulative impact of Project-related air emissions.
  - 3. The Project will not result in any measurable changes to water quality downstream of the Project in the St. Louis River, including downstream locations at Forbes (upper St. Louis River)" (p. 14).
- The USACE ROD states, "[t]he net effect…would be an overall reduction in mercury loadings to the downstream St. Louis River upstream of the Fond du Lac Reservation Boundary. The Project is not expected to add to any potential exceedance of the Fond du Lac mercury water quality standard of 0.77 ng/L within the Reservation" (p. 42), and "there is no expected change in fish mercury concentrations, and no substantial change in human health risks related to fish consumption" (p. 74).
- The Minnesota Court of Appeals, in the NorthMet Project NPDES/SDS Permit case,[4] states "the PCA did not err by issuing a permit that does not ensure compliance with the Band's water-quality standards" (p. 33) and "[t]he permit ensures compliance with the Band's water-quality standards" (p. 39). The Band did appeal other decisions unrelated to the Band's water quality

[4] In the Matter of the Denial of Contested Case Hearing Requests and Issuance of National Pollutant Discharge Elimination System / State Disposal System Permit No. MN0071013 for the Proposed NorthMet Project St Louis County Hoyt Lakes and Babbitt Minnesota.

standards in this case; however, they did not appeal this court decision that the permit would not comply with the Band's water-quality standards.

Even with these conclusions in hand, the regulatory agencies added many protective conditions in the NorthMet Project permits to monitor and verify that these conclusions are correct. These permit conditions include extensive water quality, water quantity, water flow, and water level monitoring in upstream, downstream, and adjacent wetlands, groundwater, and streams surrounding the Project. This monitoring includes extensive monitoring for sulfate and mercury and, to a lesser extent, but certainly relevant, methylmercury.

There are also extensive permit conditions requiring PolyMet to provide reports to the agencies to evaluate the adequacy of the engineering controls and the comprehensive monitoring network. Numerous permit conditions require that PolyMet review and update the Project's water modeling annually to verify and update the future predictions of potential long-term impacts on water resources. Even further, although PolyMet has an Adaptive Management Plan, there are many permit conditions that require adaptive management and mitigation, including the processes PolyMet is required to follow if changes need to be made as a result of the monitoring and modeling required in these other permit conditions. Specifically, the permits include the following:

Multiple Permit Requirements:

- Annual Model Verification: The NorthMet Project NPDES/SDS Permit (conditions 5.181.191-5.181.211), Permit to Mine (conditions 32-34), and Water Appropriation Permits (conditions "Model Updates and Assessments") collectively require PolyMet to assess the predictions of water quality and quantity against the actual observed values from the comprehensive monitoring program. The water models are required to be rerun with actual inputs (climate, mine feature dimensions, material movements, water rock sulfur content, water quality and quantities, etc.) to verify previously predicted long-term impact assessments were correct and, if not, to determine if Project changes are needed to remedy predicted changes that could result in unacceptable impacts to water resources.
- Adaptative Management and Mitigation: The 404 Wetland Permit (conditions 18, 27, 31, 33), 401 Water Quality Certification (conditions 2, 4, 5B, and 6), NPDES/SDS Permit (conditions 5.175.69, 5.175.71, 5.175.84, 5.175.175, 5.181.205, 5.181.213, 5.181.217-218, 6.174.16), Permit to Mine (conditions 80-80a), and Water Appropriation Permits (conditions "Adaptative Management") collectively require PolyMet to act if monitoring data and modeling results for unacceptable impacts to water resources as a result of the Project, with a process laid out in most of these permits that PolyMet must follow to remedy the potential issue.

NorthMet Project NPDES/SDS Permit:

- Special conditions 5.181.212 to 5.181.215 require PolyMet to provide an annual groundwater evaluation report that assesses the groundwater monitoring well data at the Mine Site and Plant Site. The report is required to evaluate "the overall suitability of the existing groundwater monitoring networked at the Mine Site and Plant Site to adequately monitor groundwater flows from the Mine and Plant Site, including its ability to detect a potential future groundwater impact to any surface water." These conditions include the process PolyMet must follow if the report shows that changes are needed to the monitoring network.

- Special conditions 5.181.216 to 5.181.218 require PolyMet to provide an annual comprehensive assessment of the performance of the facility engineering controls at the Mine Site and Plant Site "in minimizing impacts to water resources downstream of the facility, including the avoidance of an unauthorized discharge to surface waters." The intent of this report is "to identify in a proactive manner the potential for unauthorized impacts such that adaptive management, mitigation or corrective actions can be undertaken prior to the potential impact occurring." This report is required to utilize "all relevant monitoring and performance data, including waste stream monitoring results, groundwater monitoring results, surface water monitoring results and internal operating data." The permit conditions list several questions the report needs to address and include the process PolyMet must follow if the report shows that the engineering controls are not operating as intended or providing a sufficient level of control.

Comprehensively, as shown in this report and the Project documentation as a whole, there are adequate controls in place, both in Project design and in permit requirements, to verify that the Project will not violate water quality standards associated with sulfate, mercury, or methylmercury at the Fond du Lac Reservation on the lower St. Louis River, over 110 river miles downstream from the nearest Project discharge.

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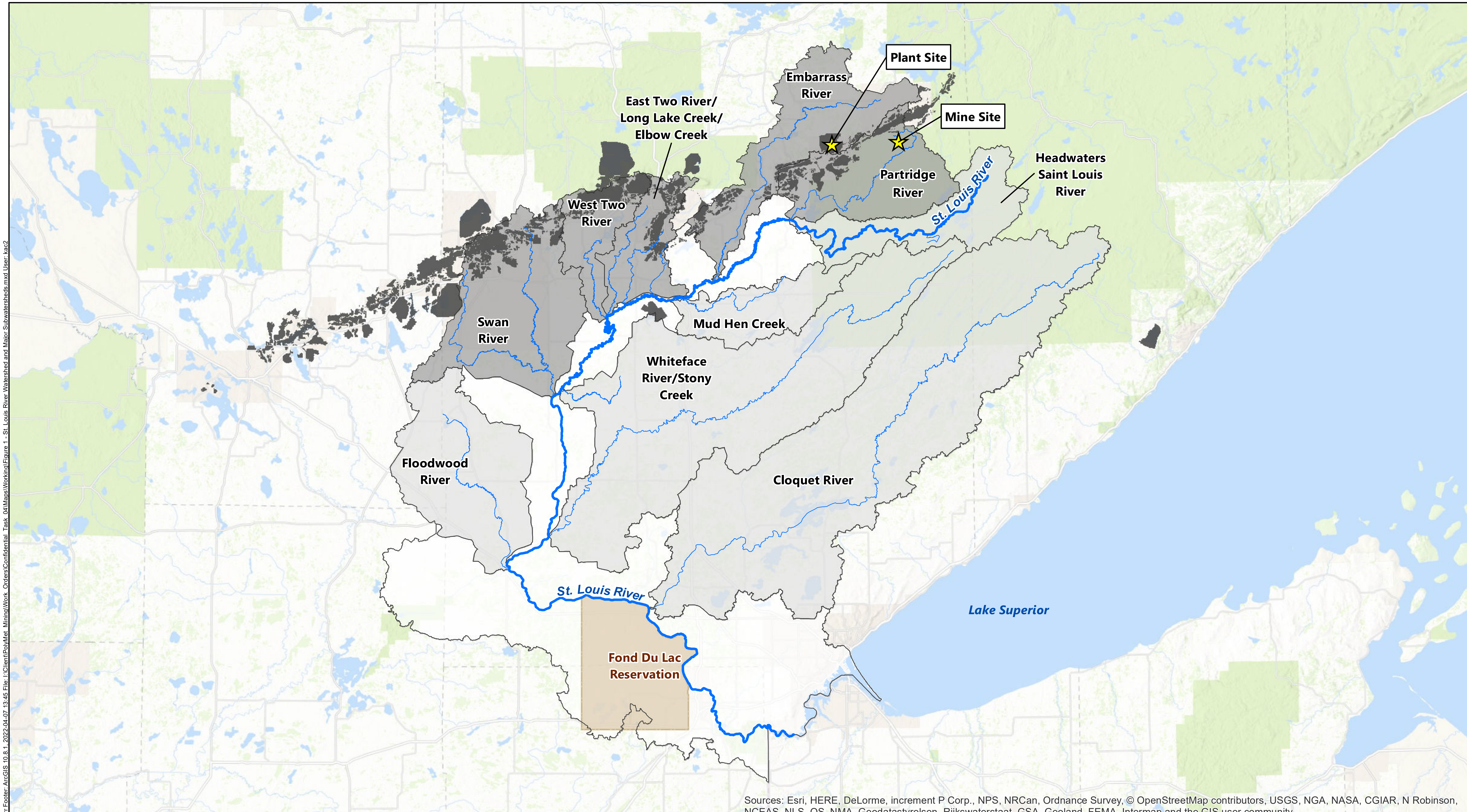
Large Figures



Watershed Boundary
Mining Watershed
Non-Mining Watershed
Mine Feature

0 5 10 20
Miles

Large Figure 1
ST. LOUIS RIVER WATERSHED
AND MAJOR SUBWATERSHEDS
NorthMet Project
Poly Met Mining, Inc.

Attachment 1

Cliff Twaroski Resume (CV)

CLIFF TWAROSKI
Vice President, Senior Environmental Scientist

BARR

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Education MS, Forest Management, University of Minnesota, 1982

BS, Forest Management, University of Wisconsin–Stevens Point, 1979

Work History

September 1997 to present	Barr Engineering Co., Minneapolis (principal and vice president since 2007)
August 1982 to September 1997	Minnesota Pollution Control Agency, St. Paul

Work Experience Cliff has four decades of experience assessing potential environmental effects from chemicals released to the environment. His early work at the Minnesota Pollution Control Agency (MPCA) included evaluating potential effects from atmospheric deposition of sulfur, nitrogen, mercury and particulate metals on Minnesota's aquatic, terrestrial, and wetland ecosystems; assessing contaminant levels in soil, groundwater, surface waters, and sediment in and around spill sites and closed landfills and working with responsible parties to remediate the contamination; and assessing potential risks to human health from pollutants in air, soil, and water.

Since joining Barr, he has continued assessing the potential impacts of air emissions on aquatic, terrestrial, and wetland ecosystems and human health. He also conducts technical work related to environmental monitoring; atmospheric deposition and potential impacts to air quality, soil, vegetation, wetlands, surface water, and biota; human-health and ecological risk assessments; and cumulative analyses for ambient air impacts as well as potential impacts on wetlands and surface waters (e.g., ecosystem acidification, mercury fish-tissue concentrations). Examples of Cliff's work are provided below.

Atmospheric loading from air emissions to aquatic, terrestrial, and wetland ecosystems (cross-media analyses and ecological risk assessments)

- Managing and directing a team of scientists conducting a cross-media analysis in support of Clean Water Act (CWA) Section 401 certification permitting to assess potential effects from a mining project's sulfur and particulate-metal air emissions from stacks (combustion-related), mobile sources, and sulfide-mineral fugitive dust on surface-water concentrations of methylmercury and metals (arsenic, copper, and cobalt) in streams draining through wetlands. The analysis required frequent meetings with regulatory agency staff to scope the work and help them understand the links among the analysis components.

  Analysis components and key deliverables included an air-dispersion and -deposition modeling protocol; air-dispersion and -deposition modeling to a distance of 30 miles (50 kilometers) to estimate gas-phase deposition and particle loading; estimated releases of sulfate and metals from dust particles to use in calculating loading to individual receptors and subwatershed areas; set up calculations to estimate potential concentrations of sulfate and metals in wetland water, including retention of metals in wetlands; calculated potential changes in methylmercury export from wetland watersheds to downstream waters, as well as potential changes in fish-tissue mercury concentrations; draft reports; presentation of results to an independent review team; and multiple meetings with MPCA and Minnesota Department of Natural Resources (DNR) staff to address review comments and finalize the results reporting

- Overseeing and directing a cross-media screening analysis in support of a federal environmental review to assess potential effects from a mining project's sulfur and particulate-metal air emissions from stacks (combustion-related), mobile sources, and sulfide-mineral fugitive dust on surface-water concentrations of methylmercury and metals (arsenic, copper, and cobalt) in streams draining wetlands and a nearby large lake.

  Analysis components and key deliverables included air-dispersion and -deposition modeling to estimate gas-phase deposition and particle loading; calculated releases of sulfate and metals from dust particles to use in estimating loading to individual receptors and subwatershed areas; set up calculations to estimate potential concentrations of sulfate and metals in wetland water, including retention of metals in wetlands; potential changes in methylmercury export from wetland watersheds to the downstream lake were estimated, as well as potential changes in fish-tissue mercury concentrations in the lake; a draft report for the project team; and coordination with air, water, and wetland teams to apprise them of cross-media results.

- Managing and directing a team of scientists conducting a cross-media analysis for a taconite mining project to assess potential effects from selenium air emissions on nearby lake-water quality and determine if exceedances of the selenium water-quality standard might occur due to project atmospheric loading.

  A work plan outlining the assessment approach was prepared for the client. Upon client approval, air emission estimates were reviewed and refined, individual lakes and their direct drainage watersheds were identified in GIS, air deposition modeling was conducted with the AERMOD model, deposition estimates to surface water and the watershed were obtained from model output, screening calculations were set up to estimate the estimate potential loading of selenium in runoff water from the watershed to a lake, and then mixing of waters within the lake to estimate an incremental selenium concentration; background selenium concentrations for each water body were obtained from baseline sampling data and a "total" concentration (background + increment from project) was estimated and compared to the selenium water quality standard. Preliminary and final results were provided to the client; a draft report was prepared for the client for submittal to state agencies; follow-up discussions were held with state agency staff to discuss the methodology and findings.

- Updating an ecological risk assessment for a closed phosphorus-mining site in the western U.S. Ecological risks were reevaluated based on more representative estimates of metal bioavailability in soils, surface water, and pond and stream sediments. Work included reviewing available parameter concentration data for soil, sediment, and surface water (metals, sulfide, pH, etc.) for specific areas of the site and background areas.

Cliff developed an approach and methodology to address U.S. Environmental Protection Agency (EPA) comments on the original ecological assessment and meet client needs for resolution of the required remediation work. An extensive literature review of metal bioavailability in circumneutral pH soils (pH 6 to 8) was conducted to provide the technical support needed to develop the detailed work plan. The work plan was submitted to the EPA for review and evaluation and required discussions with agency staff to address.

Following work-plan approval, bioavailable concentrations for individual metals in circumneutral soils (pH 6 to 8), surface water, and pond and stream sediments were estimated based on organic matter content, soil and sediment characteristics, and available partitioning coefficients and estimates from peer-reviewed literature. Ecological risk quotients for each metal in each medium (soil, water, and sediment) were recalculated based on the refined estimate of the bioavailable concentration. The revised risk estimates, all significantly lower than previously estimated for the site, additional support information, and the determination of no likely effects from metal concentrations on soil organisms or aquatic biota were provided to the EPA in an updated ecological risk report. After discussing the report findings with the agency, then adding additional information to the report to address staff comments, the revised report was accepted by the EPA, and the site mitigation plan was adjusted to reflect the revised soil, surface-water, and sediment ecological risk estimates.

- Managing and directing a team of scientists conducting screening-level ecological risk assessments for multiple companies (mining operations, power plants, refineries) to evaluate cumulative chemical loading from projects' water discharges and air emissions (atmospheric deposition) to soil, surface water, and sediment; overseeing air dispersion and deposition modeling of projects' air emissions; reviewing model-estimated air concentrations and media-specific concentrations; accounting for metals retention in terrestrial and wetland systems; assimilating toxicity reference values for soil, water, and sediment and calculating ecological screening quotients (ecological risk estimates) for the individual chemicals; review and interpreting the risk results; summarizing the results for a nontechnical audience; and preparing technical reports for submittal to state agencies.
- Managing and directing a team of scientists conducting a quantitative screening ecological risk assessment (SLERA) to assess potential air emission impacts from a combined-heat-and-power (CHP) cogeneration project. Work including conducting gas-phase and particle-phase deposition modeling with AERMOD; setting up the modeling receptor grid set up to meet USEPA requirements for receptor density and distance; assimilating ecological benchmark values (toxicity

reference values), and calculating screening ecological risks by comparing chemical concentrations to benchmark values for soil, water, and sediment. Particulate metal deposition estimated to be small; all ecological risk estimates below guideline values.

Except for formaldehyde in soil, the highest estimated media concentrations for all other chemicals depositing to soil, surface water, or sediment were less than the lowest available ecological benchmark. A special review was conducted for formaldehyde, and based on the chemical's physicochemical properties, it was determined the air deposition modeling was overly conservative and that volatile chemicals like formaldehyde were unlikely to deposit and remain in soil; therefore, no effects to soil ecological receptors were expected from formaldehyde. Overall, the SLERA provided further support that there were no expected impacts from speciated volatile or particulate hazardous air pollutants (HAPs) or ammonia.

- Managing and overseeing a team of scientists and technical expert assessing potential effects to state- and federally listed endangered species from project construction activities, air emissions of HAPs, and wastewater discharges of organic and inorganic (metals) chemicals. Work for multiple companies (mining, manufacturing, power plants, refineries) has included:
  - Developing assessment scopes with regulatory agencies, including coordinating with U.S. EPA regions and the U.S. Fish and Wildlife Service offices to assess potential effects on specific listed species
  - Coordinating and managing AERMOD and CALPUFF modeling to estimate deposition of chemicals to nearby receptors and overseeing modeling or setting up spreadsheet calculations to estimate incremental chemical concentrations in soil, surface water, and sediment
  - Comparing estimated media concentrations to toxicity reference values (for estimating ecological risk), water quality standards (where applicable), and background concentrations (when available)
  - Estimating the potential for bioaccumulation of chemicals such as mercury
  - Investigating metals speciation in groundwater, soil, surface water, and sediment
  - Conducting cumulative analyses of multiple sources of pollutants and their potential effects on multiple receptors
  - Preparing final reports and discussing results with regulatory agencies

- Managing and directing a team of scientists assessing potential air-quality impacts and deposition (chemical loading) impacts to Federal Class I areas and to areas of interest to state agencies. Work included estimating deposition to terrestrial and aquatic systems (including nearby and remote water bodies) using AERMOD and CALPUFF models. Model-estimated deposition used to estimate potential effects from sulfur, nitrogen, and particulate metals (e.g., selenium, nickel) on water quality, vegetation, and soils, and interpreting and reporting the results. Assessments included receptor locations in federal wilderness areas and national parks in the upper Midwest, such as the Boundary Waters Canoe Area Wilderness, Rainbow Lake Wilderness Area, Voyageurs National Park, and Isle Royale National Park.

Modeling results were compared to available threshold values and the potential for significant effects was determined and reported to the client. Technical reports were prepared for submittal to federal and state agencies.

- Managing and directing multiple assessments of potential cumulative impacts from numerous sources of SO_2 and NOx air emissions on terrestrial and aquatic systems. Work included conducting statistical analysis for trends in regional sulfate and nitrate deposition (Minnesota, Wisconsin, and Michigan), along with assessing the relationship between local, state, and national emission trends, monitored air concentrations, and estimated deposition. Reports were prepared for clients for submittal to federal land managers overseeing Class I areas.
- While at the MPCA, managing and coordinating an environmental monitoring study to assess potential impacts on the local environment from an existing permitted hazardous-waste incinerator emitting mercury, particulate metals, and dioxins/furans. Served as lead technical reviewer for the air, soil, and sediment portions of the study; provided contract management and oversight of an independent review team from the University of Minnesota that assisted with study design and data review and interpretation; and provided contract management and oversight to independent contractor for the dioxin/furan investigation.

  Major tasks as the lead scientist on the MPCA team included developing an initial work plan that was submitted to the company and its consultant for review; finalizing the work plan with the company; third party review of air monitoring for particles (PM_{10}) upwind and downwind of the incinerator were conducted; review of soil sampling in four transects away from the facility to identify any trend in increasing or decreasing concentrations in surface soil; directing a screening evaluation for dioxins/furan deposition and concentrations in nearby pond sediments. Other tasks included coordinating with and managing the work of the company and its consultant; conducting technical meetings to discuss monitoring results, review data and statistical analysis methods and results; review and approve technical reports; and report study progress and findings to MPCA managers.

Mercury-related analyses and studies

- Managing and directing a small team of scientists assessing potential changes in mercury air-emission speciation and fate and transport from proposed air-emission-control-technology requirements for taconite pellet furnaces. Work included assimilating emissions information and stack-test data from each facility and the potential changes in air emissions speciation based on pilot tests.

Emissions were estimated to significantly increase oxidized and particle-bound mercury emissions, which are known to deposit out of the atmosphere relatively quickly. Emission speciation scenarios were input to screening calculations to estimate potential local and regional-scale deposition. Local and regional mercury deposition was estimated to rise due to the increase in oxidized and particle-bound emissions. The approach and methodology and results were included in a summary report prepared for the Taconite Group. The report was subsequently submitted to state agency staff.

- Managing and directing a small team of scientists conducting mercury-loading assessments from mining projects to downstream waters, including the St. Louis River. The project included comprehensive assessments of water contributions to downstream waters from the project area, in existing conditions and with the project in operation, to account for water capture and treatment. Cliff also oversaw the setup of spreadsheet calculations and the detailed accounting for addition of flows and associated mercury concentrations, as well as subtraction of flows (water capture) and associated mercury concentrations. Other aspects of the project included assimilating available literature to support the methodology and calculations for the fate and transport of mercury in watersheds (uplands, wetlands, streams), and prepared technical reports for client submittal to regulatory agencies.
- Managing and directing a small team of scientists conducting a special study to assess the effects of tailings-basin seepage with elevated sulfate concentration on methylmercury concentrations in wetland streams and downstream lakes. Four watersheds were included in the study: two received tailings-basin seepage water and two had no mining influence.

  Tasks included helping the project team prepare sampling and analysis plans (identifying sampling locations and specifying the frequency of sampling, following EPA sample-collection procedures for mercury, other parameters being included in the study, laboratory analysis, etc.); facilitating discussions with regulatory agencies; implementing sampling; overseeing fieldwork; reviewing and interpreting data for mining and non-mining watersheds; overseeing data compilation and statistical analyses; overseeing mass balance estimates for mercury and methylmercury loading to downstream lakes, sequestering within the lakes, and mass leaving the lakes to other downstream waters; providing progress updates to the client and regulatory agencies; preparing final reports; and participating in meetings with regulatory agencies to discuss results and finalize reporting.
- Directing and managing a team of scientists conducting numerous assessments of potential local deposition (atmospheric loading) to nearby lakes and associated watersheds from projects' mercury air emissions, changes in fish-tissue mercury concentrations, and potential incremental human-health risks from fish consumption. Directed and oversaw the following tasks:

- Estimating mercury air emissions and speciation, accounting for pollution-control technologies
- Conducting air dispersion modeling with AERMOD
- Performing calculations to estimate potential local mercury deposition and account for change in fish-tissue mercury concentrations and potential increase in methylation due to sulfate loading from projects
- Conducting cumulative deposition analyses for other proposed projects within a 12-mile (20-kilometer) radius of projects
- Participating in technical discussions with regulatory agencies to discuss air dispersion modeling, estimated deposition, fish consumption rates for recreational and subsistence fishers, and potential changes in fish tissue mercury and associated incremental risks.

▪ Managing and directing a team of scientists conducting total-facility mercury mass balances to determine major inputs and releases to the environment from processing plants, refineries, and mining operations. Estimated mercury releases to air, water, and land based on facility operations data, stack testing, concentrations in processing streams, products, and water; set up detailed calculations to track mercury through the various stages of manufacturing, refining, and mining and ore processing; and prepared reports for clients for use in mercury reduction plans, environmental review and permitting, and general internal planning.

Human-health screening risk assessments

▪ Managing and leading project teams in conducting screening-level multipathway human-health risk analyses for proposed mining projects. Work has included developing scopes of work to assess potential inhalation and indirect-pathway (food consumption) risks; identifying chemicals of interest; overseeing emission inventory calculations, speciation of chemicals, and air dispersion and deposition modeling; overseeing multimedia modeling and spreadsheet calculations to estimate concentrations in soil, water, and sediment; estimating human-health risks via the terrestrial food-consumption pathway (uptake by garden vegetables and forage grasses, and consumption and uptake by animals such as chickens, pigs, and cattle and subsequent consumption and uptake by humans such as resident adults and children and farmers); estimating human-health risks via the fish-consumption pathway (uptake of mercury, dioxins/furans, and metals by fish, and consumption of fish by humans); reviewing and interpreting results from air dispersion and risk models; preparing uncertainty analyses, including investigating metal speciation in air, soil, surface water, and sediment; conducting special assessments for lead and mercury; and preparing summary documents and reports. Cliff has also conducted cumulative analyses of multiple sources of air pollutants and their potential effects on air quality and chemical-specific air concentrations for selected individual receptor locations.

- Managing and leading a project team conducting a human-health screening multipathway risk assessment at a northern Minnesota taconite mine. Work included estimating gas-phase and particle-phase air emissions from stacks and fugitive dust, and conducting dispersion and deposition modeling to estimate media concentrations. Particle-size distributions were estimated for each emission source.

  The AERMOD model was used to conduct the dispersion and deposition modeling, and results were used as input to the Industrial Risk Assessment Program (IRAP) from Lakes Environmental. Wet and dry deposition were calculated for each chemical of interest and used to estimate concentrations in soil, surface water (e.g., lakes), and sediment. Metal bioavailability was assumed to be 100 percent for this screening assessment, even though laboratory test conditions indicated none of the metals were extractable from particles. Uptake of metals by vegetation and produce and subsequent transfer up the food chain to humans was accounted for in the IRAP model. Risk estimates based on deposition of project emissions to a lake's watershed, uptake of contaminants by fish (including mercury), and consumption of locally caught fish were also calculated by IRAP.

Environmental monitoring (soil, water, sediment, air) and special studies

- Assisting mining clients with baseline and Section 401 certification monitoring and reporting of wetland (porewater and outlet stream) and downstream-water quality (including metals) for comparison to water quality standards and cross-media-analysis modeling results. Work has included reviewing monitoring plans and developing or recommending parameter lists for characterizing wetland porewater and streams; reviewing wetland sampling-well design, identifying sample-collection methodologies for wetland porewater, and assisting in developing standard operating procedures; reviewing wetland porewater-sampling techniques in the field; and reviewing, interpreting, and reporting wetland porewater and stream data.
- Managing and overseeing a team of scientists conducting ambient-air compliance monitoring for hydrogen sulfide (network setup, remote data collection, tracking-system functioning and data collection, and data downloading and quality assurance) and reporting compliance data. Work included preparing or updating sampling plans and standard operating procedures and negotiating plan details with regulatory agencies.
- Helping a client conduct air monitoring for fine-particulate and amphibole mineral fibers. Also facilitated discussions and negotiations with regulatory agencies; oversaw site setup (site selection, equipment purchase, and equipment setup); and completed initial data review.

Mineral fibers (elongated mineral particles)

- Assimilating data from mining projects and archived records from the MPCA and Minnesota Department of Health to assess the potential effects of mineral fibers on human health. Also prepared qualitative discussions as part of reports for air-toxics reviews and air-emissions risk analyses.
- Evaluating mineralogical data from Minnesota's Biwabik Iron Formation and Duluth Complex. Also prepared reports and supporting information for a copper-nickel mining client's discussions with federal and state regulatory agencies about the differences in the two ore bodies and the potential release of amphibole mineral fibers to ambient air from specific parts of the mining and ore-processing operations.
- Comparing mineralogical data from the western part of the Mesabi Iron Range to data from the eastern part (near Hoyt Lakes and Babbitt, Minnesota) and preparing reports and support information for (1) taconite mining clients on the west end of the range where ore bodies being mined were not likely to contain amphibole minerals and (2) a taconite mining client near the east end of the Range, whose project would lie in the transition zone where the Duluth Complex intrudes into the Biwabik Iron Formation. Also assessed the potential for amphibole minerals to be present in the taconite ore mined by the second company's proposed project.
- Assisting a mining client with interpreting results from the Minnesota Taconite Workers Health Study about workers' potential exposure to mining-related dust and the application of additional technology to further reduce or capture fine dust particles from ore crushing and grinding operations. The assessment was termed "beyond best available control technology (BACT) for mineral fibers."
- Evaluating fibers-related data collected from ore-processing pilot studies and tests and preparing reports for submittal to Minnesota agencies on the potential for amphibole mineral fibers to be present in ore and waste rock, as well as on the potential for release of amphibole mineral fibers to ambient air and downstream waters from various parts of a mining project, and the potential effects on human health via inhalation and drinking-water pathways.

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