NorthMet Project

Water Management Plan - Mine

Version 4

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This document was prepared for Poly Met Mining Inc. by Barr Engineering Co.

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Acronyms, Abbreviations and Units

Acronym	Stands For
ac-ft	acre-feet
AWMP	Adaptive Water Management Plan
BMP	best management practice
cfs	cubic feet per second
CPS	Central Pumping Station
East EQ Basin	East Equalization Basin
fps	feet per second
FSP	Field Sampling Plan
FTB	Flotation Tailings Basin
gpm	gallons per minute
HDPE	high-density polyethylene
HRC	haul road central
HRE	haul road east
HRN	haul road north
HRW	haul road west
LCRS	leak collection and recovery system
LTVSMC	LTV Steel Mining Company
MDNR	Minnesota Department of Natural Resources
mg/L	milligram per liter
mi^2	square mile
mm	millimeter
MPCA	Minnesota Pollution Control Agency

Acronym	Stands For
MSFMF	Mine Site Fueling and Maintenance Facility
MSHA	Mine Safety and Health Administration
N/A	not applicable
NPDES	National Pollutant Discharge Elimination System
No.	Number
NWL	normal water level
OSLA	Overburden Storage and Laydown Area
OSP	Ore Surge Pile
PRB	Permeable Reactive Barrier
PTM	Permit to Mine
PW-	Process water (prefix)
QAPP	Quality Assurance Project Plan
RTH	Rail Transfer Hopper
S	Process water sump (prefix)
SAP	Sampling and Analysis Plan
SCS	Soil Conservation Service
SDS	State Disposal System
SOP	Standard Operating Procedure
SPCC	Spill Prevention Control & Counter Measures
SWPPP	Storm Water Pollution Prevention Plan
TBD	to be determined
TSS	total suspended solids
TWP	Treated Water Pipeline

Acronym	Stands For
USGS	United States Geological Survey
West EQ Basin	West Equalization Basin
WWTF	Mine Site Waste Water Treatment Facility
XP-SWMM	Software package used to model stormwater, sanitary water and river systems

1.0 Introduction

This document presents the Water Management Plan - Mine for Poly Met Mining Inc.'s (PolyMet) NorthMet Project (Project) and describes the management of process water and stormwater at the Mine Site. It includes design of process water and stormwater infrastructure associated with the Project, estimated quantity of process water to be pumped to the Flotation Tailings Basin (FTB), estimated water quality at appropriate water quality compliance points, operating plans, water quality and quantity monitoring plans, reporting requirements, and adaptive management approaches. Information from this report will become part of the Minnesota Department of Natural Resources (MDNR) Permit to Mine (PTM) application and Water Appropriation Permit application and Minnesota Pollution Control Agency (MPCA) National Pollutant Discharge Elimination System (NPDES) / State Disposal System (SDS) Permit application and is summarized in the NorthMet Project Mine Plan (Reference (1)). This and all other Management Plans will evolve through the environmental review, permitting, operating, reclamation, and long-term closure phases of the Project.

In addition to the management of water at the Mine Site, this document also briefly describes the quantity of water removed from the upper reaches of the Partridge River by the Project and the quantity of water that will be discharged from the Mine Site Waste Water Treatment Facility (WWTF) in long-term closure, as modeled in the Water Modeling Data Package Volume 1 – Mine Site (Reference (2)).

Several other Management Plans contain information that relates to the water management at the Mine Site. The NorthMet Project Rock and Overburden Management Plan (Reference (3)) includes design details for stockpile drainage containment/liner systems. The NorthMet Project Adaptive Water Management Plan (AWMP, Reference (4)) contains details of adaptive engineering controls (WWTF and Category 1 Waste Rock Stockpile cover) that will ensure compliance with applicable water quality standards at appropriate evaluation points.

The Project is described in the Project Description (Reference (5)). Detailed reclamation plans for the process water and stormwater management systems are described in this document. The overall reclamation plan and cost estimate is described in the NorthMet Project Reclamation Plan (Reference (6)).

1.1 Objective and Overview

The objective of the Water Management Plan - Mine is to describe a safe and reliable system for managing the water at the Mine Site in a manner that results in compliance with applicable surface water and groundwater quality standards at appropriate Mine Site compliance points and with water appropriations/augmentation limits as demonstrated by modeling outcomes discussed in Reference (2).

In order to manage the water at the Mine Site, an understanding of the overall Mine Plan is necessary. As described in Section 1.1 of Reference (1), ore will be mined from the East Pit from Mine Years 1 to 11 and from the West Pit from Mine Years 2 to 11. During that period, the more reactive waste rock will be placed in temporary stockpiles, and the least reactive waste rock will be placed in a permanent stockpile. Ore will be mined from the West and Central Pits from Mine Years 11 to 16. As mining of the Central Pit progresses, it will be joined to the East Pit, and the combined pits will be referred to as the East Pit. Ore will be mined only from the West Pit from Mine Years 17 to 20. Beginning in Mine Year 11, the more reactive waste rock mined from the West and Central Pits will be placed directly in the East Pit, after mining is completed in that pit. The waste rock in the temporary stockpiles will be relocated to the East Pit beginning in Mine Year 11. As the least reactive waste rock is mined, it will be placed in the permanent stockpile or the East Pit. As the East Pit is backfilled, water will be pumped to the pit to submerge the backfilled rock. By the end of operations (Mine Year 20), the East Pit will be backfilled with waste rock mined from the West and Central Pits, waste rock and overburden from the temporary stockpiles, and water, resulting in permanent subaqueous disposal of these materials.

1.2 Outline

The outline of this document is:

Section 1.0	Introduction, objective and overview, and description of the Mine Site baseline data and existing conditions
Section 2.0	Description of the design of the process water management systems and stormwater management infrastructure at the Mine Site
Section 3.0	Description of key outcomes of the design, including quantity of water treated and pumped to the FTB or East Pit and water quality at compliance points
Section 4.0	Description of operational water management plans for process water, stormwater, spills, and overflows
Section 5.0	Description of monitoring of water quantity and quality, including process water internal to the Project, stormwater from the Mine Site, external groundwater, and external surface water. The specifics of monitoring, including specific locations, nomenclature, frequency, and parameters will be finalized during the NPDES/SDS and Water Appropriation permitting processes.
Section 6.0	Description of monthly and annual reporting requirements including comparison to modeled outcomes and compliance, adaptive management plans, and available mitigations
Section 7.0	Description of the reclamation and long-term closure plan for the Mine Site water management systems including the Contingency Reclamation Plan (assumes closure in the upcoming year) for Mine Years 0 and 1

Because this document is intended to evolve through the environmental review, permitting (NPDES/SDS, Water Appropriations, and PTM), operating, reclamation, and long-term closure phases of the Project, some of the attachments are included as placeholders and are so identified. It will be reviewed and updated as necessary in conjunction with changes that occur and for future permitting needs. A Revision History is included at the end of the document.

1.3 Baseline Data

Section 4 of Reference (2) describes the baseline climate, land use, geology, surface water, and groundwater data used in water quantity and quality modeling at the Mine Site. This section provides a summary of the baseline surface water and groundwater data from Reference (2).

1.3.1 Surface Water Baseline Data

As described in Section 4.4 of Reference (2), the Mine Site is located within the Partridge River watershed, approximately 17 river miles upstream of Colby Lake (Large Figure 1). Above Colby Lake, the Partridge River watershed covers approximately 103 square miles. Tributaries to the Partridge River above Colby Lake and downstream of the Mine Site and Transportation and Utility Corridors include an Unnamed Creek downstream of the future West Pit Overflow, Wetlegs Creek, Longnose Creek, and Wyman Creek. Colvin Creek and the south branch of the Partridge River are also tributaries to the Partridge River; however, these streams will not be directly or indirectly impacted by the Project.

Daily flow data is available for the Partridge River from the U.S. Geological Survey (USGS) gaging station 04015475 – Partridge River above Colby Lake at Hoyt Lakes, Minnesota, from water years 1978 through 1987. During this period, hydrology was affected by the periodic and variable dewatering of the Peter Mitchell Pits located at the headwaters of the Partridge River. The hydrology data has been validated and adjusted for use on this Project, as described in Reference (2).

Recent (2011-present) daily flow data near the Mine Site is available from MDNR gage H03155002, located on the Partridge River at the Dunka Road crossing (surface water monitoring location PM-3/SW003). This data is not directly comparable to the USGS gage 04015475 data due to the large difference in tributary watershed size and location. Based on its location, the MDNR gage H03155002 is more heavily influenced by Peter Mitchell Pit dewatering than the USGS gage 04015475.

Several locations within the Partridge River watershed have been monitored for water quality between 2004 and 2014. These locations are shown in Large Figure 1 and include seven monitoring locations on the Partridge River above Colby Lake, two locations along Wyman Creek, three locations along tributaries to the Partridge River, and four locations in Colby Lake and Whitewater Reservoir. The results of baseline monitoring of the Partridge River, upstream of Colby Lake, and select tributaries is presented in Large Table 10 of Reference (2). Baseline monitoring data from water collected in Colby Lake and Whitewater Reservoir is presented in Large Table 9 of Reference (2). The frequency and extent (i.e., number of constituents) of monitoring varies by location. Monitoring conducted from 2004 through 2008 generally includes a wider list of constituents to characterize the baseline conditions within the watershed. Monitoring from 2008 through 2011 generally focused on a smaller list of constituents and locations to resolve specific issues (e.g., ratio of dissolved to total aluminum, inadequate thallium detection limits) with the data. More comprehensive baseline monitoring at select locations along the Partridge River and its tributaries was resumed in 2012 with a wider list of constituents.

1.3.2 Groundwater Baseline Data

As described in Sections 4.3 and 4.4 of Reference (2), baseflow in the Partridge River near the Mine Site can be considered a proxy for overall discharge through the surficial aquifer at the Mine Site because the river represents the primary sink for shallow groundwater flow. In the Mine Site area, the average 30-day low flow (considered a proxy for baseflow) in the Partridge River is estimated to be 3.8 cubic feet per second (cfs), corresponding to a contributing watershed area of approximately 95 square miles (mi^2), which represents an estimated aquifer yield of 0.04 cfs/mi^2, or 0.55 inches per year.

Based on groundwater elevations at the Mine Site surficial aquifer monitoring wells (Reference (2)) and estimated Partridge River elevations downgradient of the wells, the average hydraulic gradient across the area is on the order of 0.01. Using the approximate geometric mean of the hydraulic conductivity estimates from slug tests completed at the Mine Site (0.3 feet/day; Reference (7)) and assuming a porosity of 0.3, a representative groundwater velocity in the unconsolidated aquifer at the Mine Site is approximately 0.01 feet/day. Locally, actual velocities likely range over several orders of magnitude, depending on the gradient and hydraulic conductivity of the aquifer material present.

As described in Section 4.3 of Reference (2), the Mine Site contains 33 monitoring wells, including:

- 24 wells located in the surficial deposits (identified on Large Figure 2 with the prefix "MW")
- 5 wells within the upper 100 feet of bedrock (identified on Large Figure 2 with the prefix "OB")
- 4 wells in bedrock at depths ranging from 485 to 610 feet below grade (identified on Large Figure 2 with the prefix "P")

The locations of these wells are shown on Large Figure 2 and listed on Large Table 10. Three of the monitoring wells in the surficial deposits were installed in 2005 and have been sampled intermittently since installation. The additional 21 wells in the surficial deposits were installed between October 2011 and February 2012. A monthly groundwater sampling program of these surficial monitoring wells was initiated in November 2011 and continued through August 2012. A quarterly (excluding first quarter) sampling program was initiated in October 2012 and has continued through October 2014. The five monitoring wells within the upper 100 feet of the bedrock have each been sampled nine or ten times since installation in 2006. The four larger diameter deep bedrock wells were installed in 2006 and have been sampled during aquifer testing in 2006 and 2007. Groundwater monitoring data from the monitoring wells in the surficial deposits and bedrock wells is summarized in Large Table 3 through Large Table 6 in Reference (2).

1.4 Existing Conditions

Existing subwatersheds at and near the Mine Site are shown on Large Figure 3. Under existing conditions, runoff from the northernmost area of the Mine Site generally drains north into the One Hundred Mile Swamp and associated wetlands along the Partridge River. These wetlands form the headwaters of the Partridge River, which meanders around the east end of the Mine Site before turning southwest. Runoff from the majority of the Mine Site naturally drains to the south through culverts under Dunka Road and the adjacent rail line, into the Partridge River downstream of the Dunka Road crossing.

In addition to subwatershed boundaries, Large Figure 3 shows the 100-year flood levels and average water levels at selected locations along the Partridge River. The flood boundary was developed for the 24-hour storm event, which was the critical event for the Partridge River. The 100-year, 10-day snowmelt event was previously modeled to evaluate the peak flows in the Partridge River, but the 24-hour storm event produced higher flows and flood levels due to the quick runoff delivery in the upper watershed.

As shown by these flood levels, the Partridge River is very flat in the upstream reach in the vicinity of the One Hundred Mile Swamp; however, there is still an increase of over 10 feet in normal and flood water levels through the wetland from the east end of the Mine Site to the west end. Between the headwaters and Dunka Road, the Partridge River has a maximum slope of approximately 0.6%. The flood levels downstream of Dunka Road are more than 20 feet lower than most of the adjacent Mine Site perimeter ground elevations. There is very little risk from Partridge River flooding on the east and south sides of the Mine Site.

The increase in flood elevation from the 100-year event to the 500-year event on the Partridge River is relatively minor, varying from 0.1 to 0.5 feet on the north and east sides of the Mine Site to 1.0 foot upstream of the railroad crossing in the southeast corner of the Mine Site.

2.0 Process Water and Stormwater Management System Design

The water at the Mine Site will be managed by keeping the stormwater separate from the process water through a system of ditches, dikes, and ponds. Each of these terms is defined specifically for this Project, as follows:

- Stormwater is the result of precipitation and runoff that contact natural or reclaimed surfaces, including reclaimed stockpiles, and surface runoff that has not been exposed to mining activities. Stormwater is expected to meet water quality standards after sedimentation ponds remove total suspended solids (TSS) prior to being discharged off-site.

- Process water includes precipitation, runoff, and collected groundwater (pit dewatering water) that has contacted surfaces disturbed by mining activities, such as drainage collected on stockpile liners and runoff contacting exposed ore and waste rock and Mine Site haul road surfaces. Runoff from the Overburden Storage and Laydown Area (OSLA) is also considered process water.

Construction water will be managed as both process water and stormwater depending on its anticipated water quality. Once operations begin in Mine Year 1, the following guidelines will apply:

- Runoff from construction areas with no excavation will be managed as construction stormwater;

- Runoff from construction areas where the majority of the material being excavated is Unsaturated Overburden or Peat will be managed as construction stormwater; and

- Runoff and groundwater from construction areas of mainly Saturated Overburden (i.e., dewatering) or exposed ore will be managed as process water.

The process water system including sumps, ponds, and the piping network for Mine Years 1, 11, and 20 are shown on Large Figure 4 to Large Figure 6. The stormwater system including dikes, ditches, culverts, and sedimentation ponds for Mine Years 1, 11, and 20 are shown on Large Figure 7 to Large Figure 9.

2.1 Process Water

Process water includes runoff[1] and groundwater that has contacted surfaces disturbed by mining activities such as active stockpiles, water from the Category 1 Waste Rock Stockpile Groundwater Containment System, and pit dewatering. This water may not meet water quality discharge limits for metals or other constituents and as a result, may require treatment at the WWTF prior to being pumped through the Treated Water Pipeline (TWP) to the FTB for use as plant make-up water or for East Pit flooding in later years. Process water will be intercepted by ditches, dikes, and stockpile foundation liners/containment system to keep it separate from the stormwater collection and conveyance systems. Design drawings and flow diagrams of the mechanical infrastructure, which includes the TWP, Central Pumping Station (CPS), and process water systems, will be provided in Attachment A during permitting.

Drawing ME-003 of Attachment A (to be provided in permitting) provides a flow diagram of the process water collection and conveyance system from each source to the FTB at the Plant Site or the East Pit. Process water sources include mine pits, waste rock and ore stockpiles, the OSLA, and other mine infrastructure such as haul roads, the Rail Transfer Hopper (RTH), and the Mine Site Fueling and Maintenance Facility (MSFMF).

There are three types of stockpiles that generate process water:

- overburden stockpiles in the OSLA
- waste rock stockpiles (Category 1, 2/3, and 4)
- the Ore Surge Pile (OSP)

Precipitation coming in contact with each of these stockpiles will be managed as process water until the stockpiles are reclaimed. Runoff from the OSLA will be considered process water due to the concern regarding Peat drainage potentially containing elevated levels of mercury. As described in Section 5.2 of Reference (1), the Category 1 Waste Rock Stockpile is the only permanent stockpile and will be reclaimed. Once reclaimed, surface runoff from the Category 1 Waste Rock Stockpile will be managed as stormwater. The Category 2/3 and 4 waste rock stockpiles are temporary, and the footprints will be reclaimed after the material is relocated to the mined-out East Pit for subaqueous disposal and the liner systems are removed. The ore in the OSP will be removed by the end of Mine Year 20, the liner will be removed, and the footprint will be reclaimed.

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[1]Runoff is defined in this document as the total volume of stormwater or process water that collects above ground. According to this definition, runoff from active stockpiles is process water and runoff from reclaimed stockpiles is stormwater. Runoff from active stockpiles includes the total yield from surface runoff, liner drainage, and leakage through the liner. Runoff from reclaimed stockpiles includes flows from the top of the cover and interflow that infiltrates into the cover and exits the stockpile without contacting the waste rock.

As described in Section 3.1 of Reference (4), incremental reclamation of the Category 1 Waste Rock Stockpile is planned beginning in Mine Year 14. The timing of cover placement will have a large impact on the water flows. The total flow from the reclaimed stockpile will include:

- Infiltration through the cover that drains through the waste rock and is stored in the stockpile. This process water will not be seen in any collection system.
- Infiltration through the cover that drains through the waste rock and is collected by the groundwater containment system and routed to the WWTF. Design of the groundwater containment system is provided in Section 2.1.2 of Reference (3).
- Infiltration through the cover that drains through the waste rock, bypasses the containment system, and flows via groundwater to the pits for collection as process water during operations or to the West Pit lake or East Pit wetland during reclamation and long-term closure. Modeling and capture efficiency of the groundwater containment system is provided in Section 2.1.2.2 and 2.1.2.3 of Reference (3).
- Infiltration through the cover that drains through the waste rock, bypasses the groundwater containment system, and is not captured in the groundwater containment system or the pits. Modeling and capture efficiency of the groundwater containment system is provided in Section 2.1.2.2 and 2.1.2.3 of Reference (3).
- Surface runoff from the stockpile cover (stormwater) that will be collected by the stormwater ditch surrounding the stockpile and routed through sedimentation ponds prior to off-site discharge or routed to the West Pit lake during reclamation.

2.1.1 Design Criteria for the Process Water Systems

Design criteria for the process water design features are provided in Table 2-1 with preliminary sizing of the components listed on Drawing ME-004 of Attachment A (to be provided in permitting). Process water system components at the Mine Site have been designed to route process water by gravity flow to sumps or process water ponds that are designed to contain water from a component-specific “design event”. The design event chosen for each component was based on the expected quality of water handled by the component and the overflow potential of the component. This allows matching the level of protection applied to the component to the expected water quality handled by the component and the potential for overflows by choosing larger design events as necessary. Water from the sumps and process water ponds will be pumped to the WWTF, if needed, and then to the CPS pond. The CPS will pump water from the pond through the TWP to the FTB or the East Pit during pit flooding.

The following sections describe the design of the major components of the Process Water System, which includes the collection and conveyance of water from the pits, the waste rock stockpiles, the OSLA, the OSP, and applicable construction areas.

Table 2-1 Design Criteria for Process Water Infrastructure

Infrastructure Draining	Process Water Structure Name(1)	Design Event	Overflow Pond Design Event
Category 1 Waste Rock Stockpile	Groundwater Containment System (Section 2.1.2 of Reference (3))	100-year, 24-hour(2)	Not applicable (N/A); overflow to mine pits
Category 2/3 Waste Rock Stockpile	S23-1, S23-2, S23-3; PW-S23-1, PW-S23-3(2)	Sump: 10-year, 24-hour(2)	100-year, 24-hour less sump capacity(2)
Category 4 Waste Rock Stockpile	S4; PW-S4(2)	Sump: 10-year, 24-hour(2)	100-year, 24-hour less sump capacity(2)
Ore Surge Pile	SOSP; PW-SOSP	Sump: 10-year, 24-hour(2)	100-year, 24-hour less sump capacity(2)
Rail Transfer Hopper	PW-RTH	Pond: 100-year, 24-hour(2), (3)	N/A
Haul Roads	PW-HRE, PW-HRN, PW-HRC, PW-HRW	Pond: 100-year, 24-hour(2)	N/A
Overburden Storage and Laydown Area	PW-OSLA	25-year, 24-hour(2)	N/A
Pit Pumps and Pipes	Varies	Annual snowmelt event (removal within 3 days)	N/A
Other Pumps / Pipes	Varies	Annual snowmelt event (removal within 30 days)	N/A

(1) Process water sumps are named with the prefix S followed by an abbreviation of the infrastructure the drainage is coming from. Process water ponds are named with the prefix PW followed by an abbreviation of the infrastructure the drainage is coming from.
(2) Process water sumps and ponds include a safety factor in the form of freeboard (typically three feet) in addition to the design storm volume.
(3) PW-RTH was sized based on available area with a larger pump capacity to meet the design storm volume.

2.1.2 Mine Site Water Balance

The details of the Mine Site water balance can be found in Section 6.1 of Reference (2). The details include quantification and breakdown of stormwater, groundwater, and process water, including the water balance associated with the stockpiles.

2.1.3 Pit Dewatering

The estimated average annual inflow rates and peak inflow rates for the three pits were modeled as part of Reference (2) and are listed in Table 2-2. Mine pit inflows will be directed to sumps within the pits where the water can be collected and pumped to the WWTF. The mine pit pump capacities have been designed to minimize delay to mining operations during the typical spring snowmelt event.

Table 2-2 Mine Pit Inflows

Mine Pit	Inflow Component	Mine Year 1 Inflows(1)		Mine Year 11 Inflows(1),(2)		Mine Year 20 Inflows(1)	
		Average Annual (gallons per minute [gpm])	90th Percentile (gpm)	Average Annual (gpm)	90th Percentile (gpm)	Average Annual (gpm)	90th Percentile (gpm)
West Pit	Groundwater(3)	Not Applicable		81	104	44	58
	Runoff			224	278	236	298
	Total(4)			303	367	280	346
Central Pit	Groundwater	Not Applicable		30	40	4.9	6.4
	Runoff			7.2	8.9	68	81
	Total(4)			37	47	73	86
East Pit	Groundwater(3),(5)	101	134	738	977	161	210
	Runoff	114	144	124	153	217	258
	Total(4)	205	252	863	1,096	378	448

(1) Source of data: Section 6.1 of Reference (2)
(2) The Central Pit exists for only a portion of Mine Year 11; the values shown are for the latter third of the year when the pit is operational. The East Pit begins to be backfilled in Mine Year 11, but backfilling does not significantly change the natural inflows to the pit; the values shown are for the entire year.
(3) Groundwater flows to the West and East Pits include seepage from the Category 1 Waste Rock Stockpile. See Section 2.1.2 of Reference (3).
(4) Groundwater and runoff values do not sum to totals due to probabilistic model (i.e., high groundwater and high runoff conditions do not necessarily occur simultaneously).
(5) East Pit groundwater inflows are significantly higher than the West and Central Pit inflows due to its proximity to the Virginia Formation. The hydraulic conductivity of the Virginia Formation is almost 3 orders of magnitude higher than the Duluth Complex. The East Pit intersects the Virginia Formation, and the West and Central Pits do not.

Water management within the pit will occur as part of mine development, with the pit floors sloped toward collection sumps. The sumps will be excavated as part of mine operations. Pumps in the sumps will either be submersible pumps or pumps on a raft floating in the sump. These pumping systems could include one single large pump or several smaller pumps, depending on an optimization analysis. Hoses will connect the pumps to pipes which may connect to additional pumps at the rim of the pits conveying the water to the WWTF. The alignment of the pit dewatering system is based on the future pit development, thus minimizing the need to frequently move the pipes. In locations where a pipe will intersect a road, the pipes will be placed inside a culvert or a larger pipe buried under the road. Hoses may be used in some places, where design allows, providing operational flexibility and simplicity.

Inflows to the pits include contributions from groundwater and runoff within the pit. The size and location of the sumps and pumps will change as the pits expand in size and depth, requiring periodic evaluation of the pumping system. Pump capacities are based on peak annual flows from the snowmelt event, assuming a rapid spring snowmelt (40% of the snowmelt occurring within one day). The pumping systems are designed to handle groundwater inflows and the average annual runoff volumes from a snowmelt event, removing approximately 100% of the groundwater inflows and 40% of the annual snowmelt runoff (1.28 inches) within 3 days; the volume from this snowmelt event is approximately equivalent to the runoff volume expected in the pits during the 5-year, 24-hour storm event. The sumps are designed with capacity to hold the remaining volume from this snowmelt runoff event.

In the event that a storm exceeds the sump and pump capacity, the lowest level of the pit will be used to store the excess water, with mining operations relocated to higher levels or delayed until water levels are pumped down. During extreme storm events, pit dewatering may temporarily be stopped to allow the WWTF to handle the increased volumes from other process water sources to minimize overflow of process water sumps and ponds across the Mine Site.

The pipes associated with these pumps are sized to maintain average velocities less than 5 feet per second to minimize friction losses and surge pressures (i.e., water hammer) in the pipes. The pump sizes were evaluated for each Mine Year, because, as the pits deepen, larger pumps will be needed to overcome the change in static head.

The number and size of pumps will be evaluated on a regular basis due to changes in head, pumping distances, and availability of electrical power sources.

The preliminary pit sump, pump, and pipe sizes for pit dewatering are listed on Drawing ME-004 of Attachment A (to be provided in permitting). Pipe configurations for pit dewatering are shown on Drawings PW-001, PW-002, and ME-003 of Attachment A for Mine Years 1 and 11 (to be provided in permitting).

2.1.4 Stockpile Drainage

The design of the stockpile liner and underdrain system for the Category 2/3 and Category 4 waste rock stockpiles and the OSP, and the design of the Category 1 Waste Rock Stockpile Groundwater Containment System are described in Section 2.1 of Reference (3). This section discusses the evaluation of leakage through the liners, the collection of water on top of the liners, and the routing of the process water away from the temporary stockpiles, and the containment system for collection of drainage from the Category 1 Waste Rock Stockpile.

Table 2-3 presents the range of total annual process water volumes and flow rates estimated from the temporary stockpiles based on modeling results. These annual volumes assume that process water drainage from the stockpiles will begin within the first year and that all process water is conveyed to the sumps.

Table 2-3 Temporary Stockpile Drainage

Stockpile	Mine Year 1(1)		Mine Year 11(1),(2)		Mine Year 20(1),(3)	
	Average Annual Inflow (gpm)	90th Percentile Inflow (gpm)	Average Annual Inflow (gpm)	90th Percentile Inflow (gpm)	Average Annual Inflow (gpm)	90th Percentile Inflow (gpm)
Category 2/3 Waste Rock	44	53	120	140	9.9	12
Category 4 Waste Rock	20	24	34	41	Not Applicable	
Ore Surge Pile	20	24	20	24	20	24

(1) Source of data: Section 6.1 of Reference (2)
(2) The Category 4 Waste Rock Stockpile exists through the first half of Mine Year 11; the stockpile is removed in the latter half of the year.
(3) All mass is removed from the Category 2/3 Waste Rock Stockpile by the end of Mine Year 19. The Mine Year 20 values represent the water collected on the liner as it is being removed and the stockpile is being reclaimed.

2.1.4.1 Temporary Stockpile Drainage Collection Systems

As described in Section 2.1.3 of Reference (3), the temporary stockpiles, which include the Category 2/3 and 4 waste rock stockpiles and the OSP, have drainage systems with underdrains in the foundation that will flow by gravity to underdrain sumps in addition to the stockpile liner drainage systems that will flow by gravity to process water sumps and overflow ponds. The water will be pumped from the process water sumps to the WWTF for treatment before being sent to the CPS to be pumped through the TWP to the FTB or to the East Pit for pit flooding. This section describes the design of the stockpile sumps and the overflow ponds that collect the water from the temporary stockpile liner system. See Section 2.1.3 of Reference (3) for design of the foundation underdrain sumps.

2.1.4.1.1 Temporary Stockpile Overliner Sump and Overflow Pond Design

Process water sumps will be located along the perimeter of the temporary stockpiles to collect overliner runoff, as shown in Large Figure 4 to Large Figure 6. The number of process water sumps associated with each stockpile depends on the stockpile foundation design (Section 2.1.3 of Reference (3)), as follows:

- The Category 2/3 Waste Rock Stockpile will have 3 sumps, S23-1, S23-2, and S23-3, located on the south side of the stockpile, between the stockpile and Dunka Road. Overflow process water ponds include PW-S23-1, which provides overflow capacity for S23-1 and S23-2, and PW-S23-3, which provides overflow capacity for S23-3.

- The Category 4 Waste Rock Stockpile will have one sump, S4, located on the south side of the stockpile, with one overflow pond PW-S4.

- The OSP will have one sump, SOSP, located on the southwest side of the OSP, with one overflow pond PW-SOSP.

The sumps will be designed to contain process water drainage from active stockpiles during a 10-year, 24-hour rainfall event with the flood level below the stockpile liner discharge pipe elevation. To minimize uncontrolled overflows from the sumps, the volume generated by the 100-year 24-hour storm event in excess of the sump capacity will flow by gravity to overflow ponds adjacent to each sump. Dikes will be constructed around the perimeter of each sump and pond with a combined capacity for the 100-year, 24-hour process water yield plus a safety factor in the form of freeboard (typically three feet). Further discussion of overflows is included in Section 4.4. Preliminary sump and pond footprints for the temporary stockpiles are listed in Table 2-4.

The temporary stockpile process water sumps will be constructed with a double composite liner system consisting of an upper high-density polyethylene (HDPE) primary liner underlain by a geonet leak collection and recovery system (LCRS) which is underlain by a secondary HDPE liner that overlies a one-foot thick soil liner as shown in Detail 2 of Drawing PW-014 of Attachment A (to be provided in permitting) or equivalent protection. Overflow ponds will be constructed with a single liner system overlying a one-foot thick soil liner as shown on Detail 1 of Drawing PW-014 of Attachment A (to be provided in permitting). Temporary stockpile process water sumps and ponds are designed with an average depth between 6 and 12 feet depending on the depth to bedrock, depth to groundwater, and stockpile outlet pipe elevation. Drawings PW-003 to PW-007 of Attachment A (to be provided in permitting) show the layout of each of these sumps and associated overflow ponds.

The sump and pond dikes and slopes will be vegetated or riprapped to limit erosion. The design will be finalized once the foundation grading design is completed, and sump and pond elevations can be established. This will be dependent on site-specific investigations of depth to bedrock and depth to groundwater. The design elevations will allow runoff from the temporary stockpiles to be conveyed by gravity into the sumps with gravity overflow into the overflow ponds. The outlet for both the sumps and ponds will be a pump and piping system to convey this process water to the WWTF.

Table 2-4 Stockpile Sump and Pond Dimensions – Approximate

Stockpile	Sump/Pond Name	Area (acres)	Required Capacity (acre-feet)	Design Volume (acre-feet)(1)
Category 2/3 Waste Rock	S23-1	2.4	14.9	14.9
	S23-2	2.5	11.9	12.0
	S23-3	1.5	6.6	6.6
	PW-S23-1	4.3	21.4	21.5
	PW-S23-3	1.5	5.3	5.3
Category 4 Waste Rock	S4	2.5	10.1	12.5
	PW-S4	2.0	8.1	9.9
Ore Surge Pile	SOSP	2.1	8.5	8.7
	PW-SOSP	1.6	4.8	5.3

(1) The design volume does not account for the freeboard (typically three feet) planned as part of the design.

2.1.4.1.2 Ore Surge Pile (OSP) Sump and Sump Liner

The temporary OSP is different from the temporary waste rock stockpiles because it will likely have periods with very little material on the liner throughout the mine operations. Due to the potential for small quantities of material to be on the liner of the OSP, the sump SOSP has been designed with more overall capacity than the temporary waste rock stockpile sumps. This was achieved by increasing the yield coefficients used in sizing the sumps to 100% of precipitation for the OSP in order to reflect the potential for these periods of small quantities of cover material, which will increase the quantity and timing of runoff within the footprint. This sump was designed to contain the entire precipitation volume from an open liner during the 10-year 24-hour event. The combined capacity of the sump and overflow pond PW-SOSP will contain the 100-year 24-hour precipitation volume.

2.1.4.1.3 Construction of Lined Sumps and Ponds

In general, sumps and overflow ponds will be excavated below the natural ground, designed to optimize the pond bottom with the expected groundwater and bedrock while draining the stockpile liners by gravity. Construction of a lined sump or pond requires adequate foundation drainage to prevent excessive pore pressure from developing under the liner. Due to the high groundwater and high bedrock outcrops in this area and low overliner discharge pipes from the stockpiles, the lined sumps and overflow ponds may have to be designed with the pond bottom below the groundwater level. Additional geotechnical and hydrologic investigation is needed to determine the actual depth of groundwater and bedrock in these locations prior to construction level design. These investigations will be done after the Project has completed environmental review. If the sumps and ponds must be constructed with the pond bottom below the groundwater level, the following options will be evaluated to prevent excessive pore pressures from building up below the liners:

- The stockpile underdrain sumps could be extended below the sump and pond bottom to allow for pumping to maintain dry foundations. The advantage of this is that it would minimize the number of pumps on-site; however, the disadvantage is that it would increase the amount of water pumped and managed.

- A separate underdrain system could be installed below the sump and pond bottom to allow for pumping to maintain dry foundations. The advantage of this is that it is separate from the stockpile underdrain system and could potentially be discharged off-site (clean groundwater); however, this would increase the number of pumps required, increasing capital and maintenance costs.

- A clay liner could be used instead of the geomembrane liners. The advantage of this would be that an underdrain system with a separate pump and piping system would not be needed below the sumps and ponds; however, use of a clay liner would increase the amount of water pumped due to increased leakage rates <u>into</u> the sump and pond to maintain inward drainage to prevent leakage out of the sumps and ponds to groundwater. The disadvantage of this is that it would increase the amount of process water pumped from the sumps and ponds.

- The ballast, or weight on top of the liner, in the sump and pond could be increased to counteract the buoyancy forces of groundwater. The advantage of this option is that there would be no additional pumping or piping systems required and no extra water to manage and treat. However, the ballast used to hold down the liner would reduce the capacity of the sumps/ponds, so increased volumes and potentially larger sump and pond footprints would be required.

These options will be evaluated after the additional geotechnical and hydrologic investigation are performed.

2.1.4.2 Category 1 Waste Rock Stockpile Groundwater Containment System

A groundwater containment system will be constructed to capture stockpile drainage from below the Category 1 Waste Rock Stockpile and convey this water to sumps for collection and pumping to the WWTF. Drainage through the stockpile is significantly reduced once portions of the stockpile are reclaimed. See Section 2.1.2 of Reference (3) for more details of this design.

2.1.5 Process Water Ponds for Other Infrastructure

Process water ponds provide storage for gravity flow of process water volumes during large rainfall or snowmelt events and during short power outages. Apart from the temporary stockpile ponds, there will be six other process water ponds constructed at the Mine Site, as shown on

Large Figure 4 to Large Figure 6 and Drawing PW-001 and PW-002 of Attachment A (to be provided in permitting). These include:

- PW-OSLA will collect drainage from the OSLA
- PW-HRE, PW-HRW, PW-HRN, and PW-HRC will collect process water from the haul roads
- PW-RTH will collect process water from the RTH

The process water ponds for the haul roads and RTH are designed to contain runoff volumes from the 100-year, 24-hour storm. The process water pond for the OSLA is designed to handle the 25-year, 24-hour storm. Preliminary sizing for the process water ponds is listed in Table 2-5. The process water ponds will have the added benefit of reducing TSS, which will limit the amount of sediment in the pumping and piping system.

Table 2-5 Process Water Pond Dimensions – Approximate

Infrastructure	Sump/Pond Name	Area (acres)	Required Capacity (acre-feet)	Design Volume (acre-feet)
Overburden Storage and Laydown Area	PW-OSLA	7.1(1)	10.7	14.5(1)
Haul Road	PW-HRE	2.2	10.7	10.7
	PW-HRN	1.4	4.4	4.6
	PW-HRC	1.7	6.1	6.9
	PW-HRW	1.7	3.7	4.0
Rail Transfer Hopper	PW-RTH(2)	0.4	0.7	0.7

(1) PW-OSLA was oversized to allow for storage of Peat within the pond, as described in Section 2.1.5.1.
(2) PW-RTH was sized based on available area with a larger pump capacity to meet the design storm volume.

Table 2-6 presents the range of annual process water volumes and flow rates estimated from process water infrastructure ponds based on modeling results.

Table 2-6 Process Water Pond Drainage

Infrastructure	Mine Year 1(1)		Mine Year 11(1)		Mine Year 20(1)	
	Average Annual Inflow (gpm)	90th Percentile Inflow (gpm)	Average Annual Inflow (gpm)	90th Percentile Inflow (gpm)	Average Annual Inflow (gpm)	90th Percentile Inflow (gpm)
Overburden Storage and Laydown Area(2)	5.4	6.6	5.4	6.6	5.4	6.6
Haul Roads(3)	53	67	53	67	53	67
Ore Surge Pile(4)	20	24	20	24	20	24

(1) Source of data: Section 6.1 of Reference (2)
(2) The OSLA footprint will be fully developed in Mine Year 1 and not reclaimed until after Mine Year 20.
(3) Haul roads were modeled at their largest extent; inflows represent maximum extent with no change over time.
(4) The Ore Surge Pile was modeled as fully developed in Mine Year 1 and not reclaimed until after Mine Year 20.

The liner system for these process water ponds has been chosen based on the quality of the water that it will be collecting. The PW-RTH drainage is expected to be similar to that collected from the OSP or Category 4 Waste Rock Stockpile; therefore it will be constructed with the same liner as designed for the Category 4 Waste Rock Stockpile sumps, as described in Section 2.1.4.1. The haul road process water ponds will be constructed with a single HDPE geomembrane over a one-foot thick soil liner, and the OSLA pond will be constructed without a liner.

In general, ponds will be partially excavated and partially filled above the natural ground, designed to optimize the pond bottom with the expected groundwater and bedrock information. As described in Section 2.1.4.1, construction of a lined pond requires adequate foundation drainage to prevent excessive pore pressure from developing under the liner. The pond dikes and slopes will be vegetated or riprapped to limit erosion. The pond dike design will be finalized once the foundation grading design is completed and pond elevations can be established. The pond elevations will allow runoff from disturbed surfaces to be conveyed by gravity into the ponds. The outlet for the haul road ponds and the RTH pond will be a pump and piping system to convey this process water to the WWTF. The outlet for the OSLA pond will be a pump and piping system to convey the process water directly to the CPS pond unless monitoring shows that treatment is necessary.

2.1.5.1 Overburden Storage and Laydown Area (OSLA) Drainage

This section describes the collection and conveyance of runoff from the OSLA including design of the process water pond.

As described in Section 2.2.3 of Reference (1), the OSLA is a temporary storage area used to screen, sort, and temporarily store Unsaturated Overburden and Peat that may be used for future construction or reclamation purposes. As described in Reference (1), the area will be graded to provide a relatively even, well drained site that directs surface runoff to process water pond PW-OSLA in the southwest corner of the area. Pond PW-OSLA was designed to accommodate runoff from the 25-year, 24-hour storm event with three feet of freeboard. As shown on Table 2-5, this pond was oversized to allow for storage of Peat within the pond to maintain wetland characteristics for future restoration.

Surface runoff from the OSLA is considered process water because there is concern about the potential release of mercury from Peat storage. Surface runoff from the OSLA will drain to a process water pond for storage and reduction of TSS. The water in Pond PW-OSLA is expected to exhibit water quality similar to construction stormwater and is not expected to require treatment for dissolved substances; however, water quality will be monitored throughout the life of the mine, as described in Section 5.1.3. The water will be pumped from the process water pond directly to the CPS and on to the FTB or to the East Pit during pit filling. See Section 6.9 of Reference (8) and Section 6.5 of Reference (2) for a discussion of mercury in Plant Site and Mine Site discharges, respectively, in long-term closure.

Storage of peat in the OSLA begins prior to the start of mining when peat is removed from areas to be used for stockpiles and the area encompassed by the East Pit. Peat removal from the West and Central Pits will be completed between Mine Years 2 and 11; additions of peat to the OSLA are not expected to occur after Mine Year 11. During operations, peat stored in the OSLA will have the potential to decompose and release mercury.

For newly placed material in the OSLA, the decomposition process of younger peat from the surface oxygenated zone of a wetland may release a pulse of mercury that could occur relatively rapidly based on data from natural peatlands (Reference (9)) and soil laboratory studies (*e.g.*, Reference (10)), with a much slower release rate as time progresses due to a number of factors that include organic materials more resistant to decomposition (Reference (x)). Older peat from below the water table that is placed on the stockpile surface will be exposed to oxygen similar to the oxygenated zone of a peatland (Reference (11)) or an upland forest (Reference (12)), but the decomposition rate is likely to be slow because this older peat has already been subject to decomposition during its longer residence time in the wetland (Reference (13)); therefore, the probability of a pulse of mercury being released from the older peat is likely lower than for younger peat. Because older peat represents the largest mass of material in a peatland (Reference (13)), it will also represent the largest mass of material in the peat stockpile, and because the mixing of younger and older peat will occur, the overall decomposition rate of the newly stored peat is uncertain as is the potential for the release of mercury from the newly stored peat.

The placement of peat in the OSLA will occur over time and will result in previously stored peat being covered (buried) with newly stored peat. As more peat material is added to the stockpile and the peat compresses, oxygen is likely to be limited at depth in the pile (anoxic conditions), and decomposition would be limited as typically occurs in the anoxic zone of undisturbed wetlands (Reference (11)). The limited oxygen (anoxic conditions) with depth in the stockpile likely limits the decomposition of the peat and release of mercury similar to the reduced mercury release from the decomposition of organic matter in new reservoirs where oxygen depletion (anoxic conditions) limits organic matter decomposition (Reference (14)).

Mercury released from the decomposition of peat is likely to be Hg(II) (Reference (15)), but has the potential to be: a) converted to elemental mercury (Reference (16)) and volatilized to the atmosphere similar to what occurs in existing upland/peatland watersheds (Reference (15)); b) converted to elemental mercury and adsorbed to organic matter (Reference (16)); or c) re-adsorbed by organic matter and humic acids that have a high affinity for mercury (Reference (16)). Mercury released from organic matter decomposition will have the potential to move with precipitation that falls on the OSLA. However, as shown by upland forest systems that have received atmospheric inputs of mercury for decades and where organic matter is added and decomposed annually, a large share of the mercury is found associated with organic matter (forest floor and upper mineral soil layer enriched with organic matter) (Reference (17); (Reference (18)); Reference (19)). The affinity of the organic matter within the stockpile for mercury may result in less mercury release from the stored peat than might otherwise be expected to occur. Drainage from the OSLA is considered to be process water and is collected in the process water pond PW-OSLA. Settling of solids associated with runoff from the OSLA likely further reduces the amount of mercury that may be associated with water in Pond PW-OSLA. Additionally, TSS in the pond water may provide a medium to adsorb mercury from the water column. Settling of these solids may provide another potential mechanism to reduce the mercury concentration in the pond water.

In Mine Years 1 to 11, water from the OSLA will be routed to the FTB. Any mercury in the water routed to the FTB has the opportunity to mix with Flotation Tailings and be sequestered with the tailings, thereby limiting any release to the environment. In Mine Years 12 to 20, some water from the OSLA is expected to be routed to backfill the East Pit. Mercury in the water routed from the OSLA to the East Pit will mix with the NorthMet waste rock and other fill materials to form a slurry, and similar to the processes occurring in taconite tailings basins and the FTB, mercury is expected to associate with solids and be sequestered at depth in the East Pit. By the time the flooding of the West Pit begins in Year 21, the OSLA will no longer be in operation. In addition, any contributions of water after Mine Year 21 from the East Pit to the West Pit will reflect water from the East Pit and its associated watershed runoff and will not reflect process water drainage from the OSLA, because the OSLA will be reclaimed, as described in Section 7.2.3 of Reference (3).

Because peat removal from the areas to be mined will be completed by Mine Year 11, any potential pulse of mercury from stored peat materials will have occurred, or be ending, by the time water is routed from the OSLA to the East Pit beginning in Mine Year 12. Therefore, the potential release of mercury from the decomposition of peat at the OSLA is not included in the West Pit mercury evaluation in Section 6.5 of Reference (2).

2.1.5.2 Haul Road Drainage

The quality of the water coming off the haul roads will be related to the amount and type of waste rock and ore spillage occurring on the roadways; therefore drainage from the haul roads will be collected in process water ditches and directed to one of four lined haul road ponds. Haul roads will generally be kept clear of material for safe travel of the vehicles and as part of best management practices at the Mine Site.

As shown on Table 2-5, haul road drainage will be directed to four separate process water ponds, PW-HRE, PW-HRN, PW-HRC and PW-HRW, as shown on Large Figure 4 to Large Figure 6 and on Drawings PW-001 and PW-002 of Attachment A (to be provided in permitting). PW-HRE is located on the south side of the haul road leading to the Category 2/3 Waste Rock Stockpile, west of the OSP. PW-HRW is located along the haul road to the West Pit, between the haul road and the OSLA. PW-HRN is located south of the Category 4 Waste Rock Stockpile and Central Pit, east of the West Pit, at the intersection of two haul roads. PW-HRC is located on the south side of the haul road leading to the OSP. PW-HRC and PW-HRE will be needed in Mine Year 1, while PW-HRW and PW-HRN will be constructed as the haul roads are expanded to those areas.

Haul road ponds have been designed to contain runoff from the 100-year, 24-hour storm event with three feet of freeboard with design capacities as listed on Table 2-5. Drainage from the haul roads will be directed to these process water ponds prior to being pumped to the WWTF. In some cases, haul road runoff may be directed to a mine pit and included in mine dewatering rather than routed to these ponds.

The haul roads will either be constructed to divide surface runoff to both sides of the road by crowning the middle of the road or by directing surface runoff to one side by super-elevating one side of the road. Depending on the height of these roads above the natural grade, ditches will either be built in the road section or adjacent to the road. These process water ditches will only collect surface runoff from the road cross-section. Stormwater runoff from adjacent areas will be intercepted before entering the road section and routed to stormwater ponds. This may mean construction of parallel ditches in some areas, one for process water and one intercepting adjacent stormwater. This will minimize the size of the process water ditches and the amount of water requiring treatment from haul road drainage.

The haul roads will be constructed with safety berms as required by the Mine Safety and Health Administration (MSHA) and described in Section 2.1 of Reference (1). The safety berms will be constructed of coarse rock to allow surface drainage from the haul roads to flow through the berm into the process water ditches.

2.1.5.3 Rail Transfer Hopper (RTH) Area Drainage

As described in Section 2.2.1 of Reference (1), the RTH is used for loading ore into rail cars. Due to the nature of the work and potential for ore spillage, surface runoff from the RTH active areas will be considered process water. The layout of the RTH consists of a raised platform on which haul trucks enter and exit the area and from which they dump ore into a hopper over a pan feeder, which conveys the ore into rail cars. There will be a sloped concrete floor within the RTH, directing runoff to the south. The runoff will cross the rail spur on sloped concrete panels to a small swale along the south side of the railroad track to pond PW-RTH. Water from PW-RTH will get pumped to the WWTF.

Pond PW-RTH will be designed to accommodate runoff volumes from the 100-year, 24-hour storm event from the RTH with one foot of freeboard with design capacities as listed on Table 2-5.

2.1.6 Waste Water Treatment Facility (WWTF)

Mine Site process water, with the exception of process water from the OSLA, will be treated at the WWTF and then pumped to the FTB for re-use or to the East Pit during pit filling after Mine Year 11. The purpose of this water treatment is to improve the quality of water going to the FTB. The design and treatment process of the WWTF can be modified as needed. Because the design of the WWTF can be adapted as modeling and monitoring require, the details of the design are included in Section 2.2 of Reference (4).

The WWTF will be located west of the RTH, as shown on Large Figure 4. Process water streams at the Mine Site will be combined into three waste streams for treatment at the WWTF: construction water, process water with relatively high levels of metals and sulfate, and process water with relatively low levels of metals and sulfate. Process water from construction dewatering of Saturated Overburden will be treated in a construction water stream and will only be produced through approximately Mine Year 11. Process water that is anticipated to contain relatively high levels of metals and sulfate (drainage from the temporary Category 2/3 and Category 4 Waste Rock Stockpile liners and the temporary OSP liner) will be stored in the West Equalization Basin (West EQ Basin) and routed to the chemical precipitation treatment train. Process water that is anticipated to contain relatively low concentrations of metals and sulfate (drainage from haul roads, the RTH, pit dewatering and Category 1 Waste Rock Stockpile drainage) will be stored in the East Equalization Basin (East EQ Basin) and routed to the membrane filtration treatment train.

The WWTF effluent will be conveyed to the CPS pond to be blended with the OSLA runoff prior to being pumped through the TWP for use at the FTB or used to supplement flooding of the East Pit after approximately Mine Year 11.

2.1.7 Central Pumping Station (CPS) and Treated Water Pipeline (TWP)

Process water treated by the WWTF and process water from the OSLA that does not need treatment are discharged into the CPS pond, which is the collection point for all water that will be pumped to the FTB or to the East Pit during pit filling. Consequently, the CPS pond will be constructed with a clay liner to minimize loss of water from leakage. The CPS pond will have an active storage capacity of approximately 1.2 million gallons plus three feet of freeboard.

The CPS houses three pumps that have a combined design capacity of 4,000 gpm. Water collected in the CPS pond will be pumped through the TWP to the FTB (see Drawing ME-003 of Attachment A, to be provided in permitting), with the exception of any water needed during East Pit flooding operations, starting in Mine Year 12. A pipeline will be constructed from the CPS to the pits to facilitate pit flooding. Flows through the CPS are expected to be continuous year-round, with lower flows during the winter months and during periods with low precipitation. The CPS pond is expected to receive flows that do not vary significantly as a result of storm and snowmelt events due to the upstream storage in process water ponds and the WWTF equalization basins and treatment units.

The TWP will be used continuously throughout the year and will be designed and constructed to prevent freezing in the winter. The TWP will consist of the pipeline, air/vacuum relief valves, drain valves, and in-line flow meters on each end of the TWP.

The alignment selected for the TWP is parallel to the existing Dunka Road alignment and has a total length of approximately 40,000 feet. The TWP will be designed so that it safely discharges into the FTB to prevent any potential erosion of tailings or the FTB dams. The following criteria were used in selecting this route:

- The TWP will be next to Dunka Road, which will be utilized for daily mine traffic. This means that the corridor will be under regular observation by mine personnel. In the unlikely event that a leak should develop, it can be quickly identified and repaired. In addition, flow meters at both ends of the TWP will allow for quick detection of any loss of fluid.

- Wetland impacts along this established route are not as great as along the other alignments considered.

- The alignment never crosses a major road planned for regular mine traffic or a rail line, minimizing the risk of structural failure due to surface loads from heavy mine vehicles or trains.

- The majority of the route is in areas already disturbed by previous activities.

- This route provides easy access for operations, maintenance, and repairs of the TWP.

- Preliminary review of the alignment did not identify any major constructability concerns.

The TWP will be designed to handle flow rates from 1,000 to 4,000 gpm. The maximum total design head (static plus dynamic) is estimated at approximately 470 feet at the maximum design flow. In order to accommodate this range of flow rates, a nominal pipe diameter of 16 inches was selected. Smaller pipe diameters result in a significant increase in pumping head at higher flows, and larger pipe diameters result in unacceptably slow velocities at lower flow rates. Pipeline velocities will vary from approximately 1.8 feet per second (fps) at 1,000 gpm up to 7 fps at 4,000 gpm. These pipe velocities are considered acceptable by current design standards.

In preparation for TWP construction, the alignment will be cleared and a bedding material will be placed along the alignment to support the TWP. Once the TWP is in place, it will be covered with approximately eight feet of material to protect it from freezing during winter operations. Side slopes of this cover will be approximately 1.5 (horizontal) to 1 (vertical), resulting in a footprint that will be approximately 26 feet in width.

The material used for bedding and cover will consist of overburden from the TWP construction or from the Mine Site, and/or LTV Steel Mining Company (LTVSMC) tailings from the Plant Site. LTVSMC tailings will be ideal for use as pipe bedding and cover, but will not facilitate vegetation growth on the resultant berm. If LTVSMC tailings are used as pipe cover material, the tailings will be covered by a minimum of two feet of overburden material and seeded to stabilize the material against erosion.

The TWP drawings included in Attachment A (to be provided in permitting) include the general layout (Drawing TWP-001), plan and profile sheets (Drawing TWP-002 to TWP-009), typical sections (Drawing TWP-010), and details of the installation (Drawing TWP-011). Because varying topographic conditions along the TWP corridor will require different installation methods, five typical cross-sections have been developed to illustrate the methods of construction. Although it is anticipated that the five standard cross-sections shown on Drawing TWP-010 will address most conditions encountered, variations and modifications to these standard arrangements may occasionally be necessary. Where modifications are required in the field, they will be done in conjunction with the Engineer. The TWP will be constructed to generally follow the surface profile of the Dunka Road corridor with sufficient cut and backfill to avoid abrupt changes in elevation. The TWP layout also avoids abrupt changes in direction. Automatic air/vacuum relief valves will be placed along the alignment at the high points as shown on the plan and profile sheets. Likewise, manually operated drain valves will be provided at the low points to allow drainage of pipeline sections for maintenance.

2.2 Stormwater Management

Three types of stormwater will be managed at the Mine Site:

- Non-contact stormwater is precipitation and runoff that contact natural or reclaimed surfaces, including reclaimed portions of the permanent Category 1 Waste Rock Stockpile, and surface runoff that has not been exposed to mining activities.

- Stormwater associated with construction activities (i.e., construction stormwater) which consists of runoff from construction areas with no excavation and construction areas where the majority of the material being excavated is Unsaturated Overburden or Peat.

- Stormwater associated with industrial activities (i.e., industrial stormwater) which consists of precipitation and runoff that come in contact with on-site features constructed of rock (either Category 1 waste rock or rock from off-site sources), where the discharge is composed entirely of stormwater and not combined with process water.

These three categories of stormwater will be comingled and will be kept separate from process water through a system of ditches, dikes, and ponds. For the purpose of this chapter, these three categories of stormwater will be referred to collectively as stormwater.

Runoff from the Transportation and Utility Corridors, including the Dunka Road corridor and the adjacent railroad corridor (which will generally remain in its existing condition), will contribute to the stormwater runoff volumes from the Project.

The Mine Site stormwater management system will be developed as required throughout the mining operation to control site stormwater up to the 100-year, 24-hour storm event. The overall system capacity will be based on the Mine Site configuration, and the individual segments will be installed when needed, as shown on Large Figure 7 to Large Figure 9. Permit design drawings of the stormwater system will be included in Attachment B during permitting

Stormwater management is modified during reclamation and during long-term closure, including filling of some ditches, construction of new ditches, and reclamation of the sedimentation ponds into wetlands or uplands, as described in Section 7.0.

Stormwater in and around the Mine Site will be managed in a manner that reduces potential impacts to mining activities, protects the environment, and maintains existing flow patterns to the extent practicable. The volume and rate of stormwater flows will be altered by construction of stockpiles, pits, and mine infrastructure (haul roads, RTH, OSLA, etc.), because runoff from these areas will be captured and treated as process water.

Stormwater flowing on and off the Mine Site will be controlled by natural watershed divides and a series of dikes and ditches constructed around the perimeter of the Mine Site, along the pit rims, and around the interior of the Mine Site. Sedimentation ponds will be constructed along the perimeter of the Mine Site to reduce TSS from these stormwater ditches prior to discharging off-site.

2.2.1 Stormwater Modeling

The stormwater ditches and sedimentation ponds were modeled using XP-SWMM, Version 10.6, which is a software package used to model stormwater, sanitary water, and river systems. The design for the stormwater ditches and sedimentation ponds was based on a critical year, which represents the Mine Year producing the highest quantity of runoff for each ditch and pond network. Once the critical year was established, the sedimentation ponds and stormwater ditches were designed using the 10-year and 100-year, 24 hour Soil Conservation Service (SCS) Type II storm events.

For the sedimentation ponds, the design goal was to control, at a minimum, the 10-year, 24-hour storm event through the outlet pipe(s). The ponds provide a secondary spillway to control the discharge up to the 100-year, 24-hour storm event. See Section 2.2.4.2 for detailed information regarding the pond and outlet design. It should be noted that the stormwater pond model does not use the groundwater component of the model because it was used to analyze single storm events rather than long-term modeling; it accounts for the groundwater/surface water interactions by assuming an average antecedent moisture content which classifies all wetland areas as partially impervious.

The following sections describe the major components of the stormwater management system.

2.2.2 Exclusion Dikes

Dikes will be placed at strategic locations around the perimeter of the site and around the pit rim as described in the following sections.

2.2.2.1 Perimeter Dikes

The purpose of constructing dikes and ditches at or near the perimeter of the Mine Site is to:

- minimize the amount of surface water flowing onto the Mine Site
- minimize dewatering of wetlands outside the perimeter of the Mine Site
- eliminate process water (i.e., water that has contacted surfaces disturbed by mining activities) flowing uncontrolled off the Mine Site
- manage the rate and location of stormwater flowing off the Mine Site

The criteria used to select dike alignments include:

- as close to the Project boundary as practicable to avoid obstructing mining operations
- where needed to facilitate construction of subsurface flow cutoff to prevent shallow groundwater flow from entering the Mine Site
- where the ground surface at the Project boundary is lower than flood levels in surrounding water bodies, and flood levels are high enough to flow onto the Mine Site if not controlled
- where process water from construction areas or other surfaces disturbed by mining activities will otherwise discharge off the site and where ditches will not adequately control the runoff

- where needed to ensure that stormwater runoff is detained and discharged in a manner that will meet stormwater quality requirements

Dikes will be constructed of the silty sands or glacial till material excavated during construction of ditches and removal of overburden. Side slopes will be vegetated to control erosion. Small dikes will also be constructed, as needed, along interior stormwater ditches and around stockpile construction areas to separate stormwater and process water around the Mine Site.

In order to convey stormwater adjacent to the dikes, prevent surface runoff from entering the mine pits, intercept stormwater prior to reaching process water areas, and prevent water from pooling in areas where the dikes cut across low areas, ditches will be constructed along the interior of most of the perimeter dike system. In addition, there will be some areas along the site perimeter where the existing ground is already relatively high so that a ditch will be able to capture the site surface runoff without a dike. Stormwater captured by the ditches will be directed to sedimentation ponds and then routed into a natural drainage system. Where glacial till is present in the dike foundation zone below the water table and where inspection trenching (conducted at the time of construction) indicates potential for high-permeability conditions or where peat is present, seepage control measures may be installed to restrict groundwater movement. As part of construction-level design, test trenches will be excavated along the perimeter dike alignments to determine the underlying soil conditions. The test trenches will be used to evaluate the need for construction of cutoff trenches.

In areas where glacial till is present, seepage control measures may include soil cut-off trenches constructed of compacted silty sand or compacted glacial till, or slurry trenches. The decision on which design to use will depend on depth to bedrock and soil type on which the dike will be built. In areas where peat is present, seepage will be prevented by compressing the peat by placing earthen dike materials over the surface to surcharge the peat to create a low-permeability layer. If a sand seam or other high-permeability material is found in the dike foundation zone below the peat deposit, a soil cutoff trench, slurry wall, or sheetpile wall will be installed (depending on depth to bedrock) to cut off seepage. Geotechnical testing has indicated that silty sand soils found at the Mine Site are a relatively low-permeability material in their natural state, as discussed in Section 4.1 of Reference (20). Therefore, seepage cutoffs are generally not planned to be used in areas where dike foundation soils are silty sand.

The alignment of the perimeter dikes for the various years of mine operation are shown on Large Figure 7 to Large Figure 9 or on Drawing SW-003 and SW-004 of Attachment B (to be provided in permitting).

2.2.2.2 Pit Rim Dikes

Pit rim dikes will be constructed in areas where surface water might otherwise drain into the mine pits. The pit rim dikes are temporary in nature, intended to be in place only as long as the rim of the mine pit is at a specific location. Dikes will be constructed by pushing up a ridge of soil where needed around the rims of the pits during overburden stripping operations. Pit rim dikes do not require as rigorous control of construction materials (compaction and moisture content control) as the perimeter dikes need. They can be constructed quickly and economically to cut off surface water flow into the pits. Dikes will be removed and reconstructed in a new location as the mine pit expands. These dikes are intended only to intercept and direct surface runoff, not to impede movement of groundwater flow. The dikes will also serve as safety berms for mining operations at some locations and will need to remain in place until mining operations are terminated at those locations.

2.2.3 Interior Ditches

The intent of stormwater ditch construction throughout the interior of the Mine Site is to:

- route stormwater away from the areas of mining activity to minimize the amount of process water created on the Mine Site
- convey collected stormwater to perimeter ditches and sedimentation ponds prior to controlled discharge from the Mine Site
- minimize the impacts of mining operations on the Partridge River system

The layout of the proposed stormwater system was designed to match the existing drainage patterns at the Mine Site to the extent practical while still maintaining the objectives of the system. The primary strategy is to intercept stormwater prior to contacting areas that have been disturbed by mining activities, which will minimize the amount of process water and the overall impacts to the Partridge River.

Mine Site Stormwater Permit Support Drawings SW-003 through SW-005 (Attachment B, to be provided in permitting) show the layout of the stormwater ditches, dikes, and ponds for Mine Years 1, 11, and 20, respectively. Ditch plan and profile views are shown in Drawings SW-012 through SW-029 (Attachment B, to be provided in permitting). Cross-sections and details for stormwater ditches are shown in Drawing SW-006 through SW-011 (Attachment B, to be provided in permitting).

2.2.4 Sedimentation Ponds and Outlets

Sedimentation ponds will be constructed to reduce TSS from stormwater runoff and allow for controlled discharge of stormwater from the Mine Site. There are five stormwater sedimentation ponds planned for the Mine Site, as shown on Large Figure 7 to Large Figure 9. Pond A is located at the northeast corner of the Category 1 Waste Rock Stockpile and directs stormwater from the north and west sides of the stockpile off-site. Pond B is located between the East Pit and northern border of the property. Pond C (West) is located west of the West Pit and was designed to provide additional flood storage prior to Pond C (East), which is located west of the OSLA and downstream of Pond C (West). Pond D is located west of the OSP, on the north side of Dunka Road.

Stormwater will be routed from the Mine Site to these five locations around the perimeter of the site. These locations were selected to match existing flow paths to mimic existing conditions to the extent possible and minimize the overall hydrologic impacts to the Partridge River. Some existing culvert locations along Dunka Road were consolidated through diking and ditching to limit the number of outlets from the site to simplify management, monitoring, and operations. Four of these sedimentation ponds (shown on Drawing SW-003 of Attachment B, to be provided in permitting) will be constructed in Mine Year 1, with the remaining pond, Pond C (West), constructed in Mine Year 2.

2.2.4.1 General Design Criteria

The stormwater sedimentation ponds will be designed to limit TSS outflow concentrations into natural flow paths to meet the TSS discharge limits established in the NPDES/SDS Multi-Sector General Permit for Industrial Stormwater Activity (Permit Number [No.] MNR050000). It may take several years to establish a thick vegetative cover on the reclaimed stockpile surfaces and as a result, sediments in stormwater may temporarily be higher than under natural conditions until the vegetative cover is fully established.

The inflow TSS concentrations may fluctuate over time and can only be estimated for this design. The design assumes inflow TSS concentrations of 50 milligram per liter (mg/L) during baseflow conditions and 100 mg/L during storm events. These TSS estimates are believed to overestimate the actual concentrations, although the inflow concentrations used in the design will need to be confirmed once water quality sampling can be conducted.

Sediment removal in the sedimentation ponds is extremely sensitive to the grain size distribution of the sediments in the stormwater entering the pond. The grain size distribution of the inflow sediments used in the design will also need to be confirmed once water quality sampling can be conducted at the site and additional geotechnical data can be obtained. The ponds and outlet configuration will be modified according to any new data as necessary to meet the permit requirements. The pond surface areas were designed to remove 70% of sediment during the 10-year and 100-year storm events. The baseflow and the 10-year storm event assumes a larger percentage of fines using a design gradation of 0.0363 millimeters (mm), 70% of which will be larger than this according to the reference gradations. The 100-year storm event uses a design gradation of 0.05 mm, of which 70% of the expected sediment will be larger than this according to the reference gradations. However, a small change in the grain size distribution could result in a large change in the required surface area of the pond for sediment removal.

Additionally, stormwater permitting has been taken into account in the design of these ponds. The MPCA issued its new NPDES/SDS Multi-Sector General Permit for Industrial Stormwater Activity (Permit No. MNR050000) on April 5, 2010. This permit includes TSS storm event benchmark limit of 100 mg/L. The Project is expected to have an individual NPDES/SDS permit but these same limits will likely apply; therefore this requirement was used in the design criteria. The MPCA has issued its next version of the NPDES/SDS Multi-Sector General Permit for

Industrial Stormwater Activity (Permit No. MNR050000), which goes into effect April 5, 2015. This new permit maintains the TSS storm event benchmark limit of 100 mg/L.

The annual average flow was used to size the ponds for the baseflow condition, for which a lower TSS concentration but higher percent of finer sediments is expected. The peak flows from the SCS Type II, 10-year and 100-year, 24-hour storm events determined from the XP-SWMM model were used to size the ponds for storm event flows, for which a higher TSS concentration but lower percent of finer sediments is expected. The 100-year, 24-hour storm event flow was the driving factor in the required pond surface area. The pond, culvert, and weir sizes were designed to slow the flow through the stormwater ponds long enough to allow the required settling within each pond. TSS removal was estimated using the assumption of a steady-state plug flow reactor and computing sediment fall velocity (in still water) according to Dietrich (Reference (21)).

In general, the sedimentation ponds will be partially excavated and partially filled above the natural ground. The planned 3 (horizontal) to 1 (vertical) side slopes of the pond dikes will ensure a stable cross-section that will provide sufficient flow path length to control leakage. Side slopes will be covered with soil and seeded to control erosion. With this design, the diversion ditches will flow by gravity from the channels into the sedimentation ponds, and additional storage can be provided above the ground. This also allows better control of the pond outflows and increases their sediment trapping efficiency.

2.2.4.2 Sedimentation Pond Sizing and Outlet Design

The sizes of the sedimentation ponds have been designed and will be constructed to meet the objectives for the MPCA's NPDES/SDS Multi-Sector General Permit for Industrial Stormwater Activity (Permit No. MNR050000). The primary design objective is reduction of sediment in runoff from storms up to the 100-year, 24-hour storm event.

The primary outlet structures for the ponds will be designed and constructed to allow flows up to the 10-year, 24-hour storm to pass without overtopping the pond. Detention storage will be provided to assist with containing flows up to the 10-year storm event. An earthen weir and secondary spillway will also be constructed through the pond embankment to accommodate flows from the 100-year storm event without overtopping the dikes or roads. The downstream side of these overflow structures will include erosion control measures such as riprap. Accumulated sediment will be removed from sedimentation ponds by pumping, as required. Due to its outlet through Dunka Road, Pond D has a single weir outlet (with no secondary spillway) to serve up to the 100-year storm to convey flows from the pond to an existing wetland south of Dunka Road.

Due to the proximity to the Partridge River, and the predicted elevations of the Partridge River flood flows, each of the outlets on Ponds A and B will be fitted with check valves to prevent water from flowing from off-site into the ponds. Both the primary outlet and an emergency outlet will be evaluated on a site-specific basis, with the first one designed to provide flood attenuation capacity and the second one designed to pass flows larger than the design values used to size the sedimentation pond. The pond outlet configuration showing the primary outlet pipes and secondary overflow earthen weirs are illustrated on the Drawings SW-007 to SW-011 in Attachment B (to be provided in permitting). Similar to all long-term infrastructure at the Mine Site, this outlet design was chosen to minimize maintenance.

The ponds will be excavated to have 8 to 10 feet of dead storage to prevent resuspension of sediment that has already settled to the bottom of the ponds and to provide capacity for the sediment that settles out. As required under the MPCA's general stormwater program, these ponds will have depths no greater than 10 feet. The ponds will typically be sized to achieve a length-to-width ratio that will range from about 2 to 3 to eliminate short-circuiting and allow adequate sedimentation for flows up to the 100-year storm event.

In many proposed pond locations, groundwater is near or at the existing ground surface. The normal water level of the ponds will be based on the expected groundwater elevations which may be approximately at the existing ground elevation.

To achieve the desired TSS removal efficiencies, the surface area of the ponds range from 1.7 to 6.0 acres. For all ponds, with the exception of Pond D, the primary outlet of each pond will consist of between one and six reinforced concrete pipes with diameters ranging from 24 to 48 inches with the invert set at the normal water level (NWL) and having a positive slope discharging to the downstream side of the dike or road embankment. With the exception of Pond D, each pond will also have a secondary overflow structure to allow flows up to the 100-year event to be conveyed without overtopping the dikes or road embankments with one foot of freeboard. The spillway will be an earthen spillway with an elevation set between 0.5 feet and one foot below the dike elevation and vary in length from 6 to 200 feet. The downstream side of these spillways will include erosion control measures such as riprap as needed. The riprap will either be Minnesota Department of Transportation Standard Specification 3601 Random Riprap Class III, IV, or V, depending on the size of riprap required for the calculated normal depth velocity for the spillway.

Existing culvert invert elevations under Dunka Road were maintained where they will be replaced to ensure that existing flows will not be impeded. Therefore, culverts to or from ponds located adjacent to Dunka Road, including culverts directing flow from Pond D and Pond C-East, are designed to maintain the surveyed grades of the existing corrugated metal pipe culverts under the road. The culverts under Dunka Road for Pond C-East have been designed to convey the 100-year, 24-hour storm event.

3.0 Key Outcomes

Through modeling (described in detail in Reference (2)), water quantity and quality estimates have been determined and used in the design of these water management systems. The modeling also includes the expected water quantity and quality outcomes resulting from these water management systems which are summarized in this section.

3.1 Water Quantity

The Mine Site water balance determines the quantity of water that will be removed from the Upper Partridge River watershed and the disposition of that water. Process water will be pumped to the FTB, which will reduce the amount of water withdrawn from Colby Lake, or used to flood the mine pits.

Reference (2) describes the water quantity modeling with key outcomes summarized in Table 3-1. Additional groundwater appropriation will be needed for groundwater collected from temporary stockpile underdrains during operations and from dewatering during construction. Dewatering may be necessary for pit stripping and for construction of stockpile foundations and sumps, the Category 1 Waste Rock Stockpile Groundwater Containment System, stormwater ponds, and process water ponds. Estimated water appropriation flows for these groundwater needs will be provided in permitting.

Table 3-1 Upper Partridge River Water Appropriation and Disposition

Water Source Location	Source Water	90th Percentile Maximum Estimated Daily Volumes (Million Gallons per Day)(1)	90th Percentile Maximum Estimated Annual Volume (Million Gallons per Year)(1)
Operations Phase			
Category 1 Stockpile Groundwater Containment System	Groundwater	0.98	213
East Pit Dewatering Sump (Mine Years 1-20)	Groundwater	0.15	46.3
West Pit Dewatering Sump (Mine Years 2-20)	Groundwater	1.45	528
Central Pit Dewatering Sump (Mine Years 11-20)	Groundwater	0.06	17.9

(1) Source of data: Section 6.1 of Reference (2)

3.2 Water Quality

Reference (2) describes the water quality modeling with key outcomes summarized as follows:

- estimated West Pit lake water quality in Large Table 1
- estimated groundwater quality in Large Table 2 and Large Table 3 along two surficial groundwater flow paths downstream of the Mine Site
- estimated surface water quality in Large Table 4 and Large Table 5 at two surface water locations downstream of the Mine Site
- estimated stockpile drainage water quality in Large Table 6
- estimated Treated Water Pipeline water quality in Large Table 7

4.0 Operating Plan

Once construction begins and until the West Pit lake concentrations meet the required water resource objectives or until non-mechanical treatment has been proven effective at achieving water quality objectives, as described in Section 2.1.1 of Reference (4), water at the Mine Site must be continually channeled, monitored, treated at the WWTF, and pumped as necessary to allow the mine to function efficiently and to protect the environment. This section describes the steps and processes planned at the Mine Site during the operating phase. Section 7.0 describes the management of water during reclamation and in long-term closure.

4.1 Process Water

Process water may not meet water quality limits for metals or other constituents. With the exception of water from the OSLA, all process water will be routed to the WWTF prior to being routed through the TWP to the FTB or for pit flooding in later years. Process water will be intercepted by ditches, dikes, the Category 1 Waste Rock Groundwater Containment System, and stockpile foundation liners to keep it separate from the stormwater conveyance systems as detailed below.

4.1.1 Waste Water Treatment Facility (WWTF)

In the early months of Mine Site development (Mine Year 0), the first phase of the WWTF will be built, specifically the East EQ Basin and the Construction Water Treatment Building. These facilities will treat construction water generated during Mine Site development activities described in Section 2.2 of Reference (4). During Mine Year 1, these facilities will treat both construction water and process water, while construction of the West EQ Basin, Construction Water Basin, and the first half of the mechanical treatment are taking place. Mechanical treatment includes chemical precipitation and membrane filtration treatment. The WWTF will be fully operational at the end of Mine Year 1 and able to treat Mine Site process water. After Mine Year 1, construction water will be routed to the Construction Water Basin, treated by chemical addition from the Construction Water Treatment Building, and subsequently discharged to the CPS pond. It is anticipated that the second half of the mechanical treatment will be constructed starting in Mine Year 3.

Operation of the WWTF is described in Section 2.2 of Reference (4).

4.1.2 Central Pumping Station (CPS)

Under normal conditions, the CPS pumps will be operated automatically by liquid level sensing equipment. The three pumps will be started in sequence, one at a time, as required to maintain the water level in the CPS pond at safe levels. Start pump and stop pump levels will be based on the depth of water in the basin. As the water level in the pond rises, the first pump will be started at reduced speed. If the water level continues to rise, a second pump will be started at reduced speed. Likewise, the third pump will be started should the inflow to the CPS pond exceed the capacity of two pumps operating at maximum speed to maintain the desired water level in the basin.

Preventive maintenance will be an integral part of the operation of the CPS. Preventive maintenance will be focused on keeping equipment operable under the expected range of operating conditions. Preventive maintenance tasks include, but are not limited to:

- daily observation of pump operation and review of alarm conditions, if any, that have occurred
- daily verification that the flow meters at the CPS and the end of the TWP are properly sending data and that data appears to be valid over the previous 24-hour period
- weekly inspection of the intake screens; clearing debris as required
- inspection of any ice control measures at the intake, prior to winter, to ensure that they are operational; during winter, daily inspection of the pump station intake to ensure that ice is not forming to the extent that could damage the intake and/or restrict flow to the pumps
- annual inspection of instrumentation, controls, and electrical components and replacement of worn or damaged parts
- annual cleaning of intake well, as required, to remove any solids that may have collected
- inspection of pumps and valves, with rebuilding, as required, at intervals of approximately one billion gallons of water pumped for each pump; valve lubrication as required
- regular inspection of building services, such as heating and ventilation; service as required

4.1.3 Treated Water Pipeline (TWP)

A flow meter will be installed at each end of the TWP. The difference in flow between these flow meters will be continuously evaluated. If the flows are different (indicating a leak), an alarm will sound and the CPS pumps will automatically be stopped.

4.1.4 Mine Site Pipelines

The Mine Site pipelines will carry the water from the process water sumps and ponds, located around the Mine Site, to the WWTF and CPS pond. The only water that is expected to be pumped directly to the CPS pond is from the OSLA process water pond (PW-OSLA). All other process water at the Mine Site is expected to require treatment and will be sent to the WWTF.

The process water piping system will expand as the mine expands, connecting the pits, stockpiles, and ore handling areas with the WWTF and CPS pond. The condition of the pipes will be monitored, and maintenance will be performed as necessary.

4.1.5 Mine Site Sumps and Pumps

Sumps are located throughout the Mine Site in the pits, around the edge of the temporary waste rock stockpiles, and along the edge of the OSP, as described in Section 2.1.4.1. The water that collects in these sumps will be pumped to the WWTF via the process water pipelines. The condition of the pumps, and sumps will be monitored, and maintenance or replacement of the pumps will be performed, as necessary.

4.1.6 Mine Site Process Water Ponds

If a storm event, snowmelt, or power outage creates more water than a stockpile sump can contain, the excess water from the sumps will overflow to adjacent process water ponds.

Process water ponds without sumps are located in six locations to collect drainage from the haul roads, RTH, and OSLA. In these cases, process water runoff will flow by gravity from these process water drainage areas to their appropriate ponds. Water in the process water ponds will be pumped to the WWTF for treatment via the process water pipelines.

The condition of the ponds and pumps will be monitored, and maintenance or replacement of the pumps will be performed as necessary. Process water ponds have been designed with access for maintenance clean out, as needed. The need for and frequency of sediment clean out will be assessed during annual pond inspections.

4.2 Stormwater

Stormwater ponds will be inspected annually to determine the depth of sedimentation within the ponds. These ponds will be dredged if the depth of sedimentation reduces the required storage capacity beyond what is needed based on the pond design.

Stormwater dikes and ditches will be monitored after construction as part of standard operation and maintenance activities to detect excessive seepage. Should a zone of excessive seepage be identified, sheet pile, grouting, or other seepage control technologies can be installed with the dike in place. Alternatively, a low-permeability material could be compacted in a trench excavated near the toe of the dike without disturbing the dike.

The stormwater management infrastructure will be operated in accordance with the Construction Stormwater Pollution Prevention Plan (SWPPP), which is included as Attachment C (to be developed prior to construction), and the Industrial SWPPP, which is included as Attachment D (to be developed prior to the start of operations). These SWPPPs will be developed to meet the requirements of the Minnesota NPDES/SDS Construction Stormwater General Permit (Permit

No. MN R100001) and the Minnesota NPDES/SDS Industrial Stormwater General Permit (Permit No. MNR050000), respectively.

A SWPPP is a “living” document that evolves with changes at a site. PolyMet will amend these SWPPPs whenever there is:

- a change in Mine Site facilities
- a change in the operating procedures of the facility
- a change that may impact the potential for pollutants to be discharged via stormwater

The intent of these SWPPPs is to protect water quality by preventing pollution from stormwater associated with construction activities and industrial activities, respectively. These SWPPPs will identify and describe controls and Best Management Practices (BMP) proposed for the site; these controls and BMPs are designed to minimize the discharge of potential pollutants in stormwater runoff.

Inspections and recording activities are important parts of the continued success of these SWPPPs. The frequency and extent of the inspections will be defined in each SWPPP.

4.3 Spills

This section is a summary of the Mine Site Spill Prevention Control and Countermeasures (SPCC) Plan which is included as Attachment E (to be developed prior to start of operations). The SPCC provides the procedures for response to spills. These procedures apply to all PolyMet employees, contractors, and vendors delivering, dispensing, or using petroleum products at the Mine Site. It is the policy of PolyMet to promote a long-term, continuous effort towards spill prevention first, and control and countermeasures where necessary. An SPCC Plan Administrator will be designated and is responsible for developing, implementing, and maintaining the SPCC Plan. In the case of a spill, the procedures for emergency contacts and a spill contingency plan are further described in Attachment E. Training sessions and spill prevention briefings for operating personnel will review the requirements of the SPCC Plan and highlight and describe recently developed precautionary measures.

4.4 Overflows

This section includes discussion of what will occur in the event of an overflow of process and stormwater containment features. An overflow may occur when a storm event exceeds the design storm or an extended power outage occurs at the Mine Site. In order to prevent and mitigate the effects of possible overflows, the following operational plan will be used.

4.4.1 Process Water

The storage capacities of the process water sumps and ponds are provided on Table 2-4 and Table 2-5 and on Drawing ME-004 of Attachment A (to be provided in permitting). Where the sumps and ponds are next to each other, the sump volume only includes the volume before it will overflow into the pond, whereas the pond volume is the remaining volume apart from the sump. This is the storage capacity of the design and does not include the freeboard (typically three feet) or contingency response plans for removing or rerouting the water to prevent overtopping.

Process water collection from the temporary stockpiles, haul roads, and ore handling areas (OSP and RTH) will likely require treatment to meet water quality standards. The design storm for these facilities, the 100-year, 24-hour event, only has a 1% chance of being exceeded in any given year, or an 18% chance of being exceeded during the 20-year life of the Mine Site. Although these facilities have been designed according to a significant design storm, there may be occasions during the life of the mine that the design storm is exceeded, resulting in runoff exceeding the capacity of the facilities. The design includes a factor of safety in the form of freeboard volume, and additional contingencies have been developed to minimize environmental impacts in the event the total volume available is exceeded.

For storm events in excess of the design storm, process water from temporary stockpiles, haul roads, and the ore handling areas will continue to fill the ponds within the excess capacity (freeboard) included in the design of each pond. With the exception of the RTH pond, the sump and pond designs include three feet of freeboard based on the MPCA's *Recommended Pond Design Criteria* (Reference (22)). Due to the lack of room, the RTH pond has been designed with one foot of freeboard, but will include a larger pump with that can meet the higher capacities. Use of freeboard in the design provides a significant factor of safety for these ponds, with a total excess capacity (design volume plus freeboard) ranging from approximately 30% to 170% over the required capacity, as shown in Table 4-1.

Table 4-1 Sump and Pond Excess Capacity

Infrastructure	Sump/Pond Name	Required Capacity (acre-feet)	Design Volume (acre-feet)	Freeboard Volume (acre-feet)	Excess Capacity[(1)]
Category 2/3 Waste Rock Stockpile	S23-1	14.9	14.9	15.7	33%
	S23-2	11.9	12.0		
	PW-S23-1	21.4	21.5		
	S23-3	6.6	6.6	6.4	54%
	PW-S23-3	5.3	5.3		
Category 4 Waste Rock Stockpile	S4	10.1	12.5	10.6	81%
	PW-S4	8.1	9.9		

Infrastructure	Sump/Pond Name	Required Capacity (acre-feet)	Design Volume (acre-feet)	Freeboard Volume (acre-feet)	Excess Capacity(1)
Ore Surge Pile	SOSP	8.5	8.7	5.6	47%
	PW-SOSP	4.8	5.3		
Overburden Storage and Laydown Area	PW-OSLA	10.7	14.5(2)	14.1(2)	167%(2)
Haul Roads	PW-HRE	10.7	10.7	4.2	39%
	PW-HRN	4.4	4.6	2.8	69%
	PW-HRC	6.1	6.9	3.0	61%
	PW-HRW	3.7	4.0	2.6	77%
Rail Transfer Hopper	PW-RTH(3)	0.7	0.7	0.3	43%

(1) Excess capacity compares the total capacity (design volume plus freeboard volume) to required capacity.
(2) PW-OSLA was oversized to allow for storage of Peat within the pond, as described in Section 2.1.5.1.
(3) PW-RTH was sized based on available area with a larger pump capacity.

Although the chance that the total design volume will be exceeded is small, an operational contingency plan has been developed in the event that this occurs. The pumping networks draining these sumps and ponds are sized for the snowmelt event; therefore any additional pumping capacity required must be increased through a second pump system. Although it will not be cost-effective to have a second permanent pump and pipeline network in place in the event of an extended power outage or storm event that causes the design capacities to be exceeded, an emergency operating procedure has been developed to manage process water under these circumstances. This operational contingency plan includes use of temporary diesel pumps to operate during events greater than the design volume or under circumstances of extended power outages associated with heavy rainfall. This plan will maintain water levels below the total capacity of the sumps and ponds, pumping to the pits until process water volumes are down to manageable levels.

Under circumstances of design events exceeding sump and pond capacity or extended power outages during heavy rainfall, it is likely that the WWTF may also reach capacity and shut down the pumping network leading to it. In these circumstances, pumped process water may be temporarily pumped into the pits, with mining operations in the lower levels temporarily shut down until water in the pit sumps are back to manageable levels. If the emergency operating procedure, as described above, is put into effect, process water will be pumped to the pits, based on the level of reactivity of material stockpiled, following these priorities in descending order of reactivity and priority: OSP sump SOSP and overflow pond PW-SOSP; Category 4 Waste Rock stockpile sump S4 and overflow pond PW-S4; Category 2/3 Waste Rock Stockpile sumps and overflow ponds; RTH runoff pond PW-RTH; haul road runoff ponds PW-HRC, PW-HRE, PW-

HRW, and PW-HRN; and OSLA runoff pond PW-OSLA. Pit dewatering may be temporarily stopped during these conditions to allow lowering of the water in these sumps and process water ponds to manageable levels.

In the unlikely event of runoff exceeding the total design capacity of the sumps and ponds and containment under the emergency contingency plan is insufficient, overflows from the process water areas will ultimately overflow into the Mine Site stormwater system, which ultimately flows off-site to the Partridge River.

Sump overflow ponds will contain sump overflow during events exceeding the 10-year, 24-hour storm up to the 100-year, 24-hour storm, but they will also receive direct precipitation during all rainfall events. Therefore these ponds will require periodic pumping because there is not a separate pumping system for these ponds. The pump system installed for the sumps will be used for periodic pumping of these overflow ponds to maintain capacity for the design storm.

After major storm events, stockpile sumps will be pumped down to their normal water levels to maintain storage volume for future storms, and then the overflow pond water will be conveyed to the WWTF, taking a lower priority over the stockpile sumps.

Overflow from the Category 1 Waste Rock Stockpile Groundwater Containment System is prevented by gravity overflow pipes from system sumps directly to the East and West Pits (Section 2.1.2 of Reference (3)).

4.4.2 Stormwater

Stormwater Sedimentation Ponds A and B will have their outlets fitted with controls to temporarily shut off discharge from the site, or onto the site under Partridge River flooding conditions, if so desired. For each of the four exterior stormwater sedimentation ponds, both the primary outlet and an emergency outlet will be evaluated on a site-specific basis, with the primary outlet designed to provide flood attenuation capacity and the emergency outlet designed to pass flows larger than the design values used to size the sedimentation pond. During large flood events in the headwaters of the Partridge River along the north side of the Mine Site, excess stormwater from Ponds A and B will be pumped to the stormwater ditch that flows south to Pond C or off-site using temporary portable pumps. If necessary, pumping priorities will be given to the stormwater pond with potential to overflow into the process water systems.

5.0 Water Quantity and Quality Monitoring

Proper long-term management of water quality and quantity at the Mine Site will depend in part on a systematic monitoring plan that will be finalized in permitting. As operations proceed, the monitoring plan will be updated as required. Monitoring will be used to determine project compliance with permits, improve model accuracy, identify potential causes of changes to water quality or quantity, and identify options, if necessary, to adapt the Project to ensure short-term and long-term compliance. The proposed water quality and quantity monitoring plan that is expected to be required by the various permits and regulations applicable to mining operations are summarized in Table 5-1 and described in Sections 5.1 to Section 5.5. The specifics of monitoring for the Project, including the specific locations, nomenclature, frequency, and parameters, will be outlined in the permit applications, and finalized during the permitting process.

In aggregate, the monitoring plan will provide a comprehensive and thorough evaluation of water flow, water elevation, and water quality on a continuous, monthly, or three times a year (first month of non-freezing quarters – approximately April, July, October) basis depending upon the component being monitored. For example, during mine operations stockpile drainage and pit water flow will be monitored continuously, and the quality of these waters will be monitored monthly at multiple locations (when flows are present). Stormwater and surface water quantity and quality will be monitored monthly at multiple locations, and wetland hydrology will be monitored at a frequency yet to be determined at multiple locations during non-frozen conditions. Finally, groundwater quality will be monitored quarterly at multiple monitoring well locations.

A summary of each proposed monitoring plan component is presented below and provided in Large Table 8 to Large Table 12. For each monitoring plan, the tables specify the following:

- Media to be monitored
  - D = drainage
  - GW = groundwater
  - PS = process stream
  - SW = surface water
  - TW = treated water

  Status of Monitoring System:
  - E = existing
  - P = proposed

- Station ID: monitoring station nomenclature as shown in Large Table 8 to Large Table 12
- Location Map: Large Figure 10 to Large Figure 12 provide locations of monitoring stations
- Frequency: the frequency of monitoring
- Parameter Groups(s): Large Table 13 provides lists of monitoring parameters for each plan
- Reporting Requirements: the frequency of monitoring report submittal

Table 5-1 Overview of Monitoring Plans at Mine Site

Monitoring Plan Component		Purpose	Summary	General Locations
Internal Streams	Pit Water (Section 5.1.15.1.1)	Compare water balance with expected conditions. Define future pumping requirements, and evaluate trends in pit water quality.	Continuous flow monitoring and monthly water quality samples at up to four sumps[(1)]	Stations installed to monitor flows and water quality from each pit sumps
	Stockpile Drainage (Section 5.1.25.1.2)	Compare water balance with expected conditions. Define future pumping requirements, and evaluate trends in stockpile drainage water quality.	Continuous flow monitoring and monthly water quality samples at up to twelve locations[(1)]	Stations installed to monitor drainage from each stockpile liner, each stockpile underdrain, and the two Category 1 Waste Rock Stockpile Groundwater Containment System sumps

Monitoring Plan Component		Purpose	Summary	General Locations
Internal Streams (continued)	Overburden Storage and Laydown Area Runoff (Section 5.1.3)	Compare water balance with expected conditions. Define future pumping requirements, and evaluate trends in OSLA water quality.	Continuous flow monitoring and monthly water quality samples in the OSLA pond(1)	Station installed to monitor flows and water quality from the OSLA pond
	Haul Road Runoff (Section 5.1.4)	Compare water balance with expected conditions. Define future pumping requirements, and evaluate trends in haul road water quality.	Continuous flow monitoring and monthly water quality samples in the haul road ponds(1)	Stations installed to monitor flows and water quality from the haul road ponds
	Rail Transfer Hopper Runoff (Section 5.1.5)	Compare water balance with expected conditions. Define future pumping requirements, and evaluate trends in RTH water quality.	Continuous flow monitoring and monthly water quality samples in the RTH pond(1)	Station installed to monitor flows and water quality from the RTH pond
	Waste Water Treatment Facility Influents and Effluents (Section 5.1.6)	Optimize the treatment operations and demonstrate acceptable effluent characteristics.	Continuous flow monitoring and monthly water quality samples in the influent and effluent streams	Inlets and outlet of the Waste Water Treatment Facility
	Treated Water Pipeline Flows (Section 5.1.7)	Compare water balance with expected conditions.	Continuous flow monitoring and monthly water quality samples at the inlet and outlet	Inlet and outlet of the Treated Water Pipeline

Monitoring Plan Component		Purpose	Summary	General Locations
Stormwater	Stormwater (Section 5.2)	Evaluate trends in stormwater quality.	Monthly flow monitoring and water quality sampling at four pond outlets(1)	Stormwater pond outlets
Groundwater	Surficial Aquifer (Section 5.3)	Evaluate groundwater level and water quality trends in the surficial aquifer.	Thirty-three sampling locations sampled approximately April, July, and October	Surficial aquifer monitoring wells installed down gradient of each stockpile and pit
	Bedrock (Section 5.3)	Evaluate groundwater level and water quality trends in the bedrock.	Number of wells are yet to be determined with sampling approximately April, July, and October	Bedrock monitoring well locations are yet to be determined
Wetlands	Wetlands (Section 5.4)	Evaluate potential effects of mining operations on wetlands and determine if the potential indirect impacts from the mining operations have occurred or if additional mitigation is needed.	Number of piezometers and sampling frequency yet to be determined	Continuation of the baseline monitoring program

Monitoring Plan Component		Purpose	Summary	General Locations
Surface Water	Partridge River and Tributaries (Section 5.5.1)	Evaluate trends in surface water quality and flow	Monthly sampling of flow and water quality at nine sampling locations during non-frozen conditions	Partridge River, Longnose Creek, Wetlegs Creek, Wyman Creek, and West Pit Overflow (when applicable)
	Colby Lake and Whitewater Reservoir (Section 5.5.2)	Evaluate trends in water quality in Colby Lake and water levels for Colby Lake and Whitewater Reservoir	Monthly water quality and water level sampling at one location during non-frozen conditions	Colby Lake and Whitewater Reservoir

(1) Water quantity monitoring will occur continuously based on flow meters or pump run times. Water quality monitoring will occur during non-frozen conditions.

These monitoring plan components will be detailed in the Sampling and Analysis Plans (SAP) that will be prepared as part of the permit application process or as required by other regulatory programs. Each SAP will detail the monitoring stations, sampling frequency, sample collection protocol, analytical methods and parameters, and quality assurance requirements. At a minimum, the SAP will consist of a Field Sampling Plan (FSP) and a Quality Assurance Project Plan (QAPP). The FSP will detail the field activities and documentation requirements for the sample collection and management in the field. The field activities and documentation requirements will be organized as Standard Operating Procedures (SOP) specific to the various activities to be performed. The QAPP will detail the data quality objectives for the monitoring plans, summarize the monitoring stations, analytical methods, parameters and quality control limits, data validation procedures, and data management practices.

The SAPs will incorporate analytical methods or standard practices approved by the U.S. Environmental Protection Agency or other agency, as appropriate. Sample collection frequency was selected based on conditions specified in permits for similar operations, and considered potential rate of transport where appropriate. The entire monitoring plan will be finalized in permitting.

5.1 Internal

Key internal waters will be monitored for water quality and quantity or level. Large Table 8 and Large Figure 10 show the details of internal monitoring locations.

5.1.1 Pit Water

The quantity of the pit water delivered to the WWTF will be monitored continuously from the pit dewatering pumps based on flow meters.

The quality of the pit water will be monitored on a monthly basis during non-frozen conditions (approximately April to October).

During East Pit backfilling and during reclamation for the West Pit, the water level in each pit will be monitored on a monthly basis while being flooded.

The water quality in the East, Central, and West Pits will be monitored on a monthly basis during pit flooding.

5.1.2 Stockpile Drainage

The quantity of stockpile drainage delivered to the WWTF will be monitored continuously from the stockpile sump pumps from flow meters.

The quality of the stockpile drainage will be monitored on a monthly basis during non-frozen conditions (approximately April to October). Water quality samples will be taken from stockpile liner system outlet pipes, rather than from sumps or ponds where water quality will be affected by precipitation.

5.1.3 Overburden Storage and Laydown (OSLA) Area Runoff

The quantity of OSLA surface water runoff delivered to the CPS pond or WWTF will be monitored from the OSLA pond pump based on pump run hours with a flow meter.

The quality of the OSLA surface water runoff will be monitored on a monthly basis during non-frozen conditions (approximately April to October).

5.1.4 Haul Road Runoff

The quantity of haul road runoff delivered to the WWTF will be monitored from the haul road pond pumps based on flow meters.

The quality of the haul road runoff will be monitored on a monthly basis during non-frozen conditions (approximately April to October).

5.1.5 Rail Transfer Hopper (RTH) Area Runoff

The quantity of RTH runoff delivered to the WWTF will be monitored continuously from the RTH pond pump based on a flow meter.

The quality of the RTH runoff will be monitored on a monthly basis during non-frozen conditions (approximately April to October).

5.1.6 Waste Water Treatment Facility (WWTF) Influents and Effluent

The quantity of WWTF influent and effluent will be monitored continuously with flow meters.

The quality of WWTF influent and effluent will be monitored on a daily or monthly basis, depending on the parameter being monitored, during non-frozen conditions (approximately April to October).

5.1.7 Treated Water Pipeline (TWP) Flows

The quantity of flow will be monitored continuously with flow meters at the CPS and at the TWP outlet.

The quality of flow at the CPS and at the TWP outlet will be monitored on a monthly basis during non-frozen conditions (approximately April to October).

5.2 Stormwater

Stormwater will be monitored at the perimeter Mine Site stormwater pond outlets as shown on Large Figure 10. Large Table 9 provides the details of stormwater monitoring.

The quantity of stormwater flowing from the Mine Site will be monitored on a monthly basis at each stormwater pond outlet.

The quality of the stormwater flowing from the site will be monitored on a monthly basis at each stormwater pond outlet during non-frozen conditions (approximately April to October).

5.3 Groundwater

Groundwater from the Mine Site generally flows south to the property boundary. Project impacts at the property boundary will be monitored from groundwater monitoring wells and compared to groundwater quality standards.

Groundwater elevation and quality will be monitored quarterly downgradient of the stockpiles and the pits, along with baseline monitoring locations. Large Table 10 shows the details of groundwater monitoring with proposed locations shown on Large Figure 11.

5.4 Wetlands

Wetland hydrology monitoring will be developed as part of wetland permitting and is expected to be similar to the baseline wetland hydrology monitoring program currently underway; see Section 4 of Reference (23) and Large Table 11.

5.5 Surface Water

Key surface waters will be monitored, as listed on Large Table 12 and shown on Large Figure 12.

5.5.1 Partridge River and Tributaries

Groundwater flow from the Mine Site and the Transportation and Utility Corridors generally flows south to the Partridge River and its tributaries (Wetlegs Creek, Longnose Creek, Wyman Creek), as shown on Large Figure 12. Project impacts to this system will be monitored and compared to surface water quality standards.

The Partridge River flow and water quality upstream and downstream of the Project will be monitored on a monthly basis during non-frozen conditions (approximately April to October).

Flow and water quality in Wetlegs Creek, Longnose Creek, and Wyman Creek downstream of the Project will be monitored on a monthly basis during non-frozen conditions (approximately April to October).

5.5.2 Colby Lake and Whitewater Reservoir

Partridge River flows into the east side of Colby Lake and out the west side of Colby Lake. The Whitewater Reservoir water levels are maintained by diverting Colby Lake/Partridge River into the reservoir through gates on the south end of Colby Lake with overflows to the Partridge River from the south end of the reservoir.

Water levels in Colby Lake and Whitewater Reservoir will be monitored on a monthly basis during non-frozen conditions (approximately April to October). Water quality in Colby Lake will be monitored on a monthly basis during non-frozen conditions (approximately April to October).

6.0 Reporting and Adaptive Management

Adaptive management is a system of management practices based on clearly defined outcomes and monitoring requirements to determine if management actions are meeting the desired outcomes; and, if not, implementing changes that will best ensure that outcomes are met or re-evaluated. Adaptive management recognizes the uncertainty associated with estimates based on natural systems as a result of the baseline monitoring data, waste characterization, scale of plan, decisions on modeling inputs and other limiting factors. Adaptive management measures will be developed through the Environmental Review process, permitting, and during operations, reclamation, and long-term closure to define when changes are needed to the proposed water management system.

A key component of adaptive management for water is the Adaptive Water Management Plan (Reference (4)) that describes adaptive engineering controls that manage water quality and quantity. Fixed engineering controls (liners, dikes, ditches, etc.) are described in this plan and other management plans. Contingency mitigations that could be applied if engineering controls do not manage water quality and quantity properly are also described in this document.

6.1 Monthly Reporting

The NPDES/SDS permit and the Water Appropriations permit will require and define routine water quality and quantity reporting and annual reports. The content required for those reports will be defined in those permits.

Routine water quality reports will be submitted to the MPCA, and monthly water quantity reports will be submitted to the MDNR. In addition to water quantity and quality monitoring described in Section 5.0, it is anticipated that routine reports will include:

- sulfur content of ore and waste rock placed in stockpiles
- monthly precipitation
- identification and explanation of variations from permit requirements, if any

6.2 Annual Reporting

An Annual NPDES/SDS Report will be submitted to the MPCA. It is anticipated that it will include:

- a comparison of actual mine pit and stockpile drainage water chemistry to the water chemistry estimated by the Project water quality model from start of operations through the past year

- identification of any changes to the stockpile liners or groundwater containment system made during the last year
- a summary of any previously reported variations from permit requirements during the past year, if any
- identification of any changes to the stockpile liners or groundwater containment system planned for the coming year

An Annual PTM Report will be submitted to the MDNR. A draft version of the Annual PTM Report is included in Reference (1) (Attachment A, to be provided in permitting) and will include:

- the total tons of overburden and waste rock by type placed in stockpiles or mine pits from the start of operations through the past year and the remaining planned capacity
- the average sulfur content (based on the most recent block model) of waste rock placed in stockpiles, used for construction (by construction location), placed in the East Pit from the West and Central Pits and, to the extent practical, from temporary stockpiles (recognizing that the rock placed in the East Pit from temporary stockpiles will not be re-evaluated for sulfur content prior to pit disposal)
- the total tons of overburden and waste rock by type used for constructions from the start of operations through the past year and remaining planned applications
- a map showing where waste rock and overburden were placed and where vegetation was established for reclamation during the past year
- a map showing where overburden and waste rock are planned to be placed and where vegetation is planned to be established for reclamation during the coming year
- identification of any planned changes in operations that could impact final reclamation
- an update of the waste rock waste characterization program
- an update of any Special Performance Monitoring defined in Reference (4)
- an update on the results of any Test Projects defined in Reference (4)

An Annual Appropriations Report will be submitted to the MDNR. This appropriation report will include the monitoring data collected in accordance with the permit including:

- monthly records of the amount of water appropriated or used for each appropriation

- total amount of water appropriated for the year

6.3 Annual Comparison to Model

Annual reports will include comparison of actual water quantity and quality to the quantity and quality estimated by the Project water quality model updated with the most recent monitoring data for the conditions existing at the time of the report.

6.4 Model Refinements

The Project water model developed in Reference (2) is an integrated model that includes all aspects of the Project. If the annual comparison of the model shows differences that can be logically explained as being caused by modeling assumptions that have been demonstrated to be incorrect, the model will be refined.

The adjusted model will be used to update the Project water quantity and quality estimates. If the update indicates that outcomes will not be acceptable, adaptive management will be initiated as described in Section 6.5.

6.5 Adaptive Management

There are adaptive management actions that could be implemented if there is an exceedance of a surface or groundwater standard detected as part of water quality monitoring or the water model projects a future exceedance of surface or groundwater standards given observed conditions. In general the steps will be:

1. Initiate any field studies that may be necessary to determine the root cause of the exceedance.
2. Once the root cause is identified, implement any adjustments that can be made to the adaptive engineering controls described in Reference (4) that will remedy the root cause. Adjustments to the adaptive engineering controls include changing the scale or type of control and its design.
3. If the modeled exceedances persist, implement contingency mitigation (Section 6.66.6) that will remedy the root cause and include that contingency mitigation as an adaptive engineering control in Reference (4).
4. Monitor and model effects to the environment with new or adjusted engineering control. If issue persists, begin step 1 again.

6.6 Contingency Mitigations

If monitoring or refined model estimates with adaptive engineering controls show that water quantity or quality at compliance points are projected to not meet compliance parameters, mitigations are available that would address the following situations. The contingency mitigations described in the following paragraphs are feasible but depend on site-specific conditions and do not include modifications to adaptive engineering controls which are described in Reference (4). These mitigations would be developed and designed if needed and coordinated with the MDNR and MPCA as appropriate.

A. A pattern of overflows of the process water sumps or ponds develop.

   i. As described in Section 4.4, there is excess capacity designed as a safety factor in all the process water sumps and ponds ranging from approximately 30 to 170% of required capacity. Additional capacity could be developed by expanding the pond areas.

B. Streams along the railroad corridor between the Mine Site and Plant Site show degradation in water quality as a result of material spilled from the rail cars.

   i. The PTM application will include details of the loading, unloading, and transport of ore and the engineering controls and procedures that will be used to minimize the potential of ore spillage along the railroad corridor. If degradation of water quality is found as a result of ore spillage, catchment areas could be developed adjacent to the tracks at stream crossings to further minimize the amount of spilled material that reaches the streams. Solids in the catchment areas would be removed and placed in the Process Plant, Category 4 Waste Rock Stockpile, or the East Pit.

C. Groundwater downgradient of lined infrastructure or the mine pits has compliance issues.

   i. Interception wells could collect groundwater flows impacted by a leak from one of the liner systems. Water collected by interception wells would be pumped to the WWTF or an approved non-mechanical treatment system for treatment. Because all liner systems at the Mine Site are for temporary infrastructure (temporary stockpiles, temporary ponds, etc.), the interception wells would only be needed while the liner is in use or until a liner repair could be performed.
   ii. Interception wells could collect groundwater flows impacted by pit overflow into the surficial aquifer. Water collected by interception wells would be pumped to the WWTF or an approved non-mechanical treatment system for treatment.
   iii. Groundwater outflows from the pits could be contained by the use of injection grouting or grout curtains, as described in PolyMet's conceptual plan for bedrock groundwater flow mitigation (Reference (24)).

D. West Pit water quality is worse than expected.

   i. The contaminant load from the West Pit walls could be reduced by several methods:

a. Once the West Pit reaches its full water level, dams could be constructed in the low areas of the pit rim to raise the water level, decreasing the amount of exposed wall rock.

b. A low permeability soil barrier could be constructed along the Ore Grade Material portions of the exposed pit wall such that the groundwater level rises in that area to an elevation above the top of the exposed Ore Grade Material. This would effectively create a wetland over this material, holding water over the exposed material, and limiting groundwater flow through the material.

ii. The contaminant load to the West Pit from the East Pit could be reduced by several methods:

a. A low permeability soil barrier could be constructed along the Virginia Formation portion of the exposed pit wall such that the groundwater level rises in that area to an elevation above the top of the exposed Virginia Formation. This would effectively create a wetland over this material, holding water over the exposed material, and limiting groundwater flow through the material.

b. A Permeable Reactive Barrier (PRB) could be installed in the East Pit outlet channel to remove contaminates. Use of PRBs to remove sulfate, trace metals, and other dissolved or suspended constituents from water is described in detail in Section 6 of Reference (4).

c. The water leaving the East Pit could be pumped to the WWTF for treatment before flowing to the West Pit.

iii. Injection grouting or grout curtains could be used to minimize groundwater inflows to the pits, as described in PolyMet's conceptual plan for bedrock groundwater flow mitigation (Reference (24)).

iv. The West Pit water could be diluted by routing additional stormwater to the West Pit.

v. The West Pit could be treated by several methods:

a. The West Pit water could be pumped to the WWTF, treated, and returned to the West Pit.

b. The West Pit lake could be treated in-situ with iron salts, fertilizer, or other methods tailored to the contaminant of concern. For example, Alexco is the industry leader for pit lake remediation and has technologies that have successfully treated billion gallon pit lakes for contaminants including selenium, zinc, uranium, and nitrate. Alexco's technologies have been successfully applied at numerous sites and locations and have demonstrated successful remediation.

7.0 Reclamation and Long-Term Closure

Reclamation information included in this document is for the Mine Site water management systems only. This includes incremental reclamation, final reclamation, and long-term closure activities. Reclamation information for the mine pits is in Reference (1). Reclamation information for the stockpiles is in Reference (3). Reclamation information for other Mine Site infrastructure is included in Reference (6).

7.1 Incremental Reclamation

The Category 2/3 and 4 Waste Rock Stockpiles are temporary and, starting in Mine Year 11, the waste rock and Saturated Overburden materials in the stockpiles will be relocated to the East and Central Pits for ultimate disposal. The Category 4 Waste Rock Stockpile will be completely removed and dismantled in Mine Year 11, with stripping of the Central Pit occurring in that same year. The Category 2/3 Waste Rock Stockpile will be relocated to the East Pit starting in Mine Year 12 and continuing through Mine Year 19. Reclamation of the former temporary stockpile footprints will occur incrementally as large areas of the stockpile are removed to make it efficient to complete reclamation. This will include portions of the temporary Category 4 Waste Rock Stockpile that are outside the extent of the Central Pit and the entire footprint of the Category 2/3 Waste Rock Stockpile. Reclamation will also include removal of all piping, pump systems, and liner systems associated with the stockpile foundations and the stockpile sumps and ponds. Once these systems have been removed, the stockpile, sump, and pond footprints will be reclaimed into a mixture of upland and wetland areas, depending on the ultimate elevation of the remaining materials. Once reclamation in these areas is complete, the haul roads to these areas will also be scarified and seeded to allow continued access by small vehicles only for long-term monitoring.

7.2 Final Reclamation

Once mining operations in the West Pit are complete, final reclamation at the Mine Site will begin. During this time the West Pit will be flooded, as described in Section 6.2.6 of Reference (1) and Section 2.1.1 of Reference (4). Large Figure 13 shows infrastructure that will be removed or reclaimed during reclamation, and Large Figure 14 shows the Mine Site infrastructure that will remain for long-term closure.

7.2.1 Perimeter and Interior Dikes

The perimeter dike located north of the Central and East Pits will be maintained in order to minimize mixing of Partridge River flows with the East Pit water. Perimeter dikes located on the north side of the Category 1 Waste Rock Stockpile and along the west boundary of the Mine Site will be maintained to provide access to groundwater monitoring locations.

Most pit rim dikes will be removed. During reclamation, stormwater runoff within the Mine Site will be routed to the mine pits using a combination of existing and new ditches (Section 7.2.2). Some portions of the pit rim dikes will remain in place during reclamation if they are needed to prevent an uncontrolled discharge inflow to the pits and potential erosion (headcutting) of the pits walls. A more detailed evaluation of this requirement will be conducted prior to Mine Year 20.

Material will be removed from the main body of the dikes and will be used at the site for restoration of disturbed surfaces prior to reclamation. To minimize disturbance of subsurface soils, the subsurface seepage control component of the dikes will remain in place. Typical construction erosion control measures will be taken as part of the dike removal work, such as installing silt fence on the down slope side of disturbed areas and control of surface water runoff. The reclaimed surface will be scarified, topsoil placed, and the area will be revegetated, as described in PolyMet's Reclamation Seeding and Mulching Procedure (Attachment A of Reference (6)).

7.2.2 Ditch Filling and Rerouting

Large Figure 14 shows the proposed alignment of ditches that will be maintained to direct stormwater into the West Pit for flooding. Use of ditches that already exist in Mine Year 20 will been maximized, but a few new ditches may need to be constructed to direct stormwater runoff into the East or West Pits during reclamation. New ditches will be designed using the same criteria as other stormwater ditches at the Mine Site (Section 2.2.3). Reclamation of ditches will include either installing ditch blocks or filling, covering with topsoil, and vegetating the restored surface.

7.2.3 Stormwater and Process Water Pond Restoration

At closure, the stormwater sedimentation ponds, the process water ponds, and the remaining stockpile sumps and overflow ponds will be reclaimed by developing wetlands or by filling, covering with topsoil, and revegetating the area (Large Figure 13). Outlet control structures from Ponds A and B will remain in-place to prevent Partridge River floodwater from entering the Mine Site. Outlet control structures from Ponds C (East) and D will remain in-place to direct water under Dunka Road and the railroad to the Partridge River along natural drainage paths. The overflow weir in Pond C (West) will be modified to create a more natural transition to the remaining stormwater ditch.

The process water sumps and ponds may require cleanout and removal of the geomembrane liner in closure. Material removed from the ponds will be disposed of in the pits or an approved landfill.

7.2.4 Pipe and Pump Removal

During reclamation, all process water pipes and pumps will be removed and recycled or abandoned in place except those used for the flooding of the West Pit or recycling of the East or West Pit water.

7.2.5 Central Pumping Station and Treated Water Pipeline Removal

Once no longer necessary, the CPS building will be reclaimed and vegetated according to Minnesota Rules, part 6132.2700 by a qualified reclamation contractor. The CPS pond will be reclaimed as a wetland or filled, covered with topsoil, and revegetated.

The TWP will be removed, recycled or disposed, or abandoned in place. The area disturbed by these activities will be revegetated.

7.3 Long-Term Closure

Monitoring, reporting, and water treatment will continue after the reclamation process is complete, until release from these activities is granted via the PTM. If any of the monitoring data shows that additional work is needed, a plan will be created and implemented to further improve water quality. During long-term closure, the water level in the West Pit will be maintained below the natural overflow elevation by discharging treated water to a small watercourse south of the West Pit that flows off-site to the Partridge River, as shown on Large Figure 14. The discharged water will have been pumped from the West Pit to the WWTF for treatment to meet the appropriate water discharge limits as described in Section 2.2 of Reference (4) prior to discharge. The ultimate objective is to transition from the mechanical treatment provided by the WWTF to a non-mechanical treatment system once the non-mechanical treatment system has been demonstrated to provide the required water treatment. Potential non-mechanical treatment systems, including construction of an outlet structure from the West Pit, are described in Section 6 of Reference (4).

7.3.1 Monitoring and Reporting

The monitoring and reporting described in Section 5.05.0 and Section 6.06.0 will continue until the MDNR releases the company from doing so under the PTM and the MPCA releases the company from doing so under the NPDES/SDS permit.

7.3.2 Water Treatment

As described in Section 2.0 of Reference (3), the Saturated Overburden and waste rock in the Category 2/3 and Category 4 waste rock stockpiles will be relocated to the East Pit. This will result in a flushing of oxidation products into the East Pit water. As the East and West Pits flood with water, oxidation products that have accumulated on the pit wall rock will be flushed into the pits as the water level rises.

The flushed oxidation products will be removed from the West and East Pits by pumping the pit water to the WWTF for treatment and returning the treated water to the pits. The potential for pit stratification in the West and East Pits is discussed in Section 6.1.3 of Reference (2).

For long-term closure, water treatment is expected to continue until the West Pit water quality reaches an acceptable level, as described in Section 2 of Reference (4). The WWTF will be maintained operable until MDNR releases the company from doing so under the PTM.

7.4 Contingency Reclamation Estimates

The following section provides an overview of the contingency reclamation plan for Mine Year 0 and Mine Year 1. For more specific details on reclamation and the associated cost estimates, see the permit-level version of the Reclamation Plan with the contingency reclamation estimates that will be part of the PTM application.

7.4.1 Contingency Reclamation Plan (Mine Years 0 and 1)

7.4.1.1 Mine Year 0 (end of construction/development)

If closure were to occur at the end of Mine Year 0, there will be no waste rock in the stockpiles, no ore in the OSP, and no mine pits. Stripping of the East Pit will have begun. The stockpiles and OSP foundations will be the size shown in Large Figure 4. The WWTF will be of limited operability for treatment, consisting only of the East EQ Basin and Construction Water Treatment Building for treating construction water. The activities described in Section 7.2 and Section 7.3 will be implemented. Key parameters driving reclamation costs for water management systems are shown in Table 7-1, which will be developed based on the permit-level design for the contingency reclamation cost estimate for the PTM application.

Table 7-1 Key Reclamation Cost Parameters – PLACEHOLDER

Key Parameter	Removal / Reclamation	Construction	Monitoring	Treatment
Stormwater Dikes	TBD	N/A	TBD	N/A
Stormwater Ditches	TBD	TBD	TBD	N/A
Stormwater Ponds	TBD	N/A	TBD	N/A
Process Water Ponds	TBD	N/A	TBD	N/A
Pipes	TBD	N/A	N/A	N/A
WWTF	N/A	N/A	TBD	TBD

This plan is used to develop the Mine Year 0 Contingency Reclamation Estimate that will be the basis for financial assurance required by Minnesota Rules, part 6132.1200, which is required before a PTM can be granted.

7.4.1.2 Mine Year 1 (end of first year of operations)

If closure were to occur at the end of Mine Year 1, the activities described in Section 7.2 and Section 7.3 will be implemented. Development of the Mine Site will be as shown in Large Figure 4 and Large Figure 7. Only the East Pit will be developed, with stripping of the West Pit not yet started. Key parameters driving reclamation costs for water management systems are shown in Table 7-2, which will be developed based on the permit-level design for the contingency reclamation cost estimate for the PTM application.

Table 7-2 Key Reclamation Cost Parameters – PLACEHOLDER

Key Parameter	Removal / Reclamation	Construction	Monitoring	Treatment
Stormwater Dikes	TBD	N/A	TBD	N/A
Stormwater Ditches	TBD	TBD	TBD	N/A
Stormwater Ponds	TBD	N/A	TBD	N/A
Process Water Ponds	TBD	N/A	TBD	N/A
Pipes	TBD	N/A	N/A	N/A
WWTF	N/A	N/A	TBD	TBD

This plan will be used to develop the contingency reclamation estimate that will be the basis for financial assurance required by Minnesota Rules, part 6132.1200 the first or second calendar year (depending on construction progress) after the issuance of the PTM. The Reclamation Plan and contingency reclamation estimate will be updated annually to include contingency reclamation for the site conditions representative of the end of the upcoming year of operation.

Revision History

Date	Version	Description
11/30/2011	1	Initial release
01/09/2013	2	Significant changes to incorporate project changes related to the decisions made in the AWMP Version 4 and 5. These project changes include the extension of the groundwater containment system along the south side of the stockpile, the use of a geomembrane cover on the Category 1 Waste Rock Stockpile, the use of long-term mechanical treatment and the potential for non-mechanical treatment in long-term closure.
12/31/2014	3	Changes were made for clarification, to address agency comments (Sections 1.0, 1.1, 1.2, 1.3.2, 1.4, 2.1.1, 2.1.4.1.1, 2.1.4.1.2, 2.1.5.1, 2.1.7, 2.2.4.1, 4.0, 4.1, 4.2, 4.4.1, 4.4.2, 5.0, 5.1.6, 5.3, 6.0, 6.2, 6.3, 6.5, 6.6, 7.2.1), to incorporate minor design changes and project refinements (Sections 2 and 4), and to incorporate the results of water modeling (Section 3).
03/09/2015	4	Minor changes were made to address agency comments (Sections 1.0, 1.2, 1.3.1, 1.3.2, 2.1, 2.1.5.1, 2.1.6, 3.1, 5.0, 5.1.1, 5.1.2, 5.1.3, 5.1.3, 5.1.4, 5.1.5, 5.5.2, 6.1, 6.2, 6.6, and 7.2.3, Large Table 8, and Large Figure 12)

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Large Table 1 Estimated West Pit Lake Water Quality

Constituent	Mine Year	Surface Water Quality Standard[1]	Mine Year 25[1]			Mine Year 55[1], [3]			Mine Year 75[1], [4]		
	Percentile / Units		Average P10[2]	Average P50[2]	Average P90[2]	Average P10[2]	Average P50[2]	Average P90[2]	Average P10[2]	Average P50[2]	Average P90[2]
Ag (Silver)	µg/L	1	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Al (Aluminum)	µg/L	125	0.93	1.41	2.15	0.93	1.41	2.15	0.93	1.41	2.15
Alkalinity	mg/L	--	34.82	39.69	51.12	34.82	39.69	51.12	34.82	39.69	51.12
As (Arsenic)	µg/L	53	10.88	13.59	18.77	8.88	10.81	14.88	7.98	9.72	13.32
B (Boron)	µg/L	500	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Ba (Barium)	µg/L	--	28.13	30.30	31.29	28.12	36.05	38.22	26.95	36.88	39.50
Be (Beryllium)	µg/L	--	0.40	0.40	0.40	0.35	0.40	0.40	0.32	0.40	0.40
Ca (Calcium)	mg/L	--	49.34	54.98	70.72	34.31	38.74	49.46	30.80	34.72	44.77
Cd (Cadmium)[5]	µg/L	2.6	1.16	1.89	4.72	0.77	1.50	**3.88**	0.68	1.41	**3.63**
Cl (Chloride)	mg/L	230	12.53	13.42	15.41	8.16	10.64	14.99	7.29	9.54	13.35
Co (Cobalt)	µg/L	5	21.90	52.83	113.41	**17.21**	**38.25**	**80.09**	**15.47**	**33.99**	**73.49**
Cr (Chromium)	µg/L	11	3.86	4.00	4.14	2.37	2.57	2.91	2.10	2.29	2.59
Cu (Copper)[5]	µg/L	9.8	118.98	236.74	656.69	**118.98**	**236.74**	**654.58**	**118.98**	**236.74**	**654.58**
F (Fluoride)	mg/L	--	0.28	0.32	0.35	0.20	0.25	0.31	0.18	0.22	0.27
Fe (Iron)	µg/L	--	45.83	59.87	199.13	45.83	59.87	199.13	45.83	59.87	199.13
K (Potassium)	mg/L	--	12.83	14.19	17.31	7.96	10.00	13.71	7.06	8.85	12.05
Mg (Magnesium)	mg/L	--	32.72	35.27	39.74	14.42	15.84	18.88	12.98	14.27	16.94
Mn (Manganese)	µg/L	--	191.36	232.02	311.95	126.32	146.00	198.30	121.08	139.69	188.04
Na (Sodium)	mg/L	--	43.69	50.32	63.67	25.82	34.11	52.18	23.12	30.32	46.09
Ni (Nickel)[5]	µg/L	54.6	330.95	683.53	1466.24	**269.24**	**488.73**	**902.46**	**241.09**	**433.22**	**801.56**
Pb (Lead)[5]	µg/L	3.4	7.62	11.46	20.93	**5.61**	**7.87**	**11.89**	**5.10**	**7.06**	**10.55**
Sb (Antimony)	µg/L	31	9.90	11.21	13.67	6.37	7.68	9.56	5.64	6.83	8.50
Se (Selenium)	µg/L	5	0.25	2.71	3.40	0.25	1.78	2.41	0.25	1.61	2.17
SO4 (Sulfate)	mg/L	--	95.11	104.71	124.55	48.35	56.77	68.54	43.15	50.86	61.90
Tl (Thallium)	µg/L	0.56	0.11	0.12	0.13	0.08	0.08	0.09	0.07	0.08	0.09
V (Vanadium)	µg/L	--	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Zn (Zinc)[5]	µg/L	125.4	86.02	115.60	274.24	63.58	98.58	**229.45**	57.38	95.73	**221.91**

(1) Surface water quality standard only applies at overflow, and therefore is only compared to Mine Years 55 and 75; values for those years above the applicable water quality standard are shown in bold with light red shading.
(2) Values shown are the average of the monthly P10, P50, and P90 values, as indicated, for the referenced Mine Year; see Section 6.2 of Reference (2).
(3) Flooding of the West Pit has a 90% probability of being complete by the end of Mine Year 55.
(4) Concentrations in the West Pit are typically stable or trending downward in long-term closure.
(5) Standard is hardness-based and evaluated at a hardness of 105.5 mg/L; see Section 6.5.3 of Reference (2) for surface water monitoring station SW004a, which is downstream of the West Pit discharge.

Large Table 2 Estimated Surficial Groundwater Quality along the East Pit-Category 2/3 Stockpile Flow Path at the Property Boundary

Constituent	Mine Year	Water Quality Standard	Mine Year 10			Mine Year 30			Mine Year 75			Mine Year 150			Mine Year 200[2]		
	Percentile		Average P10[1]	Average P50[1]	Average P90[1]	Average P10[1]	Average P50[1]	Average P90[1]	Average P10[1]	Average P50[1]	Average P90[1]	Average P10[1]	Average P50[1]	Average P90[1]	Average P10[1]	Average P50[1]	Average P90[1]
	Units																
Ag (Silver)	µg/L	30	0.11	0.11	0.11	0.11	0.12	0.14	0.11	0.11	0.11	0.11	0.12	0.13	0.11	0.12	0.13
Al (Aluminum)[3]	µg/L	--	49.64	54.05	58.90	72.17	134.72	335.31	49.89	55.17	70.97	43.76	49.95	56.02	42.94	47.52	53.35
Alkalinity	mg/L	--	61.71	64.55	67.52	61.69	64.53	67.51	61.57	64.45	67.49	57.04	61.87	65.82	55.70	60.17	64.50
As (Arsenic)	µg/L	10	0.67	0.72	0.76	0.67	0.72	0.76	0.67	0.72	0.76	0.67	0.72	0.76	0.67	0.72	0.76
B (Boron)	µg/L	1,000	26.60	27.03	27.47	26.67	27.12	27.59	26.63	27.10	27.71	26.92	27.95	29.74	26.96	27.69	28.89
Ba (Barium)	µg/L	2,000	29.41	31.36	33.44	29.38	31.35	33.43	29.41	31.35	33.43	28.71	31.60	34.69	26.57	30.32	34.59
Be (Beryllium)[4]	µg/L	0.45	0.12	0.12	0.12	0.12	0.12	0.13	0.12	0.12	0.12	0.12	0.13	0.15	0.12	0.13	0.15
Ca (Calcium)	mg/L	--	14.84	15.45	16.09	15.09	15.80	16.65	14.89	15.56	16.37	14.35	15.63	17.21	13.96	14.91	16.29
Cd (Cadmium)	µg/L	4	0.10	0.10	0.10	0.11	0.12	0.19	0.10	0.10	0.13	0.10	0.14	0.28	0.11	0.13	0.20
Cl (Chloride)	mg/L	250	0.62	0.65	0.69	0.62	0.66	0.70	0.62	0.66	0.98	0.69	1.34	2.71	0.82	0.99	2.13
Co (Cobalt)	µg/L	--	0.79	0.87	0.98	1.19	2.76	10.42	0.80	0.92	2.20	0.94	1.78	3.48	1.06	1.52	2.73
Cr (Chromium)	µg/L	100	0.89	0.93	0.98	0.90	0.94	0.99	0.89	0.94	0.99	0.84	0.94	1.03	0.81	0.89	0.99
Cu (Copper)	µg/L	--	2.30	2.49	2.69	2.30	2.49	2.69	2.30	2.49	2.69	2.31	2.49	2.69	2.32	2.51	2.70
F (Fluoride)	mg/L	2	0.07	0.07	0.08	0.07	0.07	0.08	0.07	0.07	0.08	0.07	0.08	0.11	0.07	0.07	0.10
Fe (Iron)[3]	µg/L	--	1,217.80	1,427.00	1,673.30	1,235.30	1,451.00	1,714.00	1,215.80	1,423.70	1,674.80	1,109.20	1,318.10	1,562.20	1,077.80	1,273.30	1,496.40
K (Potassium)	mg/L	--	1.63	1.69	1.74	1.66	1.72	1.78	1.64	1.70	1.98	1.64	2.33	3.75	1.55	1.81	3.03
Mg (Magnesium)	mg/L	--	6.67	6.96	7.26	6.82	7.14	7.70	6.71	7.00	7.36	6.49	7.01	7.63	6.33	6.72	7.27
Mn (Manganese)[3],[4]	µg/L	1,002	477.87	551.07	635.44	485.10	558.64	644.69	477.65	550.89	635.37	436.35	516.97	599.18	423.87	497.62	576.79
Na (Sodium)	mg/L	--	5.12	5.35	5.57	5.20	5.44	5.70	5.16	5.40	6.42	5.19	7.50	12.75	4.88	5.71	10.06
Ni (Nickel)	µg/L	100	1.86	2.01	2.18	1.86	2.01	2.18	1.86	2.02	2.18	1.88	2.04	2.23	1.91	2.08	2.35
Pb (Lead)	µg/L	--	0.57	0.61	0.65	0.62	0.68	0.85	0.57	0.62	0.66	0.60	0.72	0.85	0.64	0.78	0.86
Sb (Antimony)	µg/L	6	0.25	0.25	0.25	0.25	0.25	0.26	0.25	0.26	0.32	0.26	0.28	0.35	0.26	0.27	0.33
Se (Selenium)	µg/L	30	0.52	0.52	0.53	0.53	0.56	0.64	0.52	0.53	0.56	0.50	0.55	0.65	0.49	0.51	0.61
SO4 (Sulfate)	mg/L	250	9.15	9.62	10.15	10.01	11.30	15.84	9.19	9.83	11.37	9.39	11.35	15.76	9.17	10.09	13.71
Tl (Thallium)	µg/L	0.6	0.12	0.12	0.13	0.12	0.12	0.13	0.12	0.12	0.13	0.11	0.12	0.13	0.11	0.12	0.12
V (Vanadium)	µg/L	50	3.50	3.62	3.75	3.52	3.64	3.77	3.50	3.64	3.78	3.59	4.08	4.61	3.49	4.20	4.66
Zn (Zinc)	µg/L	2,000	4.21	4.36	4.54	4.72	6.22	12.06	4.24	4.46	6.62	4.55	9.19	18.24	5.81	8.49	14.68

NOTE: Values above the applicable water quality standard are shown in bold with light red shading.
(1) Values shown are the average of the monthly P10, P50, and P90 values, as indicated, for the referenced Mine Year; see Section 6.3 of Reference (2).
(2) Model runs evaluated through Mine Year 200.
(3) Not evaluated against the secondary groundwater standard.
(4) Evaluated against the site-specific evaluation criteria shown.

Large Table 3 Estimated Surficial Groundwater Quality along the West Pit Flow Path at the Property Boundary

Constituent	Mine Year / Percentile / Units	Water Quality Standard	Mine Year 50 Average P10(1)	Mine Year 50 Average P50(1)	Mine Year 50 Average P90(1)	Mine Year 75 Average P10(1)	Mine Year 75 Average P50(1)	Mine Year 75 Average P90(1)	Mine Year 150 Average P10(1)	Mine Year 150 Average P50(1)	Mine Year 150 Average P90(1)	Mine Year 200(2) Average P10(1)	Mine Year 200(2) Average P50(1)	Mine Year 200(2) Average P90(1)
Ag (Silver)	µg/L	30	0.11	0.11	0.11	0.11	0.11	0.13	0.14	0.15	0.16	0.15	0.16	0.16
Al (Aluminum)(3)	µg/L	--	49.54	53.99	58.87	43.07	52.63	58.21	25.16	28.14	36.09	24.85	27.62	30.69
Alkalinity	mg/L	--	61.71	64.55	67.52	59.57	63.79	67.09	49.38	53.01	59.06	49.10	52.33	57.77
As (Arsenic)	µg/L	10	0.67	0.72	0.76	0.67	0.72	0.76	0.67	0.72	0.76	0.67	0.72	0.76
B (Boron)	µg/L	1,000	26.59	27.03	27.47	26.70	27.41	44.44	52.40	63.08	65.67	55.42	61.52	65.13
Ba (Barium)	µg/L	2,000	29.41	31.36	33.44	29.55	31.62	33.62	27.25	33.67	36.60	24.74	33.32	38.14
Be (Beryllium)(4)	µg/L	0.45	0.12	0.12	0.12	0.12	0.12	0.18	0.19	0.24	0.27	0.17	0.22	0.26
Ca (Calcium)	mg/L	--	14.82	15.43	16.07	14.98	15.81	21.26	20.35	22.60	27.00	17.80	20.03	24.11
Cd (Cadmium)	µg/L	4	0.10	0.10	0.10	0.10	0.11	0.47	0.32	0.64	1.73	0.28	0.56	1.73
Cl (Chloride)	mg/L	250	0.62	0.65	0.69	0.63	0.68	3.26	3.08	4.27	5.80	2.70	3.55	5.06
Co (Cobalt)	µg/L	--	0.77	0.85	0.94	0.80	0.96	10.40	6.34	14.11	30.82	5.80	11.40	26.67
Cr (Chromium)	µg/L	100	0.89	0.93	0.98	0.90	0.96	1.35	1.29	1.44	1.60	1.12	1.23	1.47
Cu (Copper)	µg/L	--	2.30	2.49	2.69	2.30	2.49	2.69	2.30	2.49	2.69	2.30	2.49	2.69
F (Fluoride)	mg/L	2	0.07	0.07	0.08	0.07	0.07	0.12	0.11	0.13	0.16	0.10	0.11	0.14
Fe (Iron)(3)	µg/L	--	1,217.80	1,427.10	1,673.30	1,089.10	1,376.70	1,652.40	642.89	778.48	1,029.80	634.53	753.62	913.80
K (Potassium)	mg/L	--	1.63	1.69	1.74	1.65	1.73	3.70	3.62	4.53	5.82	3.06	3.82	5.11
Mg (Magnesium)	mg/L	--	6.67	6.95	7.25	6.72	7.11	9.39	8.77	9.68	10.96	7.76	8.52	9.94
Mn (Manganese)(3),(4)	µg/L	1,002	477.78	551.04	635.42	446.63	532.35	621.33	307.76	350.13	429.52	297.51	337.82	387.57
Na (Sodium)	mg/L	--	5.12	5.34	5.57	5.18	5.49	12.72	11.68	15.12	22.23	10.00	12.80	18.37
Ni (Nickel)	µg/L	100	1.86	2.01	2.18	1.86	2.01	2.18	1.86	2.01	2.18	1.86	2.01	2.18
Pb (Lead)	µg/L	--	0.57	0.61	0.65	0.58	0.65	2.35	2.34	3.23	4.88	2.10	2.76	4.07
Sb (Antimony)	µg/L	6	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.27
Se (Selenium)	µg/L	30	0.51	0.52	0.53	0.51	0.53	0.77	0.41	0.94	1.18	0.39	0.82	1.07
SO4 (Sulfate)	mg/L	250	9.11	9.58	10.08	9.25	10.00	21.62	21.60	26.19	31.65	18.74	22.15	28.46
Tl (Thallium)	µg/L	0.6	0.12	0.12	0.13	0.11	0.12	0.13	0.09	0.10	0.11	0.09	0.09	0.10
V (Vanadium)	µg/L	50	3.50	3.62	3.75	3.53	3.69	5.17	5.79	6.77	7.02	6.57	6.82	7.03
Zn (Zinc)	µg/L	2,000	4.18	4.34	4.50	4.26	4.57	29.09	25.42	45.04	105.51	22.13	42.11	106.05

NOTE: Values above the applicable water quality standard are shown in bold with light red shading.
(1) Values shown are the average of the monthly P10, P50, and P90 values, as indicated, for the referenced Mine Year; see Section 6.3 of Reference (2).
(2) Model runs evaluated through Mine Year 200.
(3) Not evaluated against the secondary groundwater standard.
(4) Evaluated against the site-specific evaluation criteria shown.

Large Table 4 Estimated Surface Water Quality for the Partridge River at SW004

Constituent	Mine Year	Water Quality Standard	Mine Year 20			Mine Year 55			Mine Year 75			Mine Year 125			Mine Year 200[2]		
	Percentile		Average P10[1]	Average P50[1]	Average P90[1]	Average P10[1]	Average P50[1]	Average P90[1]	Average P10[1]	Average P50[1]	Average P90[1]	Average P10[1]	Average P50[1]	Average P90[1]	Average P10[1]	Average P50[1]	Average P90[1]
	Units																
Ag (Silver)	μg/L	1	0.10	0.11	0.11	0.10	0.11	0.11	0.10	0.10	0.11	0.10	0.10	0.11	0.10	0.10	0.11
Al (Aluminum)	μg/L	125	30.09	70.35	**244.71**	30.78	70.81	**246.21**	44.88	96.38	**254.55**	41.59	95.87	**257.23**	43.47	94.89	**270.05**
Alkalinity	mg/L	--	25.47	73.28	129.93	24.53	72.90	128.45	19.11	54.26	145.87	18.43	53.13	129.76	19.06	52.69	130.10
As (Arsenic)	μg/L	53	0.20	0.88	2.36	0.20	0.88	2.13	0.13	0.56	2.17	0.12	0.56	2.50	0.12	0.56	2.19
B (Boron)	μg/L	500	18.86	81.35	162.27	17.75	81.37	195.40	9.95	36.47	158.70	9.89	35.92	161.46	10.71	36.56	192.83
Ba (Barium)	μg/L	--	2.67	9.54	18.12	2.66	9.68	18.30	2.09	9.30	27.59	2.12	9.39	27.91	2.01	9.30	27.85
Be (Beryllium)	μg/L	--	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.12	0.10	0.10	0.12	0.10	0.10	0.12
Ca (Calcium)	mg/L	--	6.99	19.94	33.58	6.76	20.03	33.39	5.10	13.71	33.37	5.01	13.50	33.05	5.18	13.77	31.95
Cd (Cadmium)[3]	μg/L	2.5	0.03	0.08	0.14	0.03	0.08	0.14	0.02	0.07	0.15	0.02	0.07	0.15	0.02	0.07	0.15
Cl (Chloride)	mg/L	230	1.69	8.29	15.00	1.72	8.33	16.26	0.64	2.45	13.68	0.61	2.51	15.06	0.59	2.37	13.58
Co (Cobalt)	μg/L	5	0.06	0.32	0.89	0.06	0.33	0.83	0.04	0.38	1.27	0.05	0.38	1.09	0.05	0.38	0.98
Cr (Chromium)	μg/L	11	0.23	0.57	1.15	0.24	0.57	1.20	0.20	0.63	1.25	0.20	0.63	1.29	0.23	0.63	1.34
Cu (Copper)[3]	μg/L	9.5	0.44	1.15	2.68	0.41	1.17	2.79	0.41	1.43	3.11	0.43	1.43	3.15	0.39	1.42	3.20
F (Fluoride)	mg/L	--	0.03	0.09	0.18	0.03	0.09	0.18	0.02	0.07	0.20	0.02	0.07	0.19	0.02	0.06	0.18
Fe (Iron)	μg/L	--	549.50	1,838.05	4,718.10	551.61	1,844.31	4,406.60	441.44	1,467.87	5,267.90	396.27	1,453.83	4,813.50	461.71	1,433.34	4,737.80
K (Potassium)	mg/L	--	0.59	2.05	3.59	0.58	2.03	3.63	0.37	1.32	3.83	0.40	1.38	5.03	0.43	1.35	3.96
Mg (Magnesium)	mg/L	--	4.19	10.27	14.56	4.31	10.17	14.50	3.23	6.64	14.15	3.28	6.72	12.77	3.32	6.73	13.82
Mn (Manganese)	μg/L	--	13.94	131.67	277.54	15.31	132.79	281.62	9.24	141.46	498.47	8.45	141.73	504.29	8.53	141.72	502.25
Na (Sodium)	mg/L	--	1.31	6.69	12.17	1.24	6.73	11.45	0.56	3.23	10.53	0.62	3.30	13.07	0.62	3.25	11.29
Ni (Nickel)[3]	μg/L	53.3	0.24	0.93	2.56	0.25	0.95	2.97	0.20	1.12	3.28	0.19	1.13	3.37	0.22	1.14	3.28
Pb (Lead)[3]	μg/L	3.3	0.03	0.23	0.58	0.03	0.23	0.61	0.02	0.23	0.79	0.02	0.23	0.74	0.02	0.24	0.77
Sb (Antimony)	μg/L	31	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.26	0.25	0.25	0.26	0.25	0.25	0.26
Se (Selenium)	μg/L	5	0.23	0.65	1.20	0.23	0.65	1.19	0.17	0.48	1.44	0.18	0.49	1.30	0.18	0.48	1.25
SO4 (Sulfate)	mg/L	--	3.86	15.11	26.25	4.03	15.03	26.24	1.95	7.02	15.90	2.35	6.94	16.49	2.21	6.92	14.80
Tl (Thallium)	μg/L	0.56	0.00	0.03	0.06	0.00	0.03	0.06	0.00	0.03	0.11	0.00	0.03	0.11	0.00	0.03	0.11
V (Vanadium)	μg/L	--	1.01	1.41	2.01	1.01	1.41	2.03	0.99	1.59	3.26	1.00	1.60	3.32	1.00	1.60	3.33
Zn (Zinc)[3]	μg/L	122.3	1.31	5.03	19.41	1.37	5.08	17.34	1.06	4.30	20.97	0.91	4.40	21.88	1.04	4.28	19.31
Hardness	mg/L	500	43.57	93.40	128.18	41.55	93.89	128.38	35.42	65.27	121.94	34.64	64.59	121.91	36.63	65.25	119.64

NOTE: Values above the applicable water quality standard are shown in bold with light red shading.
(1) Values shown are the average of the monthly P10, P50, and P90 values, as indicated, for the referenced Mine Year; see Section 6.5 of Reference (2).
(2) Model runs evaluated through Mine Year 200.
(3) Standard is hardness-based and evaluated at a hardness of 102.5 mg/L; see Section 6.5.3 of Reference (2).

Large Table 5 Estimated Surface Water Quality for the Partridge River at SW004a

Constituent	Mine Year	Water Quality Standard	Mine Year 20			Mine Year 55			Mine Year 75			Mine Year 125			Mine Year 200[2]		
	Percentile		Average P10[1]	Average P50[1]	Average P90[1]	Average P10[1]	Average P50[1]	Average P90[1]	Average P10[1]	Average P50[1]	Average P90[1]	Average P10[1]	Average P50[1]	Average P90[1]	Average P10[1]	Average P50[1]	Average P90[1]
	Units																
Ag (Silver)	µg/L	1	0.10	0.10	0.11	0.10	0.11	0.12	0.10	0.11	0.15	0.10	0.11	0.15	0.10	0.11	0.15
Al (Aluminum)	µg/L	125	32.96	79.13	**267.93**	29.20	75.87	**254.52**	33.05	82.98	**250.45**	31.88	83.07	**256.89**	32.03	82.77	**263.34**
Alkalinity	mg/L	--	21.32	65.79	137.96	21.49	64.01	132.84	18.68	52.34	145.05	17.39	51.32	128.21	18.52	50.96	127.26
As (Arsenic)	µg/L	53	0.15	0.76	2.61	0.16	0.90	2.23	0.16	0.92	2.43	0.15	0.93	2.47	0.14	0.92	2.45
B (Boron)	µg/L	500	12.92	64.04	168.74	13.75	64.83	199.71	10.19	43.53	159.36	10.39	43.24	163.91	10.90	40.59	195.10
Ba (Barium)	µg/L	--	2.27	9.31	21.80	2.33	10.37	23.01	2.23	11.39	32.48	2.25	11.14	33.31	2.10	10.54	34.76
Be (Beryllium)	µg/L	--	0.10	0.10	0.11	0.10	0.11	0.15	0.10	0.12	0.24	0.10	0.12	0.24	0.10	0.11	0.23
Ca (Calcium)	mg/L	--	5.72	17.49	34.03	5.65	17.88	34.65	5.09	15.02	33.78	5.09	14.76	33.55	5.34	14.70	31.81
Cd (Cadmium)[3]	µg/L	2.6	0.03	0.08	0.14	0.03	0.13	0.39	0.03	0.17	0.89	0.03	0.15	0.91	0.03	0.13	0.77
Cl (Chloride)	mg/L	230	1.12	6.05	13.62	1.21	6.23	16.37	0.75	3.23	13.37	0.66	2.95	15.30	0.62	2.58	13.64
Co (Cobalt)	µg/L	5	0.05	0.33	0.91	0.07	0.54	1.22	0.06	0.78	2.91	0.07	0.83	3.03	0.08	0.81	2.93
Cr (Chromium)	µg/L	11	0.21	0.59	1.20	0.24	0.70	1.26	0.21	0.81	1.63	0.22	0.76	1.39	0.24	0.70	1.34
Cu (Copper)[3]	µg/L	9.8	0.40	1.25	2.91	0.43	1.65	3.08	0.44	2.15	5.57	0.46	2.15	5.57	0.44	2.12	5.59
F (Fluoride)	mg/L	--	0.02	0.08	0.18	0.03	0.09	0.20	0.02	0.08	0.20	0.02	0.08	0.19	0.02	0.07	0.19
Fe (Iron)	µg/L	--	464.80	1,682.78	5,123.50	477.17	1,578.39	4,539.00	415.39	1,259.69	5,259.70	373.14	1,257.83	4,524.60	434.73	1,236.18	4,679.40
K (Potassium)	mg/L	--	0.46	1.79	3.77	0.48	1.68	3.67	0.36	1.20	3.80	0.39	1.24	4.98	0.40	1.23	3.96
Mg (Magnesium)	mg/L	--	3.71	8.96	13.72	3.80	8.82	13.83	3.27	6.99	14.33	3.29	7.03	12.84	3.29	6.93	13.91
Mn (Manganese)	µg/L	--	10.01	132.57	357.08	11.43	126.31	334.87	8.68	125.66	417.39	8.03	126.21	424.46	8.02	125.81	421.94
Na (Sodium)	mg/L	--	0.87	5.34	12.21	1.00	6.67	16.08	0.79	5.99	20.72	0.75	5.39	17.77	0.72	4.57	12.41
Ni (Nickel)[3]	µg/L	54.6	0.20	0.98	2.80	0.39	3.07	9.03	0.40	5.11	24.61	0.46	5.38	25.14	0.47	5.11	24.90
Pb (Lead)[3]	µg/L	3.4	0.02	0.23	0.63	0.03	0.35	0.79	0.03	0.48	1.79	0.04	0.49	1.79	0.03	0.48	1.78
Sb (Antimony)	µg/L	31	0.25	0.25	0.25	0.25	0.53	1.63	0.27	0.76	3.60	0.26	0.64	2.87	0.26	0.49	1.87
Se (Selenium)	µg/L	5	0.19	0.58	1.25	0.20	0.63	1.25	0.18	0.58	1.46	0.18	0.57	1.32	0.18	0.53	1.26
SO4 (Sulfate)	mg/L	--	2.92	11.96	24.17	3.12	11.57	22.04	2.00	7.22	15.94	2.35	7.22	16.53	2.21	7.18	14.54
Tl (Thallium)	µg/L	0.56	0.00	0.03	0.08	0.00	0.03	0.08	0.00	0.03	0.11	0.00	0.03	0.11	0.00	0.03	0.10
V (Vanadium)	µg/L	--	1.00	1.46	2.46	1.02	1.81	3.31	1.02	2.24	6.47	1.02	2.29	6.48	1.02	2.21	6.51
Zn (Zinc)[3]	µg/L	125.4	1.10	4.64	21.80	1.52	8.64	20.83	1.54	11.74	46.39	1.48	10.92	48.09	1.39	9.49	45.35
Hardness	mg/L	500	39.07	82.56	124.06	37.88	83.30	128.16	35.38	69.56	122.73	34.54	68.75	122.42	37.02	68.11	119.28

NOTE: Values above the applicable water quality standard are shown in bold with light red shading.
(1) Values shown are the average of the monthly P10, P50, and P90 values, as indicated, for the referenced Mine Year; see Section 6.5 of Reference (2).
(2) Model runs evaluated through Mine Year 200.
(3) Standard is hardness-based and evaluated at a hardness of 105.5 mg/L; see Section 6.5.3 of Reference (2).

Large Table 6 Estimated Water Quality from Stockpile Drainage

Constituent[(1)]	Stockpile	Category 2/3 Stockpile (Temporary)			Category 4 Stockpile (Temporary)		Ore Surge Pile (Temporary)			Category 1 Stockpile (Permanent)				
	Mine Year / Units	Mine Year 1	Mine Year 11	Mine Year 19[(2)]	Mine Year 1	Mine Year 11[(2)]	Mine Year 1	Mine Year 11	Mine Year 20[(2)]	Mine Year 1	Mine Year 11	Mine Year 20	Mine Year 30[(3)]	Mine Year 75[(3)]
Ag (Silver)	µg/L	0.18	16.30	41.87	21.43	32.89	0.16	39.13	40.54	0.000	0.003	0.01	0.19	0.20
Al (Aluminum)	µg/L	0.44	150,188.33	378,285.83	253,425.83	404,926.67	0.40	351,548.33	345,180.00	1.14	1.41	1.41	1.41	1.41
Alkalinity	mg/L	25.03	16.65	0.00	0.00	0.00	21.19	1.17	0.14	32.13	39.69	39.68	39.69	39.69
As (Arsenic)	µg/L	89.42	100.00	100.08	122.93	159.34	79.47	99.83	97.32	17.53	100.00	99.98	100.00	100.00
B (Boron)	µg/L	89.46	138.35	200.40	617.68	1,247.21	81.00	193.41	194.70	80.77	100.00	99.98	100.00	100.00
Ba (Barium)	µg/L	28.18	10.27	11.32	73.24	91.62	25.52	7.78	11.72	31.96	14.96	14.50	10.79	10.67
Be (Beryllium)	µg/L	0.36	6.66	16.61	11.30	14.94	0.32	15.69	13.84	0.12	0.40	0.40	0.40	0.40
Ca (Calcium)	mg/L	215.42	577.78	405.76	294.51	434.49	80.20	422.61	387.71	144.00	682.43	683.98	683.89	684.28
Cd (Cadmium)	µg/L	4.23	45.66	64.31	90.65	125.67	2.33	82.88	24.41	1.06	3.48	3.59	3.67	3.67
Cl (Chloride)	mg/L	44.57	10.18	0.00	21.82	3.98	12.83	0.00	0.00	37.48	9.52	0.00	0.00	0.00
Co (Cobalt)	µg/L	261.85	5457.81	2881.22	6,449.77	15,151.08	662.06	28,145.75	8,023.15	83.27	122.65	122.62	122.65	122.65
Cr (Chromium)	µg/L	6.19	12.28	15.96	8.35	17.16	4.56	15.57	15.29	5.92	10.00	10.00	10.00	10.00
Cu (Copper)	µg/L	4,751.60	61,553.42	149,495.83	1,437.46	11,040.08	4,300.46	140,653.33	145,123.33	191.18	236.74	236.69	236.73	236.74
F (Fluoride)	mg/L	1.81	1.53	1.78	1.83	1.90	1.07	1.75	1.75	1.84	1.37	1.37	1.37	1.37
Fe (Iron)	µg/L	86.86	32,754.25	86,679.25	194,950.00	317,081.67	78.62	80,801.83	84,178.58	48.52	59.87	59.86	59.87	59.87
K (Potassium)	mg/L	31.92	42.03	27.98	9.41	13.29	13.84	29.22	27.03	23.74	46.90	46.89	46.90	46.90
Mg (Magnesium)	mg/L	35.77	389.22	303.89	276.57	1,059.48	25.80	732.48	226.73	32.95	146.90	150.97	150.76	151.06
Mn (Manganese)	µg/L	583.62	11212.28	7176.27	8,960.25	61,068.75	1,386.01	45,722.58	17,019.33	150.96	232.11	232.06	232.10	232.11
Na (Sodium)	mg/L	40.55	154.53	62.91	11.32	20.20	34.07	77.90	59.26	35.56	219.15	225.86	234.82	235.37
Ni (Nickel)	µg/L	3,669.22	83,192.58	42,749.81	9,183.46	31,350.58	12,158.82	588,671.67	146,079.33	1,062.53	2,226.35	2,227.61	2,230.10	2,230.10
Pb (Lead)	µg/L	1.79	137.15	360.09	288.10	385.96	1.62	337.01	341.77	0.62	7.35	10.77	99.93	100.00
Sb (Antimony)	µg/L	40.93	691.01	702.75	414.47	1,714.23	28.02	1,557.98	359.45	22.68	52.61	53.26	54.15	54.15
Se (Selenium)	µg/L	12.85	81.09	99.86	39.08	109.64	15.17	99.25	96.78	0.19	1.68	2.02	4.28	4.46
SO4 (Sulfate)	mg/L	394.16	4,251.70	2,978.15	4,225.02	11,551.67	369.83	7,846.88	2,728.82	119.90	1,265.19	1,393.40	2,727.05	2,793.10
Tl (Thallium)	µg/L	0.10	1.03	2.07	1.07	2.75	0.16	2.14	1.95	0.01	0.08	0.08	0.20	0.20
V (Vanadium)	µg/L	8.94	27.53	55.00	9.78	15.42	8.09	52.29	53.17	8.08	10.00	10.00	10.00	10.00
Zn (Zinc)	µg/L	305.46	3,640.50	6,322.72	7,779.83	10,721.28	346.31	7,991.74	3,635.80	55.38	181.17	187.68	192.16	192.16

(1) Values shown are the average of the monthly P50 values for the referenced Mine Year; see Section 6.2 of Reference (2).
(2) Temporary stockpiles are shown through the years they are active: Category 2/3 Stockpile through Year 19, Category 4 Stockpile through Mine Year 11, and Ore Surge Pile through Mine Year 20.
(3) Concentrations in the Category 1 Waste Rock Stockpile seepage are typically stable from approximately Mine Year 30 through long-term closure.

Large Table 7 Estimated Treated Water Pipeline Water Quality

Constituent	Mine Year	Mine Year 1			Mine Year 11			Mine Year 20		
	Percentile	Average P10(2)	Average P50(2)	Average P90(2)	Average P10(2)	Average P50(2)	Average P90(2)	Average P10(2)	Average P50(2)	Average P90(2)
	Units									
Ag (Silver)	µg/L	0.34	0.76	0.84	0.98	1.00	1.00	0.97	0.98	1.00
Al (Aluminum)	µg/L	104.42	104.45	104.48	125.00	125.00	125.00	125.00	125.00	125.00
Alkalinity	mg/L	602.17	674.52	758.37	24.33	33.74	42.91	30.90	36.62	43.63
As (Arsenic)	µg/L	8.62	8.74	8.92	10.00	10.00	10.00	10.00	10.00	10.00
B (Boron)	µg/L	107.64	135.82	170.18	80.00	103.63	136.54	69.67	82.93	101.98
Ba (Barium)	µg/L	668.86	746.93	836.44	47.60	63.13	81.98	87.42	97.84	109.22
Be (Beryllium)	µg/L	0.42	0.69	3.07	0.90	1.34	3.08	0.42	0.84	1.13
Ca (Calcium)	mg/L	16.99	22.13	28.70	37.26	44.29	51.62	50.19	59.18	66.16
Cd (Cadmium)	µg/L	3.05	3.35	3.38	3.88	4.00	4.00	1.74	3.00	3.89
Cl (Chloride)	mg/L	78.60	98.38	135.09	31.63	47.47	70.84	111.16	129.11	140.68
Co (Cobalt)	µg/L	4.58	4.58	4.58	5.00	5.00	5.00	5.00	5.00	5.00
Cr (Chromium)	µg/L	2.57	3.83	5.03	4.28	5.04	6.21	4.60	5.29	5.95
Cu (Copper)	µg/L	26.19	27.50	27.50	30.00	30.00	30.00	30.00	30.00	30.00
F (Fluoride)	mg/L	1.83	1.83	1.83	1.90	1.99	2.00	2.00	2.00	2.00
Fe (Iron)	µg/L	275.00	275.00	275.00	300.00	300.00	300.00	300.00	300.00	300.00
K (Potassium)	mg/L	42.30	50.13	58.64	42.14	56.04	72.34	183.79	210.93	240.25
Mg (Magnesium)	mg/L	38.39	42.40	45.53	29.50	33.97	38.25	20.63	24.89	30.37
Mn (Manganese)	µg/L	45.83	45.83	45.83	50.00	50.00	50.00	50.00	50.00	50.00
Na (Sodium)	mg/L	247.70	285.64	334.89	140.14	192.87	248.75	502.24	589.61	686.07
Ni (Nickel)	µg/L	91.67	91.67	91.67	100.00	100.00	100.00	100.00	100.00	100.00
Pb (Lead)	µg/L	6.79	11.72	14.30	19.00	19.00	19.00	19.00	19.00	19.00
Sb (Antimony)	µg/L	18.95	25.94	26.23	31.00	31.00	31.00	17.89	24.64	31.00
Se (Selenium)	µg/L	2.74	4.08	4.24	5.00	5.00	5.00	3.61	4.78	5.00
SO4 (Sulfate)	mg/L	229.17	229.17	229.17	250.00	250.00	250.00	250.00	250.00	250.00
Tl (Thallium)	µg/L	0.10	0.13	0.18	0.23	0.32	0.56	0.12	0.17	0.23
V (Vanadium)	µg/L	6.31	8.00	13.76	9.95	11.06	14.37	9.79	10.68	11.56
Zn (Zinc)	µg/L	282.98	322.86	326.37	380.37	388.00	388.00	249.70	351.99	388.00

(1) Values shown are the average of the monthly P10, P50, and P90 values, as indicated, for the referenced Mine Year; see Section 6.2 of Reference (2).

Large Table 8 Monitoring Plan – Internal Streams - NorthMet Mine Site

Monitoring Plan	Media	Status	Station ID (Nomenclature)	Location Map	Parameter Group(s)	Frequency	Reporting Requirements	Additional Information
Pit Water (PW)	GW/ SW	P	WS-PW-WW WS-PW-WE WS-PW-C WS-PW-E	Large Figure 10	Flow Rate	Continuous	Monitoring Reports • Annual • May, August, November	Monitor pump rates to manage water in the pits to compare water balance to expected conditions and define future pumping requirements. Monitor at each pit sump Flow rates to be based on flow meters.
					Water Quality (Large Table 13, Internal Streams)	Monthly	Monitoring Reports • Annual • May, August, November	Monitor water quality of pit water in each pit sump
Stockpile Liner (SL) and Containment System (CS) Drainage	S	P	WS-SL-OSP WS-SL-4 WS-SL-231 WS-SL-232 WS-SL-233 WS-CS-1 WS-CS-2	Large Figure 10	Flow Rate	Continuous	Flow Rate Monitoring Reports • Annual • May, August, November	Monitor drainage from stockpile liners to compare water balance to expected conditions and define future pumping requirements. Monitor at each stockpile sump Flow rates to be based on flow meters.
					Water Quality (Large Table 13, Internal Streams)	Monthly	Water Quality Monitoring Reports • Annual • May, August, November	Monitor water quality of stockpile liner drainage in each stockpile sump
Stockpile Underdrain (SU) Drainage	GW	P	WS-SU-OSP WS-SU-4 WS-SU-231 WS-SU-232 WS-SU-233	Large Figure 10	Flow Rate	Continuous	Flow Rate Monitoring Reports • Annual • May, August, November	Monitor drainage from the underdrains (beneath the liner) when flows are present. Monitor at each stockpile underdrain sump Flow rates to be based on flow meters.
					Water Quality (Large Table 13, Internal Streams)	Monthly	Water Quality Monitoring Reports • Annual • May, August, November	Monitor water quality of stockpile underdrains (beneath the liner) in each stockpile underdrain sump when flows are present
Overburden Storage and Laydown Area Runoff	SW	P	WS-OSLA	Large Figure 10	Flow Rate	Continuous	Flow Rate Monitoring Reports • Annual • May, August, November	Monitor drainage from OSLA to compare water balance to expected conditions. Monitor at OSLA pond Flow rates to be based on a flow meter.
					Water Quality (Large Table 13, Internal Streams)	Monthly	Water Quality Monitoring Reports • Annual • May, August, November	Monitor water quality of OSLA drainage in OSLA pond when flows are present

Monitoring Plan	Media	Status	Station ID (Nomenclature)	Location Map	Parameter Group(s)	Frequency	Reporting Requirements	Additional Information
Haul Road (HR) Runoff	SW	P	WS-HRE WS-HRN WS-HRC WS-HRW	Large Figure 10	Flow Rate	Continuous	Flow Rate Monitoring Reports • Annual • May, August, November	Monitor drainage from haul roads to compare water balance to expected conditions. Monitor at haul road ponds Flow rates to be based on flow meters.
					Water Quality (Large Table 13, Internal Streams)	Monthly	Water Quality Monitoring Reports • Annual • May, August, November	Monitor water quality of haul road drainage in haul road ponds when flows are present
Rail Transfer Hopper (RTH) Area Runoff	SW	P	WS-RTH	Large Figure 10	Flow Rate	Continuous	Flow Rate Monitoring Reports • Annual • May, August, November	Monitor drainage from RTH to compare water balance to expected conditions. Monitor at RTH pond Flow rates to be based on a flow meter.
					Water Quality (Large Table 13, Internal Streams)	Monthly	Water Quality Monitoring Reports • Annual • May, August, November	Monitor water quality of RTH drainage in RTH pond when flows are present
Waste Water Treatment Facility (WWTF) Influents	PS	P	One station per influent stream • Construction water • East Pit and haul road (HRN) (with Central Pit) • Category 1 Waste Rock Stockpile Groundwater Containment System • Category 2/3 Waste Rock Stockpile and OSP • Category 4 Waste Rock Stockpile • RTH and haul roads (HRC, HRE) • West Pit and haul road (HRW)	TBD (at influent splitter structure)	Flow Rate	Continuous	Flow Rate Monitoring Reports • Annual • Monthly	Operational monitoring of influent streams to evaluate if treatment is required.
					Water Quality (Large Table 13, WWTF List 1)	Daily Grab	Water Quality Monitoring Reports • Annual • Monthly	
Waste Water Treatment Facility (WWTF) Influents (continued)	Combined PS	P	Combined West EQ Influent (Chemical precipitation treatment train)	TBD (after EQ Basin inside WWTF Building)	Flow Rate	Continuous	Flow Rate Monitoring Reports • Annual • Monthly	Monitor influent characteristics to modify and/or optimize treatment operations.
					Water Quality (Large Table 13, WWTF List 2)	Daily: 24-Hr Composite	Water Quality Monitoring Reports • Annual • Monthly	

Monitoring Plan	Media	Status	Station ID (Nomenclature)	Location Map	Parameter Group(s)	Frequency	Reporting Requirements	Additional Information
			• Consists of flows from the Category 2/3 and 4 waste rock stockpiles and the OSP		Water Quality (Large Table 13, WWTF List 3)	Monthly		
	Combined PS	P	Combined East EQ Basin Influent (Membrane filtration treatment train) • Consists of flows from haul road, RTH, pit dewatering and Category 1 Waste Rock Stockpile Groundwater Containment System	TBD (after EQ Basin inside WWTF Building)	Flow Rate	Continuous	Flow Rate Monitoring Reports • Annual • Monthly	Monitor influent characteristics to modify and/or optimize treatment operations.
					Water Quality (Large Table 13, WWTF List 2)	Daily: 24-Hr Composite	Water Quality Monitoring Reports • Annual • Monthly	
					Water Quality (Large Table 13, WWTF List 3)	Monthly		
Waste Water Treatment Facility (WWTF) Effluents	TW	P	Effluent • Consists of whole effluent	TBD	Flow Rate	Continuous	Flow Rate Monitoring Reports • Annual • Monthly	Monitor effluent characteristics to document water quality prior to reuse in closure operations
					Water Quality (Large Table 13, WWTF List 2)	Daily: 24-Hr Composite	Water Quality Monitoring Reports • Annual • Monthly	
					Water Quality (Large Table 13, WWTF List 3)	Monthly		
Treated Water Pipeline (PP) Flows	TW	P	WS-PP-1 WS-PP-2	Large Figure 10	Flow Rate and Pressure	Continuous	Flow Rate Monitoring Reports • Annual • May, August, November	Monitoring both ends of the pipeline to detect leaks.
					Water Quality (Large Table 13, Internal Streams)	Monthly	Water Quality Monitoring Reports • Annual • May, August, November	

Large Table 9 Monitoring Plan – Stormwater - NorthMet Mine Site

Monitoring Plan	Media	Status	Station ID (Nomenclature)	Location Map	Parameter Group(s)	Frequency	Reporting Requirements	Additional Information
Stormwater (OS)	SW	P	SD-OS-A SD-OS-B SD-OS-C SD-OS-D	Large Figure 10	Flow Rate	Monthly	Monitoring Reports • Annual • May, August, November	Monitor stormwater outflows from the Mine Site at 5 pond outlet locations.
					Water Quality (Large Table 13, Stormwater)	Monthly	Monitoring Reports • Annual • May, August, November	Monitor water quality from stormwater outflows from the Mine Site at 5 pond outlet locations.

Large Table 10 Monitoring Plan – Groundwater - NorthMet Mine Site

Monitoring Plan	Media	Status	Station ID (Nomenclature)	Location Map	Parameter Group(s)	Frequency	Reporting Requirements	Additional Information
Monitoring Wells – Surficial Aquifer	GW	E	24 existing wells: MW-05-02 MW-05-08 MW-05-09 MW-1 through MW-5 MW-6S/6D MW-7 MW-8S/8D MW-9 MW-10S/10D MW-11 through MW-18	Large Figure 11	Elevation	Quarterly	Annual Monitoring Report • Evaluate groundwater flow gradient and direction.	Surficial aquifer wells will be generally located downgradient of mine features such as pits and stockpiles. Groundwater is expected to flow toward the mine pit during mine dewatering operations. Groundwater flow direction is expected to revert to the natural flow direction after mine reclamation. Sampling frequency is preliminary and may be revised based on the outcome of ongoing discussions. When nested monitoring wells are installed, they are numbered with MW-# with an S or D following the ID number to indicate a shallow and deep monitoring well.
					Water Quality (Large Table 13, Groundwater)	Quarterly	Annual Monitoring Report • Summarize water quality data and evaluate trends.	
Monitoring Wells – Bedrock	GW	E P	9 existing wells: OB-1 through OB-5 P-1 through P-4 TBD (proposed wells: MW-BR-x	Large Table 11	Elevation	Quarterly	Annual Monitoring Report • Summarize water quality data and evaluate trends. • Evaluate groundwater flow gradient and direction.	Number and location of bedrock wells have not yet been identified.
					Water Quality (Large Table 13, Groundwater)	Quarterly	Annual Monitoring Report • Summarize water quality data and evaluate trends.	

Large Table 11 Monitoring Plan – Wetland Hydrology - NorthMet Mine Site

Monitoring Plan	Media	Status	Station ID (Nomenclature)	Location Map	Parameter Group(s)	Frequency	Reporting Requirements	Additional Information
Wetlands – Baseline Monitoring								
Baseline Wetlands for the Mine Site and Transportation and Utility Corridors	GW	E	Well 1 through Well 2 Well 4 and 4A Well 6 through Well 16 Well 21 through Well 48 Ref 1 through Ref 3 Ref 1M	Large Figure 7 and 8 in Reference (23)	Elevation – relative to ground surface	In progress Began in 2005 Ranging from monthly to continuous during non-freezing months	Varies	Provide sufficient hydrology information to allow identification of potential indirect hydrologic impacts to wetlands. There are currently 43 wetland hydrology monitoring wells in the Mine Site; see Section 4.2 of the Wetland Management Plan (Reference (23)) Wells 3, and 17-20 were removed during the baseline monitoring phase, and several additional wells were added.
Wetlands – Operations Monitoring								
Mine Site Wetlands	GW	E P	TBD in permitting TBD in permitting	Large Figure 7 and 8 in Reference (23)	Elevation – relative to ground surface	TBD in permitting	TBD in permitting	This program will provide the necessary information to determine whether indirect hydrologic impacts have occurred and to assess required mitigation measures. Additional information is available in Section 4.2 of the Wetland Management Plan (Reference (23)) Final number of stations is TBD in permitting

Large Table 12 Monitoring Plan – Surface Water - NorthMet Mine Site

Monitoring Plan	Media	Status	Station ID (Nomenclature)	Location Map	Parameter Group(s)	Frequency	Reporting Requirements	Additional Information
Partridge River	SW	E	SW002 (PM-2) SW003 (PM-3) SW004 (PM-16) SW004a SW005 (PM-4)	Large Figure 12	Flow Rate	Monthly	Flow Rate Monitoring Reports • Annual • May, August, November	Monitoring of the Partridge River to define trends in water flow and identify potential impacts from the Project SW001 and SW006 have been omitted; SW001 is upstream of the Mine Site. This site was omitted from further monitoring because it was one of two surface water monitoring stations upstream of the Mine Site and potential Mine Site impacts; SW002 is also upstream (Large Figure 1). SW006 is downstream of the Mine Site, upstream of Colby Lake. This site was omitted from further monitoring due to its proximity to SW005, with no additional surface waters entering the Partridge River between the two monitoring stations (Large Figure 1).
					Water Quality (Large Table 13, Surface Water)	Monthly	Water Quality Monitoring Reports • Annual • May, August, November	Monitoring of the Partridge River to define trends on water quality and identify potential impacts from the Project
Partridge River Tributaries	SW	E	WP-1 LN-1 WL-1 PM-5	Large Figure 12	Flow Rate	Monthly	Flow Rate Monitoring Reports • Annual • May, August, November	Monitoring of the Partridge River tributaries to define trends in water flow and identify potential impacts from the Project
					Water Quality (Large Table 13, Surface Water)	Monthly	Water Quality Monitoring Reports • Annual • May, August, November	Monitoring of the Partridge River tributaries to define trends on water quality and identify potential impacts from the Project
Colby Lake	SW	P	LCy-2	Large Figure 12	Water Quality (Large Table 13, Surface Water)	Monthly	Water Quality Monitoring Reports • Annual • May, August, November	Monitoring of Colby Lake to define trends in water quality
					Water Level	Monthly	TBD in permitting	TBD in permitting
Whitewater Reservoir	SW	P	Location TBD in permitting	Large Figure 12	Water Level	Monthly	TBD in permitting	TBD in permitting

Large Table 13 Monitoring Plan – Parameter Lists - NorthMet Mine Site

Internal Streams – Pit Water (Large Table 8) • Parameter List TBD in permitting
Internal Streams – Stockpile Drainage, Overburden Storage and Laydown Area Runoff, Haul Road Runoff, Rail Transfer Hopper Runoff (Large Table 8) • Parameter List TBD in permitting
Internal Streams – Waste Water Treatment Plant Influent (WWTF List 1) (Large Table 8) • Parameter List TBD in permitting
Internal Streams – Waste Water Treatment Plant Daily Influent and Effluent (WWTF List 2) (Large Table 8) • Parameter List TBD in permitting
Internal Streams – Waste Water Treatment Plant Monthly Influent and Effluent (WWTF List 3) (Large Table 8) • Parameter List TBD in permitting
Stormwater – (Large Table 9) • Parameter List TBD in permitting
Groundwater – Surficial Aquifer and Bedrock (Large Table 10) • Parameter List TBD in permitting
Surface Water – Partridge River, Partridge River Tributaries, and Colby Lake (Large Table 12) • Parameter List TBD in permitting

Large Figures

△ USGS Stations

Mine Site

Surface Water Monitoring Locations - Colby Lake, Whitewater Reservoir

Surface Water Monitoring Locations - Stream

Partridge River Watershed

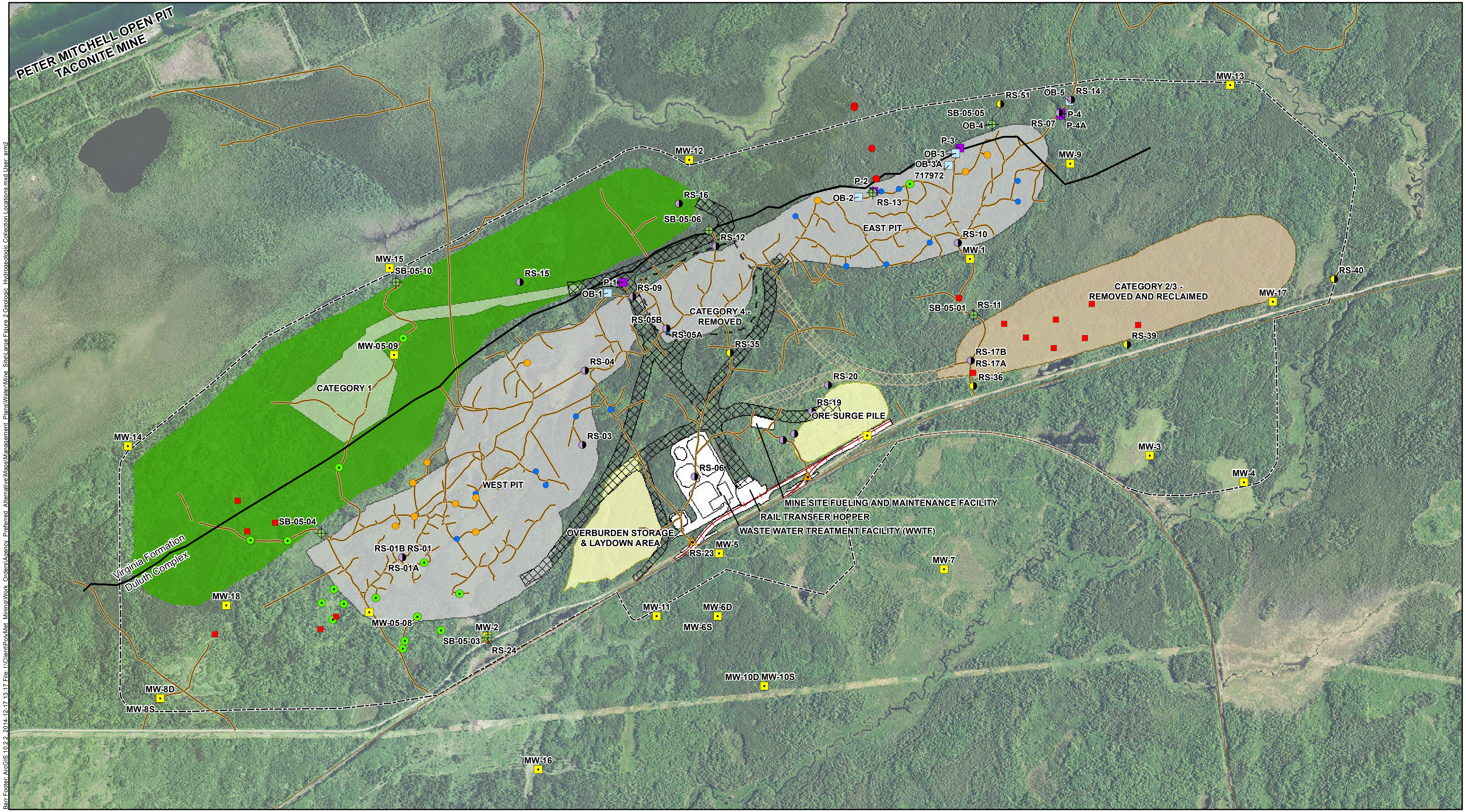
Partridge River Subwatersheds

N

0 0.75 1.5 3

Miles

Large Figure 1
PARTRIDGE RIVER WATERSHEDS
AND SURFACE WATER MONITORING LOCATIONS
NorthMet Project
Poly Met Mining Inc.
Hoyt Lakes, MN



Mine Site

Mine Year 20

Active Stockpile

Removed and Reclaimed Stockpiles

Removed Stockpile

Uncovered Stockpile

Covered Stockpile

Mine Pits

Haul Roads

Reclaimed Haul Roads

Phase I

Bedrock Aquifer Testing Location - 2005

Soil Boring - 2005

Phase II

Observation Wells - 2005/2006

Pumping Test Wells - 2005/2006

Phase III - Wetland Piezometer - 2006

Overburden Geochem/Geotech Boring - 2008

2011/2012 Rotasonic Borings

Exploratory Borehole Sump Logging Location - 2010

Sorption Sampling Location - 2009

Monitoring Well

Bedrock Groundwater Elevation Measurement - 2006

Golder Test Trench - 2006

Unit Boundaries

Existing Trails and Roads

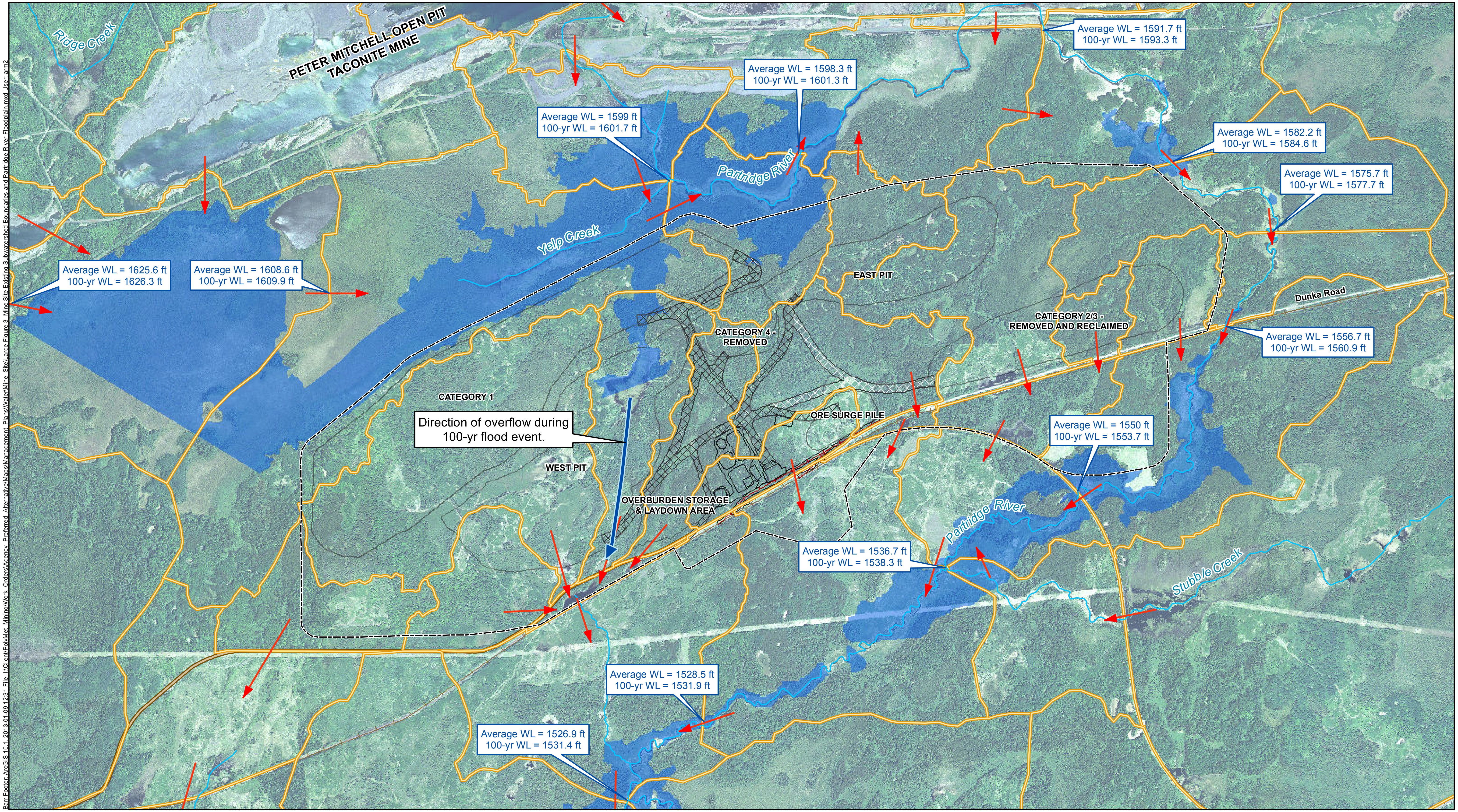
Proposed Railroad Track

Existing Private Railroad

0 750 1,500 3,000

Feet

Large Figure 2
GEOLOGIC/HYDROGEOLOGIC
DATA COLLECTION LOCATIONS
NorthMet Project
Poly Met Mining Inc.
Hoyt Lakes, MN



Streams/Rivers

Subwatershed Flow Direction

Partridge River Subwatersheds

100-yr Floodplain (without NorthMet Project)

WL = Water Level

Mine Site

Mine Footprint - Year 20

Haul Roads

Dunka Road

Proposed Railroad Track

Existing Private Railroad

0 1,000 2,000 4,000

Feet

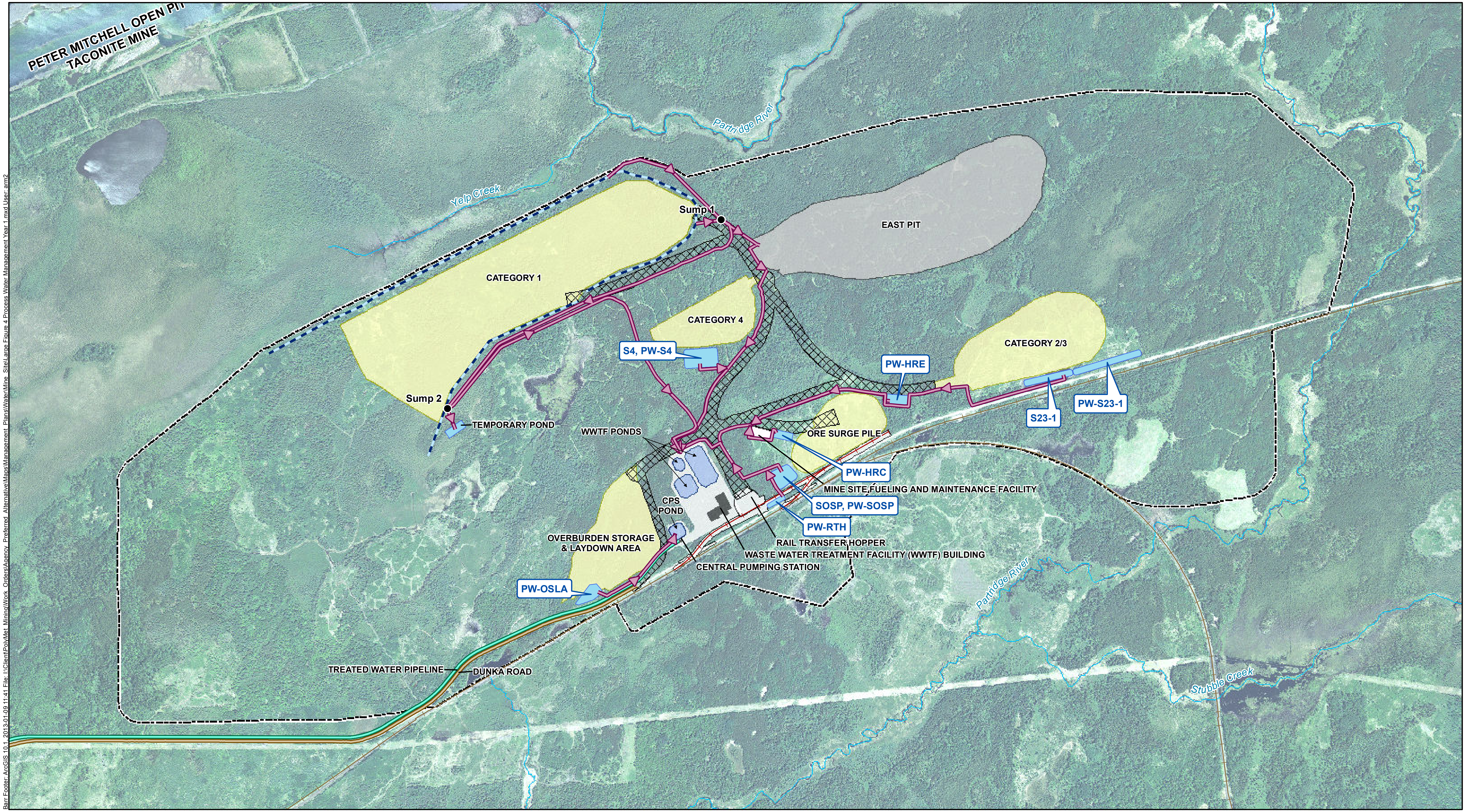
Large Figure 3

MINE SITE EXISTING SUBWATERSHED BOUNDARIES AND PARTRIDGE RIVER FLOODPLAIN

NorthMet Project

Poly Met Mining Inc.

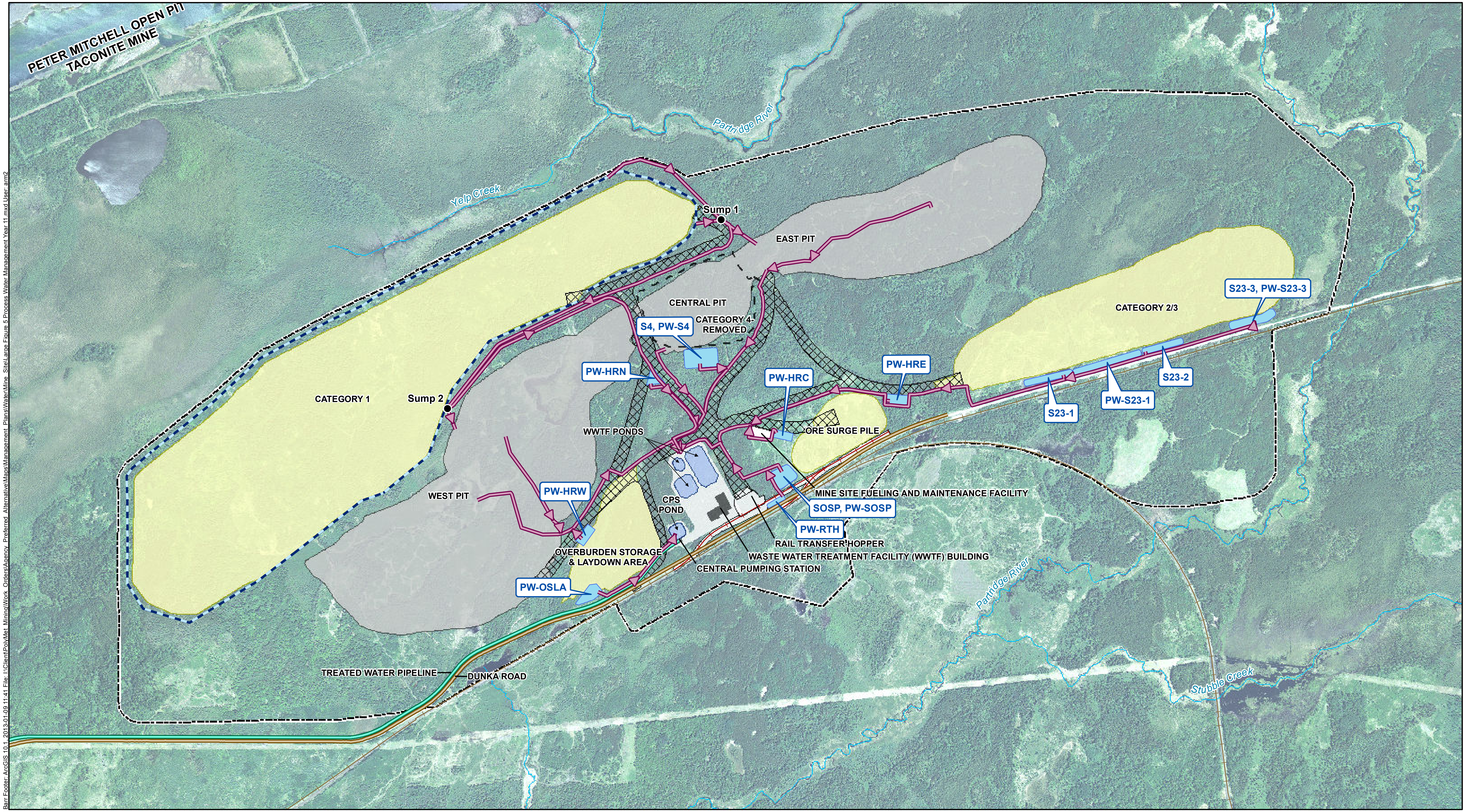
Hoyt Lakes, MN



Mine Site
Mine Pit
Active Stockpile
Haul Roads
Proposed Railroad Track
Existing Private Railroad
Process Water Pipe
Groundwater Containment System
Ponds and Sumps
PW = Process Water Pond; S = Sump

0 750 1,500 3,000
Feet

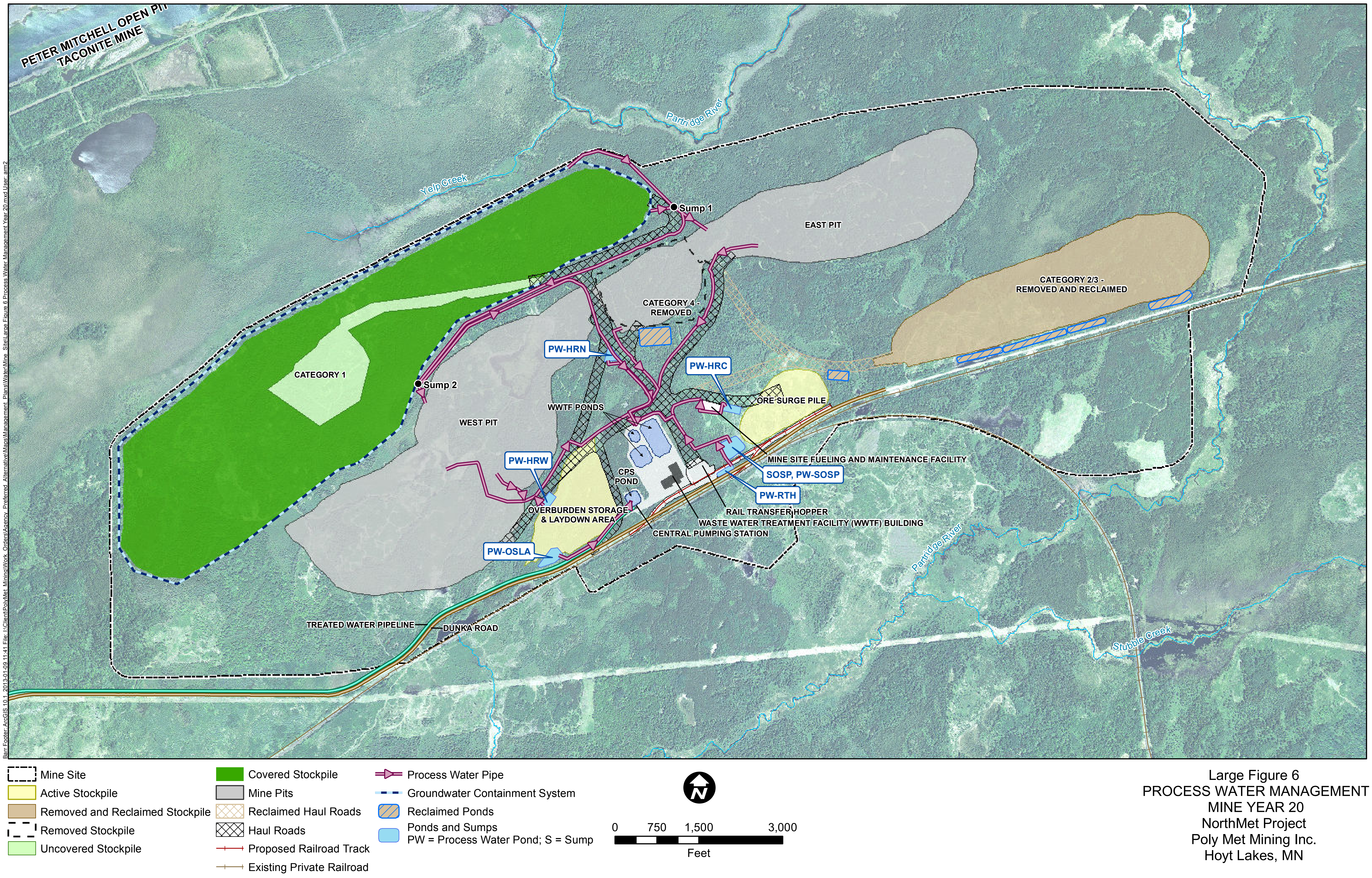
Large Figure 4
PROCESS WATER MANAGEMENT
MINE YEAR 1
NorthMet Project
Poly Met Mining Inc.
Hoyt Lakes, MN



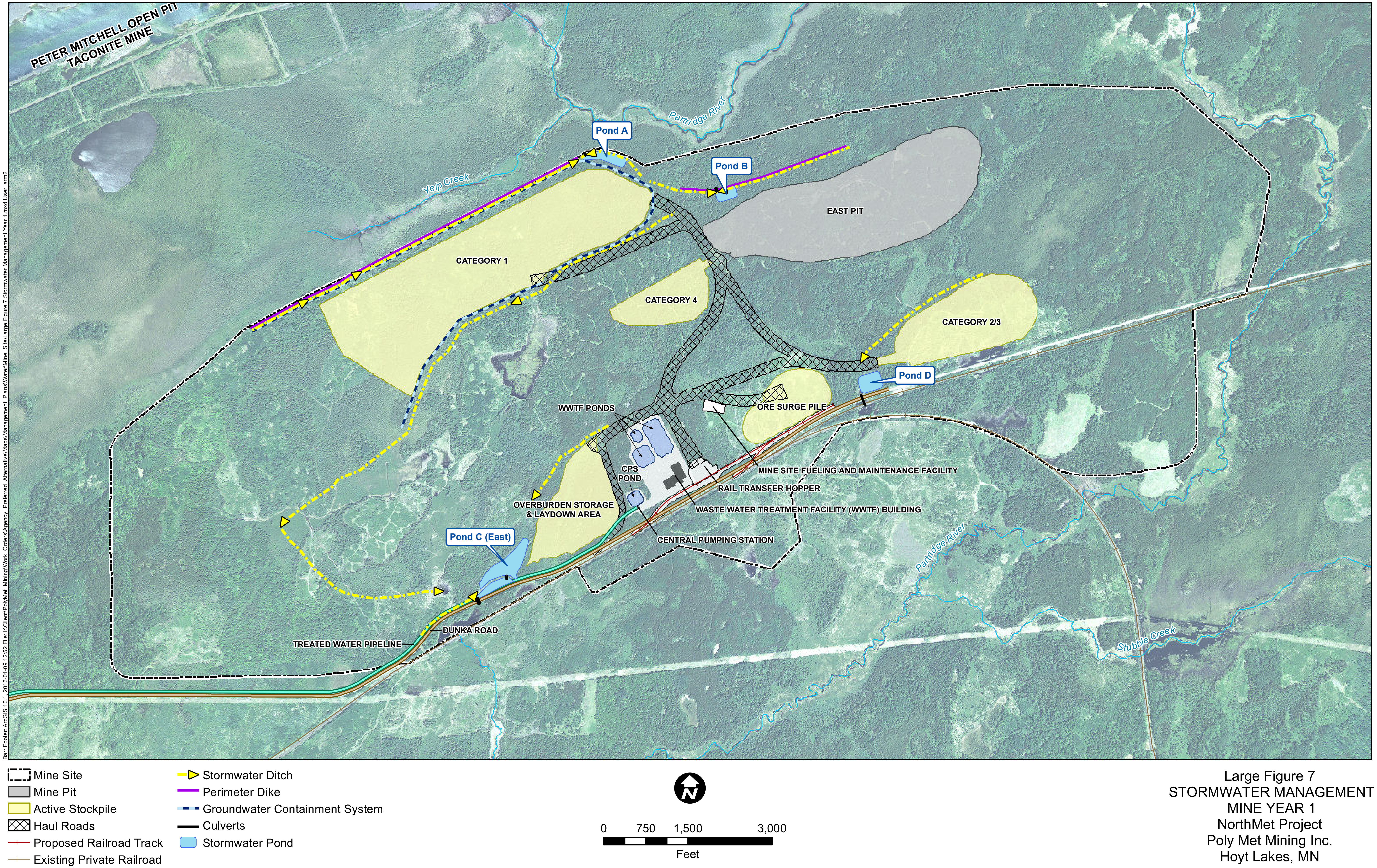
Mine Site
Mine Pits
Active Stockpiles
Removed Stockpile
Haul Roads
Proposed Railroad Track
Existing Private Railroad
Process Water Pipe
Groundwater Containment System
Ponds and Sumps
PW = Process Water Pond; S = Sump

0 750 1,500 3,000
Feet

Large Figure 5
PROCESS WATER MANAGEMENT
MINE YEAR 11
NorthMet Project
Poly Met Mining Inc.
Hoyt Lakes, MN

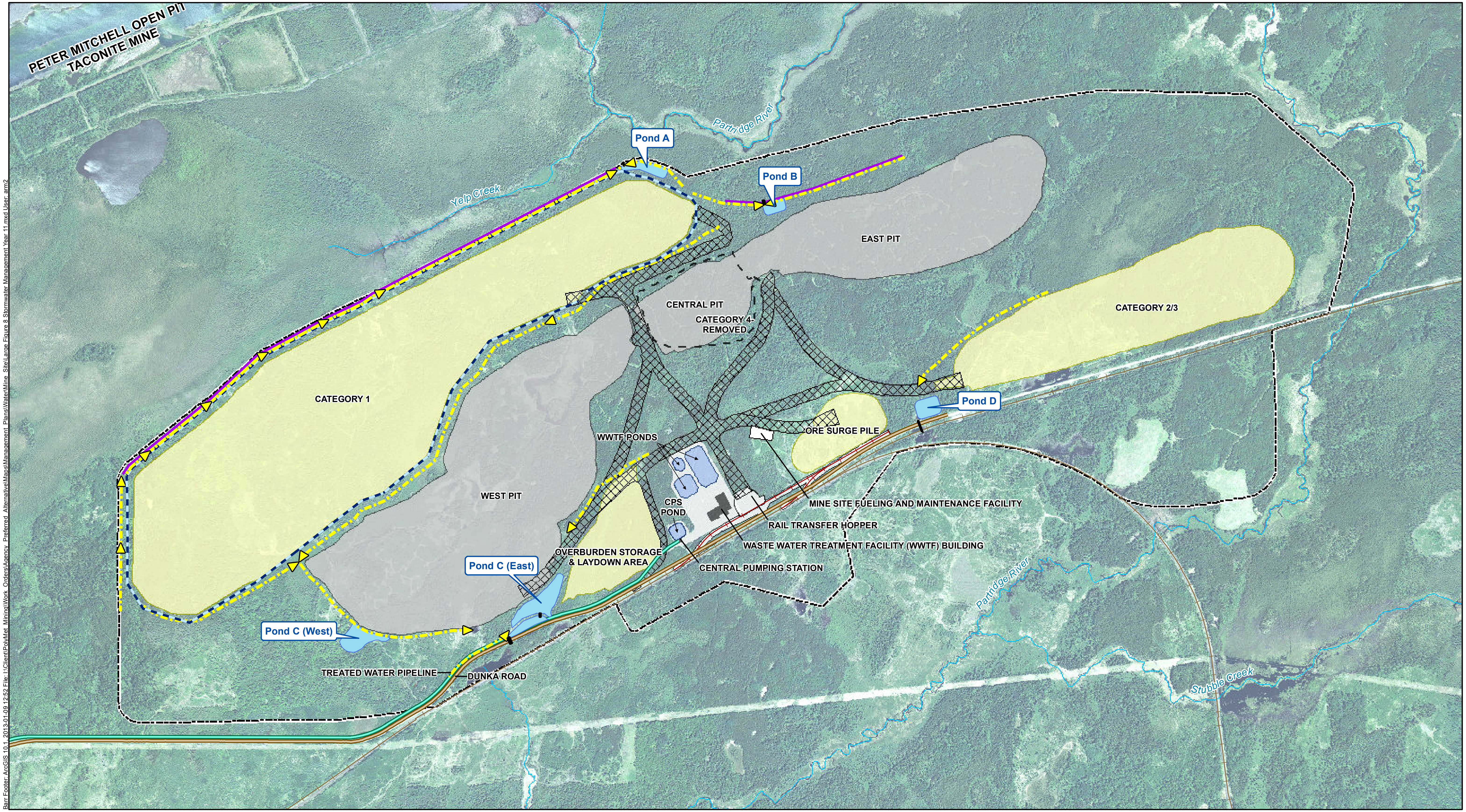


Large Figure 6
PROCESS WATER MANAGEMENT
MINE YEAR 20
NorthMet Project
Poly Met Mining Inc.
Hoyt Lakes, MN



Barr Footer: ArcGIS 10.1, 2013-01-09 12:52 File: I:\Client\PolyMet_Mining\Work_Orders\Agency_Preferred_Alternative\Maps\Management_Plans\Water\Mine_Site\Large Figure 7 Stormwater Management Year 1.mxd User: arm2

Large Figure 7
STORMWATER MANAGEMENT
MINE YEAR 1
NorthMet Project
Poly Met Mining Inc.
Hoyt Lakes, MN

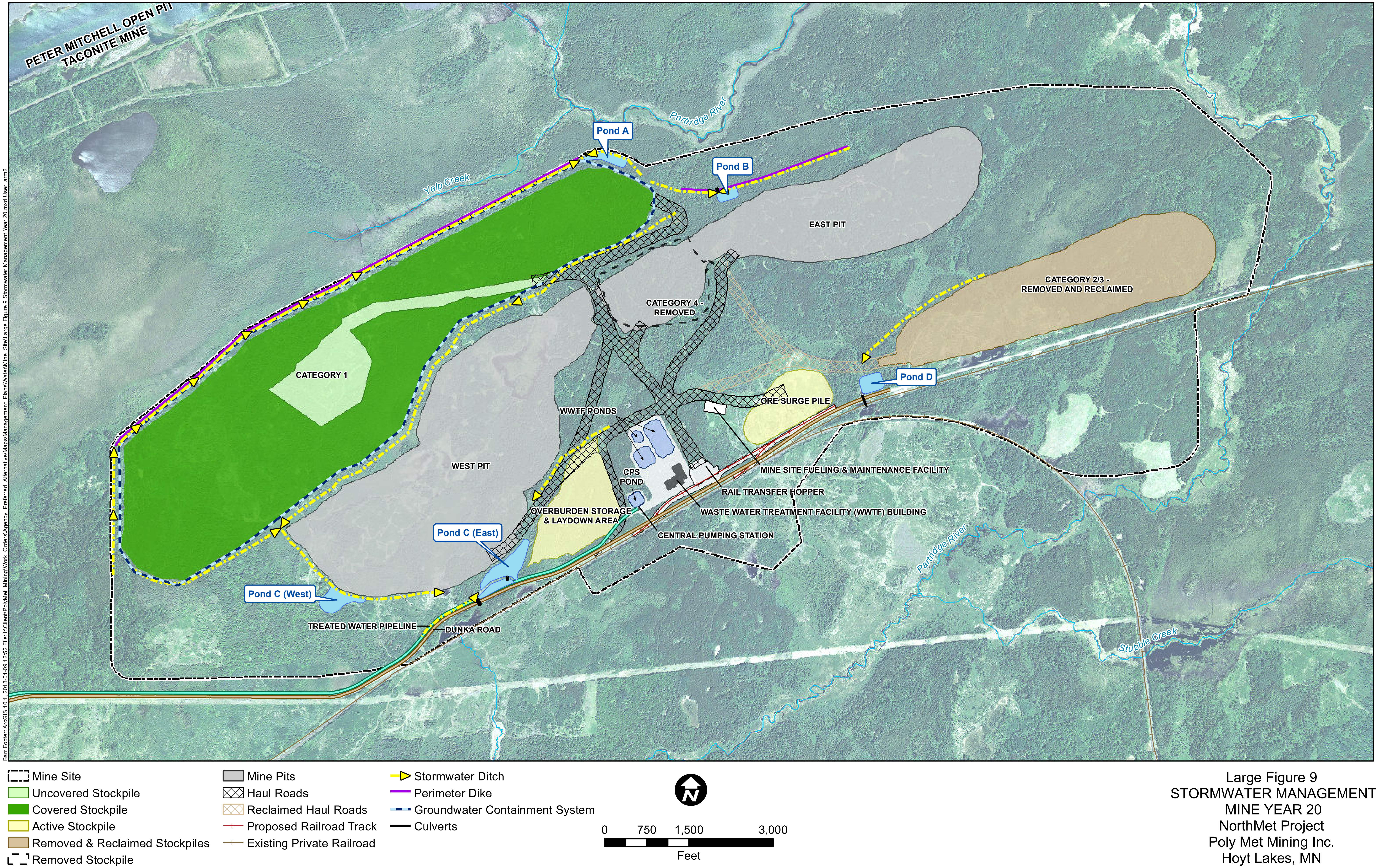


Barr Footer: ArcGIS 10.1, 2013-01-09 12:52 File: I:\Client\PolyMet_Mining\Work_Orders\Agency_Preferred_Alternative\Maps\Management_Plans\Water\Mine_Site\Large Figure 8 Stormwater Management Year 11.mxd User: arm2

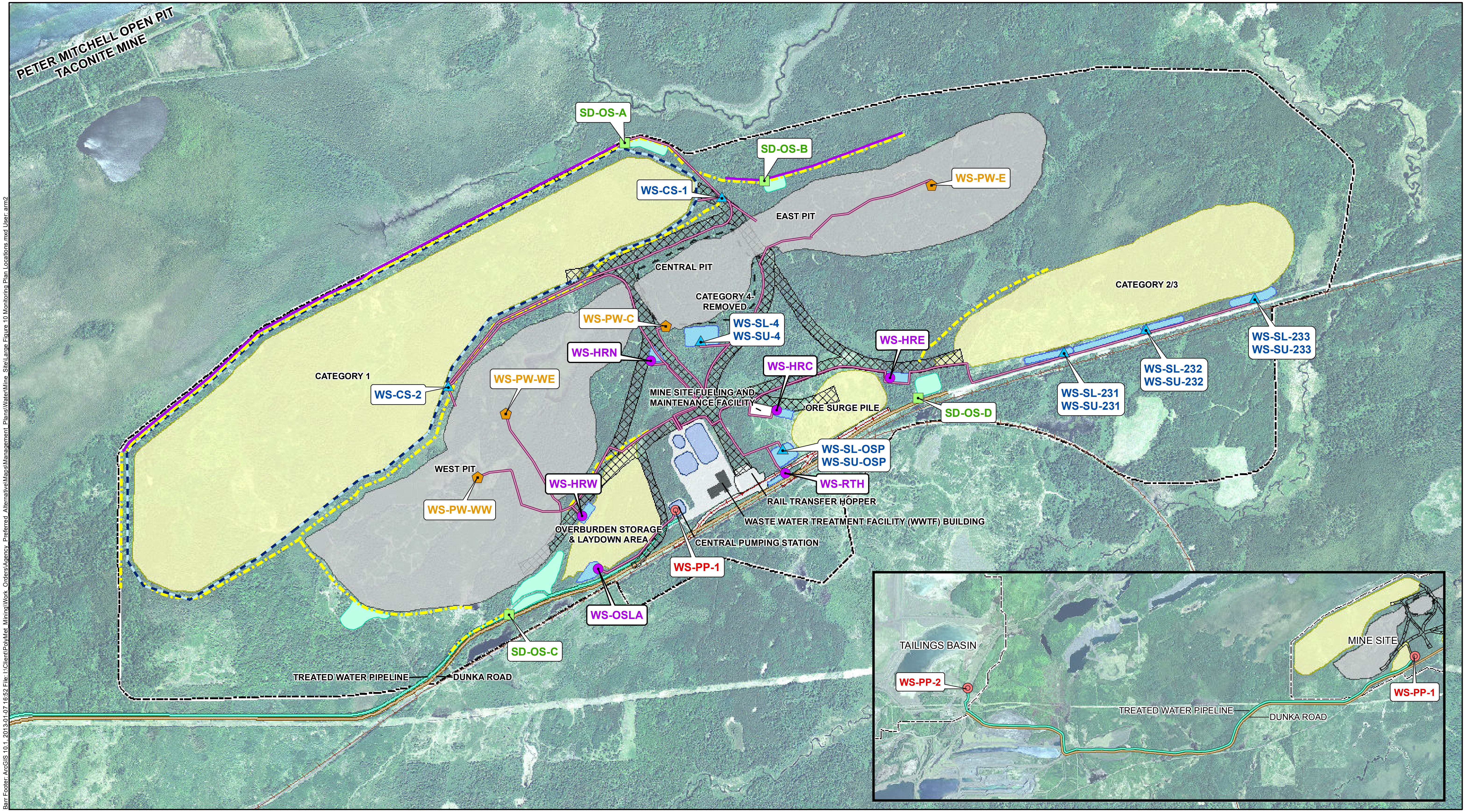
- Mine Site
- Mine Pits
- Active Stockpiles
- Removed Stockpile
- Haul Roads
- Proposed Railroad Track
- Existing Private Railroad
- Stormwater Ditch
- Perimeter Dike
- Groundwater Containment System
- Culverts
- Stormwater Pond

0 750 1,500 3,000
Feet

Large Figure 8
STORMWATER MANAGEMENT
MINE YEAR 11
NorthMet Project
Poly Met Mining Inc.
Hoyt Lakes, MN



Large Figure 9
STORMWATER MANAGEMENT
MINE YEAR 20
NorthMet Project
Poly Met Mining Inc.
Hoyt Lakes, MN



Monitoring Locations
- Process Water
- Stormwater
- Stockpile Drainage
- Pit Water
- Pumping Station Flows

See Large Tables 1 and 2 for Naming Conventions

- Groundwater Containment System
- Process Water Pipe
- Stormwater Ditch
- Perimeter Dike
- Stormwater Pond
- Process Water Ponds

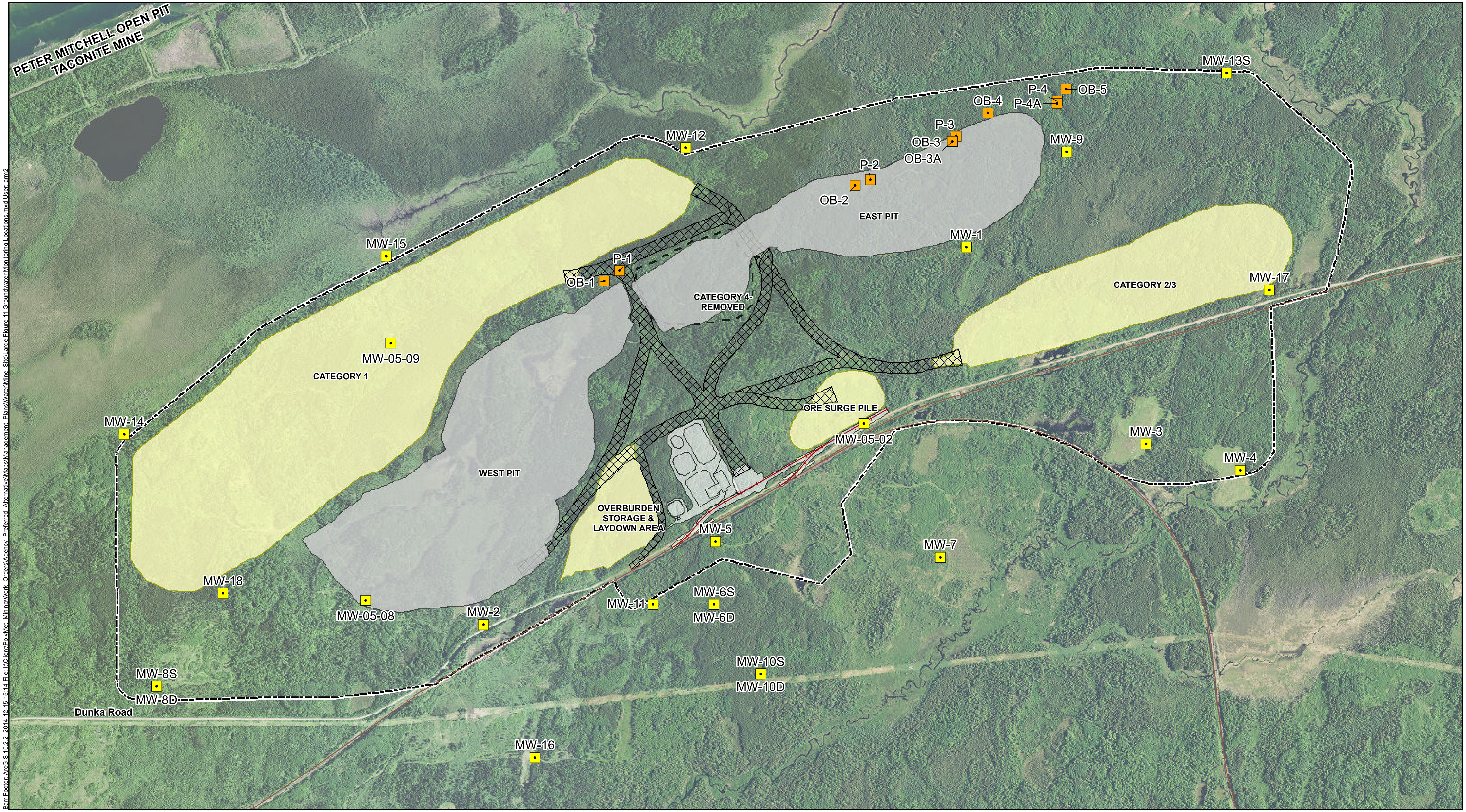
- Mine Site

Mine Plan - Year 11
- Mine Pits
- Active Stockpiles
- Removed Stockpile
- Haul Roads

N

0 750 1,500 3,000
Feet

Large Figure 10
PROPOSED MONITORING PLAN
MINE SITE MONITORING LOCATIONS
NorthMet Project
Poly Met Mining Inc.
Hoyt Lakes, MN



- Surficial Monitoring Well
- Bedrock Monitoring Well
- Mine Site
- Existing Railroad
- Proposed Track

See Large Table 3

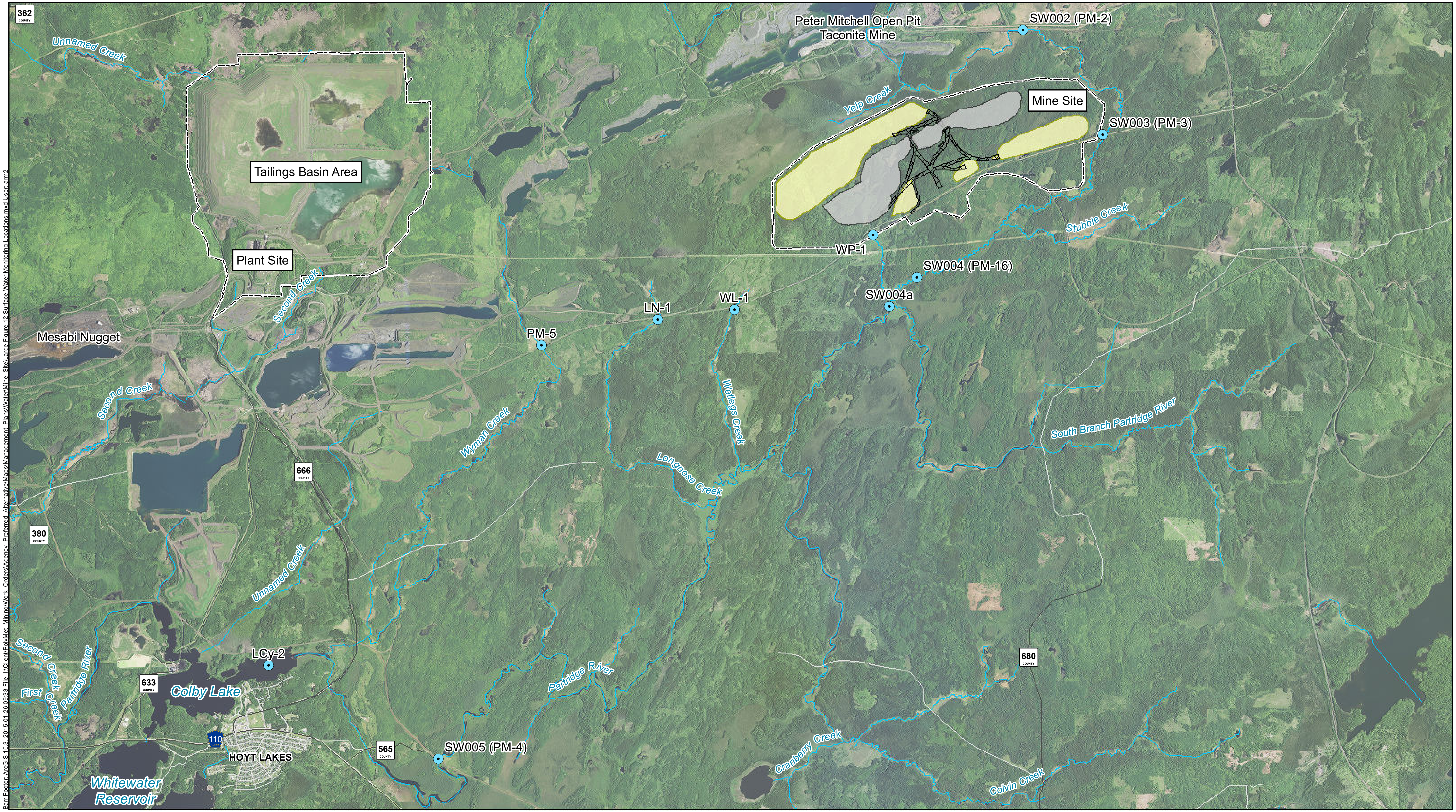
Mine Plan - Year 11

- Mine Pits
- Haul Roads
- Active Stockpiles
- Removed Stockpile

0 750 1,500 3,000

Feet

Large Figure 11
PROPOSED MONITORING PLAN
GROUNDWATER MONITORING LOCATIONS
NorthMet Project
Poly Met Mining Inc.
Hoyt Lakes, MN



Surface Water Monitoring Locations

Streams/Rivers

Project Areas

See Large Table 5

Mine Plan - Year 11

Mine Pits

Active Stockpiles

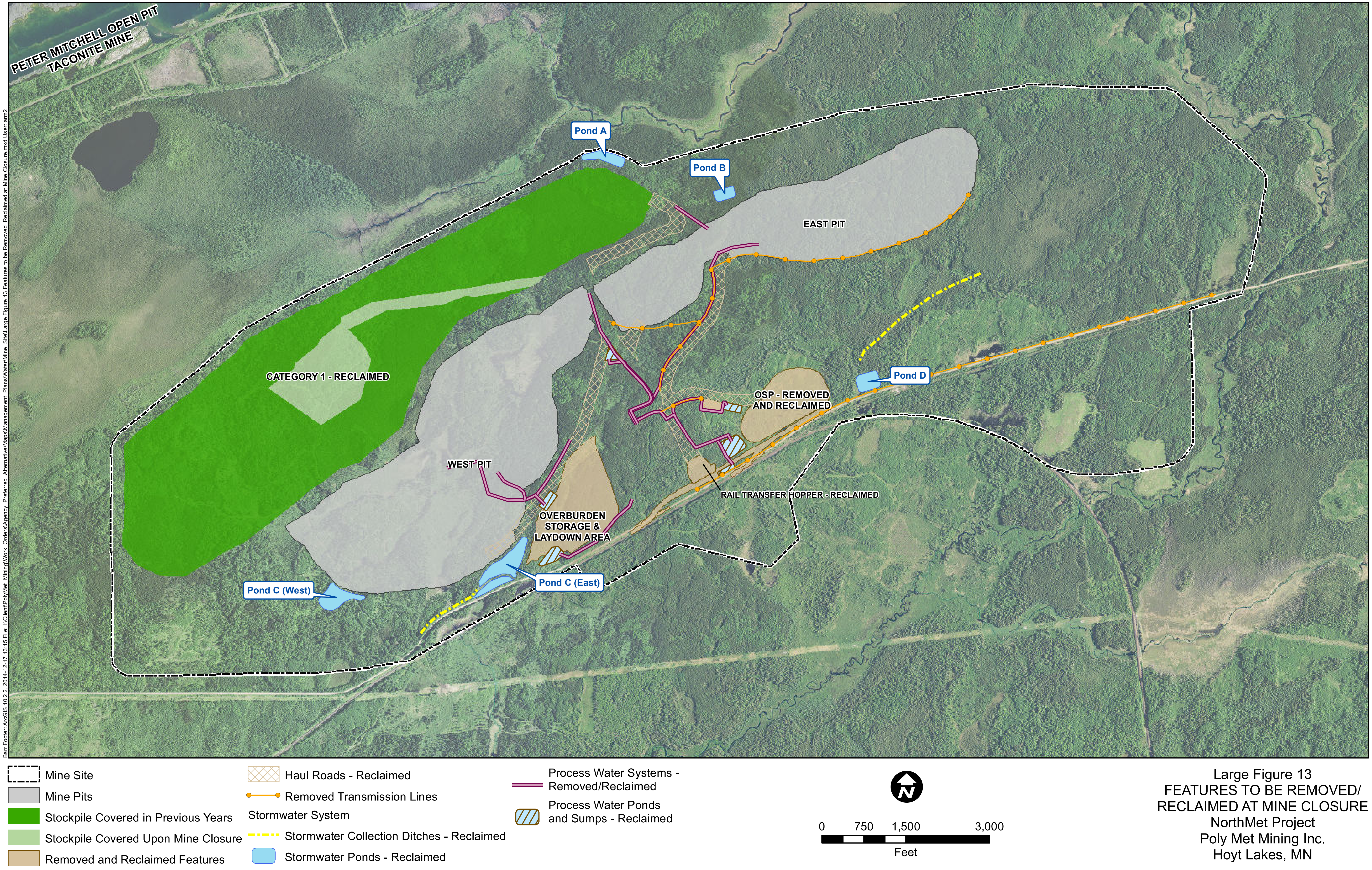
Removed Stockpile

Haul Roads

0 0.5 1 2

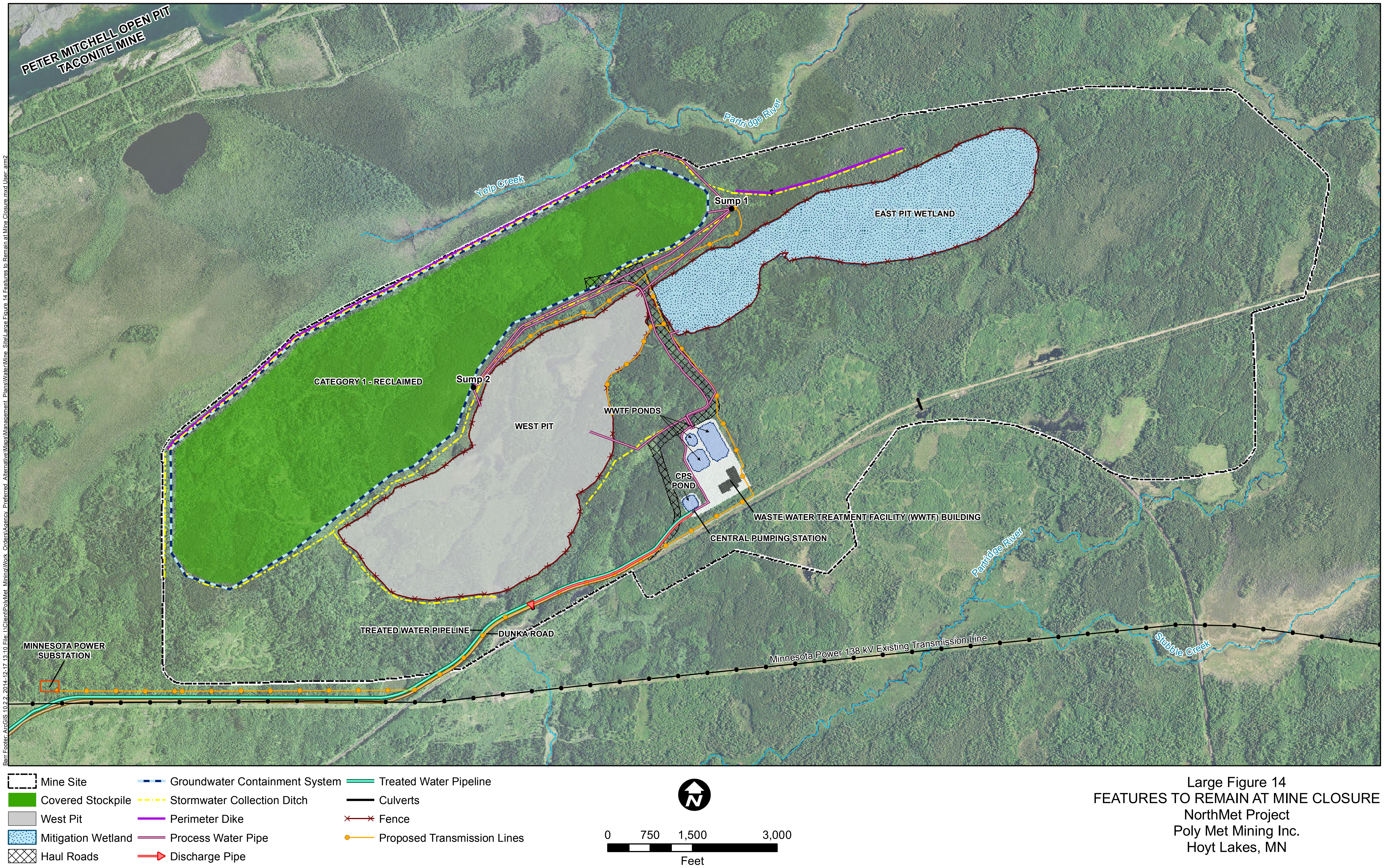
Miles

Large Figure 12
PROPOSED MONITORING PLAN
SURFACE WATER MONITORING LOCATIONS
NorthMet Project
Poly Met Mining Inc.
Hoyt Lakes, MN



Barr Footer: ArcGIS 10.2.2, 2014-12-17 13:15 File: I:\Client\PolyMet_Mining\Work_Orders\Agency_Preferred_Alternative\Maps\Management_Plans\Water\Mine_Site\Large Figure 13 Features to be Removed_Reclaimed at Mine Closure.mxd User: arm2

Large Figure 13
FEATURES TO BE REMOVED/
RECLAIMED AT MINE CLOSURE
NorthMet Project
Poly Met Mining Inc.
Hoyt Lakes, MN



Large Figure 14
FEATURES TO REMAIN AT MINE CLOSURE
NorthMet Project
Poly Met Mining Inc.
Hoyt Lakes, MN

Attachments

Attachment A

Mechanical Design Drawings – PLACEHOLDER

Attachment B

Stormwater Design Drawings – PLACEHOLDER

Attachment C

Mine Site Construction Storm Water Pollution Prevention Plan (SWPPP) – PLACEHOLDER

Attachment D

Mine Site Industrial Storm Water Pollution Prevention Plan (SWPPP) - PLACEHOLDER

Attachment E

Mine Site Spill Prevention Control and Countermeasures (SPCC) Plan – PLACEHOLDER