4.0 AFFECTED ENVIRONMENT

4.1 INTRODUCTION

Pursuant to the requirements of NEPA regulations at 40 CFR 1502.15 and *Minnesota Rules*, part 4410.2300, this chapter describes the affected environment of the NorthMet Project Proposed Action and Land Exchange Proposed Action. The information within this chapter provides context to the analyses of the environmental consequences addressed in Chapter 5. Resource topics were identified through scoping for both the NorthMet Project Proposed Action and Land Exchange Proposed Action, development of the DEIS, and public comment on the DEIS. Refer to Chapter 2 for more information on the SDEIS development process. The discussion of the affected environment is limited to those resources that may be subject to potential environmental effects from either the NorthMet Project Proposed Action or Land Exchange Proposed Action.

Table 4.1-1 lists the structure of Chapter 4.0 with respect to the NorthMet Project Proposed Action and Land Exchange Proposed Action. Section 4.2 describes the existing conditions for the natural and human environment that may be affected, directly or indirectly, by the NorthMet Project Proposed Action. Section 4.3 describes the existing conditions of the same natural and human environment resources as in Section 4.2, but specific to the areas that may be affected, directly or indirectly, by the Land Exchange Proposed Action or Land Exchange Alternative B.

Table 4.1-1 Resource Topic Areas Discussed in Chapter 4

Resource Topic	NorthMet Project Proposed Action	Land Exchange Proposed Action
Land Use	4.2.1	4.3.1
Water Resources	4.2.2	4.3.2
Wetlands	4.2.3	4.3.3
Vegetation	4.2.4	4.3.4
Wildlife	4.2.5	4.3.5
Aquatic Species	4.2.6	4.3.6
Air Quality	4.2.7	4.3.7
Noise and Vibration	4.2.8	4.3.8
Cultural Resources	4.2.9	4.3.9
Socioeconomics	4.2.10	4.3.10
Recreation and Visual Resources	4.2.11	4.3.11
Wilderness and Special Designation Areas	4.2.12	4.3.12
Hazardous Materials	4.2.13	4.3.13
Geotechnical Stability	4.2.14	4.3.14

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4.2 NORTHMET PROJECT PROPOSED ACTION

4.2.1 Land Use

This section describes the lands that may be affected by the NorthMet Project Proposed Action. Local, federal, and tribal management frameworks regulate the use of the lands. The Mine Site, Transportation and Utility Corridor, Plant Site, and non-federal lands fall within the 1854 Ceded Territory. The Mine Site and a portion of the Transportation and Utility Corridor fall within the Superior National Forest and are managed by the Forest Plan.

The Plant Site and existing LTVSMC Tailings Basin are located in a brownfield area dominated by the existing facilities and infrastructure of the former LTVSMC processing plant. In 2002, Cliffs Erie conducted a Phase I Environmental Site Assessment (Phase I ESA) of the former LTVSMC processing plant and identified 62 potential AOCs. The Legacy Contamination discussion in Section 4.2.1.4.2 elaborates on the status of AOCs.

4.2.1.1 Regulatory Considerations

The lands that may experience direct or indirect effects from the NorthMet Project Proposed Action (as well as the non-federal lands evaluated in Section 4.3.1) are located within the following jurisdictions:

- The cities of Babbitt and Hoyt Lakes;
- The 1854 Treaty Authority (including the 1854 Ceded Territories Conservation Code);
- Fond du Lac Tribal Conservation Codes for 1854 Ceded Territories;
- St. Louis, Lake, and Cook counties; and
- Superior National Forest.

County and municipal land use controls are described in Section 4.2.1.1.1; federal and tribal management frameworks are described in Section 4.2.1.1.2. Table 4.2.1-1 summarizes the relationship between these land use controls and project components.

Table 4.2.1-1 Land Use Controls Affecting the NorthMet Project Proposed Action

	Mine Site	Plant Site	Transportation and Utility Corridor
City of Hoyt Lakes Zoning Ordinance		X	X
City of Babbitt Zoning Ordinance	X		X
City of Babbitt Comprehensive Land Use Plan	X		X
St. Louis County Comprehensive Land Use Plan	X	X	X
Land and Resource Management Plan for Superior National Forest	X		X
1854 Treaty Authority	X	X	X

4.2.1.1.1 Local Land Use Management

Land use is regulated by municipal or county zoning ordinance, while comprehensive land use plans provide additional guidance for future development (League of Minnesota Cities 2011). A zoning designation identifies a list of allowed uses. If a proposed activity is one of these allowed uses, then it can be developed "as of right." If a potential use is not specifically allowed, the zoning ordinance will indicate that a variance or some similar action is required. The lands potentially directly affected by the NorthMet Project Proposed Action are in areas currently zoned for mining and/or industrial use. Some of these areas have already been affected by historic mining activity.

4.2.1.1.2 Federal and Tribal Land Use Management

The Mine Site, Transportation and Utility Corridor, Plant Site, and non-federal lands are within the territory ceded by the 1854 Treaty between the U.S. Government and the Chippewa of Lake Superior. Hunting, fishing, gathering, and other traditional uses under the 1854 Treaty are exercised on public lands within this territory, and on private lands with the permission of the land owner.

In addition, a portion of the Mine Site and Transportation and Utility Corridor are within the Superior National Forest. As such, they are governed by the Forest Plan. The Forest Plan uses the management area framework (see Section 4.2.1) to define the management approach for the Superior National Forest. The Forest Plan provides direction on desired conditions for forestry resources, mineral resources and extractive activity, vegetative communities, wildlife management, public recreation opportunities, and visual character, among other characteristics (USFS 2004b).

4.2.1.2 Mine Site

The federal lands, comprising 6,495.4 acres, are located in St. Louis County, approximately 70 miles north of the City of Duluth, 20 miles south of the BWCAW, 6 miles south of the City of Babbitt, and less than 2 miles south of the Northshore Mine. The federal lands are bounded on the south by the Transportation and Utility Corridor.

Except for an area south of the Transportation and Utility Corridor (see Section 4.2.1.3 below), the Mine Site is contained within the federal lands on part of the Superior National Forest and within the municipal limits of the City of Babbitt (see Figure 4.2.1-1). Most of the Mine Site and adjoining federal lands are part of the General Forest – Longer Rotation Management Area, while the remainder is within the General Forest Management Area (see Figure 4.3.1-1).

The General Forest – Longer Rotation Management Area is characterized by a diverse array of land and resource management uses, goods and services (including commercial goods), scenic quality, developed and dispersed recreation opportunities, and habitat for wildlife and fish. Roads open to public travel in this management area provide access to resources and road recreation opportunities. Non-motorized recreation opportunities also exist. The USFS allows exploration, development, and production of mineral resources on National Forest lands used for timber productions under conditions where the activities "are conducted in an environmentally sound manner so that they may contribute to economic growth and national defense" (USFS 2004b).

The characteristics and use of the General Forest Management Area are similar to the General Forest – Longer Rotation Management Area, except that timber harvests are more frequent, more uniform in age, and more extensive. The General Forest Management Area has the highest amount of young forest and the largest sized timber harvest units.

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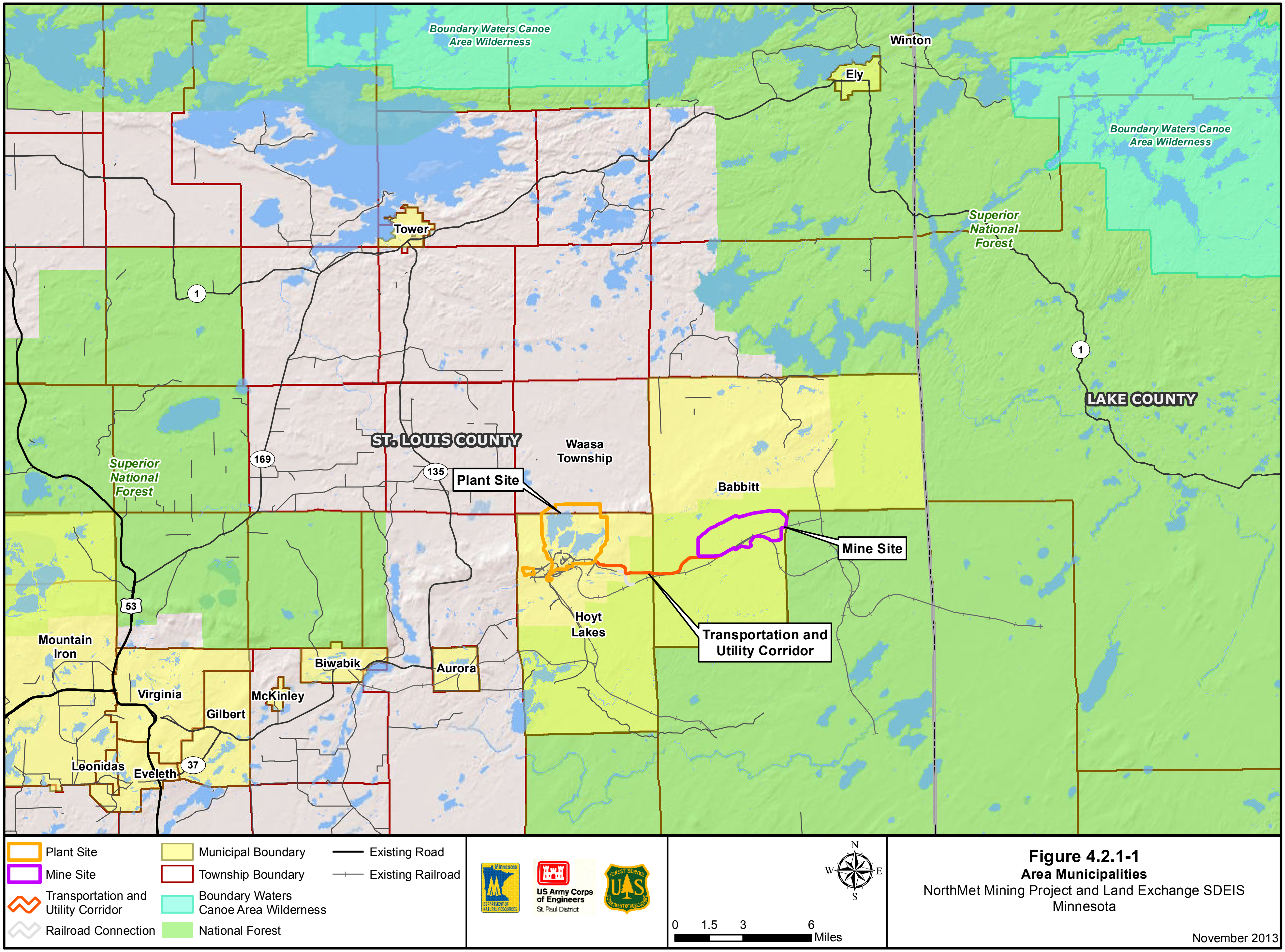

Figure 4.2.1-1
Area Municipalities
NorthMet Mining Project and Land Exchange SDEIS
Minnesota

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Federal lands designated for the Mine Site have been subject to mineral exploration since 1969. As of 2011 (the most recent year for which data were available), this exploration included 123 exploration drill sites, soil borings, and the construction of approximately 0.5 mile of temporary road access. Final reclamation of the closed portions of the temporary access roads has been completed (USFS 2011a). There is no known existing contamination by hazardous materials at the Mine Site.

The federal lands are a part of the territory ceded by the Chippewa of Lake Superior to the United States in 1854 (1854 Treaty Authority 2006). The Chippewa reserve rights to hunt, fish, and gather on public lands (and on private land with permission) in the 1854 Ceded Territory. Harvest levels and other activities are governed by either individual tribal entities (in the case of the Fond du Lac Band) or the 1854 General Codes and subsequent Amendments under the 1854 Treaty Authority (in the case of the Grand Portage and Bois Forte Bands [MDNR 2011r]).

The federal lands drain to the Partridge River, a tributary of the Upper St. Louis River. These lands, therefore, also fall within the jurisdiction of the St. Louis County Comprehensive Land Use Plan in the management of the St. Louis River Watershed. The goals of the plan are to actively manage development in the watershed to promote preservation and improvement of water quality, recreational opportunities, ecological health, and archaeological resources (St. Louis County 2005).

The City of Babbitt's zoning ordinance classifies the Mine Site area as a Mineral Mining district. This allows for existing and potential mineral mining, processing, and tailings and waste disposal, as well as accessory and support activities needed for the proper operation of mining activities outside the limits of open pit and ore formations. The zoning ordinance falls within the city's broader Comprehensive Land Use Plan, which was revised in 2011 (Arrowhead 2011). The draft plan includes goals and objectives in support of mining-related economic development opportunities.

Use of the area surrounding the Mine Site is varied. The area to the north/northwest of the Mine Site is within the City of Babbitt Mineral Mining district. The district includes part of the Plant Site and the Transportation and Utility Corridor, and the Northshore Mine (City of Babbitt 1996). The area to the east of the Mine Site is Superior National Forest land that is within the General Forest – Longer Rotation Management Area. The area to the south of the federal lands is within the City of Babbitt's Mineral Mining district and is a mix of private use (railroad and buffer area), Superior National Forest land within the General Forest Management Area, and state-owned lands.

4.2.1.3 Transportation and Utility Corridor

The Transportation and Utility Corridor connects the Plant Site and Mine Site, and includes Dunka Road, a railroad, and the land between them. The corridor traverses an area that straddles the boundary between the City of Babbitt and City of Hoyt Lakes (see Figure 4.2.1-1). The corridor passes through private, state, and Superior National Forest lands, some of which were previously mined. The private lands are within the City of Babbitt Mineral Mining zoning district and the City of Hoyt Lakes Mineral Mining district. The Superior National Forest areas are within the General Forest – Longer Rotation Management Area.

Dunka Road is a private road, with segments owned and leased by Cliffs Erie, PolyMet, and Minnesota Power. It serves as the access point for USFS Roads 125, 108, and 109, which are used for forest maintenance in the area of the Mine Site. Dunka Road also provides access to an existing electrical transmission line that runs parallel to and south of the road. The railroad is privately owned and in operating condition, but has not been extensively used since operations at LTVSMC ceased in 2001.

The Transportation and Utility Corridor crosses over Wyman, Longnose, and Wetlegs Creeks, which drain to the Partridge River, a tributary of the Upper St. Louis River (see Figure 3.2-1). It therefore also falls within the jurisdiction of the St. Louis County Comprehensive Land Use Plan in the management of the St. Louis River Watershed (see Section 4.2.1.1 above).

4.2.1.4 Plant Site

4.2.1.4.1 Summary of Land Use Conditions

The Plant Site is west of the Mine Site, in an area dominated by the existing facilities and infrastructure of the former LTVSMC processing plant and Tailings Basin, along with additional acreage purchased for the purpose of plant upgrade and buffer zones. The site is characterized by historical heavy industrial use, with extensive mechanical facilities, rail lines, mine workings, tailings storage, and closed pits. The majority of the Plant Site is located within the incorporated limits of the City of Hoyt Lakes and governed by the City of Hoyt Lakes Zoning Ordinance, last updated in 2010 (Hoyt Lakes Planning Commission 2010). The City does not have a comprehensive land use plan. The Hoyt Lakes portion of the Plant Site is in the City's Mineral Mining district, which identifies areas of existing and potential mineral mining, processing, tailings and waste disposal, and related activities, outside of the boundaries of the open mine pit and ore formations themselves.

The northern section of the Tailings Basin within the Plant Site is located within unincorporated Waasa Township (see Figure 4.2.1-1) and governed by the St. Louis County Comprehensive Land Use Plan. This area of the county is zoned for industrial use (the IND-4 zoning district; St. Louis County 2011). This district designates land for mining and quarrying, manufacturing, mineral exploration and evaluation, and a number of other related activities.

The Plant Site is accessible by Dunka Road from the east and from County Road 666 from the south. The Plant Site drains to the Partridge and Embarrass rivers, tributaries of the Upper St. Louis River. It therefore is within the jurisdiction of the St. Louis County Comprehensive Land Use Plan in the management of the St. Louis River Watershed (see Section 4.2.1.1 above).

The NorthMet Project Proposed Action includes the use of an existing water pipeline which runs from the northernmost section of Colby Lake northward to the Plant Site. The pipeline corridor is within the City of Hoyt Lakes Mineral Mining district. Colby Lake is an in-stream lake within the Partridge River. The corridor therefore is within the jurisdiction of the St. Louis County Comprehensive Land Use Plan in the management of the St. Louis River Watershed.

4.2.1.4.2 Legacy Contamination

In 2002, Cliffs Erie commissioned a Phase I ESA of the former LTVSMC processing plant and improvements (NTS 2002), which identified 62 potential AOCs. Designation as an AOC means that these areas require further investigation, but does not necessarily mean that contamination occurred in the past or is currently present.

As shown in Table 4.2.1-2, PolyMet would assume responsibility for 29 of the 62 AOCs upon acquiring the property from Cliffs Erie (Barr Engineering [Barr] 2007f). Of the 29 AOCs to be acquired, four have been closed or received a no further action letter from the MPCA; one is a permitted former landfill under post-closure monitoring pursuant to the Minnesota solid waste landfill requirements; and 24 require further investigation, including AOC #8, another closed permitted landfill, which requires further investigation to assess a groundwater plume. Table 4.2.1-2 summarizes the potential issues and status of these AOCs. PolyMet intends to continue the VIC program initiated by LTVSMC and continued by Cliffs Erie, and will investigate and remediate as necessary these AOCs on a schedule approved by the MPCA.

All historic and any potentially operational AOCs not already addressed by the start of mine closure would be investigated and remediated as necessary. The MDNR has indicated that any associated cleanup costs for the legacy AOCs would be included in the financial assurance requirements for any Permit to Mine issued to PolyMet for the NorthMet Project Proposed Action (Watkins, Pers. Comm., April 13, 2009).

The status of the remaining 33 AOCs for which PolyMet does not have any responsibility are as follows:

- ten sites have been closed through the VIC program;
- six sites are pending closure through the VIC program or awaiting confirmatory sampling;
- four sites have completed initial investigations, sampling plans in place, and are awaiting MPCA review;
- three sites have not yet been investigated;
- eight sites have a status that is unknown or not readily available;
- one site is being managed through the NPDES program; and
- one site will likely require additional remediation (i.e., Pellet Plant).

Table 4.2.1-3 summarizes the potential issues and status of these AOCs.

Additionally, the LTVSMC Tailings Basin seeps are being managed under the Cliffs Erie Consent Order using short-term measures until long-term mitigation measures are determined.

Table 4.2.1-2 NorthMet Project Proposed Action Area of Concern Summary List for Voluntary Investigation and Cleanup Program

AOC	Location	Site Description	Identified Potential Issues	Status
1	Area 1	Area 1 Shops and Reporting	Domestic septic systems and drain field.	A Phase I ESA/SAP has been prepared.
6	Area 1	Oily Waste Disposal Area	Waste from general shop area floor drains.	No actions have been taken with regard to this site.
7	Area 1	Bull Gear Disposal Area	One time 1970s disposal of heavy lubricant.	No actions have been taken with regard to this site.
8	Area 1	Private Landfill	Permitted industrial waste landfill that operated until 1993. *Identified presence of groundwater plume.*	*The closed LTVSMC Private Landfill exists within the site of active permitted Industrial Waste Landfill (SW-619). Monitoring activities for the closed LTVSMC Private Landfill are incorporated into the active SW-619 permit (held by Cliffs Erie). Work plan submitted to MPCA to define the extent of the facility's groundwater plume, assess the stability of the groundwater, and assess the ability of the gas vents to aid in the remediation of the groundwater plume.*
9	Area 1	Area 1 RR Panel Yard	Railroad tie disposal area co-mingled with scrap metal, wood, and demolition debris.	*Scrap and trash were disposed. Some items remain to be removed. A SAP was submitted to the MPCA and was implemented. A historic release was identified. Further recommendations for cleanup are ongoing to the MPCA.*
10	Area 1	Area 1 Airport	Some areas of soil staining.	No actions have been taken with regard to this site.
11	Area 1	Stoker Coal Ash Disposal	Disposal area until 1980s with marginal cover.	No actions have been taken with regard to this site.
12	Area 1	Mill Rejects Area	Solid waste from concentrator building.	Site closed: No Further Action required.
13	Area 2/2E/3	2001 Storage Area	Some areas of soil staining.	No actions have been taken with regard to this site.
14	Area 2/2E/3	Large Equipment Paint Area	Buildup of blasting sand.	No actions have been taken with regard to this site.
24	Area 5	Area 5 Reporting	Scrap and salvage area with some stained soils.	Site closed through the VIC program in letter dated 7/30/08.
25	Area 5	Area 5 Loading Pocket & Storage	Some areas of stained soils along rail siding.	Site closed through the VIC program in letter dated 7/30/08.
35	Plant Site	Dunka WWTP Sludge Staging Area	Little evidence of any residue remaining.	Water treatment plant sludge residue removed.

AOC	Location	Site Description	Identified Potential Issues	Status
36	Plant Site	Coal Ash Landfill	Cover appears to be in good condition.	Permitted Landfill. Closed and subject to post-closure monitoring.
37	Plant Site	Line 9 Area 5 Petroleum Contaminated Soil	Permitted petroleum land application site with 25,000 cubic yards of soils.	The MPCA sent a closure letter for this site on February 24, 2006.
38	Plant Site	Area 2 Shops	Contains a locomotive fueling station and a septic system.	Excavation conducted Summer 2007. Pending MPCA PRP conditional closure. Full closure is contingent on sampling results for the land treated soils.
40	Plant Site	Heavy Duty Garage	Formerly used for equipment maintenance.	Building and one UST removed. *Site reuse planned, further investigation at PolyMet closure.*
42	Plant Site	Bunker C Tank Farm	Large ASTs *which previously contained #4 and #6 fuel oil.*	*Some excavation and removal of surface stains complete. Pump house demolished, day tanks removed and will be scrapped, petroleum-impacted soils removed. Further work required to remove large ASTs and some fuel lines.*
43	Plant Site	Administration Building	One heating oil UST was abandoned in place.	Facility still in use. *Further investigation at PolyMet closure.*
44	Plant Site	Main Gate Vehicle Fueling Area	Contains several AST used for fueling trucks.	Facility still in use. *Further investigation at PolyMet closure.*
46	Plant Site	Plant Site Proper/General Shops	Former taconite processing area – no specific issues identified.	*Reuse planned, further investigation at PolyMet closure.*
47	Tailings Basin	Tailings Basin Reporting	Septic system remains.	Two USTs removed.
48	Tailings Basin	Transformers	Several transformers present, but records indicate that they do not contain PCBs.	No actions have been taken with regard to this site.
49	Tailings Basin	Coarse Crusher Petroleum Contaminated Soil Stockpile	Contained floor sweepings (containing oil).	All contaminated soil was removed in 1990s.
50	Tailings Basin	Emergency Basin	*Received water from process sumps in the Concentrator during power outages and emergency conditions, and stormwater outfall.*	*A SAP was submitted to the MPCA and was implemented. No releases were identified and a report will be prepared requesting no further action related to this site.*
51	Tailings Basin	Salvage and Scrap Areas	Some areas of soil staining.	No actions have been taken with regard to this site.
52	Tailings Basin	Cell 2W Salvage Area	Several small stained soil areas as well as the remnants of a mobile AST.	No actions have been taken with regard to this site.

AOC	Location	Site Description	Identified Potential Issues	Status
53	Tailings Basin	Cell 2W Hornfels waste rock	Sulfide waste rock disposed under a MPCA/MDNR approved plan.	NPDES monitoring ongoing.
59	Colby Lake	Colby Lake Pumping Station	One transformer remaining.	One heating oil AST removed in 1970. *Reuse planned, further investigation at PolyMet closure.*

Sources: NTS 2002; Scott 2009, Pers. Comm., 2011.

Italic text in Table 4.2.1-2 indicates that the "Identified Potential Issues" and "Status" have been updated since the DEIS.
PCB = Polychlorinated biphenyl
PRP = Potentially Responsible Party
SAP = Sampling and Analysis Plan
UST = Underground storage tank

Table 4.2.1-3 Non-NorthMet Project Areas of Concern Status

AOC	Responsible Party	Site Description	Issues	Status
2	Mesabi Nugget	Area 1 petroleum contaminated soil	Petroleum contaminated soil.	Unknown.
3	Mesabi Nugget	Sludge site	Sludge contaminated soil.	Unknown.
4	Mesabi Nugget	1004 storage area	Soil staining and debris.	Unknown.
5	Mesabi Nugget	Roofing disposal site	Roofing debris.	Unknown.
15	Cliffs Erie	Railroad storage area	Debris.	No action to date.
16	Cliffs Erie	Area 2 vibratory loading pocket		Phase II submitted November 2008, requested no further action.
17	Cliffs Erie	Area 2 truck fueling		Site closed through the VIC program.
18	Cliffs Erie	Area 2 superpocket		Phase II submitted November 2008, requested no further action.
19	Mesabi Nugget	Area 2WX reporting		Site closed through the VIC program in letter dated 7/31/08.
20	Mesabi Nugget	Area 2WX shovel salvage		Site closed through the VIC program in letter dated 7/31/08.
21	Mesabi Nugget	Area 2WX truck fueling		Site closed through the VIC program.
22	Mesabi Nugget	Area 2WX vibratory loading pocket		Site closed through the VIC program in letter dated 7/31/08.
23	Mesabi Nugget	Area 2WX superpocket		Site closed through the VIC program.
26	Mesabi Nugget	Area 6 truck fueling		Site closed through the VIC program.
27	Mesabi Nugget	Area 6 misfired blast		Site closed through the VIC program.
28	Mesabi Nugget	Area 9S former Aurora dump site	Debris.	Unknown.
29	Mesabi Nugget	Stockpile #9021	Debris related to Aurora dump site.	Unknown.
30	Mesabi Nugget	Pre-taconite plant	Debris.	Unknown.
31	Mesabi Nugget	Area 9N vibratory loading pocket	Septic tank and drain field.	Unknown.
32	Duluth Metals	Dunka shops and reporting	Demolition debris, closed leak site.	Phase I ESA and SAP complete, but not yet submitted.
33	Duluth Metals	North loading pocket – Dunka	Abandoned wells and septic system.	Phase I ESA and SAP complete, but not yet submitted.

AOC	Responsible Party	Site Description	Issues	Status
34	Duluth Metals	South loading pocket – Dunka	Abandoned wells and septic system.	Phase I ESA and SAP complete, but not yet submitted.
39	Cliffs Erie	Knox Railroad fueling station		Pending closure based on confirmatory sampling.
41	Cliffs Erie	Oxygen plant		Pending closure.
45	Cliffs Erie	Pellet storage area and load-out	Soil staining and petroleum residue.	No action to date.
54	Cliffs Erie	Taconite Harbor marine fueling ASTs		Pending closure based on confirmatory sampling.
55	Cliffs Erie	Taconite Harbor oil track		Pending closure based on confirmatory sampling.
56	Cliffs Erie	Coal ash landfill - Taconite Harbor		Managed through NPDES permit, no VIC action.
57	Cliffs Erie	Murphy City	Soil staining, well and septic system.	Phase I ESA and SAP complete, but not yet submitted.
58	Cliffs Erie	Rail lubricators	Stained soil.	No action to date.
60	Cliffs Erie	Brick recycling area		Site closed through the VIC program.
61	Cliffs Erie	PCB ditch investigation (pellet plant)		Site closed through the VIC program.
62	Cliffs Erie	Pellet plant	Soil staining and debris.	Phase I ESA and SAP submitted in December 2008, additional action likely.

Cliffs Erie received a permit (SW-625) in 2006 from the MPCA to locate two individual land treatment sites within Cell 2W of the existing LTVSMC Tailings Basin. This facility is being used to land farm petroleum-contaminated (i.e., diesel fuel) soils excavated from AOCs #38 (Area 2 Shops) and #39 (Knox Railroad fueling station).

In May 2009, Cliffs Erie conducted a detailed assessment of both surface and groundwater quality at the existing LTVSMC Tailings Basin, including testing for volatile organic compounds (VOCs), SVOCs, PCBs, and other parameters to determine if there was any organic contamination that could be transported off site via stormwater runoff or groundwater seepage. The laboratory analyses showed no evidence of organic contamination leaving the site (Cliffs Erie 2009). Based on the investigations and laboratory analyses to date, which include sampling at seven monitoring wells, 14 surface discharges, 12 internal waste streams, and six downstream surface water monitoring stations, and visual observation and limited field analyses at 33 seeps at or near the existing LTVSMC Tailings Basin, no off-site contamination has been documented. The extent of on-site contamination from the legacy sites appears to be limited to localized soils and groundwater.

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4.2.2 Water Resources

This section describes the existing groundwater and surface water hydrology and water quality within the Partridge River and Embarrass River watersheds. The Mine Site, Transportation and Utility Corridor, the former LTVSMC processing plant, and a small portion of existing LTVSMC Tailings Basin drain to the Partridge River Watershed (see Section 4.2.2.2), while most of the Tailings Basin and the Emergency Basin drain to the Embarrass River Watershed (see Section 4.2.2.3).

4.2.2.1 Regional Setting

4.2.2.1.1 Meteorological Conditions

The NorthMet Project area is located near the headwaters of the Partridge River and Embarrass River watersheds at an approximate elevation of 1,600 ft amsl. Meteorological data are available for the NorthMet Project area from two weather stations operated by the National Weather Service. The Babbitt 2SE weather station is located approximately 5 miles from the Mine Site and has 66 years of records. The Hoyt Lakes 5N weather station is located approximately 1 mile from the Plant Site and has 25 years of records (see Figure 4.2.2-1).

Table 4.2.2-1 shows the monthly and annual average air temperature and precipitation for the two National Weather Service stations. Precipitation averages approximately 28 inches annually. Snowfall in the NorthMet Project area typically occurs between October and April. Estimates of annual average evaporation for northern Minnesota range from 18 inches (Siegel and Ericson 1980) to 22 inches (SCS 1975).

Table 4.2.2-1 Normal Monthly and Annual Average Air Temperature and Precipitation Near the NorthMet Project

Station Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Air Temperature (°F)													
Babbitt 2 SE	5.5	12.3	23.8	39.2	52.8	61.5	66.5	64.4	54.5	44.4	27.1	11.8	38.7
Hoyt Lakes 5N	1.5	9.0	22.4	37.5	50.6	59.0	64.6	61.9	52.3	41.8	25.3	9.5	36.3
Precipitation (inches)													
Babbitt 2 SE	0.91	0.74	1.07	1.99	3.17	4.17	3.67	3.98	3.40	2.60	1.73	1.04	28.47
Hoyt Lakes 5N	0.95	0.66	1.23	2.08	3.23	3.96	3.86	3.86	3.36	2.75	1.25	0.97	28.16

Source: WRCC 2012.

°F = Degrees Fahrenheit
Period of Record: Babbitt = 1948 to 1986; Hoyt Lakes = 1958 to 1984.

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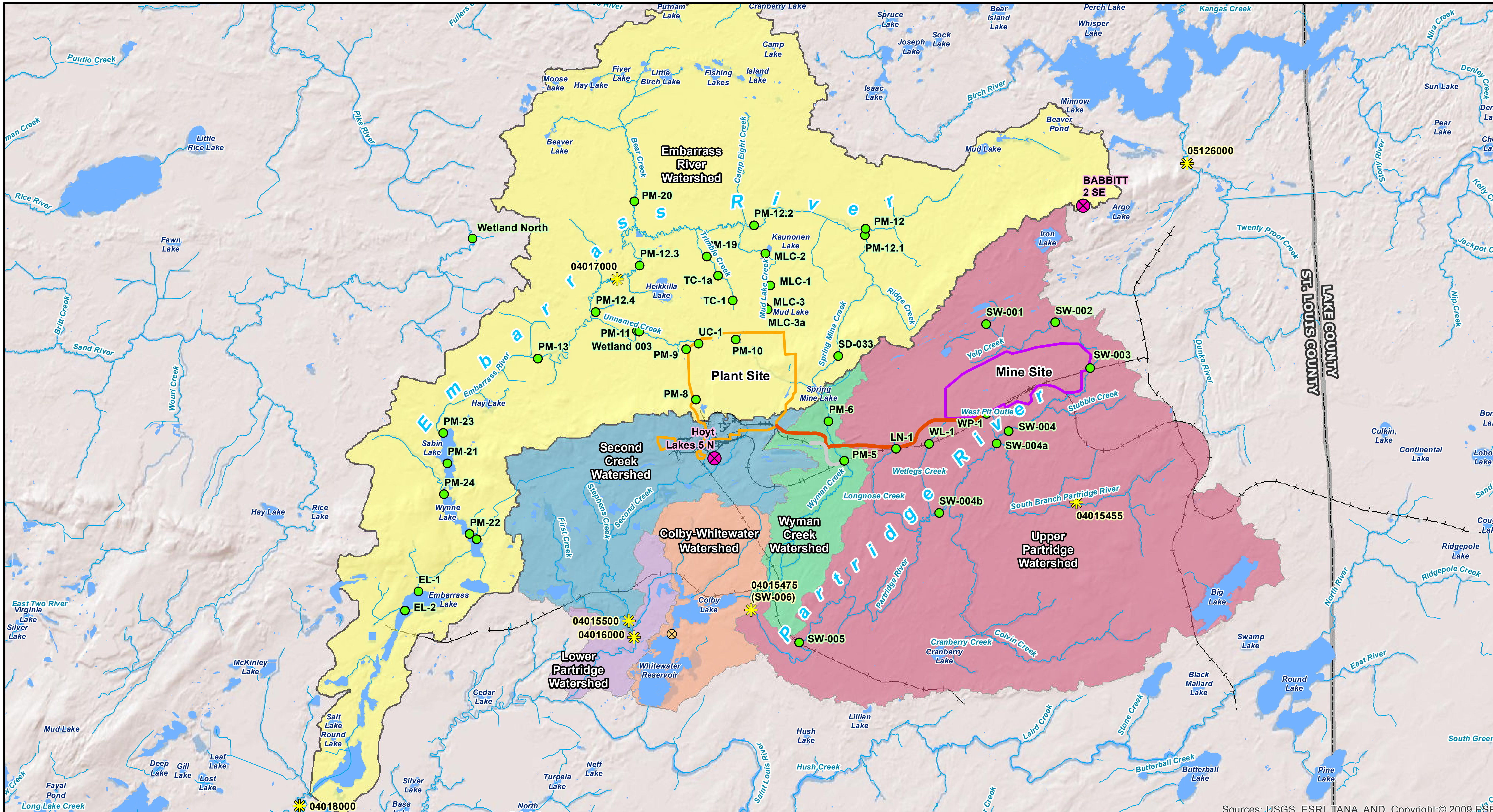

- Surface Water Quality Data Location
- USGS Gaging Station (not active)
- Weather Station
- Diversion Works
- Stream/River
- Mine Site
- Plant Site
- Transportation and Utility Corridor
- Railroad Connection
- Existing Railroad

Minnesota Department of Natural Resources | US Army Corps of Engineers St. Paul District | Forest Service U.S. Department of Agriculture

0 1 2 4 6 Miles

N S E W

Figure 4.2.2-1

Watersheds, Streams and Data Collection Sites

NorthMet Mining Project and Land Exchange SDEIS

Minnesota

November 2013

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4.2.2.1.2 Water Resource Use Classifications

A key element of water management is "use classification," which identifies beneficial uses for which a water body must be protected. The State of Minnesota has adopted a framework that identifies a broad range of potential uses, including:

- domestic consumption – Class 1,
- aquatic life and recreation – Class 2,
- industrial consumption – Class 3,
- agriculture and wildlife – Class 4,
- aesthetics and navigation – Class 5,
- other uses – Class 6, and
- limited resource value – Class 7.

These classes can be further divided into subclasses with letter designations. The use classifications are not intended to imply a priority rank to the uses.

<u>Groundwater</u>

Following *Minnesota Rules* 7060.0200, it is the policy of the State of Minnesota to consider the actual or potential use of groundwater for potable water supply as constituting the highest priority use and, as such, to provide maximum protection to all underground waters. Therefore, all groundwater is considered to have one beneficial use, domestic consumption (Class 1). The MDNR has water allocation priorities defined under statute 103G.261 as follows:

(a) The commissioner shall adopt rules for allocation of waters based on the following priorities for the consumptive appropriation and use of water:

> (1) first priority, domestic water supply, excluding industrial and commercial uses of municipal water supply, and use for power production that meets the contingency planning provisions of section 103G.285, subdivision 6;
>
> (2) second priority, a use of water that involves consumption of less than 10,000 gallons of water per day;
>
> (3) third priority, agricultural irrigation and processing of agricultural products involving consumption in excess of 10,000 gallons per day;
>
> (4) fourth priority, power production in excess of the use provided for in the contingency plan developed under section 103G.285, subdivision 6;
>
> (5) fifth priority, uses, other than agricultural irrigation, processing of agricultural products, and power production, involving consumption in excess of 10,000 gallons per day; and
>
> (6) sixth priority, nonessential uses.

(b) For the purposes of this section, "consumption" means water withdrawn from a supply that is lost for immediate further use in the area.

(c) Appropriation and use of surface water from streams during periods of flood flows and high water levels must be encouraged subject to consideration of the purposes for use, quantities to be used, and the number of persons appropriating water.

(d) Appropriation and use of surface water from lakes of less than 500 acres in surface area must be discouraged.

(e) The treatment and reuse of water for nonconsumptive uses shall be encouraged.

Principal groundwater resources in the NorthMet Project area are contained in bedrock geologic units and overlying surficial glacial deposits, which are also referred to as unconsolidated deposits. The water table is primarily located within the surficial aquifer; however, it is also likely located within the bedrock in areas of local bedrock highs. This means that saturated conditions exist within the unconsolidated deposits and in the underlying bedrock. Recharge to the bedrock is by infiltration of precipitation in outcrop areas and leakage from the overlying surficial aquifer (Siegel and Ericson 1980).

Surface Water

All surface waters in Minnesota are classified and protected for multiple beneficial uses. *Minnesota Rules* 7050.0470 lists individual waters and their associated use classifications. However, only a limited subset of all waters are actually listed, which include trout waters, surface waters protected for drinking water use, outstanding resource value waters, and Class 7 limited-resource-value waters. All of the remaining surface waters of the State, which include most of the waters of the State, are considered “unlisted waters.” These unlisted surface waters are uniformly classified as Class 2B (cold or warm water sport or commercial fishing), 3C (industrial cooling and materials transport), 4A (irrigation use), 4B (livestock and wildlife use), 5 (aesthetics and navigation), and 6 (other uses) waters.

In the NorthMet Project area, most of the rivers and streams are unlisted. The two listed waterbodies in the NorthMet Project area are Colby Lake and Wyman Creek. Colby Lake, which is used for domestic consumption by the City of Hoyt Lakes, is designated as Classes 1B (treated with simple chlorination for domestic consumption) and 2Bd (cool or warm water sportfish and drinking water) waters as well as the other default Classes 3C, 4A, 4B, 5, and 6. Wyman Creek, which is a designated trout stream, is designated as Classes 1B as well as 2A (aquatic life and recreation), 3B (industrial consumption-moderate treatment), as well as the other default classes 3C, 4A, 4B, 5, and 6 (*Minnesota Rules*, part 7050.0470).

All NorthMet Project area waters are also designated Outstanding International Resource Waters (*Minnesota Rules*, parts 7050.0460 and 7052.0300), which prohibits any new or expanded point source discharges of bioaccumulative substances of immediate concern (i.e., mercury) unless a nondegradation demonstration is completed and approved by the MPCA.

In addition to the above water use classifications for establishment of state water quality standards (*Minnesota Rules*, Chapters 7050 and 7052), certain waters of the state are also classified by the MDNR as Public Waters. Public Waters are all water basins, wetlands, and watercourses that meet the criteria set forth in Minnesota Statutes, section 103G.005, subdivision 15, and that are identified on Public Water Inventory maps authorized by Minnesota Statutes, section 103G.201 (see Figure 4.2.2-2). Any proposed activity that alters the course, current, or cross section of a mapped Public Water is subject to a variety of state regulations (*Minnesota*

Rules, Chapter 6115), depending on the proposed activity. The Public Waters program does not regulate water quality.

Impaired Waters

The federal CWA requires states to adopt water quality standards to protect waters from pollution. These standards, which are typically based on the beneficial use classifications described above, define how much of a pollutant can be in the water and still meet beneficial uses, such as drinking water, fishing, and swimming. Water quality standards are the fundamental tools used to assess the quality of all surface waters. States must monitor and assess the water quality of their waters to identify those that are "impaired" (i.e., not fully supporting their beneficial uses).

Section 303(d) of the CWA requires states to publish and update a list of impaired waters for which a Total Maximum Daily Load (TMDL) Study is needed. This list, known as the "303(d) List" or "TMDL List" is updated every two years via assessment of water quality data and an extensive public participation process. The final 2012 TMDL List was developed by the MPCA and approved by the USEPA in July 2013. If the extent of the violations of standards for any water exceeds the guidelines described in the Guidance Manual (MPCA 2012e), those surface waters are considered to be "impaired." The goal of the MPCA is to protect high-quality waters and improve the quality of impaired waters so water quality standards are met and beneficial uses are maintained and restored, where these uses are attainable.

Table 4.2.2-2 shows the waters within the Embarrass River and Partridge River watersheds that are on the final 2012 TMDL List (see Figure 4.2.2-1).

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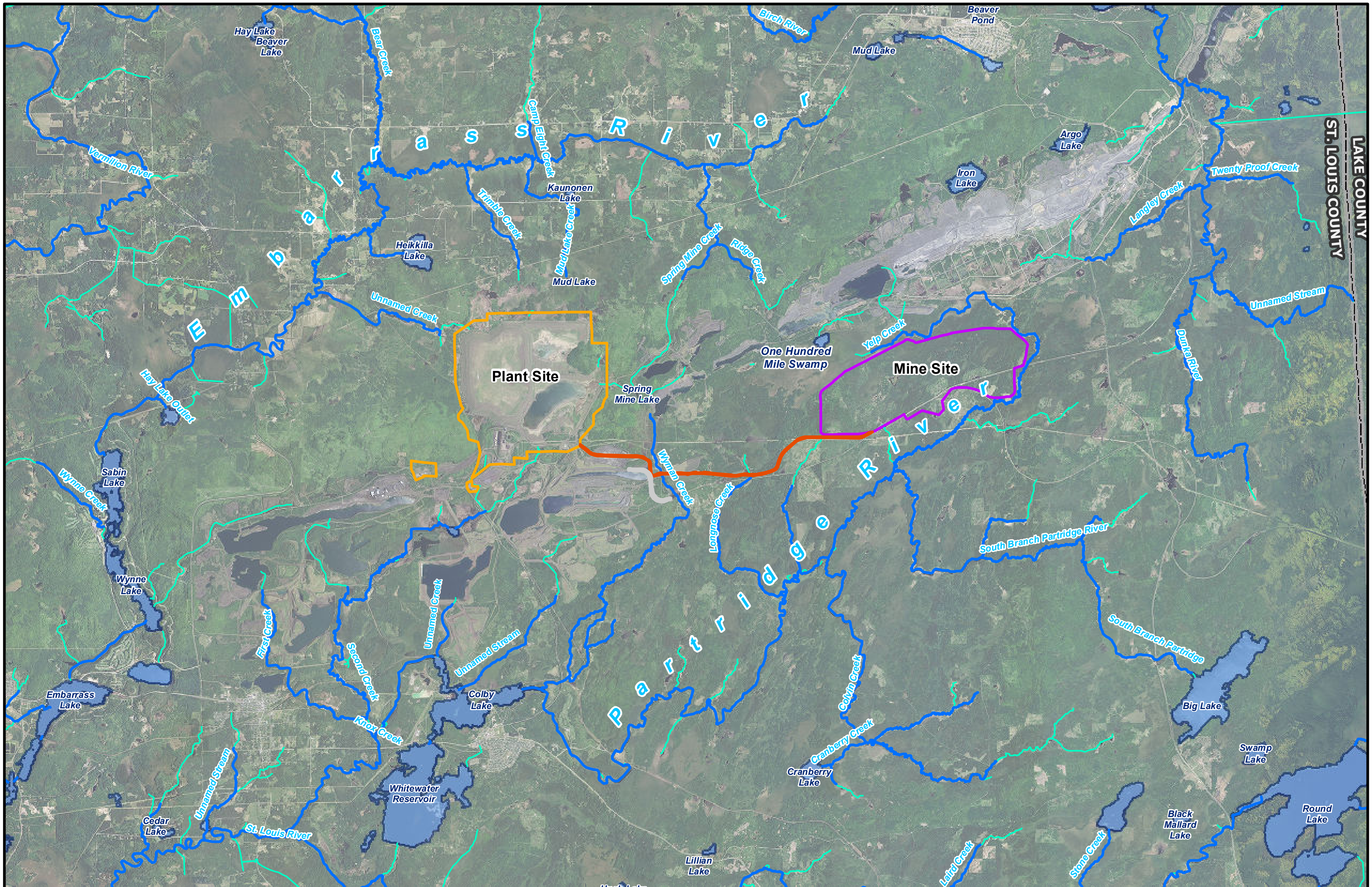

MDNR Designated Public Waters Inventory (PWI) Stream/River
Non MDNR Designated Public Waters Inventory (PWI) Stream/River
MDNR Designated Public Waters Inventory (PWI) Lake/Wetland
Mine Site
Plant Site
Transportation and Utility Corridor
Railroad Connection

US Army Corps of Engineers
St. Paul District

0 0.5 1 2 3 Miles

Figure 4.2.2-2
MDNR Designated Public Waters
NorthMet Mining Project and Land Exchange SDEIS
Minnesota

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Table 4.2.2-2 Impaired Waters within the Embarrass River and Partridge River Watersheds

Water Name	**Affected Designated Use**	**Pollutant/Stressor**	**TMDL Target Date**
Embarrass River: headwaters to Embarrass Lake	Aquatic Life	Fishes Bioassessments	2015
Sabin/Wynne Lake (MDNR designated as one Lake)	Aquatic Consumption	Mercury in fish tissue	2015
Embarrass Lake	Aquatic Consumption	Mercury in fish tissue	2015
Esquagama Lake	Aquatic Consumption	Mercury in fish tissue	2015
Wyman Creek: headwaters to Colby Lake	Aquatic Life	Fishes Bioassessments	2015
Colby Lake or Whitewater Reservoir[1]	Aquatic Consumption	Mercury in fish tissue	2015
St. Louis River: Partridge River To Embarrass River	Aquatic Consumption	Mercury in fish tissue	2025
Spring Mine Creek: from Ridge Creek to Embarrass River	Aquatic Life	Fishes Bioassessments; Aquatic Macroinvertebrates Bioassessments	2015

[1] Both Colby Lake and Whitewater Reservoir are included on the 2012 Inventory of All Impaired Waters List; however, only Colby Lake is on the final 2012 TMDL List. Whitewater Reservoir has an EPA Category of 4A, meaning fish tissue levels are low enough that it is included under the Statewide Mercury TMDL and no further TMDL is needed.

The "mercury in fish tissue" pollutant listed in Table 4.2.2-2 indicates that the mercury content in sampled fish tissue from these waters was found to be above the state's human health chronic standard. See Section 4.2.6.4 for further information about mercury in water and fish. The pollutant listed in the table as "Fishes or Macroinvertebrates Bioassessments" reflects an impaired fish and/or benthic macroinvertebrate population, based on Index of Biological Integrity (IBI) monitoring and assessment, without a specific cause, or stressor, yet being identified. (The MPCA has developed fish and invertebrate IBI scores to assess the aquatic life use of rivers and streams in Minnesota. Monitoring the aquatic community, via biological and chemical monitoring, is a direct way to assess aquatic life use support. The aquatic community integrates the cumulative effect of pollutants, habitat alteration, and hydrological modification of a water body over time. The IBI incorporates multiple attributes of the aquatic community, called metrics, which are used to create a cumulative IBI score for each sample location. The MPCA has developed assessment thresholds or biocriteria for aquatic use. In general, an IBI score above the assessment threshold indicates aquatic life use support, while a score below indicates non-support.) When stressors become known through further investigations and studies, the TMDL can be completed and consideration can be given to permit conditions for individual projects, as warranted.

4.2.2.1.3 Wild Rice

Wild rice is an important resource in terms of its economic and environmental values, as well as having significant cultural value to the native Ojibwe people, which includes the Bands. This section provides baseline information on the importance of wild rice, its habitat requirements, and presence within the NorthMet Project area. Section 4.2.9 discusses the cultural importance of wild rice to the tribes in further detail.

Importance of Wild Rice

The Ojibwe people have a special cultural and spiritual tie to natural wild rice. Their migration story describes how they undertook a westward migration from eastern North America, which tribal prophets had foretold would continue until the Ojibwe people found “the food that grows on water” (Benton-Banai 1988). That food was wild rice, known as manoomin, and it is revered to this day by the Ojibwe as a special gift from the Creator. Natural wild rice remains a mainstay of traditional foods for the Ojibwe community and offers significant nutritional value. The tradition of hand harvesting natural wild rice continues to this day among both tribal and non-tribal cultures. It is estimated that more than 3,000 tribal members participate in wild rice harvesting statewide along with about 1,500 non-tribal individuals (MDNR 2008c).

Wild rice also represents an important food source for both migrating and resident wildlife. Wild rice has been listed as one of the 10 most important sources of food for ducks throughout the United States and Canada. In Minnesota, research conducted at Chippewa National Forest found that natural wild rice was the most important food for mallards during the fall, although many other species of duck also use beds of wild rice. The stems of wild rice provide nesting material for several species and critical brood cover for waterfowl. The entire wild rice plant provides food during the summer for herbivores. In addition, rice worms and other insect larvae feed heavily on natural wild rice. These insects provide a rich source of food for various birds. In the spring, decaying rice straw supports a diverse community of invertebrates and thus provides an important source of food for a variety of wetland wildlife. As a result, many species of wildlife use wild rice lakes and streams for reproduction and foraging areas, including 17 species listed in the MDNR Comprehensive Wildlife Conservation Strategy (MDNR 2006d) as Species of Greatest Conservation Need (SGCN).

In addition to its importance for wildlife, natural wild rice has other ecological values. Emergent aquatic plants like wild rice protect shorelines from erosion, provide habitat for fish, and temporarily sequester nutrients during the growing season, thereby reducing the potential for stream and lake eutrophication and turbidity.

Natural wild rice is an important component of tribal and local economies in Minnesota. In 2007, nearly 0.3 million pounds of unprocessed natural wild rice were purchased from the Leech Lake Band of Ojibwe-licensed harvesters generating more than $400,000 of income for tribal members (MDNR 2008c).

Minnesota was the world’s first producer of cultivated wild rice in the 1950s and remains one of the world’s leading producers of cultivated wild rice, producing 4 to 6 million pounds annually (MCWRC 2012). Cultivated wild rice, which depends on natural wild rice to an important degree in maintaining genetic diversity, plays an important role Minnesota’s economy (MDNR 2012h).

Preferred Habitat and Life Cycle

The historic range of natural wild rice is believed to have encompassed all of Minnesota (Moyle 1945), although it was most common in areas of glacial moraines in central and northern Minnesota. Based on a recent inventory, natural wild rice is still found in 55 counties in Minnesota (MDNR 2008).

The distribution and abundance of natural wild rice is dependent on its habitat requirements, which include the following (MDNR 2008c):

- surface water hydrology – some moving water, with rivers, flowages, and lakes with inlets and outlets being optimal areas for growth;
- seasonal water depths – water levels that are relatively stable or decline gradually during the growing season are preferred, with optimal depths of 0.5 to 3.0 ft of water;
- substrate – although wild rice may occur in a variety of lake bottoms, the most consistently productive stands are those with soft, organic sediments;
- water clarity – clear to moderately colored (stained) water is preferred as darkly stained water can limit sunlight penetration and hinder early plant development; and
- water chemistry – wild rice grows within a wide range of chemical parameters; however, productivity is highest in water with a pH of 6.0 to 8.0 and alkalinity greater than 40 mg/L. Wild rice stands require nitrogen and phosphorus, although excess levels of some nutrients, especially phosphorus, can adversely affect productivity. Wild rice is an annual plant that develops in the spring from a seed that drops off the plant to bottom sediments during the previous fall. The seed requires a dormancy period of 3 to 4 months in 35°F or colder water before germinating in the spring when water temperatures reach 40°F. The plant goes through several distinct growth phases during its lifecycle. During the submerged leaf stage in late May to early June, a cluster of underwater leaves forms. The floating leaf stage typically begins in mid-June as floating leaves develop and lay flat on the water surface. This stage is when wild rice is most susceptible to being uprooted by rapidly rising water levels or waves generated by high winds.

Aerial shoots typically begin to develop by the end of June and grow to a height of 2 to 8 ft above the water surface by August. Wild rice begins to flower in late July and the seeds develop in August and September. The wild rice seeds on the same plant mature across a staggered time period, ensuring that some seeds survive environmental conditions to perpetuate the stand. Some seeds may remain dormant in the bottom sediment for many years to several decades if conditions are not suitable for germination, allowing wild rice populations to survive through time periods with less than optimal conditions and reduced productivity. The time period from germination to dropping of mature seeds typically requires about 110 to 130 days, depending upon environmental conditions. Even under ideal growing conditions, wild rice stands undergo approximately 3- to 5-year cycles in which productivity varies. A typical cycle includes a highly productive year followed by a low productive year, which is followed by a gradual recovery.

Two primary factors that can impact wild rice productivity are changes in hydrology and water quality. Wild rice typically occurs in shallow water and is sensitive to varying water levels, especially during the floating leaf stage in early summer when abruptly rising water levels can uproot the plant. Wild rice will stop growing or become less productive if water becomes too deep (Dore 1969). A recent survey of wild rice harvesters (Norrgard et al. 2007), identified water level as the highest management priority. MDNR wildlife managers have hired trappers to remove beavers from some wild rice lakes to protect wild rice from rising water levels resulting from beaver dam activity.

Regulations Applying to Waters that Contain Wild Rice

Minnesota Rule 7050.0224 identifies a Class 4A water quality standard of 10 mg/L for sulfate concentrations in regulated discharges, "…applicable to water used for the production of wild rice during periods when the rice may be susceptible to damage by high sulfate levels." In order to effectively apply the standard, the period when wild rice may be susceptible to high sulfate needed to be determined. MPCA produced draft staff recommendations (MPCA 2012b; MPCA 2012a) that included reviews of supporting research findings and related information. The MPCA's recommendations were that the 10 mg/L sulfate standard is applicable for portions of the Partridge River and Embarrass River used for the production of wild rice and that in the portions of the Partridge River, the 10 mg/L sulfate standard is applicable from April 1 through August 31. The MPCA is overseeing a variety of studies relating to sulfate and wild rice, with the goal of informing decisions about state water quality standards. All information provided was considered when the MPCA made their recommendation. Should the application of the standard change, it would be addressed at that time.

Presence of Wild Rice within the NorthMet Project Area

Prior to the NorthMet Project Proposed Action, the existing number, location, extent, and health of wild rice stands within the Partridge River and Embarrass River were unknown. As part of development of the EIS, PolyMet conducted a review of available historic and cultural information, including the report *Natural Wild Rice in Minnesota*, United States Geological Survey (USGS) topographic maps, and a wild rice list provided by the 1854 Treaty Authority. PolyMet also analyzed historic (2004 to 2008) infrared aerial photographs and consulted with persons and groups knowledgeable about wild rice to identify potential wild rice locations along the Partridge River and Embarrass River, including Wyman Creek, a tributary of the Partridge River, and Spring Mine Creek, a tributary of the Embarrass River; and downstream on the St. Louis River. They also surveyed Hay Lake and Little Rice Lake, which are not in the Embarrass River or Partridge River watersheds, but were included as potential control sites for future monitoring of wild rice presence and health. Based on this analysis, field surveys were conducted in potential wild rice areas during August and September 2009 using a protocol adapted from the 1854 Treaty Authority. The location and both qualitative and quantitative estimates of density and crop acreage were recorded. Qualitative estimates recorded approximate stand density using a density factor with a scale of 1 (low density) to 5 (high density), similar to a method used by the 1854 Treaty Authority. Quantitative estimates of wild rice density and coverage were determined by sampling representative grids. Sulfate monitoring was also conducted during the wild rice survey (Barr 2009b; Barr 2011a). The 2009 survey was followed by additional surveys in 2010, 2011, and 2012.

Results of the 2009, 2010, and 2011 sulfate monitoring are shown in Figure 4.2.2-3. Wild rice survey and water quality monitoring results for each water body are provided in Table 4.2.2-3 (Barr 2010a; Barr 2011a; Barr 2012a; Barr 2013q).

Waterbodies at least partially surveyed during these surveys include the upper Embarrass River and its tributaries (Spring Mine, Trimble, and Unnamed creeks), the Embarrass River chain of lakes (including Sabin, Wynne, Embarrass, Lower Embarrass, Unnamed, Cedar Island, Fourth and Esquagama lakes), the lower Embarrass River, the upper Partridge River, Colby Lake, the lower Partridge River and tributaries to the Partridge River (including Wyman and Second Creeks). The results over the 4 years of surveys indicate some variability in the location and density of observed wild rice and in associated water column sulfate concentrations between survey years. The 2012 survey showed generally fewer and less dense stands of wild rice than were observed in the 2009 to 2011 surveys.

To date within the NorthMet Project area, MPCA has reached a draft staff recommendation regarding waters used for the production of wild rice (MPCA 2012b). These waters include:

- Embarrass Lake,
- the northernmost tip of Wynne Lake (Embarrass River inlet),
- the segment of the Embarrass River from Sabin Lake to the Highway 135 bridge,
- the portion of Upper Partridge River from river mile approximately 22 just upstream of the railroad bridge near Allen Junction to the inlet to Colby Lake,
- the portion of Lower Partridge River from the outlet of Colby Lake to its confluence with the St. Louis River, and
- the portion of Second Creek from First Creek to the confluence with Partridge River.

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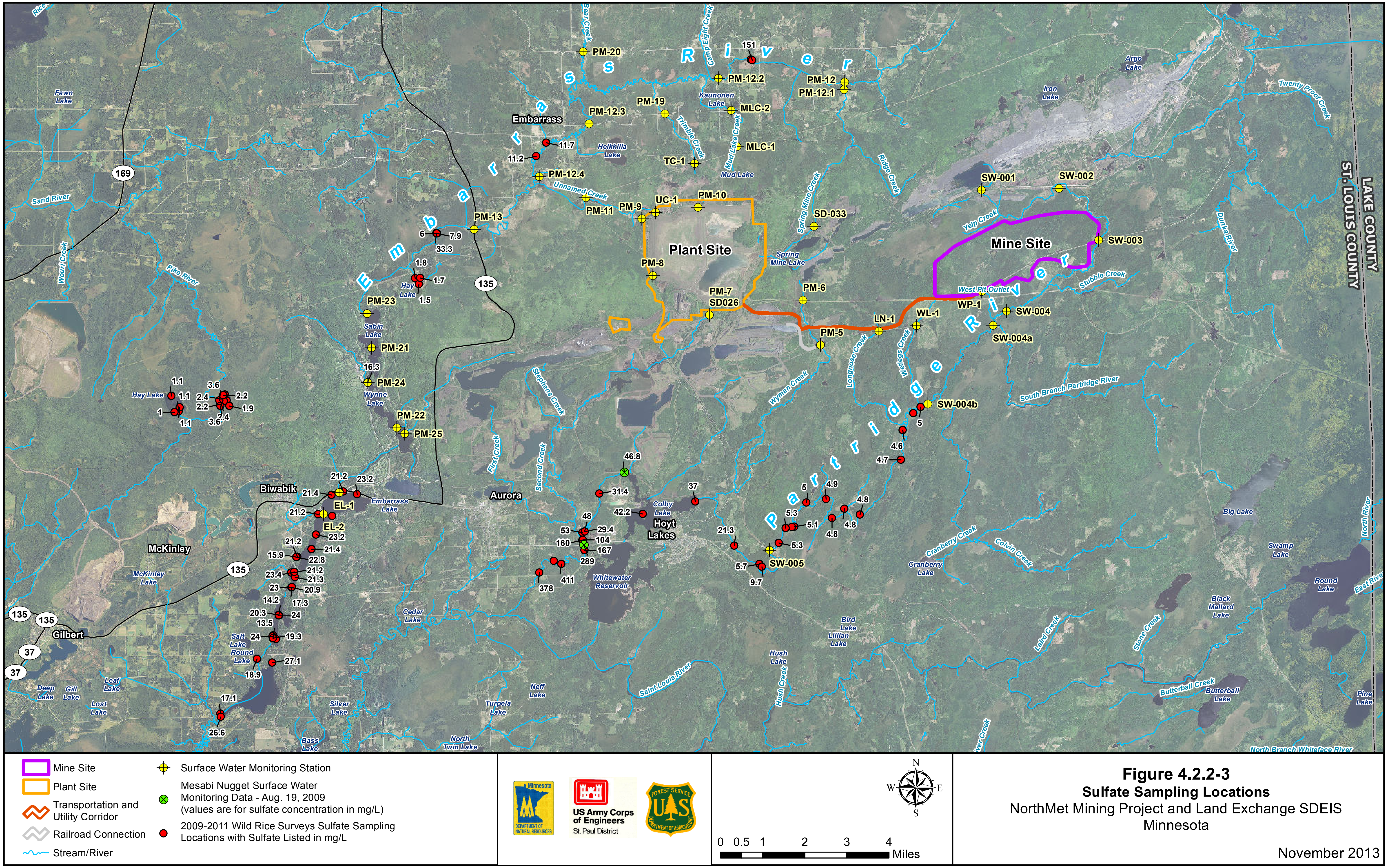

Figure 4.2.2-3
Sulfate Sampling Locations
NorthMet Mining Project and Land Exchange SDEIS
Minnesota

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Table 4.2.2-3 Wild Rice Survey and Water Quality Monitoring Results

Locations Surveyed	Survey Year	Wild Rice Found?[1]	Density Factor[2] (Scale 1-5)	Sulfate Range[3] (mg/L)
Partridge River Watershed				
Upper Partridge River (above Colby Lake, portions)	09, 10, 11, 12	Yes (isolated)	1 – 3	5 – 21 mg/L
Colby Lake	09, 10	No	---	37 – 42 mg/L
Lower Partridge River (below Colby Lake)	09, 10, 11, 12	Yes	1 – 5	17 – 411 mg/L
Wyman Creek	11, 12	No	---	---
Second Creek (portions)	09, 10, 11, 12	Yes (near mouth)	1 – 4	1,100 mg/L
Embarrass River Watershed				
Upper Embarrass River (Spring Mine Creek to Sabin Lake)	09, 10, 11, 12	Yes (isolated)	1	6 – 151 mg/L
Sabin - Wynne Lakes	09, 10, 11, 12	Yes (isolated)	1	15 – 16 mg/L
Chain of Lakes (including Embarrass, Lower Embarrass, Cedar Island, Esquagama, Unnamed, and Fourth)	09, 10, 11, 12	Yes	1 – 5	14 – 27 mg/L
Lower Embarrass River (Esquagama Lake to CR 95)	09, 10	No	---	---
Spring Mine Creek (portions)	09, 10, 11, 12	No	---	---
Trimble and Unnamed Creeks (portions)	10, 11, 12	No	---	---

Source: Barr 2009b; Barr 2010c; Barr 2011a; 2012a; Barr 2013m; Barr 2013q.

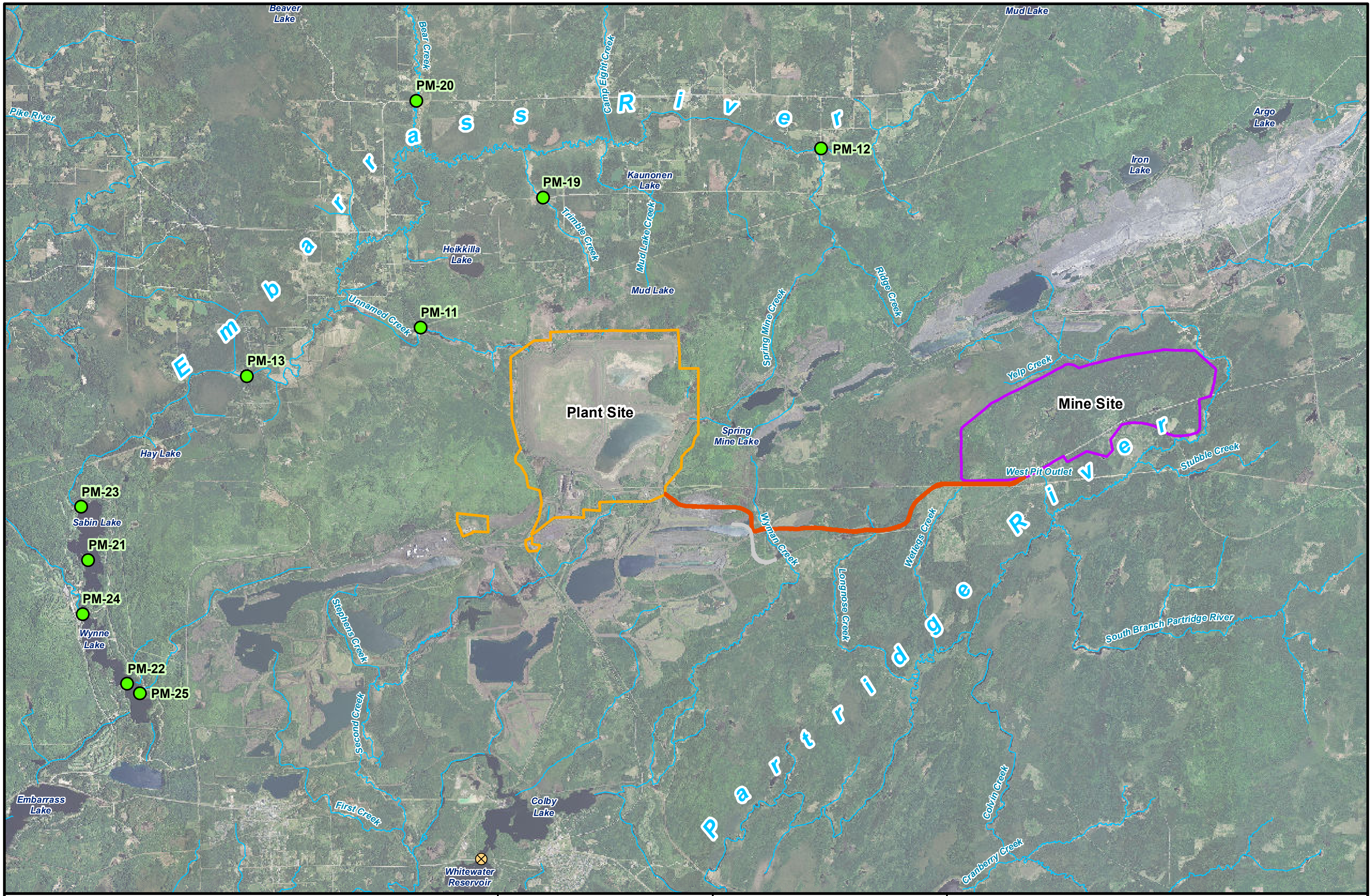
[1] 'Yes' indicates that wild rice was observed in at least one of the survey years. Simply finding wild rice in a survey is not the same as being designated a water used for the production of wild rice.
[2] Informal observational scale of relative wild rice density (1 – low density to 5 – high density)
[3] Range of water column sulfate concentration taken at time of wild rice survey. Samples were only taken when and where wild rice was observed. Values rounded to nearest 1 mg/L. Sample sizes were low resulting in relatively large variability within some individual waterbodies.

Surveys of the St. Louis River from Brookston to Lake Superior were conducted in 2009 and from the NorthMet Project area to the St. Louis Estuary in 2010. Wild rice was identified on the St. Louis River for a short distance downstream from its confluence with the Partridge River. The most dense stand (density factor of 2) was located just upstream of Highway 100, and a few sparse stands were also located approximately 500 and 1,000 ft further downstream (see Figure 4.2.2-3). Sulfate concentrations in 2010 in the St. Louis River near Highway 100 averaged 17.7 mg/L.

4.2.2.1.4 Mercury

Based on sampling in studies done for the NorthMet Project Proposed Action, it is estimated that current total mercury concentrations average about 3.6 nanograms per liter (ng/L) in the Upper Partridge River (Barr 2011a), 3.8 ng/L at monitoring station SW-005, and between 4.8 and 6.0 ng/L in Colby Lake. Total mercury concentrations are similar in the Embarrass River, averaging 4.8 ng/L at monitoring station PM-12 and 4.0 ng/L at monitoring station PM-13 from 2004 to 2012. Methylmercury concentrations in the Partridge River at SW-005 average 0.4 ng/L and in the Embarrass River average 0.5 ng/L at PM-12 and 0.4 ng/L at PM-13 over the same period.

In addition, mercury monitoring has occurred at other locations in and near the existing LTVSMC Tailings Basin (see Table 4.2.2-4 and Figure 4.2.2-4). Generally, mercury concentrations are consistent with baseline levels, averaging less than 2.0 ng/L. All samples were well below average concentrations in precipitation (approximately 9.8 ng/L).



Surface Water Monitoring Location
Diversion Works
Stream/River
Mine Site
Plant Site
Transportation and Utility Corridor
Railroad Connection

Minnesota Department of Natural Resources
US Army Corps of Engineers St. Paul District
Forest Service U.S. Department of Agriculture

N
W E
S

0 0.5 1 2 3 Miles

Figure 4.2.2-4
Additional 2009 Baseline Monitoring Stations for Sulfate and Mercury
NorthMet Mining Project and Land Exchange SDEIS
Minnesota

November 2013

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Table 4.2.2-4 Summary of Total Mercury Concentrations in the Partridge River and Embarrass River Watersheds near the Mine Site and Plant Site

		Mercury Concentrations				
Location[1]	**Dates**	**# of Detections**	**Mean[4] (ng/L)**	**Range (ng/L)**	**# Exceeding 1.3 ng/L[(2)]**	**# Exceeding 10 ng/L[(3)]**
Partridge River						
SW-001	2004, 2006, 2008	5 of 10	2.3	<1.0 - <5.0	1	0
SW-002	2004, 2006	4 of 9	3.4	<2.0 - <5.0	4	0
SW-003	2004, 2006-2008	13 of 25	2.9	<1.0 -7.8	13	0
SW-004	2006-2008, 2010-2011	18 of 27	3.3	<1.0 – 6.8	15	0
SW-004a	2010	5 of 5	3.7	2.7 – 5.4	5	0
SW-004b	2010	5 of 5	4.4	3.2 – 5.8	5	0
SW-005	2004, 2006-2008, 2010-2011	16 of 27	3.8	<1.0 – 10.8	15	1
Creeks, Partridge River Watershed						
LN-1	2011, 2012	10 of 10	3.3	1.2 – 6.2	9	0
WP-1	2011-2012	4 of 4	10.3	5.1 – 13.2	4	3
WL-1	2011-2012	9 of 9	5.0	2.2 – 9.8	9	0
PM-5	2004, 2011-2012	13 of 16	1.3	<0.25 – 2.6	4	0
PM-6	2004	3 of 4	4.2	<0.25 – 7.9	3	0
Lakes (Surface), Partridge River Watershed						
Colby Lake	2008, 2010	5 of 5	5.4	4.8 – 6.0	5	0
LTVSMC Tailings Basin Surface Water Seepage						
PM-9	2001–2006	12 of 65	1.8	0.7 – 4.1	6	0
PM-10	2001–2006	14 of 66	1.4	0.6 – 2.3	7	0
SD004	2001–2005	7 of 14	1.2	<0.25 – 4.5	3	0
SD005	2001–2004	2 of 18	1.6	1.2 – 2.0	1	0
PM-8	2001–2006	13 of 17	1.7	0.5 – 4.6	7	0
WS013	2001–2005	7 of 29	2.1	0.9 – 6.3	2	0
Cell 1E	2001–2003	3 of 25	0.2	<0.1 – 1.0	0	0
Cell 2E	2001–2003	3 of 20	0.35	<0.1 – 3.6	1	0
Cell 2W	2001	0 of 8	<0.1	NA	0	0
Emergency Basin	2001–2005	12 of 41	0.7	<0.1 – 4.2	10	0
West Seep	2001–2003	1 of 17	0.23	<0.1 - <1.25	0	0
Embarrass River						
PM-13	2004, 2006-2012	19 of 31	4.0	<1 – 12.4	19	2
PM-12	2004, 2006-2012	24 of 30	4.8	1.0 – 9.9	24	0
Creeks, Embarrass River Watershed						
PM-11	2004, 2006, 2008, 2011-2012	20 of 26	2.1	<0.25 – 5	17	0
PM-19	2009, 2011, 2012	11 of 11	1.5	0.5 – 3.9	12	0
PM-20	2009	8 of 8	2.5	1.3 – 4.0	7	0

			Mercury Concentrations			
Location[1]	**Dates**	**# of Detections**	**Mean[4] (ng/L)**	**Range (ng/L)**	**# Exceeding 1.3 ng/L[(2)]**	**# Exceeding 10 ng/L[(3)]**
TC-1	2012	1 of 1	1.1	--	0	0
TC-1A	2012	1 of 1	0.9	--	0	0
MLC-1	2011-2012	3 of 3	2.2	1.3 – 3.8	3	0
MLC-2	2011-2012	11 of 11	2.9	0.9 – 6.5	8	0
MLC-3A	2012	1 of 1	0.99	--	0	0
Lakes (surface), Embarrass River Watershed						
PM-23/Sabin Lake	2009	5 of 5	3.19	1.9 – 4.8	5	0
PM-21/Sabin Lake	2009	5 of 5	3.09	2.1 – 4.8	5	0
PM-22/Wynne Lake	2009	5 of 5	3.12	2.0 – 5.0	5	0
PM-24/Wynne Lake	2009	5 of 5	3.56	3.2 – 4.3	5	0
PM-25	2009	3 of 3	6.47	4.9 – 8.1	3	0
Wetlands						
Wetland 003	2002-2005	7 of 12	2.2	<1 – 4.4	7	0
Wetland North	2002-2005	8 of 11	3.6	<1 – 6.7	8	0

Source: Barr 2007h; Barr 2006f; Barr 2008g; Barr 2010c; Barr 2013b.

1 See Figures 4.2.2-1, 4.2.2-4, 4.2.2-9, 4.2.2-11, and 4.2.2-12.
2 Minnesota Class 2B Lake Superior standard for mercury.
3 Estimated average total mercury concentration in precipitation in Northern Minnesota (Berndt 2003).
4 Where non-detects occur, the mean was calculated using half the detection limit.

4.2.2.2 Partridge River Watershed

This section describes the baseline hydrology and water quality for the groundwater and surface water within the Partridge River Watershed portion of the NorthMet Project area. This includes all of the Mine Site and the Transportation and Utility Corridor, as well as the former LTVSMC processing plant and a small portion of the Tailings Basin.

4.2.2.2.1 Groundwater Resources

This section describes the existing geology and hydrogeology in the NorthMet Project area and the groundwater resources at the Mine Site that could be affected by the NorthMet Project Proposed Action. Since the publication of the DEIS, additional groundwater monitoring wells were installed and data collected to better describe the groundwater resources at the Mine Site. The number of groundwater samples from the Mine Site included three or more samples from each of 23 monitoring wells (a 24th well was dry after the first sampling, so it only provided a single sample). A statistical analysis indicated that total number of groundwater quality samples was sufficient, where "sufficient" was based on the USEPA request that an uncertainty range around the estimate of average concentration for each solute could be identified such that there was a less than 5 percent probability that the actual average would be outside of this range (Barr 2012y). This section describes available baseline data on the hydraulic properties at the Mine Site, the rationale for assessing its adequacy, and a summary of specific values for Mine Site baseline aquifer characteristics.

Geology of the Mine Site

The surface material that would be encountered by the NorthMet Project Proposed Action mining include a relatively thin (0 to ~59 ft thick) surficial layer of unconsolidated glacial till. This surficial till is relatively young (~14,000 to 60,000 years old), and has been described at a regional scale as unsorted sandy loam mixture with pebbles, cobbles, and boulders (Jennings and Reynolds 2005). Soil borings collected from within the Mine Site are generally consistent with this description, indicating that the surficial till is a heterogeneous and laterally discontinuous zone with a composition ranging from very dense clay to well-sorted sand (PolyMet 2013i).

The NorthMet Deposit itself is below the surficial till in the layered mafic intrusive rocks of the Duluth Complex, which are part of the Partridge River intrusion. The north edge of the Duluth Complex within the Mine Site contacts rock formations comprising the southern flank of the Mesabi Iron Range, which hosts large taconite iron ore mines (see Figure 3.2-10).

More than 10 copper-nickel-PGE zones of mineralization have been identified along the northern margin of the Duluth Complex. The deposits consist of disseminated copper-nickel-iron sulfides, with minor local massive sulfides, hosted in layered heterogeneous troctolitic (plagioclase and olivine with minor pyroxene) rocks forming the basal unit of the Duluth Complex. Extensive drilling within the Partridge River intrusion (over 1,100 drill holes) has identified seven layered troctolitic igneous rock units dipping southeast in the NorthMet Deposit (see Figure 3.2-10). Unit 1, which hosts much of the NorthMet economic sulfide mineralization, is the oldest layer.

The footwall rocks below the NorthMet Deposit consist of Paleoproterozoic sedimentary rocks. The youngest of these sedimentary rocks is the Virginia Formation, which directly underlies the intrusive Unit 1 across all of the NorthMet Project area (i.e., the Duluth Complex only contacts the Virginia Formation and does not contact the older sedimentary formations below). The Virginia Formation consists of a thinly bedded sequence of argillite and greywacke. Underlying the Virginia Formation is the Biwabik Iron Formation, which is the source of taconite iron ore and is an important water source for residential and community wells in the region. The mine pits would retain about a 130-ft separation between the final pit and the Biwabik Formation based on current drilling and interpolation of geology between drill holes (Tina Pint, Pers. Comm., August 9, 2013). The oldest of the sedimentary rocks is the Pokegama Quartzite. These sedimentary rocks are underlain by Archean granite of the Giants Ridge batholith.

Hydrogeology of the Mine Site Surficial Aquifer and Bedrock Units

The Biwabik Iron Formation has a relatively high permeability, whereas the Virginia Formation and Duluth Complex are much less permeable (Siegel and Ericson 1980). PolyMet conducted several aquifer tests to characterize the hydraulic conductivity and specific storage values for the bedrock units underlying the Mine Site (see Table 4.2.2-5). Although no testing was done in the Biwabik Iron Formation for the NorthMet Project Proposed Action, based on earlier tests in this formation (see Table 4.2.2-5) and its ongoing use as a source of water, the Biwabik Iron Formation has the highest hydraulic conductivity, followed by the Virginia Formation, with the Duluth Complex having conductivity at least one order of magnitude lower.

Hydraulic characteristics of these various geologic units in the Mine Site were determined from the following series of aquifer pumping tests (PolyMet 2013i):

- Ten pump tests on borings in the surficial aquifer (including three borings that were turned into permanent monitoring wells; see PolyMet 2013i).
- Ten aquifer performance tests on bore holes in the Duluth Complex bedrock (PolyMet 2013i).
- Four aquifer pump tests conducted on the Virginia Formation bedrock (wells P1 through P4, with monitoring in six observation wells, Ob-1, Ob-2, Ob-3, Ob-3a, Ob-4, and Ob-5, plus a water supply well; see PolyMet 2013i).
- One long-term (30-day) pump test in bedrock well P-2, with water levels monitored in wetland piezometers located north of the pumping well (PolyMet 2013i).
- Specific capacity tests at P-3 and P-4, which are open exclusively in the Virginia Formation (PolyMet 2013i).

As part of the aquifer testing, a range of specific storage values for the bedrock (i.e., 2.3×10^{-5} to 5.5×10^{-7} ft^{-1}) was determined from time-drawdown data at observation wells. The specific capacity tests conducted in two wells indicated that the upper portion of the Virginia Formation is more permeable than the lower portion (Barr 2007b). This is attributed to the increased amount of fractures and joints in the bedrock closer to the surface. Overall, groundwater flow within the bedrock units is thought to be primarily through fractures and other secondary porosity features because the rocks have low primary hydraulic conductivity. Near the ground surface, groundwater in the bedrock is thought to be hydraulically connected with the overlying surficial aquifers, resulting in similar flow directions (Barr 2007d).

Table 4.2.2-5 Bedrock and Surficial Aquifer Hydraulic Conductivity Estimates at the Mine Site

		Hydraulic Conductivity	
Aquifer	**Test Methods**	**Range**	**Geometric Mean**
Surficial	Lab permeability tests on silty sand samples	4.3×10^{-4} ft/day to 8.1×10^{-3} ft/day[1]	NA
	Single-well tests of various unconsolidated deposits	1.2×10^{-2} ft/day to 3.1×10^{1} ft/day	NA
Duluth Complex	Single-well aquifer tests on 10 exploratory borings	2.6×10^{-4} ft/day – 4.1×10^{-2} ft/day[2]	2.3×10^{-3} ft/day
Virginia Formation - Upper Portion	4 pumping wells and 5 observation wells	2.4×10^{-3} ft/day - 1.0 ft/day[3]	0.17 ft/day
Virginia Formation - Lower Portion	Single well aquifer tests on 2 wells	NA[4]	0.047 ft/day
Biwabik Formation	Specific capacity tests	0.9 ft/day[5]	

Sources: [1] Appendix B in RS22, Draft 03, Barr 2008d; [2] RS02, Barr 2006b; [3] RS10, Barr 2006c; [4] RS10A, Barr 2007b; [5] Siegel and Ericson, 1980

ft/day = Feet per day

Concerns have been raised that fractures, including faults and fracture zones, may exist that could permit transmission of groundwater through the bedrock over distances of thousands of feet. Such features have been identified elsewhere on the Canadian Shield, but have been genetically associated with tectonic events occurring more than 1,600 million years ago (Farvolden et al. 1988; Douglas et al. 2000; Rouleau et al. 2003). These events would not be relevant to the Duluth Complex as they predate its emplacement during the formation of the Mid-Continent Rift approximately 1.1 billion years ago. Foose and Cooper (1979; 1980) appear to have provided the only published work specifically looking at the presence of fracturing and faulting in the Duluth Complex. They identified numerous faults and fractures in their surface mapping of the Harris Lake area, as is commonly found in the surface exposures of crystalline bedrock. However, they described the most extensive faults—those most likely to be long distance groundwater conduits—as being largely filled with gouge. They also conclude that most of the faults and fractures formed early and at depth, during emplacement of the Duluth Complex, and were not related to post-emplacement deformation, which would have more likely resulted in fractures open to groundwater flow.

Evidence of several high-angle faults, consisting of brecciated intervals and fault gouge mineralization, was noted in the exploration cores from the NorthMet Project area (PolyMet 2007b). While correlations between boreholes could only be approximated, the faults appear to generally trend to the northeast across the site and have downward offset to the southeast, which would be consistent with generation and activation during the Mid-Continent Rift event. There have been no other more recent tectonic events in the Lake Superior region that might have generated more recent fractures and faults or reactivated preexisting ones that would serve as significant zones of groundwater transmission. Numerous lineaments have been mapped over northeastern Minnesota, but these have been associated with glacial deposition and not fracturing in the underlying bedrock (Morey 1981; Heutmaker and Morey 1982). One exploration borehole at the Minnamax prospect encountered groundwater at a depth of 1,390 ft in the Duluth Complex that flowed for a period of 6 days, indicating the potential presence of over-pressured groundwater in the bedrock (Barr 1976). However, none of the other 12 exploration borings completed on the prospect encountered similar conditions, indicating little to no hydrogeological interconnection of bedrock fracture or fault zones across the area of that prospect. No similar conditions of over-pressured groundwater flow were encountered in any of the exploration boreholes or other boreholes completed at the NorthMet Project area. Extensive, long-distance groundwater flow through shallow weathered and fractured bedrock is likely limited by glacial scouring and removal of the highly weathered and fractured upper zone of bedrock commonly observed in crystalline bedrock elsewhere in the world.

The overlying surficial sediments at the Mine Site are poorly sorted and range from very dense clay to well-sorted sand with boulders and cobbles (Barr 2006b; Golder Associates 2007). Hydraulic testing of the surficial sediments indicates that these sediments may contain layers of relatively low hydraulic conductivity (e.g., comparable to the Duluth Complex). Tests using wells that penetrate through the surficial zone, however, found much higher average hydraulic conductivity, with values similar to the Biwabik Formation aquifer (see Table 4.2.2-5). Shallow borings and test trenches at the Mine Site encountered bedrock at depths ranging from 3.5 to 17 ft below ground surface (bgs). The site exploration drilling database, drilling logs, and electrical resistivity data were used to develop an estimated depth-to-bedrock isopach map (Golder Associates 2007). The isopach map is consistent with the more limited boring and trenching data, indicating that more than 75 percent of the surficial cover at the Mine Site is 20 ft thick or less, and 92 percent is less than or equal to 30 ft in thickness. Although the isopach contouring indicates local depressions in the bedrock where estimated surficial cover thickness reaches 50 ft, no major areas of highly permeable outwash sands and gravel have been reported that might serve as groundwater conduits through the unconsolidated material.

The Mine Site is covered by extensive wetlands, many of which have only minimal hydraulic connection to the underlying groundwater. This interpretation is based on well logs, soil borings, available soil mapping, and field investigations. In particular, a 2010 field survey focused on identifying the fraction of wetlands in the NorthMet Project area that were "ombrotrophic bogs" (i.e., wetlands in which hydrology and mineral inputs are almost entirely from direct precipitation, and that have little hydraulic connection to underlying groundwater [Eggers 2011a]). Prior to conducting the analysis to identify potential indirect wetland effects resulting from changes in hydrology, bog wetlands within and surrounding the Mine Site were reclassified as either ombrotrophic or minerotrophic consistent with guidelines identified in the November 2011, USACE Memorandum (Eggers 2011a; PolyMet 2013b). These bogs form when sphagnum peat accumulation rises above the groundwater table, which reduces inputs of minerals and nutrients from groundwater. The field survey recorded those parameters that distinguish bogs from the more hydraulically connected wetlands along a representative cross section through the NorthMet Project area. Results, based on vegetation species, percent areal cover of Sphagnum mosses (high sphagnum cover is associated with bogs), and pH and specific conductivity (bogs tend to have lower pH and conductivity than hydraulically connected wetlands) indicated that approximately 90 percent of the wetlands within the Mine Site are ombrotrophic (PolyMet 2013b). The other remaining wetland communities at the Mine Site include shrub swamps, coniferous swamps, shallow marsh, wet/sedge meadows, open bogs, and hardwood swamps, which may receive some portion of their hydrology from groundwater.

Based on the groundwater elevations within the surficial deposits (see Figure 4.2.2-5), groundwater at the Mine Site generally flows to the south, with the major component from the north-northwest direction to south-southeast (perpendicular to the strike of the bedrock geologic formations) toward the Partridge River, which is the major discharge point for the area. Based on limited MDNR well records within the NorthMet Project area, natural groundwater levels in the glacial till vary seasonally between 3 and 10 ft bgs. At the Mine Site, depth to groundwater is generally less than 5 ft bgs (Barr 2006a). Three nested well pairs at the Mine Site (MW-6S/ MW-6D, MW-08S.MW-08D, and MW-10S/MW-10D) allow for evaluation of vertical hydraulic gradients in the surficial aquifer. For the nested pairs at MW-6 and MW-8, the vertical hydraulic gradients are small (approximately 0.02 ft/ft) and indicate either upward or downward groundwater flow. At MW-10, the vertical gradient is larger (approximately 0.1 ft/ft) and indicates downward groundwater flow (PolyMet 2013i).

Water table elevations measured by PolyMet in Mine Site bedrock boreholes indicate that the hydraulic gradient is similar to that of the overlying alluvium (sloping down to the south and southeast across the Mine Site), consistent with a hydraulic connection between the alluvium and bedrock units (PolyMet 2013i). The Regional Copper-Nickel Study (USGS 1980) concluded that recharge to the bedrock is from direct precipitation where bedrock outcrops at the surface, and from seepage through surficial aquifers where the top of bedrock is buried (Siegel and Ericson 1980). This study also reported that the upper 200 to 300 ft of the Duluth Complex formation appeared to be fractured and jointed more extensively than at greater depths, so that the upper portion of the bedrock should have greater hydraulic conductivity and thus better hydraulic connectivity than deeper bedrock. Hydraulic analyses, however, indicate that the hydraulic connection between surficial aquifer and underlying bedrock underlying is weak. Water-table monitoring during a 30-day pumping test at bedrock well P-2 showed a small amount of drawdown in the nearest deep wetland piezometer, but no detectable drawdown at other water table or deep wetland piezometers (PolyMet 2013i; Barr 2007b).

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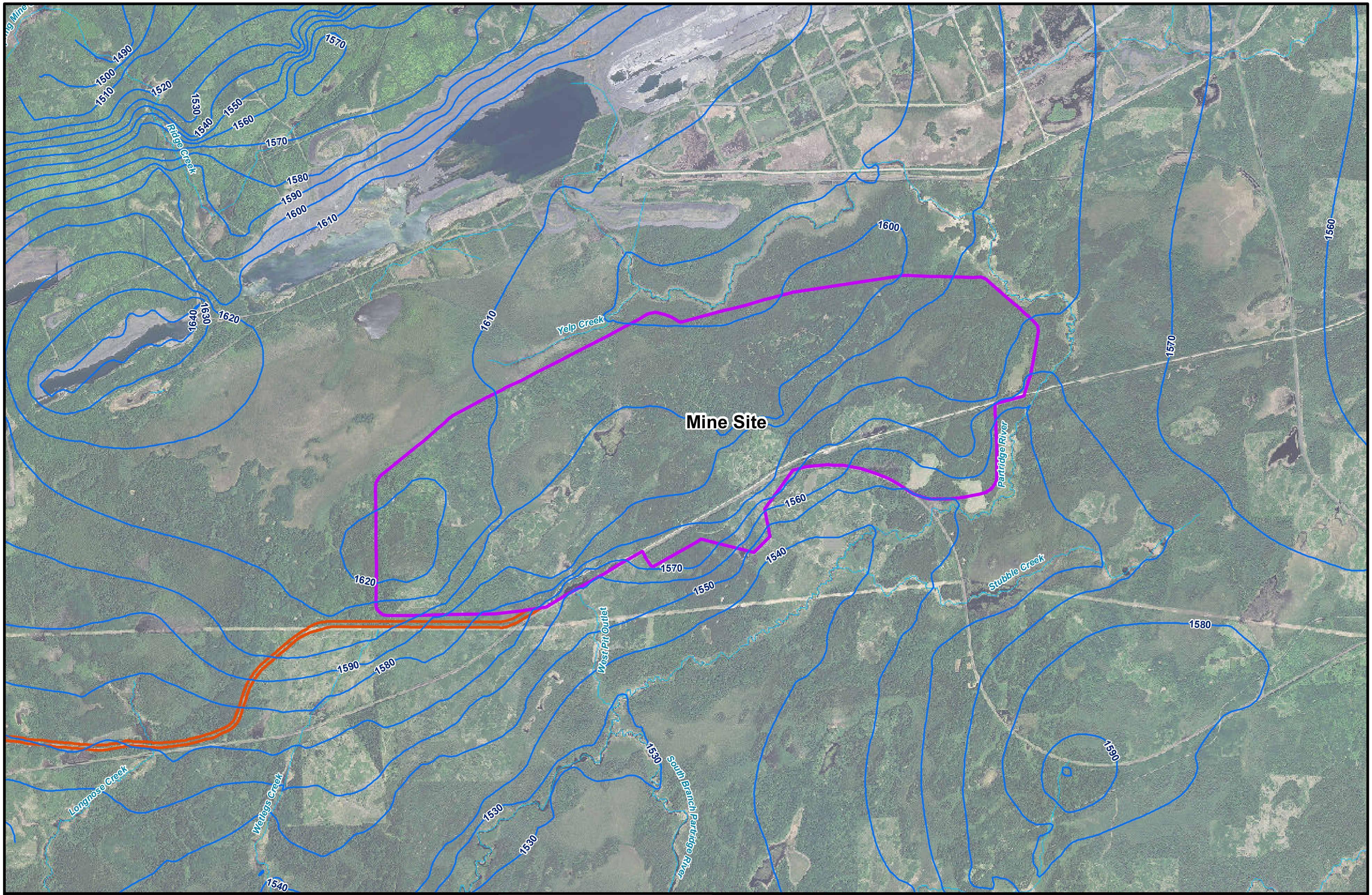

Mine Site

Transportation and Utility Corridor

Railroad Connection

* Water Table Elevation in Surficial Aquifer (Ft AMSL)

Stream/River

* Source: PolyMet 2013j

US Army Corps of Engineers
St. Paul District

N
W E
S

0 0.25 0.5 1 Miles

Figure 4.2.2-5

Estimated Existing Groundwater Contours - Mine Site

NorthMet Mining Project and Land Exchange SDEIS

Minnesota

November 2013

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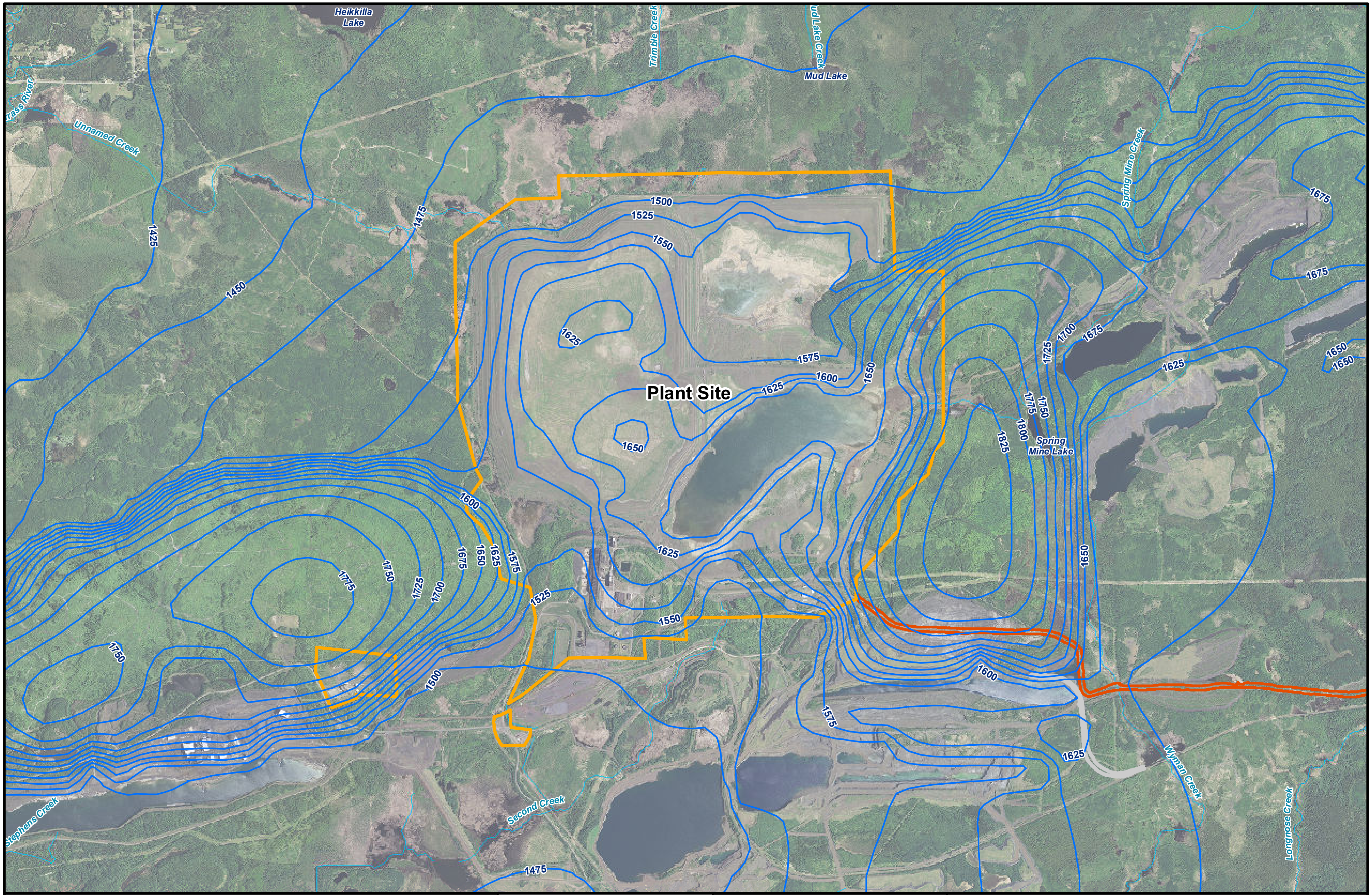

Plant Site

Transportation and Utility Corridor

Railroad Connection

* Water Table Elevation in Surficial Aquifer (Ft AMSL)

Stream/River

* Source: PolyMet 2013j

US Army Corps of Engineers
St. Paul District

0 0.25 0.5 1 Miles

Figure 4.2.2-6

Estimated Existing Groundwater Contours - Plant Site

NorthMet Mining Project and Land Exchange SDEIS

Minnesota

November 2013

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Because of the shallow water table and the generally thin nature of the surficial aquifer, flowpaths within the surficial deposits are generally thought to be short, with the recharge areas being very near the discharge areas. The water table in the surficial aquifer is generally a "subdued replica" of the topographic surface, and as a result, groundwater divides generally coincide with surface water divides (PolyMet 2013i, Section 4.3.3.1). Groundwater flow in the surficial aquifer is interrupted by bedrock outcrops, which force deviations in the groundwater flow field (Siegel and Ericson 1980). However, because the bedrock is hydraulically connected with the overlying surficial aquifer, groundwater in the bedrock flows in a similar direction as groundwater in the overlying surficial aquifer (PolyMet 2013i, Section 4.3.3.2), and topographic divides are expected to approximate the locations of flow divides in bedrock groundwater.

As recognized in other studies (MDNR 2004; Siegel and Ericson 1980), aquifer testing (see Table 4.2.2-5) showed that the ability of the surficial sediment to transmit water was highly variable and depended upon location and thickness of the sediments. No data were available regarding the storage parameters for the surficial deposits.

Baseline Groundwater Quality

Baseline groundwater quality at the Mine Site is based on data collected by PolyMet (PolyMet 2013i) at the following locations (see Figure 4.2.2-7):

- three older monitoring wells in the surficial aquifer (MW-05-02, MW-05-08, and MW-05-09), sampled from 2005 through 2011;
- 21 newer wells installed in the surficial aquifer in 2011 and 2012 (MW-1, MW-2, MW-3, MW-4, MW-5, MW-6S, MW6D, MW7, MW-8S, MW-8D, MW-9, MW-10S, MW-10D, MW-11, MW-12, MW-13, MW-14, MW-15, MW-16, MW-17, and MW-18);
- five observation wells in the upper 100 ft of the bedrock (ob-1 through ob-5), sampled from 2006 through 2010; and
- four large-diameter bedrock wells (P-1, P-2, P-3, and P-4) completed to depths ranging from 485 to 610 ft below grade, which were sampled during aquifer testing in 2006 and 2007.

These samples were subject to standard quality controls (e.g., trip blanks, field blanks, laboratory control and laboratory control duplicates, matrix spike, and matrix spike duplicates, and assessment of holding times) and were acceptable for use in the SDEIS (PolyMet 2013i; Section 4.5.2.1.3). A statistical analysis of the samples from these wells through June 2012 was used to estimate baseline groundwater quality in the bedrock unit and surficial aquifers, which subsequently was used as input into the Mine Site water quality model. Baseline groundwater quality results are summarized in Table 4.2.2-6.

Surficial Aquifer

Water samples collected from the 24 wells completed in the Mine Site unconsolidated deposits indicate that groundwater in the surficial aquifer generally meets evaluation criteria for all solutes except for elevated concentrations of aluminum (total and dissolved), beryllium (total), iron (total), and manganese (total) (see Table 4.2.2-6). Overall pH levels tended toward basic (mean of 7.2). The metals exceeding groundwater evaluation criteria in the surficial aquifer probably reflect natural conditions because there is no record of any historic activities at the Mine Site that could have contributed these constituents.

These results are generally consistent with the findings presented in the Regional Copper-Nickel Study, which identified concentrations of total cadmium, iron, manganese, and nickel at concentrations above the groundwater evaluation criteria (see Table 4.2.2-6, with data from Siegel and Ericson 1980). Results from the analysis of water samples collected from existing USGS and USFS wells completed in the surficial aquifer indicate that dissolved concentrations in some locations were at or higher than the groundwater evaluation criteria for aluminum, cadmium, cobalt, iron, manganese, and nickel (see Table 4.2.2-6). Siegel and Ericson (1980) noted that higher concentrations of copper, cobalt, nickel, and sulfate are potentially correlated with proximity to the mineralized contact zone between the Duluth Complex and older rocks, as is the case with the NorthMet Project area, and is probably related to the oxidation of sulfide minerals. The pHs measured in the initial groundwater samples from a few wells were near or slightly above 10; but pHs tended to be lower in later samples and decreased to below 10 in all wells, suggesting that cement or other reagents used during well installation and completion may have temporarily increased pH in the vicinity of these wells.

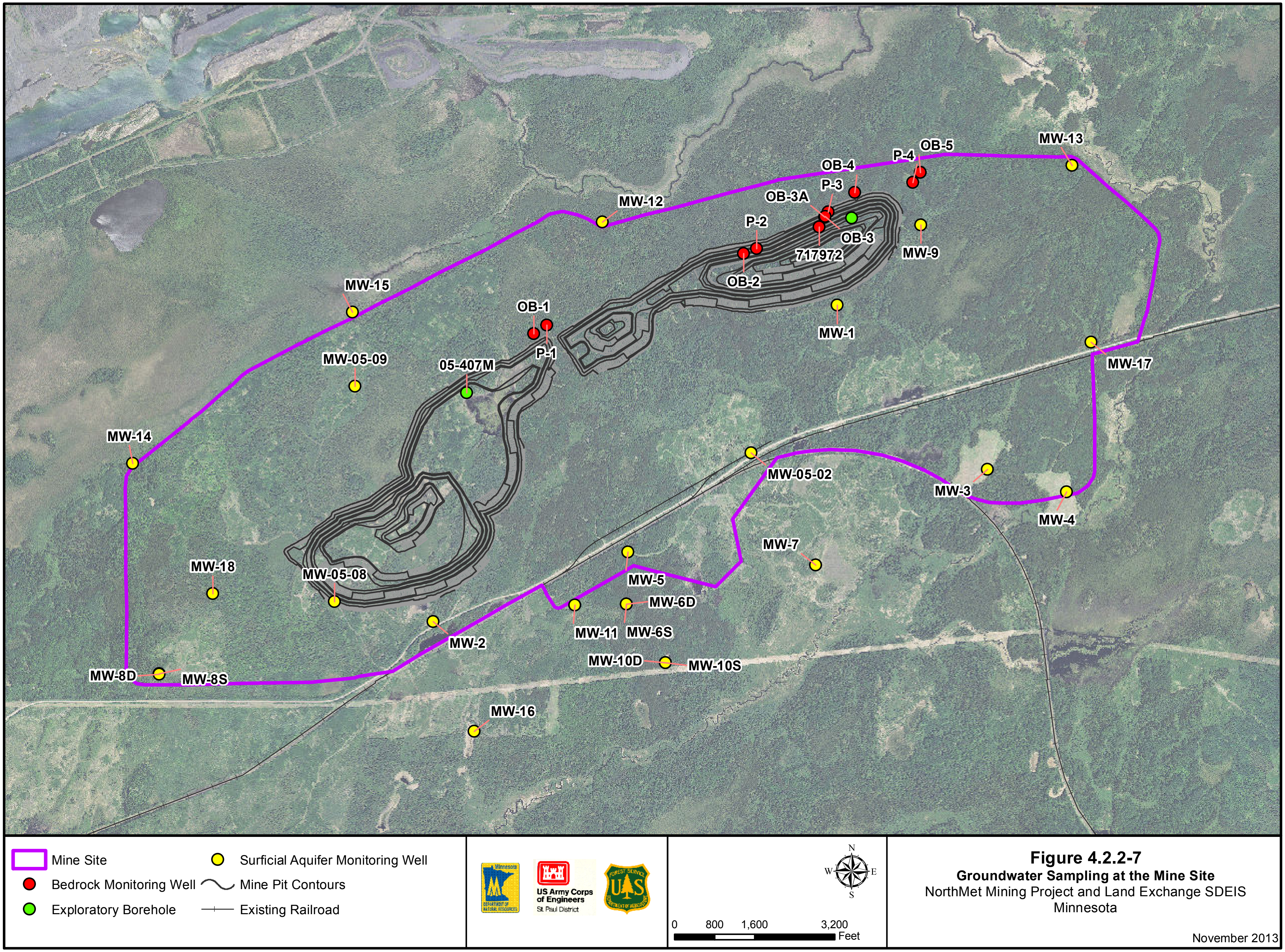

Figure 4.2.2-7

Groundwater Sampling at the Mine Site

NorthMet Mining Project and Land Exchange SDEIS

Minnesota

November 2013

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Table 4.2.2-6 Summary of Existing Groundwater Quality Monitoring Data for the NorthMet Mine Site

Constituent	Units	Groundwater Evaluation Criteria	Surficial Aquifer				Surficial Aquifer Northeast MN Baseline	Surficial Aquifer Cu-Ni Study Baseline	Bedrock Aquifer			
			Detection	**Mean[1]**	**Range**	**# Exceed.**	**Range**	**Range**	**Detection**	**Mean[1]**	**Range**	**# Exceed.**
General Parameters												
Ammonia as Nitrogen	mg/L	--	45 of 178	0.19	<0.025 to 3.30	NA	--	--	9 of 38	0.06	<0.03 to 0.27	NA
Calcium	mg/L	--	178 of 178	15.6	2.40 to 38.8	NA	0.2 to 115	6 - 150	39 of 39	15.4	5.40 to 32.5	NA
Chloride	mg/L	250	91 of 178	0.71	<0.25 to 9.33	0	0.4 to 19	0.1 to 35	30 of 38	4.0	<0.25 to 93.1	0
Fluoride	mg/L	2	45 of 178	0.07	<0.05 to 0.25	0	0.20 to 0.57	--	23 of 38	0.19	<0.05 to 1.1	0
Magnesium	mg/L	--	178 of 178	6.9	1.00 to 18.10	NA	0.1 to 326	1.1 - 64	38 of 39	9.3	<1.0 to 21.4	NA
pH	s.u.	6.5	175 of 175	7.2	5.1 to 10.41	**78**	6.0 to 8.4	5.7 to 8.0	30 of 30	0.01	5.65 to 10.3	**6**
Sulfate	mg/L	250	174 of 178	9.5	0.5 to 42.9	0	<0.3 to 14.2	0.7 to 450	37 of 38	49.1	<0.5 to 1,200	**1**
Metals - Total												
Aluminum	µg/L	200	27 of 27	**5,751**	31.6 to 32,300	**22**	<0.1 to 30	--	32 of 39	**1,114**	<12.5 to 6,950	**20**
Antimony	µg/L	6	1 of 27	0.54	<0.25 to <1.5	0	<0.01 to 0.04	--	4 of 39	0.73	<0.25 to 1.5	0
Arsenic	µg/L	10	14 of 27	1.8	<0.25 to 5.84	0	0.1 to 9.1	--	18 of 39	2.7	<0.25 to 24.1	**3**
Barium	µg/L	2,000	176 of 178	39.0	<5 to 615	0	1.6 to 191	--	25 of 39	8.0	<5 to 32.4	0
Beryllium	µg/L	0.08	18 of 178	**0.14**	<0.1 to 1.60	BDL[2]	<0.01 to 0.41	--	3 of 39	0.11	<0.1 to 0.36	**39**
Boron	µg/L	1,000	9 of 178	26.9	<17.5 to 77.0	0	<13 to 41	--	9 of 39	59.6	<25 to 518	0
Cadmium	µg/L	4	6 of 27	0.15	<0.1 to 0.56	0	<0.02 to 0.2	--	4 of 39	1.4	<0.1 to 48	**1**

Constituent	**Units**	**Groundwater Evaluation Criteria**	**Surficial Aquifer**				**Surficial Aquifer Northeast MN Baseline**	**Surficial Aquifer Cu-Ni Study Baseline**	**Bedrock Aquifer**			
			Detection	**Mean[1]**	**Range**	**# Exceed.**	**Range**	**Range**	**Detection**	**Mean[1]**	**Range**	**# Exceed.**
Cobalt	µg/L	--	22 of 27	3.5	<0.1 to 23	NA	0.05 to 0.63	--	37 of 39	2.79	<0.5 to 23.30	NA
Copper	µg/L	1,000	27 of 27	21.7	0.8 to 99.6	0	<5.5 to 22	--	28 of 39	9.02	<1 to 46.3	0
Iron	µg/L	300	27 of 27	**6,980**	54.3 to 44,400	**22**	7 to 7,816	--	38 of 39	**8,685**	<25 to 44,300	**31**
Lead	µg/L	--	53 of 178	1.1	<0.25 to 16.70	0	<0.03 to 2.0	--	10 of 39	0.63	<0.25 to 2.90	NA
Manganese	µg/L	50	26 of 27	**267**	<15 to 1,770	**22**	0.9 to 1,248	--	36 of 39	**121**	<5 to 383	**22**
Mercury	ng/L	2,000	107 of 178	3.67	<0.25 to 87.6	0	--	--	22 of 38	0.98	<0.25 to 4.90	0
Nickel	µg/L	100	25 of 27	10.7	<1 to 47	0	<6.0 to 16	--	29 of 39	48.41	<1 to 445	**7**
Selenium	µg/L	30	2 of 27	0.6	<0.5 to <1	0	<1.0 to 4.7	--	1 of 39	1.09	<0.50 to 5	0
Silver	µg/L	30	0 of 27	0.2	<0.1 to <1	0	<0.01 to 0.05	--	0 of 39	0.24	<0.1 to 0.5	0
Thallium	µg/L	0.6	22 of 27	253.4	<5 to <1300	**27**	<0.005 to 0.01	--	16 of 39	62.06	<5 to 410	**39**
Zinc	µg/L	2,000	13 of 27	15.5	<3 to 64.5	0	<2.7 to 138	--	21 of 39	20.61	<3 to 125	0
Metals-Dissolved/Filtered												
Aluminum	µg/L	200	74 of 178	**72.6**	<10 to 910	**21**	--	0 to 280	6 of 39	22.77	<12.5 to 127	0
Cadmium	µg/L	4	3 of 178	0.10	< 0.1 to 0.3	0	--	0 to 8.4	3 of 38	0.13	<0.10 to 0.92	0
Copper	µg/L	1,000	145 of 178	3.22	< 0.25 to 49	0	--	0.2 to190[(4)]	23 of 39	1.48	<0.35 to 3.48	0
Nickel	µg/L	100	134 of 178	2.2	<0.25 to 20.5	0	--	0.7 to 120	28 of 39	24.74	<1 to 158	**7**

Constituent	Units	Groundwater Evaluation Criteria	Surficial Aquifer				Surficial Aquifer Northeast MN Baseline	Surficial Aquifer Cu-Ni Study Baseline	Bedrock Aquifer			
			Detection	Mean[1]	Range	# Exceed.	Range	Range	Detection	Mean[1]	Range	# Exceed.
Selenium	µg/L	30	2 of 178	0.54	<0.5 to 4.7	0	--	--	0 of 38	0.67	<0.50 to 1.00	0
Silver	µg/L	30	0 of 178	0.12	<0.1 to <0.5	0	--	--	0 of 38	0.24	<0.10 to 0.50	0
Zinc	µg/L	2,000	44 of 178	5.1	<3 to 44.4	0	--	0.7 to 620	18 of 38	17.9	<3 to 134	0

Sources: Barr 2006b; Barr 2006c; Barr 2007b; MPCA 1999; Siegel and Ericson 1980; Barr 2013b.

Notes:
< = less than indicated reporting limit. Values in bold exceeds evaluation criteria.
1 Where non-detects occur, the mean was calculated using half the detection limit.
2 Below Detection Limit.
3 Barr 2013b data (2005-2011) is from the following wells: MW-05-02, MW-05-08, MW-05-09, MW-1, MW-2, MW-3, MW-4, MW-5, MW-6D, MW-6S, MW-7, MW-8D, MW-8S, MW-9, MW-10D, MW-10S, MW-11, MW-12, MW-13, MW-14, MW-15, MW-16, MW-17, and MW-18.
4 May reflect contamination (as cited in Siegel and Ericson 1980).

Bedrock

Groundwater samples have been collected from 10 bedrock (i.e., Duluth Complex and Virginia Formation) monitoring wells (i.e., pumping wells P1 through P4 and observation wells Ob1 through Ob5), one water supply well, and two exploratory boreholes at the Mine Site. The average water quality in the bedrock at the Mine Site was generally found to meet groundwater evaluation criteria except for aluminum, beryllium, iron, manganese, and thallium (see Table 4.2.2-6). The pH of the bedrock water samples from the Duluth Complex tended toward basic (i.e., greater than 7.0 to 9.0), while samples from the Virginia Formation were, with one exception, more acidic (i.e., less than 7.0). Sample pHs were near or slightly above 10 in a few wells; but pHs tended to be lower in later samples, suggesting that cement or other reagents used during well installation and completion may have increased pH in the vicinity of these wells. Occasional exceedances of arsenic and nickel water quality standards were detected. Ammonia was detected in nine samples, which is unusual because ammonia is not typically found in bedrock. The presence of ammonia in at least two of these samples is attributed to either collection or laboratory error as two of the samples were collected on the same day and both were from 6-inch-diameter boreholes that had collection difficulties (Barr 2006a). Nitrite or nitrate, which are the forms of nitrogen to which ammonia quickly converts, was found in four samples. This is not unprecedented as the MPCA study in northeastern Minnesota reported that nitrate was detected in two of 20 samples (MPCA 1999).

Groundwater Use

There are no existing domestic wells between the Mine Site and the Partridge River. However, there are several MDNR water appropriation permits in effect for mine pit dewatering that affect the Mine Site, including the Northshore Mine permit (Permit 1982-2097). The permit authorizes Northshore Mining Company to withdraw up to 36,000 gpm (80 cubic ft per second [cfs]), of which a maximum of 13,000 gpm (29 cfs) can be discharged to the Partridge River, a maximum of 12,000 gpm (27 cfs) can be discharged to Langley Creek, and a maximum of 11,000 gpm (25 cfs) can be discharged to Unnamed Creek.

4.2.2.2.2 Surface Water

This section describes the existing surface water resources for the Mine Site that could be affected by the NorthMet Project Proposed Action. These resources include the Upper Partridge River, the Upper Partridge River tributary streams, Colby Lake, Second Creek, Whitewater Reservoir, and the Lower Partridge River below Colby Lake downstream to its confluence with the St. Louis River. For purposes of this SDEIS, the Partridge River upstream of Colby Lake is referred to as the Upper Partridge River, while the segment downstream of Colby Lake is referred to as the Lower Partridge River (see Figure 4.2.2-1). Since publication of the DEIS, new XP-SWMM model predictions were made to estimate Partridge River flow parameters without effects of dewatering from the Northshore Mine Pit, and additional surface water quality data has been collected at many locations. These new data are summarized to better describe existing conditions as inputs for modeling potential surface water impacts.

Upper Partridge River

This section describes the baseline surface water hydrology and water quality of the mainstem of the Partridge River upstream of Colby Lake.

Upper Partridge River Hydrology

The Partridge River forms just south of the Northshore Mine, although historically its source was further upstream. It flows approximately 32 miles to its confluence with the St. Louis River, draining a total of approximately 161 square miles, as measured at Aurora, MN, approximately 3 miles from the St. Louis River confluence (see Figure 4.2.2-1). The Partridge River Watershed is primarily a mix of upland forest (39 percent), lowlands and aquatic environments (27 percent), shrubland (22 percent), and cropland/grassland (2 percent), with some development (10 percent). There are several active and inactive mines within the watershed including the active Northshore Mine in the headwaters area, as well as the inactive and former LTVSMC mine. About 5.3 miles of the Partridge River run around the northern and eastern perimeter of the proposed NorthMet Mine Site. Seeps from the southern portion of the existing LTVSMC Tailings Basin (south side of Cell 1E) naturally flow to Second Creek, a tributary of the Partridge River in the Lower Partridge Watershed (see Figure 4.2.2-1); however, they are presently being captured and pumped back to the Tailings Basin under the Consent Decree between the MPCA and Cliffs Erie. The Partridge River varies from sluggish marshy reaches, to large open ponds, to steep boulder rapids. Flow data is most valuable when there is a long term of record because the data are less affected by climate variability in an atypical year or two (Robson 2000). Data from four USGS gaging stations within the Partridge River Watershed (see Figure 4.2.2-1) are available, but the three that reflect flow from the NorthMet Project area have all been impacted by mining operations (see Table 4.2.2-7). The Partridge River above Colby Lake (USGS Station #04015475) is the gaging station that best represents flows from the NorthMet Project area because it is the most upstream station that captures all flow from the proposed Mine Site, with data available for the period from 1978 to 1988. The use of these flow data, although about 25 years old, is reasonable as there has not been any significant land cover or other changes in the watershed over the intervening years that would raise into question the applicability of these data.

The available flow records indicate that streamflow is generally very low from late fall through the winter, rising sharply during spring snowmelt, and receding during the summer, except for occasional heavy storms. This pattern of significantly reduced summer streamflow is characteristic of streams draining extensive bogs (Brooks 1992). Baseflow is very low during the winter because of the relatively thin glacial drift over bedrock, and because little groundwater recharge occurs since most precipitation falls as snow and is not available for infiltration or runoff until it melts (Siegel and Ericson 1980). The discharge statistics for the USGS Station above Colby Lake (USGS Station #04015475) are presented in Table 4.2.2-7. The modeled flow at seven locations (SW-002, SW-003, SW-004, SW-004a, SW-004b, SW-005, and SW-006) on the Partridge River (see Figure 4.2.2-8) are presented in Table 4.2.2-8.

Table 4.2.2-7 Monthly Statistical Flow Data (cfs) for USGS Gaging Stations in the Partridge River Watershed

Station:	04015475 Partridge River Above Colby Lake			04015500 Second Creek Near Aurora			04016000 Partridge River Near Aurora		
Period of Record:	1978-1988			1955-1980			1942 – 1982		
Drainage Area:	106.0 mi^2			29.0 mi^2			161.0 mi^2		
Contributing Drainage Area:	100.0 mi^2			22.4 mi^2			147.7 mi^2		
Month	**Monthly Average**	**Daily Minimum**	**Daily Maximum**	**Monthly Average**	**Daily Minimum**	**Daily Maximum**	**Monthly Average**	**Daily Minimum**	**Daily Maximum**
October	116[1]	14	775	24	1.2	134	97	3.3	1,140
November	63	13	468	20	4.0	103	71	4.0	308
December	20	4.1	95	12	2.2	35	34	5.7	116
January	7.5	1.4	23	9.2	1.5	30	21	2.3	61
February	6.4	1.0	26	8.9	1.5	28	17	2.3	41
March	16	0.6	209	16	2.0	84	41	3.0	1,560
April	242	4.0	1,960	47	5.0	233	271	6.5	2,580
May	220	11	874	34	1.7	126	333	37	3,190
June	105	5.9	568	29	1.4	95	210	17	2,920
July	104	0.5	866	23	3.1	90	101	11	950
August	55	0.7	480	20	2.6	130	64	5.2	459
September	87	2.0	383	24	1.9	100	81	3.2	438

Source: Statistical data from USGS 2008.

[1] All values in cfs unless otherwise noted.

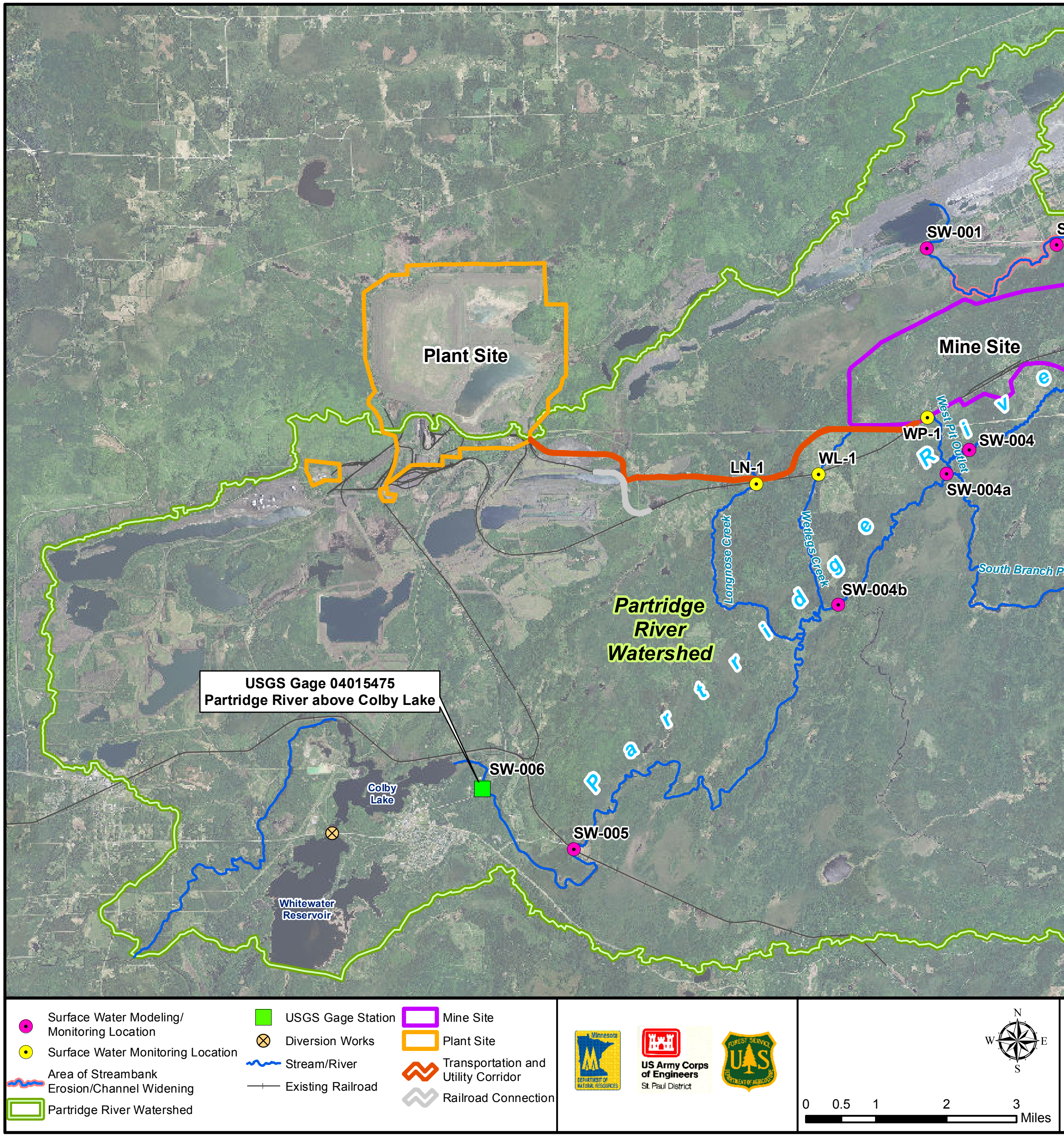

Figure 4.2.2-8
Surface Water Monitoring and Modeling Locations within the Partridge River Watershed
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Table 4.2.2-8 Modeled Flow Statistics for Various Locations along the Upper Partridge River

	Station						
Statistic (Unit)	**SW-002(1)**	**SW-003(1)**	**SW-004(1)**	**SW-004a(1)**	**SW-004b(1)**	**SW-005(1)**	**SW-006(1)**
Drainage Area (acres)[3]	3,838	1,042	5,016	19,991	15,108	13,400	2,991
Annual Daily Mean (cfs)	6.09	7.35	13.97	38.33	57.61	74.77	78.87
October Mean (cfs)	22.76	27.58	52.43	144.03	216.09	278.61	294.02
November Mean (cfs)	4.59	5.80	11.68	31.61	49.19	66.08	68.93
December Mean (cfs)	1.70	2.29	4.43	12.85	19.71	26.61	27.72
January Mean (cfs)	0.57	0.73	1.37	3.95	5.97	7.73	8.11
February Mean (cfs)	1.06	1.27	2.40	6.59	9.88	12.73	13.42
March Mean (cfs)	1.44	1.70	3.10	8.50	12.50	15.16	16.12
April Mean (cfs)	30.58	36.89	71.41	200.60	300.54	390.47	410.56
May Mean (cfs)	7.36	9.05	17.52	49.01	75.47	102.88	108.04
June Mean (cfs)	11.55	13.54	25.56	67.75	101.13	127.93	135.19
July Mean (cfs)	5.97	7.09	13.54	35.56	54.55	75.93	80.42
August Mean (cfs)	3.00	3.57	6.40	16.71	24.79	31.89	33.98
September Mean (cfs)	8.93	10.84	20.14	52.93	79.31	103.64	110.01
10-year[2] High Flow (cfs)	117.79	132.12	214.83	678.28	895.16	1,080.60	1,126.55
Average Annual 1-day Max (cfs)	82.15	93.30	156.05	467.64	630.96	737.26	761.75
Average Annual 3-day Max (cfs)	71.62	82.84	149.39	423.15	593.08	722.50	748.85
Average Annual 7-day Max (cfs)	54.13	63.57	120.31	337.99	490.93	623.57	651.79
Average Annual 30-day Max (cfs)	23.59	28.25	54.01	150.46	223.95	288.80	303.66
Average Annual 90-day Max (cfs)	13.71	16.52	31.66	87.78	131.81	170.99	180.10
10-year[2] Low Flow (cfs)	0.35	0.45	0.72	1.72	2.84	3.58	3.90
Average Annual 1-day Min (cfs)	0.40	0.52	0.85	2.08	3.36	4.32	4.69
Average Annual 3-day Min (cfs)	0.39	0.51	0.84	2.05	3.30	4.28	4.65
Average Annual 7-day Min (cfs)	0.40	0.51	0.86	2.11	3.38	4.32	4.68
Average Annual 30-day Min (cfs)	0.41	0.51	0.92	2.44	3.81	4.91	5.28
Average Annual 90-day Min (cfs)	0.63	0.80	1.46	3.87	5.87	7.61	8.10
Date of Max 1-day Mean (cfs)	168.85	168.85	169.26	168.95	169.16	169.77	169.77
Date of Min 1-day Mean (cfs)	211.94	211.94	195.10	201.64	208.29	203.28	200.39
Number of Zero Flow Days/year	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7-day Minimum/Annual Mean	0.06	0.06	0.05	0.05	0.05	0.05	0.05
No of High Pulses/yr	15.17	13.80	10.54	9.00	8.23	6.51	6.34
Mean Duration of High Pulses (days)	4.97	5.46	7.15	8.42	9.19	11.61	11.93

	Station						
Statistic (Unit)	**SW-002[(1)]**	**SW-003[(1)]**	**SW-004[(1)]**	**SW-004a[(1)]**	**SW-004b[(1)]**	**SW-005[(1)]**	**SW-006[(1)]**
Total High Pulse Duration/yr (days)	69.23	69.31	69.23	69.61	69.53	69.53	69.53
No of Low Pulses/yr	3.63	3.57	2.72	2.61	2.72	1.97	1.97
Mean Duration of Low Pulses (days)	19.04	19.15	26.30	27.34	26.37	37.26	37.31
Total Low Pulse Duration/yr (days)	70.89	70.27	73.46	73.38	73.64	75.50	75.59
Avg. Hydrograph Increase (cfs/day)	3.94	4.69	6.93	20.61	28.11	24.65	26.33
Avg. Hydrograph Decrease (cfs/day)	1.49	1.63	2.46	7.06	9.38	10.19	10.23
No of Flow Reversals/yr	54.84	49.75	38.43	38.49	38.80	34.02	38.86

Source: PolyMet 2013i, Attachment G.

Notes:
[1] Based on existing-conditions XP-SWMM model results adjusted using scale factors listed in Table 4-7 of the Mine Site Water Modeling Data Package (PolyMet 2013i).
[2] 10-year values are based on individual model years flow statistics not published in Attachment G of PolyMet 2013i. Values in Attachment G represent averages of 10-year model period.
[3] Based on existing conditions Partridge River Tributary Areas listed in Table 1-18 of the Mine Site Water Modeling Data Package (PolyMet 2013i).

Upper Partridge River Baseflow

Estimating the groundwater contribution to flow in the Upper Partridge River is necessary for modeling future impacts since groundwater and surface water quality are different. Both PolyMet and the MDNR evaluated Partridge River baseflow. The MDNR directly measured winter low flows at several locations along the Partridge River during the winters of 2008, 2010, and 2011. PolyMet used the winter 30-day low flow as a surrogate statistic for baseflow using USGS gaging station #04015475 data during the winters of water years 1986 and 1987, and January and February of 1985. PolyMet also estimated the 30-day low flow at the same locations as the MDNR winter gagings using the calibrated XP-SWMM model. Table 4.2.2-9 compares the MDNR measurements with PolyMet's XP-SWMM modeled results.

Table 4.2.2-9 Comparison of MDNR Winter 2011 Gagings with Modeled 30-day Low Flow

Partridge River Location	Average MDNR Gagings (cfs)[1]	XP-SWMM Modeled 30-day Low Flow (cfs)[2]
RR tracks south of Northshore Mine Pit	2.7	0.07
0.9 mile upstream of Dunka Road	4.9	0.41
At Dunka Road (SW-003)	5.0	0.51
At CR 666 (SW-006)	7.8	5.28

Source: MDNR Data: MDNR 2011L, Partridge River Watershed Winter 2010-2011 Base Flow Analysis. XP-SWMM Data: PolyMet 2013i.

[1] Average of three winter 2011 monitoring only. In 2011, upstream pumping by Northshore was variable preceding and during the time measurements were taken by the MDNR. Other data from 2008 and 2010 monitoring were either collected during warm weather, when surface runoff was occurring, or are incomplete.
[2] XP-SWMM model was calibrated to low-flow conditions when there was no dewatering from Northshore Mine.

For all locations along the Partridge River, the XP-SWMM-estimated baseflow is less than the MDNR-measured winter flow. This disparity is believed to occur because the XP-SWMM model was calibrated to low flow conditions when there was no dewatering from the Northshore Mine Pit (January and February 1985); however, the Northshore Mine was dewatered during the MDNR measurements. Barr’s modeled estimates of baseflow are therefore considered to be conservatively low, assuming continued dewatering from the Northshore Mine Pit. The use of a lower modeled baseflow means that any changes of flow volume due to withdrawals, discharges, or augmentation would result in greater consequences during the impact modeling compared to if higher baseflow values were used. In addition, the impact modeling would show higher concentrations of solutes in the rivers and creeks because discharges would be less diluted in lower flows. It is noted that the Partridge River flow percentiles (flow-duration curve) used for water quality impact modeling will be based on water years 1986 and 1987 when there was no dewatering from the Northshore Mine Pit, and water years 1978 to 1985 adjusted to account for Northshore Mine Pit average monthly dewatering.

Upper Partridge River Stream Geomorphology

A Level I Rosgen Geomorphic Survey (Rosgen 1996) was conducted for the Partridge River from its headwaters to Colby Lake, a distance of about 28 miles (Barr 2005). A Level I Survey is a physical classification of a stream channel to determine its geomorphic characteristics based on the relationship of its physical geometry and hydraulic characteristics. The purpose of a geomorphic survey is to evaluate the stability of a stream under existing conditions, to determine its sensitivity to hydrologic change, and to indicate how restoration may be approached if a portion of the stream becomes unstable. This survey is included in this SDEIS because it assesses erosion and/or channel widening caused by changes in flow that may occur from current or future mine water discharge, and is thus helpful in assessing project-specific or cumulative effects. This broad level characterization was performed using 2003 aerial photography, USGS 7.5 minute quadrangles with a 10-ft contour interval, available ground photographs, and two site visits.

The survey results indicated that approximately 54 percent of the Partridge River is a Type C channel, 31 percent is a Type E channel, and 13 percent is a Type B channel. Type C channels are characterized as moderately sinuous (meandering), having a mild slope and a well-developed floodplain, and being fairly shallow relative to their width. Type E channels are similar to Type

C, except that they tend to be more sinuous and deeper relative to their width. Type B channels are steeper, straighter, and have less floodplain available than Type C or E channels. Type B channels tend to be less sensitive to impact than Type C or E channels and are dominated by boulder material on the Partridge River.

The Rosgen field survey found the Partridge River to be stable, with no evidence of erosion except in its headwaters (see Figure 4.2.2-8). In general, the Partridge River has well vegetated stream banks for nearly its entire length, and a very well-developed floodplain for all but the Type B reaches. There are many beaver dams along the entire length of the Partridge River, particularly at the head of rapids sections, which create wide pools. Because its steep reaches are well-armored and the flatter reaches tend to have well vegetated shorelines, the Partridge River is considered to be a robust stream. The limited erosion and/or channel widening found in the headwaters may be attributable to pit dewatering discharges from the Northshore Mine, which has a maximum permitted discharge rate of 29 cfs, and the historic straightening of the river channel for construction of a railroad.

Partridge River Surface Water Withdrawals and Discharges

There are several mines, the City of Hoyt Lakes WWTP, and Minnesota Power’s Laskin Energy Center (a power plant) that have withdrawn or discharged water in the past, and/or are currently withdrawing or discharging water that affects flows in the Partridge River (see Figure 4.2.2-9). Table 4.2.2-10 summarizes the NPDES/SDS discharges to and surface water withdrawals from the Partridge River and its tributaries. Most of these outfalls do not discharge continuously, and many, although still “active” in terms of permit status, have not discharged for many years (i.e., various mine pit dewatering discharges).

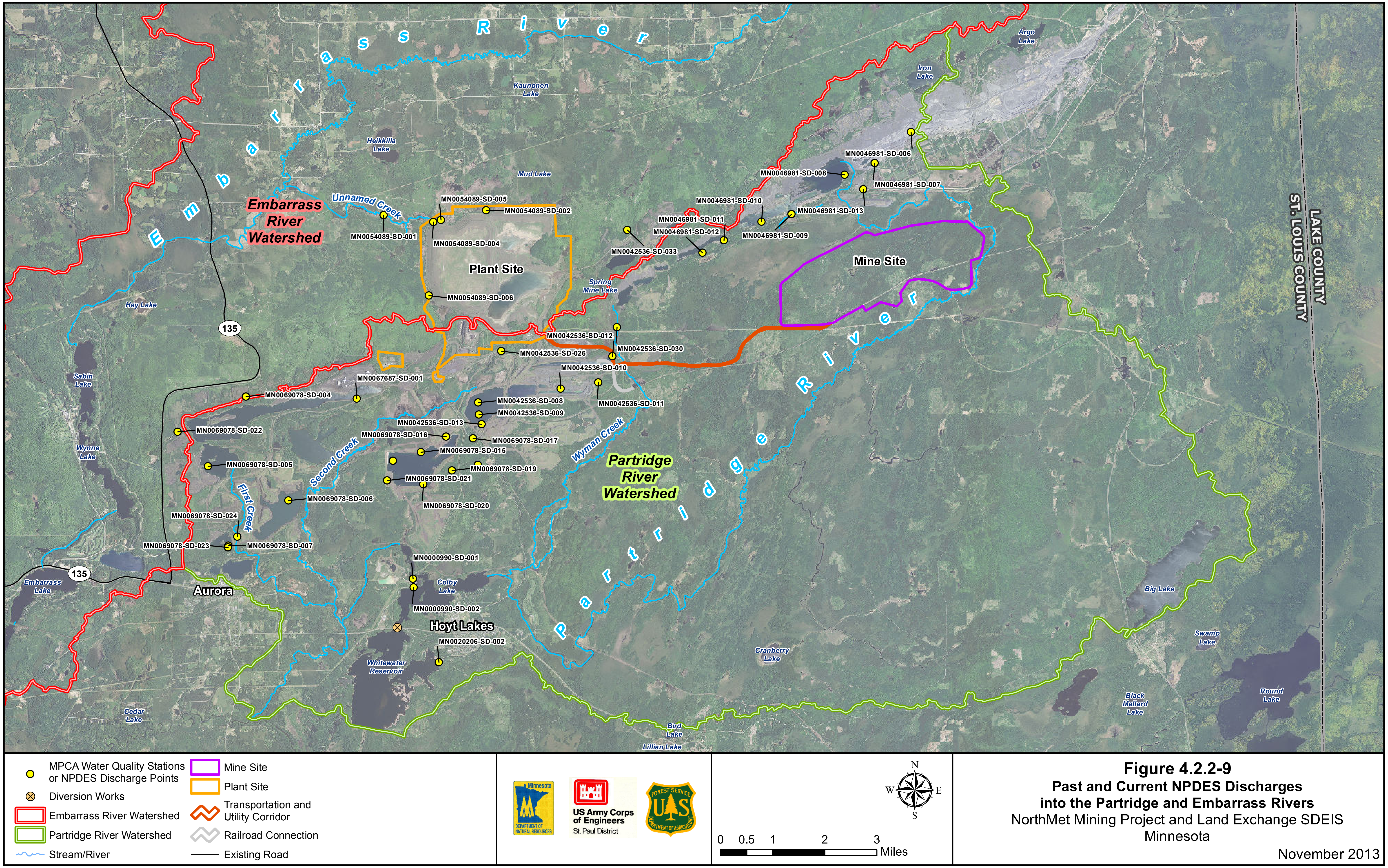

Figure 4.2.2-9
Past and Current NPDES Discharges into the Partridge and Embarrass Rivers
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Table 4.2.2-10 Discharges to and Surface Water Withdrawals from the Partridge River Watershed

NPDES Permit Number	Discharge ID	Outfall Description	Receiving Waters	Authorized Flow (cfs) Avg.	Authorized Flow (cfs) Max.
MN0069078 Mesabi Mining LLC[1]	MN0069078-SD-001	Pit 2WX, Composite SD-018 to SD-021	Colby Lake	NA	NA
	MN0069078-SD-004	Pit 1 dewatering pipe	Unnamed creek tributary to Wynne Lake	8.4	18.3
	MN0069078-SD-005	Pit 9 dewatering pipe	First Creek	7.8	11.1
	MN0069078-SD-006	Pit 6 dewatering pipe	Second Creek	15.5	22.3
	MN0069078-SD-007	Pit 9S dewatering pipe	First Creek	16.7	22.3
	MN0069078-SD-014	Pit 2WX dewatering pipe	Second Creek (via wetlands)	7.8	11.2
	MN0069078-SD-015	Pit 2WX dewatering pipe	Second Creek (via wetlands)	7.8	11.2
	MN0069078-SD-016	Pit 2WX dewatering pipe	Second Creek (via wetlands)	7.8	11.2
	MN0069078-SD-017	Pit 2WX dewatering pipe	Second Creek (via wetlands)	7.8	11.2
	MN0069078-SD-018	Pit 2WX dewatering pipe	Tributary to Colby Lake	7.8	11.2
	MN0069078-SD-019	Pit 2WX dewatering pipe	Tributary to Colby Lake	7.8	11.2
	MN0069078-SD-020	Pit 2WX dewatering pipe	Tributary to Colby Lake	7.8	11.2
	MN0069078-SD-021	Pit 2WX dewatering pipe	Tributary to Colby Lake	7.8	11.2
	MN0069078-SD-022	Pit 9 dewatering pipe	Unnamed creek tributary to Wynne Lake	7.8	11.2
	MN0069078-SD-023	Pit 9S dewatering pipe	First Creek	16.7	22.3
	MN0069078-SD-024	Pit 6 dewatering pipe	First Creek	--	11.2
MN0042536 Cliffs Erie LLC[2]	MN0042536-SD-008	Pit 2W dewatering pipe	Second Creek	7.8	11.2
	MN0042536-SD-009	Pit 2W dewatering pipe	Second Creek	7.8	22.3
	MN0042536-SD-010	Pits 2/2E/3 dewatering pipe	Wetland to Wyman Creek	7.8	11.2
	MN0042536-SD-011	Pits 2/2E/3 dewatering pipe	Wetland to Wyman Creek	7.8	11.2
	MN0042536-SD-012	Pit 3 overflow channel	Wyman Creek	7.8	11.2
	MN0042536-SD-013	Pit 2W dewatering pipe	Tributary to Colby Lake	11.1	22.3
	MN0042536-SD-026	Cell 1E seepage/stormwater	Second Creek	0.6	1.4
	MN0042536-SD-030	Pit 5S overflow	Wyman Creek	--	--
		Stormwater from Area/Shops	Second Creek	--	--
		Stormwater from Plant Area	Second Creek	--	--

NPDES Permit Number	Discharge ID	Outfall Description	Receiving Waters	Authorized Flow (cfs) Avg.	Max.
MN0067687 Mesabi Nugget Delaware	MN0067687-SD-001	Pit 1 overflow	Second Creek	2.3	9.0
MN0046981 Northshore Mining Co. Northshore Mine	MN0046981-SD-006	185S pit dewatering	Partridge River headwaters	Inactive	50.8
	MN0046981-SD-007	223S pit dewatering	Partridge River headwaters	Inactive	50.8
	MN0046981-SD-008	258S pit dewatering	Partridge River headwaters	Inactive	50.8
	MN0046981-SD-009	280/292S pit dewatering	Partridge River headwaters	11.5	50.8
	MN0046981-SD-010	360S pit dewatering	Partridge River headwaters	0.3	50.8
	MN0046981-SD-011	380S pit dewatering	Partridge River headwaters	Inactive	50.8
	MN0046981-SD-012	430S pit dewatering	Partridge River headwaters	Inactive	50.8
	MN0046981-SD-013	Crusher 2 sanitary outfall	Partridge River headwaters	Inactive	0.07
	MN0046981-SD-016	Crusher 2 area discharge	Partridge River headwaters	0.01	0.14
MN0020206 Hoyt Lakes WWTP	MN0020206-SD-002	Main Facility Discharge	Whitewater Reservoir	0.39	1.1
MN0000990 MN Power Laskin Energy Center	MN0020206-SD-001	Main Discharge	Colby Lake	194	212
	MN0020206-SD-002	Ash Pond Discharge	Colby Lake	0.6	2.2
Water Appropriation Permittee	**Permit Number**	**Intake Description**	**Water Source**	**Flow (cfs) Avg.**	**Max.**
MN Power/Cliffs Erie LLC	1949-0135	Mining process water	Colby Lake	--	26.7[(3)]
MN Power (Laskin)	1950-0172	Cooling Water	Colby Lake	--	224[(4)]
Hoyt Lakes	1954-0036	Municipal Water Supply	Colby Lake	0.5	2.3[(5)]

Source: MPCA 2012d; MDNR 2013e.

Note: Most of these outfalls do not discharge continuously, and many, although still "active" in terms of permit status, have not discharged for many years (i.e., various mine pit dewatering discharges). The actual total discharge to the river is far less than the sum of the average flows.

1 Permit remains active for closure purposes only; no active dewatering occurring. Pit 6 (SD006) filled with water and has groundwater outflow to Second Creek.
2 Permit remains active for closure purposes only; no active dewatering occurring. Pit 3 (SD012) filled with water and has passive outflow to Wyman Creek averaging 1.1 cfs. Pit 5S (SD030) filled with water and has unmeasured passive outflow to Wyman Creek. Pit 2W filled with water and has outflow to Second Creek averaging approximately 8 cfs.
3 Historically used for pellet plant makeup water; no present active pumping. Represents instantaneous peak withdrawal, permit also includes a maximum average withdrawal rate of 26.7 cfs for any continuous 60-day period or up to 33.4 cfs with prior written commissioner's approval
4 Includes a maximum 4.2 cfs consumptive use for evaporative losses.
5 Represents instantaneous peak withdrawal, permit also includes an annual maximum withdrawal rate of 2.3 cfs.

Although mine discharges have occurred at least periodically in the NorthMet Project area since 1956 when the Northshore Mine began operations, there are few readily available mine pumping records prior to 1988 when the state began requiring water appropriation permit holders to report this information. Pumping records for the Northshore Mine from 1976 to approximately 1986 are available and have an annual average of between 6.8 and 15.1 cfs. Since 1988, the highest reported average monthly discharge from the Northshore Mine to the Partridge River was 34 cfs (Barr 2008f).

In addition, former LTVSMC Pits 3 and 5S are currently overflowing into Wyman Creek (see Figure 4.2.2-9), which flows south into the Partridge River (RS74A Barr 2008). Average monthly outflow from Pit 3 (SD012), as reported to the MPCA for permit compliance during 2009 through 2011, was about 0.7 cfs. Average winter (baseflow) outflow was 0.1 cfs. There are no discharge records for outflow from Pit 5S (SD-030) because the outflow is dispersed through a wide area of broken rock. The number and volume of these combined discharges, when compared to average and especially low flow in the Partridge River, indicate that the Northshore Mine and former LTVSMC pit discharges have the potential to significantly affect flows. Lack of historical information regarding actual dates of discharge complicates interpreting the flow record.

Upper Partridge River Water Quality

Recent water quality data (collected by PolyMet in 2004, 2006, 2007, 2008, 2010, and 2011) and historic water quality data (back to 1956) are available for various constituents in various locations along the Partridge River, which are summarized in Table 4.2.2-11. Most of these water quality data represent grab samples and the frequency of sampling does not allow a detailed assessment of water quality trends, seasonal effects, or relationship to flow. Nevertheless, collectively, the data can be used to generally characterize water quality in the watershed and draw some comparisons with surface water quality standards.

Table 4.2.2-11 Available Surface Water Quality Monitoring Data in the Partridge River Watershed (see Figure 4.2.2-1)

Sample Location	Source	Sampling Period
Mainstem Partridge River (in progressive downstream order)		
SW-001	Barr	2004, 2006, 2008
SW-002	Barr/Cominco	1974-1976, 1978, 2001-2002, 2004, 2006
SW-003	Barr/C-N Study/Kennecott	1974-1978, 2001-2004, 2006-2008, 2010
SW-004	Barr	2004, 2006-2008, 2010, 2011
SW-004a	Barr	2010
SW-004b	Barr	2010
SW-005	Barr/C-N Study	1976-1977, 2004, 2006-2008, 2010-2011
Colby Lake	C-N Study, USGS, MPCA, MN Power, Barr	1976-1977, 1988, 2001-2003, 2008, 2010
Whitewater Reservoir	MPCA, Barr	1972, 1985, 2001, 2010
USGS gage #04016000/CN122	C-N Study, USGS	1956-1966, 1976-1977, 1979
USGS gage #04015475	USGS	1979
Tributaries		

Sample Location	Source	Sampling Period
West Pit Outlet Creek, WP-1	Barr	2011, 2012
S. Branch, USGS gage #04015455	C-N Study	1973-1976
Colvin Creek, CN124	C-N Study	1973-1976
Wetlegs Creek, WL-1	Barr	2011, 2012
Longnose Creek, LN-1	Barr	2011, 2012
Wyman Creek, PM-5 / PM-6	Barr	2004, 2011 (PM-5), 2005 (PM-6)
Second Creek, PM-7, PM-17, PM-18	Barr	2004, 2006-2007

Source: Barr 2007h; Barr 2008f; Barr 2007i; Siegel and Ericson 1980; Barr 2009c; Barr 2013b.

In general, ambient water quality is similar across the watershed, although a few parameters (e.g., aluminum and copper) appear to reflect a slightly increasing trend downstream (see Table 4.2.2-12). Comparing 1970s data from the Regional Copper-Nickel Study with recent (post-2000) PolyMet data collected at three monitoring stations common to both data sets shows that some parameters appear to have decreased in concentration (e.g., sulfate), but the water sampled at these stations in the 2000s is generally similar to the quality measured in the 1970s. Although a few individual samples exceeded surface water quality evaluation criteria, overall instream water quality meets state water quality standards. The only consistent exceedance of water quality standards was dissolved oxygen near the headwaters of the Partridge River (SW-002, Figure 4.2.2-4). Sufficient information is not available to interpret this exceedance, but the dissolved oxygen exceedances are localized and are not found at other upstream or downstream locations. The Upper Partridge River is not listed as an impaired water body on the 303(d) list.

There are limited water quality data available from the mainstem of the Partridge River that predate the operation of the Northshore Mine in 1956 that can be used to characterize relatively "undisturbed" conditions. There are, however, six samples that were collected during the Regional Copper-Nickel Study in 1976 and 1979 along the South Branch of the Partridge River at USGS Gaging Station #04015455 (see Figure 4.2.2-1). These samples were unaffected by mining and most potential significant sources of contamination, thus they can provide some insights on "undisturbed condition" water quality in the Partridge River for several key parameters (see Table 4.2.2-13). As these few samples indicate, water quality generally met standards for the parameters monitored.

Table 4.2.2-12 Comparison of Historic and Recent Mean Water Quality Data for Selected Parameters at Common Monitoring Stations along the Partridge River

							SW-002		SW-003		SW-005	
			Detection		**Range**				**Mean**			
General Parameter	**Units**	**Evaluation Criteria[10]**	**1970s**	**2000s[9]**	**1970s**	**2000s[9]**	**1970s**	**2000s[9]**	**1970s**	**2000s[9]**	**1970s**	**2000s[9]**
Dissolved Oxygen	mg/L	>5.0	41 of 41	45 of 45	3.3 to 11.6	0.0 to 13.9	6.7	7.6[1]	9.1	8.7	8.0	7.0
Hardness	mg/L	500	94 of 94	65 of 65	16 to 204	16.9 to 139	115	76.9	117	86	85	66
pH	s.u.	6.0-9.0	186 of 186	64 of 64	6.2 to 8.7	6.0 to 8.5	7.0	7.4	7.3	7.5	7.2	7.6
Sulfate	mg/L	--[7]	93 of 93	60 of 65	3.0 to 76	<0.50 to 25.7	20.1	6.3	18.9	11.3	18.9	9.1
Metals – Total												
Aluminum	µg/L	125	27 of 30	44 of 44	0.50 to 205	13.0 to 232	43.6	126[5]	76	52.7	123	205
Arsenic	µg/L	53	15 of 30	5 of 17	0.50 to 5.0	<1.0 to 7.0	3.8	<1[1]	3.2	<1.0[1]	0.8	1.1
Cobalt	µg/L	5.0	3 of 55	9 of 55	0.50 to 2.0	<0.50 to 12.5	0.6	<0.5	0.5	0.5	0.6[1]	1.7
Copper	µg/L	9.3[2]	67 of 68	44 of 61	0.25 to 8.0	<0.33 to 2.6	1.3	1.1	1.3	1.1	2.4	1.7
Iron	µg/L	--	78 of 78	23 of 23	400 to 7,200	540 to 5,270	1,085	1,208[3]	1,365	1,630[4]	1,528	1,884[6]
Lead	µg/L	3.2[2]	44 of 68	16 of 35	0.10 to 10.0	<0.15 to 1.6	0.6	0.4	0.8	0.3	0.7	0.5[8]
Manganese	µg/L	--	69 of 70	29 of 29	0.03 to 1,400	28.0 to 780	112	142	153	147	160	153
Nickel	µg/L	52[2]	19 of 64	47 of 61	0.50 to 9.0	<0.30 to 3.9	1.4	1.5	1.5	1.5	1.0[1]	1.9
Zinc	µg/L	120[2]	34 of 66	19 of 61	0.50 to 18.0	<0.0 to 82.9	5.6	10.1	4.4	12.7	2.0	14.4

Sources: Barr 2007i for 1970s data; Barr 2013b for 2000s data.

1 Based on fewer than five samples.
2 Water quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 100 mg/L.
3 Excludes single outlier value of 1.27 µg/L from values included in Barr 2013b.
4 Excludes single outlier value of 1.45 µg/L from values included in Barr 2013b.
5 Excludes single outlier value of 1550 µg/L from values included in Barr 2013b.
6 Excludes single outlier value of 2.03 µg/L from values included in Barr 2013b.
7 Sulfate standard of 10 mg/l applies to designated “waters supporting the production of wild rice.”
8 Excludes single outlier value of 12.3 µg/L from values included in Barr 2013b.
9 For non-detects, means were calculated at half the detection limit.
10 Section 5.2.2 includes a detailed discussion of evaluation criteria.

Table 4.2.2-13 Baseline Water Quality from the South Branch of the Partridge River[1]

Constituent	Units	Surface Water Standard	# of Samples	S. Branch Partridge R. Mean Concentration	S. Branch Partridge R. Range of Concentrations
General Parameters					
Chloride	mg/L	--	5	1.4	<0.1 to 3.2
Fluoride	mg/L	--	5	0.2	0.1 to 0.3
Hardness	mg/L	500	1	37	37
pH	s.u.	6.5 – 9.0	5	7.0	6.8 to 7.3
Sulfate	mg/L	--	5	5.2	1.4 to 8.9
Metals					
Aluminum	µg/L	125	2	150	100 to 200
Arsenic	µg/L	53	2	<1.0	<1.0
Iron	µg/L	--	5	856	320 to 1,400
Manganese	µg/L	--	2	40	30 to 50
Mercury	ng/L	1.3	2	<500	<500

Source: MPCA 2013a

[1] Based on water quality monitoring data from 1976 and 1979.

PolyMet averaged available ambient water quality data to document existing conditions (Barr 2008f) against which to evaluate impacts from the NorthMet Project Proposed Action at several locations, as shown in Figure 4.2.2-8, along the Partridge River (see Table 4.2.2-14).

Table 4.2.2-14 Average Existing Water Quality Concentrations in the Partridge River

Parameter	Units	Evaluation Criteria[7]	Detection	Range	SW-001	SW-002	SW-003	SW-004	SW-004a[5]	SW-004b[5]	SW-005
			Detection	Range	Mean						
General											
Calcium	mg/L	--	116 of 116	3.9 to 33.1	24.6	20.7	20.5	19.4	21.2	15.6	14.4
Chloride	mg/L	230	110 of 110	0.7 to 28.3	1.6	1.8	10.2	9.4	15.1	9.1	6.0
Fluoride	mg/L	--	59 of 97	<0.05 to 2.5	0.14	0.11	0.09	0.10	0.11	0.10	0.30
Hardness	mg/L	500	116 of 116	16.9 to 139	97	77	86	83	95	72	66
Magnesium	mg/L	--	116 of 116	2.7 to 14.6	10.4	7.5	8.9	8.8	10.3	8.1	7.4
Potassium	mg/L	--	48 of 49	<1.25 to 4.0	2.7	2.0	2.0	2.0	2.7	1.7	1.2
Sodium	mg/L	--	59 of 59	1.2 to 20.2	4.8	3.2	3.8	5.6	12.9	8.3	3.9
Sulfate	mg/L	10[1]	109 of 116	<0.5 to 27	21.8	6.3	11.3	11.5	15.9	9.9	9.1
Metals											
Aluminum	µg/L	125	77 of 82	<5.0 to 1,550	18.0	45.9	53	66	82	**135**	**126**[4]
Antimony	µg/L	31	0 of 20	<1.5 to 1.5	<1.5	<1.5	<1.5	<1.5	--	--	<1.5
Arsenic	µg/L	53	23 of 40	<1 to 11.7	6.5	<1	<1	1.1	1.1	1.2	1.1
Barium	µg/L	--	19 of 34	<5 to 20.1	<5	9.63	10.0	7.6	11.7	9.8	9.2
Beryllium	µg/L	--	0 of 34	<0.1 to <0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Boron	µg/L	500	47 of 59	<17.5 to 211	96	59	66	78	127	81	45.4
Cadmium	µg/L	2.5[2]	6 of 44	<0.01 to 0.10	<0.1	<0.1	0.1	0.08	0.05	0.03	0.08
Cobalt	µg/L	5.0	22 of 98	<0.12 to 12.5	0.45	<0.5	0.5	0.47	0.25	0.37	1.7

Parameter	Units	Evaluation Criteria(7)			SW-001	SW-002	SW-003	SW-004	SW-004a(5)	SW-004b(5)	SW-005
			Detection	**Range**				**Mean**			
Copper	µg/L	9.3(2)	81 of 108	<0.33 to 6.3	1.6	1.2	1.1	1.6	1.2	1.5	1.7
Iron	µg/L	--	47 of 49	<15 to 5,270	30(6)	1,036	1,397	1,209	1,534	1,944	1,675
Lead	µg/L	3.2(2)	30 of 69	<0.015 to 12.3	0.3	0.4	0.3	0.25	0.12	0.2	1.3
Manganese	µg/L	--	57 of 59	<5 to 780	7.9	142	147	112	110	153	153
Mercury	ng/L	1.3	66 of 108	<0.0025 to 0	**2.3**	**3.4**	**2.9**	**3.3**	**3.7**	**4.4**	**3.8**
Nickel	µg/L	52(2)	83 of 108	<0.41 to 4.70	1.39	1.5	1.5	1.7	1.7	2.2	1.9
Selenium	µg/L	5.0	11 of 59	<0.1 to 5.0	1.74	1.7	1.7	1.13	0.23	0.3	1.1
Silver	µg/L	1.0(2)	0 of 59	<0.10 to 0.50	0.3	0.3	0.3	0.25	<0.1	<0.1	0.3
Thallium	µg/L	0.56	12 of 65	<0.0025 to <1	**0.6**	**0.6**	0.56	0.4	0.01	0.01	0.4
Vanadium3	µg/L	--	0 of 0	0 to 0	4.3	0.9	0.9	0.9	0.9	0.9	--
Zinc	µg/L	120(2)	32 of 108	<0.5 to 82.9	8.85	10.1	12.7	14.5	<3	<3	14.4

Source: Barr 2013b.

Note: Values in bold indicates an exceedance of surface water quality standard, based on the average value of all samples. Means calculated using non-detects at half the detection limit.

1 MPCA has listed the Partridge River downstream from river mile approximately 22 just upstream of the railroad bridge near Allen Junction as Wild Rice water, so the 10 mg/L sulfate standard is only applicable to that portion of the Upper Partridge River (SW-005).
2 Water quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 100 mg/L.
3 Vanadium was not monitored in the Partridge River. Value assumed from Hem 1992.
4 Excludes single outlier value of 1,550 µg/L from values included in Barr 2013b.
5 Based on 5 samples collected in Barr 2013b.
6 Excludes single outlier value of 0.06 µg/L from values included in Barr 2013b.
7 Section 5.2.2 includes a detailed discussion of evaluation criteria.

Upper Partridge River Tributary Streams

The NorthMet Project Proposed Action could affect four small streams that are tributaries to the Partridge River, including the following (see Figure 4.2.2-1):

- Wetlegs Creek – which would be crossed by the Transportation and Utility Corridor that links the Mine Site with the Plant Site.
- Longnose Creek – which would also be crossed by the Transportation and Utility Corridor that links the Mine Site with the Plant Site.
- Wyman Creek – which would also be crossed by the Transportation and Utility Corridor that links the Mine Site with the Plant Site.
- West Pit Outlet Creek – which would receive discharge from the WWTF after closure.

No baseline flow data collection or hydrologic modeling was conducted for Wetlegs, Longnose, and Wyman creeks as the NorthMet Project Proposed Action is not expected to affect the hydrology of these streams. Stream geomorphic monitoring was initiated for the West Pit Outlet Creek during spring 2010. PolyMet used the calibrated XP-SWMM model to estimate selected flow volumes for this stream. Modeled September-October flow, possible target dates for controlled pit discharge designed to meet the downstream sulfate standard for wild rice protection, was 0.9 cfs at the pit outlet and 1.6 cfs at the Dunka Road. The modeled 2-year event was 18 cfs at the pit outlet location and 34 cfs at the Dunka Road (PolyMet 2013i).

In terms of surface water quality, Wetlegs Creek, Longnose Creek, and the West Pit Outlet Creek drain relatively undisturbed watersheds; whereas Wyman Creek drains an area previously mined by LTVSMC, including Area 3 and Area 5S Pits. Water quality data for various constituents from the two locations on Wyman Creek was collected in 2004 and again in 2011 and 2012 at PM-5. Data collection from Wetlegs Creek, Longnose Creek, and the West Pit Outlet Creek was initiated in spring 2011, with monthly sampling through December 2012 (PolyMet 2013i). Water quality data for the three streams are summarized in Table 4.2.2-15. These constituents are generally within the range documented for the main branch of the Partridge River, with the exception of iron for Longnose Creek, Wetlegs Creek, and the West Pit Outlet Creek, and manganese for all four streams, which is higher than recorded for the Partridge River. As with the Partridge River, background concentrations of mercury exceeds the 1.3 ng/L standard. Collectively, these data can be used to characterize existing background water quality for these streams.

Table 4.2.2-15 Mean Water Quality Data for Longnose Creek, Wetlegs Creek, Wyman Creek, and West Pit Outlet Creek

Parameter	Units	Detection	Range	Evaluation Criteria[8] (Longnose, West Pit Outlet and Wetlegs)	Longnose Creek[1] LN-1	West Pit Outlet Creek[9] WP-1	Wetlegs Creek[2] WL-1	Evaluation Criteria (Wyman)	Wyman Creek[3,8] PM-5	Wyman Creek[8] PM-6
					Mean					
General										
Calcium	mg/L	53 of 53	3.2 to 51.1	--	12.1	7.2	11.1	--	36.0	20.2
Chloride	mg/L	34 of 53	<0.25 to 9.9	230	0.60	0.50	1.2	100	1.7	1.0
Fluoride	mg/L	8 of 23	<0.05 to 0.2	--	<0.05	<0.05	<0.05	(2.0) (7)	<0.10	0.13
Hardness	mg/L	50 of 50	23.2 to 258	500	54.5	37.6	53.6	250	195	86.0
Magnesium	mg/L	53 of 53	1.74 to 31.7	--	5.25	3.87	5.7	--	26.6	11.8
Potassium	mg/L	44 of 46	<125 to 6,400	--	0.63	0.47	0.85	--	4.8	1.7
Sodium	mg/L	31 of 46	<1.0 to 17.5	--	1.6	1.4	1.2	--	13.3	5.1
Sulfate	mg/L	40 of 53	<0.5 to 85.1	--	0.74	1.2	2.6	(250)(7)	60.0	17.0
Metals										
Aluminum	µg/L	42 of 50	<10.0 to 716	125	71.8	**486**	120	87	29.2	**102**
Antimony	µg/L	2 of 48	<0.25 to 1.5	31	<0.25	<0.25	0.23	6	0.50	<1.5
Arsenic	µg/L	43 of 53	<0.25 to 3.7	53	1.6	2.2	1.4	2	1.7	<1.0
Barium	µg/L	21 of 30	<5.0 to 30.6	--	10.7	7.8	12.0	2,000	12.0	11.0
Beryllium	µg/L	0 of 30	<0.10 to 0.1	--	<0.10	<0.10	<0.10	4.0	<0.10	<0.10
Boron	µg/L	8 of 30	<17.5 to 72.8	500	<25.0	<25.0	<25.0	500	48.3	23.3
Cadmium	µg/L	3 of 30	<0.02 to 0.1	2.5(4)	0.10	<0.10	0.10	2.5	0.10	<0.10
Cobalt	µg/L	32 of 50	<0.10 to 8.3	5.0	0.80	2.7	5.0	2.8	0.70	<0.50
Copper	µg/L	34 of 50	<0.08 to 7.3	9.3(4)	0.50	4.1	3.6	9.3(4)	0.70	2.0
Iron	µg/L	53 of 53	240 to 35,000	--	5,183(6)	10,217	7,589	(300)(7)	**1,594**	**2,020**
Lead	µg/L	13 of 37	<0.01 to 2.1	3.2(4)	0.2	1.5	0.22	3.2(4)	<0.30	<0.50
Manganese	µg/L	53 of 53	15.2 to 4,920	--	874	629	937	(50)(7)	**1,273**	**428**

					Longnose Creek[1] LN-1	West Pit Outlet Creek[9] WP-1	Wetlegs Creek[2] WL-1	Evaluation Criteria (Wyman)	Wyman Creek[3,8] PM-5	Wyman Creek[8] PM-6
Parameter	**Units**	**Detection**	**Range**	**Evaluation Criteria[8] (Longnose, West Pit Outlet and Wetlegs)**	**Mean**					
Mercury	ng/L	39 of 43	<0.25 to 13.2	1.3	**3.3**	**10.3**	**5.0**	1.3	1.3	**4.2**
Nickel	µg/L	25 of 50	<0.25 to 12.4	52(4)	0.80	8.2	6.2	52(4)	0.80	<2.5
Selenium	µg/L	2 of 37	<0.1 to 1.0	5.0	0.30	0.40	0.40	5.0	0.50	<1.0
Silver	µg/L	0 of 30	<0.1 to 0.5	1.0(4)	<0.10	<0.10	<0.10	0.12	**0.20**	<0.50
Thallium	µg/L	9 of 43	<0.001 to 1.0	0.56	0.005	0.01	0.01	0.28	**0.30**	<1.00
Vanadium[5]	µg/L	0 of 20	<1.5 to 5.0	--	3.8	3.3	3.6	--	4.0	--
Zinc	µg/L	7 of 47	<3.0 to 20.0	120(4)	<3.0	10.0	4.7	120(4)	3.8	<5.0

Source: PolyMet 2013i.

Note: Values in bold indicates an exceedance of surface water quality standard.

1 Based on nine samples collected in 2011 and four samples collected in 2012; Source: Large Table 10, NorthMet Project Water Modeling Data Package Vol. 1 – Mine Site ver. 12, PolyMet 2013i.
2 Based on eight samples collected in 2011 and four samples collected in 2012; Source: Large Table 10, NorthMet Project Water Modeling Data Package Vol. 1 – Mine Site ver. 12, PolyMet 2013i.
3 Wyman Creek PM-5 based on four samples collected in 2004, eight samples collected in 2011, and six samples collected in 2012; PM-6 based on four samples collected in 2004.
4 Water quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 100 mg/L.
5 Vanadium was not monitored for these creeks. Value assumed from Hem (1992).
6 Excludes the 4,920-mg/L sample collected on July 25, 2011.
7 Values in parentheses indicate Secondary Maximum Contaminant Levels (sMCLs).
8 See Section 5.2.2 for a detailed discussion of the evaluation criteria.
9 West Pit Outlet Stream averages based on six or fewer samples collected in 2011 and 2012.

Colby Lake and Whitewater Reservoir

This section describes the baseline surface water hydrology and water quality of Colby Lake and Whitewater Reservoir.

Colby Lake and Whitewater Reservoir Hydrology

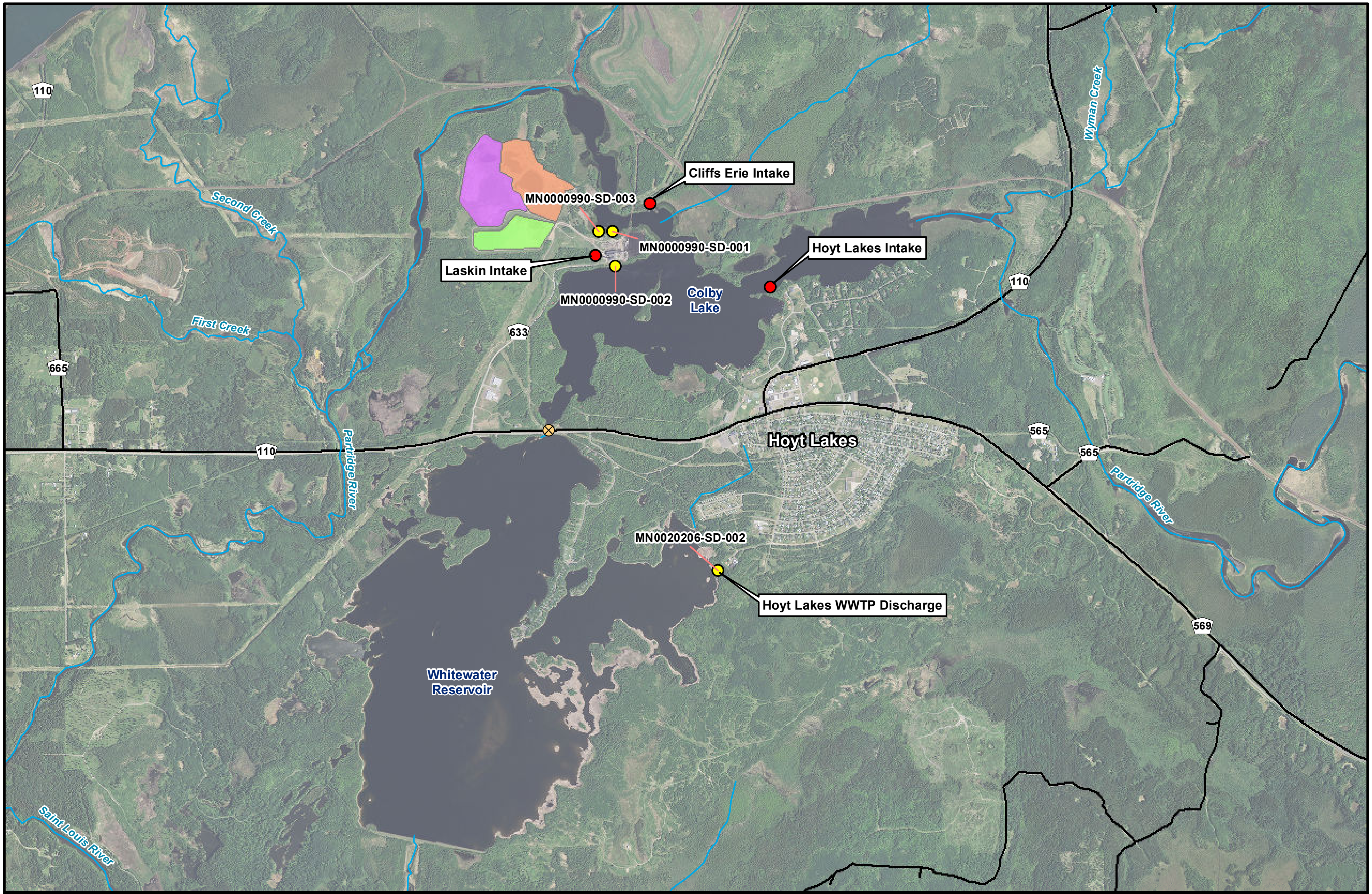
Colby Lake is located approximately 8 miles southwest from the Mine Site and about 4 miles south of the Plant Site on the Partridge River. It has a surface area of approximately 539 acres and a maximum depth of approximately 30 ft (see Figure 4.2.2-1). The outlet control of Colby Lake is at an elevation of approximately 1,439 ft amsl. The outflow from the lake stops when water levels drop below this level.

Around 1955, in order to ensure a reliable source of water, Erie Mining Company (precursor to LTVSMC) constructed Whitewater Reservoir and the Diversion Works, which connects Colby Lake and Whitewater Reservoir. Formerly known as Partridge Lake, this impoundment increased the surface area and depth of the original lake and subjected it to greater annual water level fluctuations. Whitewater Reservoir has a surface area of approximately 1,210 acres and a maximum depth of approximately 73 ft. Water losses due to seepage through the northwest and south dikes can be 15 cfs or more and drain to the Partridge River downstream of Colby Lake (MDNR 2004). The City of Hoyt Lakes discharges an annual average of 0.39 cfs of treated wastewater effluent into Whitewater Reservoir (see Table 4.2.2-10 and Figure 4.2.2-10).

The diversion works contain three 8-ft gates that can be opened to allow the release of water from Colby Lake to Whitewater Reservoir during high flows in the Partridge River. The Diversion Works also contain three high-volume pumps to move water back to Colby Lake during low water levels. During operation of the former LTVSMC processing plant, water would typically flow through the diversion works gates from Colby Lake to Whitewater Reservoir during the spring runoff, then be pumped back into Colby Lake when needed. This system was not used as much as historically expected. When water levels in Colby Lake fall below 1,439.0 ft amsl due to low inflows, the MDNR water appropriation permit (1949-0135) limits withdrawals of water from Colby Lake to the rate that water can be pumped from Whitewater Reservoir to replace the water withdrawn.

After closure of the LTVSMC mine and processing plant in 2001, Minnesota Power purchased the diversion works and most of LTVSMC's riparian land around Whitewater Reservoir. This land currently is leased as lake-front property. The water appropriation permit is currently jointly held by Minnesota Power and Cliffs Erie. An agreement has been reached, however, whereby PolyMet would replace Cliffs Erie as the co-permittee. This would enable PolyMet to obtain makeup water from Colby Lake for use at the Plant Site, subject to MDNR approval at the time of permitting.

In the five-year period after LTVSMC stopped its water withdrawals (January 2001 to December 2006) under relatively natural flows (i.e., discharges from the Northshore Mine were only occurring periodically), water levels in Colby Lake were higher with less fluctuation than when LTVSMC was withdrawing water for its mining operations (see Table 4.2.2-16). Over the same period, Whitewater Reservoir also experienced fewer fluctuations and higher average water levels (see Table 4.2.2-17).



- Water Withdrawals from Colby Lake
- MPCA Water Quality Station 2006/Discharges to Surface Waters NPDES Discharges
- Stream/River
- Existing Road
- Diversion Works
- Ash Pond Cell E
- Ash Pond Cells A and B
- Ash Pond Cells C and D

Minnesota Department of Natural Resources
US Army Corps of Engineers St. Paul District
Forest Service U.S. Department of Agriculture

N W E S

0 1,000 2,000 4,000 Feet

Figure 4.2.2-10
NPDES Discharges Colby Lake and Whitewater Reservoir Area
NorthMet Mining Project and Land Exchange SDEIS
Minnesota

November 2013

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Table 4.2.2-16 Comparison of Colby Lake Elevations over Time

Time Period	Represent	Source	Max Annual Fluctuation[1]	% Time below elevation 1,439.0
1937–1954	Pre-mining	Actual measurements	4.6 ft	5.0
1955–1992	During mining[2] (with LTVSMC withdrawals)	Actual measurements	4.1 ft	24.1
1978–1988	During mining[2] (with LTVSMC withdrawals)	Modeled predictions	5.6 ft	25-27
2001–2006	During mining[2] (without LTVSMC withdrawals)	Actual measurements	3.7 ft	7.5

Source: Barr 2008a; MDNR 2004.

1 Maximum annual fluctuation is the maximum difference between annual maximum and minimum water elevations for any single year during the indicated time period.
2 Includes effects of Northshore Mining operations from 1955 to present.

Table 4.2.2-17 Comparison of Whitewater Reservoir Elevations over Time

Time Period	Represent	Source	Max Annual Fluctuation[1]	Average Water Elevation
1937–1954[(3)]	Pre-mining	Actual measurements	2.0 ft	Not Applicable
1955–1980	During mining[2] (with LTVSMC withdrawals)	Actual measurements	14.3 ft	1,437.7 ft
2002–2008	During mining (without LTVSMC withdrawals)	Actual measurements	4.5 ft	1,438.0 ft

Source: Actual measurements taken from MDNR 2012c. No data was available between 1980 and 2001.

1 Maximum annual fluctuation is the maximum difference between annual maximum and minimum water elevations for any single year during the indicated time period.
2 Includes effects of Northshore Mining operations from 1955 to present.
3 Pre-1955 data is for Partridge Lake. Construction of Whitewater Reservoir, which raised the elevation of Partridge Lake, was not completed until 1955.

Colby Lake is currently used as a potable water source for the City of Hoyt Lakes, which is permitted to withdraw a maximum annual average of 0.5 cfs with an instantaneous peak rate of 2.3 cfs. Colby Lake is also used as a cooling water source for Minnesota Power's Laskin Energy Center coal-fired power plant. The power plant discharges the once-through, non-contact cooling water (MN0000990 SD-001) to the downstream portion of the lake, but there is up to a 4.2 cfs evaporative loss of water from the cooling tower (see Table 4.2.2-10).

Colby Lake Water Quality

Water quality in Colby Lake is affected by inflow from the Upper Partridge River Watershed, but is also affected by human activities including mine pit dewatering and overflows (i.e., Northshore Mine dewatering in the headwaters; Pits 3 and 5S overflow via Wyman Creek), two permitted discharges from Minnesota Power's Laskin Energy Center (i.e., cooling water discharge and a clarified ash pond discharge), pumping from Whitewater Reservoir during low flows, and stormwater runoff from the City of Hoyt Lakes.

Water quality data are available for Colby Lake from various sources from 1976 to 2010 (PolyMet 2013i). The most recent monitoring data (November 2008 and April through September, 2010) showed elevated concentrations of aluminum, iron, mercury, and manganese (see Table 4.2.2-18). A single exceedance of thallium was observed, although average concentration met surface water quality standards. Minnesota Power monitoring (2002 to 2003) found occasional exceedances of arsenic and copper. Aluminum, iron, and manganese are all easily removed in treatment. Colby Lake is on the Minnesota 303(d) TMDL List because of mercury concentrations in fish tissue, but is not included in Minnesota's regional mercury TMDL because the mercury concentrations in the fish are considered too high to be returned to Minnesota's mercury water quality standard. Similar to other lakes in Minnesota, the main source of the mercury is atmospheric mercury deposition. A TMDL study of Colby Lake is needed to determine what actions are required to reduce the mercury concentration in fish, but has not yet been performed.

The monitoring data also indicate that Colby Lake stratifies weakly during the summer and fall months, but is generally isothermal during winter and spring. Given the average chlorophyll-a (2.56 μg/L) and total phosphorus (27 μg/L) concentrations in the Colby Lake water column, along with the average Secchi disk depth of 4.2 ft, the lake can be considered to be mesotrophic (i.e., moderately productive).

Table 4.2.2-18 Summary of Colby Lake Water Quality Data

			C-N Study (1976–1977)		MPCA Data (1976–2007)			Minnesota Power Data (2002–2003)			Barr Data (2008, 2010)			
Parameter	**Units**	**Surface Water Evaluation Criteria**	**# Samples**	**Range**	**# Samples**	**Mean**	**Range**	**Detection**	**Mean**	**Range**	**Detection**	**Mean**	**Range**	**# Exceed**
General														
Calcium	mg/L	--	4	11to 21	14	57.1	21 to 104	--	--	--	17 of 17	19.8	9.0 to 29.1	--
Chloride	mg/L	230	5	6.3 to 9.4	17	6.1	1.8 to 9.3	--	--	--	5 of 5	2.2	2.0 to 2.3	0
Fluoride	mg/L	(2.0)[(2)]	5	0.1 to 0.7	10	0.3	0.1 to 0.4	--	--	--	3 of 5	0.1	0.1 to 1.4	0
Hardness	mg/L	500	5	41 to 83	14	91.2	40 to 150	--	--	--	17 of 17	84.3	44.4 to 119	0
Magnesium	mg/L	--	5	3.2 to 7.3	14	34.1	19 to 51	12 of 12	11.0	4.4 to 17.5	17 of 17	8.5	5.4 to 11.4	--
pH	s.u.	6.5-8.5	17	6.5 to 7.8	109	7.1	6.3 to 8.8	--	--	--	12 of 12	7.7	7.3 to 8.0	0
Potassium	mg/L	--	4	1.3 to 1.5	10	1.7	1.4 to 2.2	--	--	--	5 of 5	0.9	0.8 to 1.0	--
Sodium	mg/L	--	4	3.6 to 4.3	10	6.3	4.7 to 8.0	--	--	--	5 of 5	3.3	2.9 to 3.5	--
Sulfate	mg/L	(250)[(2)]	15	8.7 to 140	14	52.9	8.7 to 140	--	--	--	17 of 17	33.8	10.1 to 60.7	0
Metals														
Aluminum	µg/L	125	5	180 to 470	10	307	180 to 610	12 of 12	171	61 to 264	17 of 17	108	42.8 to 243	**5**
Antimony	µg/L	5.5	--	--	--	--	--	0 of 3	3	<3	0 of 5	0.25	<0.25	0
Arsenic	µg/L	2.0	3	0.4 to 2.1	4	1.4	<0.5 to 2.1	1 of 3	1.4	<2.0 to 2.3	10 of 17	0.78	<0.25 to 1.1	0
Barium	µg/L	2,000	--	--	--	--	--	2 of 3	15.7	<10.0 to 29.1	5 of 5	6.9	5.7 to 7.6	0
Beryllium	µg/L	4.0	--	--	--	--	--	0 of 3	0.2	<0.2	0 of 5	0.1	<0.1	0
Boron	µg/L	500	--	--	--	--	--	3 of 3	79	54 to 100	2 of 5	41.6	<25.0 to 72.1	0

			C-N Study (1976–1977)		MPCA Data (1976–2007)			Minnesota Power Data (2002–2003)			Barr Data (2008, 2010)			
Parameter	**Units**	**Surface Water Evaluation Criteria**	**# Samples**	**Range**	**# Samples**	**Mean**	**Range**	**Detection**	**Mean**	**Range**	**Detection**	**Mean**	**Range**	**# Exceed**
Cadmium[1]	µg/L	2.5	10	0.02 to 0.2	15	0.05	0.02 to 0.20	0 of 3	0.2	<0.2	0 of 5	0.1	<0.1	0
Cobalt	µg/L	2.8	9	<0.3 to 0.5	6	0.4	<0.3 to 1.4	2 of 12	0.7	<1.0 to 1.9	4 of 5	0.24	<0.1 to 0.4	0
Copper[1]	µg/L	9.3	12	1.6 to 7.3	15	4.9	1.6 to 8.0	8 of 12	8.3	<5.0 to 14.5	5 of 5	2.4	1.6 to 3.5	0
Iron	µg/L	(300)[(2)]	15	190 to 2,300	15	836	190 to 2,500	3 of 3	2,103	650 to 3,030	17 of 17	904	451 to 1,320	**17**
Lead[1]	µg/L	3.2	12	0.2 to 1.7	14	0.5	0.2 to 0.9	0 of 3	1.0	<1.0	0 of 5	<0.25	<0.25	0
Manganese	µg/L	(50)[(2)]	5	50 to 90	14	282	63 to 2,100	3 of 3	123	30 to 280	17 of 17	66.2	25.2 to 125	**9**
Mercury	ng/L	1.3	10	80 to 400	9	190	<1000 to 360	--	--	--	5 of 5	5.4	4.8 to 6.0	**5**
Nickel[1]	µg/L	52	10	0.1 to 6.0	13	2.7	<1 to 9.0	1 of 3	3.4	<5.0 to 5.3	5 of 5	2.5	2.0 to 3.1	0
Selenium	µg/L	5.0	--	--	2	<0.8	<0.8	0 of 12	2.0	<2.0	0 of 5	0.50	<0.5	0
Silver[1]	µg/L	1.0	--	--	--	--	--	0 of 2	1.0	<1.0	0 of 5	0.1	<0.1	0
Thallium	µg/L	0.28	--	--	--	--	--	0 of 3	2.0	<2.0	11 of 17	0.10	<0.01 to 0.46	**1**
Vanadium	µg/L	--	--	--	--	--	--	--	--	--	0 of 5	0.5	<0.5	--
Zinc[1]	µg/L	120	12	1 to 35.3	15	6.9	1.0 to 50	2 of 3	17.5	<10.0 to 36.1	0 of 5	3.0	< 3.0	0

Sources: Barr 2009c; Barr 2013b; Siegel and Ericson 1980.

[1] Water quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 100 mg/L, which approximates the hardness concentration in Colby Lake.

[2] Values in parentheses indicate sMCLs.

Whitewater Reservoir Water Quality

As a result of the Minnesota Statewide Mercury TMDL study, which was approved by the USEPA on April 3, 2008, Whitewater Reservoir was placed on the 2012 inventory of all impaired waters because of mercury concentrations in fish tissue. However, the mercury fish tissue levels are low enough that compliance with applicable standards would be achieved under the statewide TMDL. Therefore, it is not included on the final 2012 TMDL List, and does not need its own TMDL.

The City of Hoyt Lakes WWTP discharges an annual average of 0.39 cfs of treated secondary effluent into Whitewater Reservoir (Barr 2008f; Figure 4.2.2-10). The WWTP discharge most likely affects the water quality of Whitewater Reservoir by the addition of nutrients such as phosphorus and nitrogen.

Limited water quality data are available for Whitewater Reservoir (see Table 4.2.2-19). Based on the most recent data collected by PolyMet in 2010, Whitewater Reservoir has significantly lower concentrations of aluminum, iron, and manganese than Colby Lake. Data indicate that Whitewater Reservoir stratifies weakly during the summer and fall months, but is generally isothermal during winter and spring. It appears that all constituents meet applicable water quality standards, but sampling for a full suite of metals has not been done. Given the average chlorophyll-a (5.48 µg/L) and total phosphorus (33 µg/L) concentrations, along with the average Secchi disk depth of 9.5 ft, Whitewater Reservoir can be considered to be mesotrophic (i.e., moderately productive).

Table 4.2.2-19 Summary of Whitewater Reservoir 2010 Water Quality Data

Parameter	**Units**	**Surface Water Evaluation Criteria[1]**	**PolyMet Data 2010**			
			Detection	**Mean**	**Range**	**# Exceed**
General						
Calcium	mg/L	--	12 of 12	20.8	20.1 to 21.2	--
Hardness	mg/L	500	12 of 12	90.2	85.7 to 92.8	0
Magnesium	mg/L	--	12 of 12	9.3	8.6 to 9.7	--
pH	s.u.	6.5-8.5	12 of 12	7.74	7.29 to 7.81	0
Sulfate	mg/L	(250)	12 of 12	34.3	32.9 to 35.3	0
Metals						
Aluminum	µg/L	50 to 200	2 of 12	<25	<25 to 25.4	0
Arsenic	µg/L	2.0	7 of 12	<0.5	<0.5 to 0.62	0
Iron	µg/L	(300)	5 of 12	<60	<50 to 76.5	0
Manganese	µg/L	(50)	12 of 12	10.8	6.9 to 14.6	0
Thallium	µg/L	0.28	5 of 12	<0.02	<0.002 to 0.049	0

Source: PolyMet 2013i.

[1] Values in parentheses indicate sMCLs.

Lower Partridge River

This section describes the baseline surface water hydrology and water quality of the Lower Partridge River downstream of Colby Lake.

Lower Partridge River Hydrology

Downstream of Colby Lake, the Partridge River flows approximately four more miles before reaching its confluence with the St. Louis River. Second Creek (also known as Knox Creek) is a tributary of the Partridge River in this segment and until recently was receiving an annual average of 1.2 cfs of surface seepage from the existing LTVSMC Tailings Basin (see Figure 4.2.2-11 for locations of Seeps 32 and 33) (Barr 2008a). This seepage is now being pumped back into the Tailings Basin, as required by the May 2010 Consent Decree between Cliffs Erie and MPCA. Second Creek is currently receiving seepage from Pit 6. Dewatering flows from Pit 1, as part of the Mesabi Nugget Project (see Table 4.2.2-10, Mesabi Nugget, SD-001) is discharged to Second Creek (see Figure 4.2.2-9) at a rate up to 9 cfs seasonally (September 1 to March 30) as per their reissued permit. Cliffs Erie also is discharging Pit 2/2W water to Second Creek at a rate up to 9.4 cfs.

Lower Partridge River Water Quality

Water quality conditions in the Lower Partridge River, from the outlet of Colby Lake to its confluence with the St. Louis River, result from a mix of Colby Lake outflow, Second Creek inflow and local runoff. Colby Lake and Second Creek (First Creek is a tributary to Second Creek) water quality is affected by local runoff from the former LTVSMC processing plant operations.

Periodic dewatering discharges from Pits 9/9S previously drained to First Creek, but these pits have been abandoned long enough for static water levels to develop. Seepage from Pit 6 currently flows to Second Creek. This seepage has very high sulfate concentrations (greater than 1,000 mg/L). The average sulfate concentration at the confluence of First Creek and Second Creek (see Figure 4.2.2-1) is 475 mg/L. This input of sulfate raises the sulfate concentration in the mainstem of the Partridge River from about 34 mg/L as it flows from Colby Lake (see Table 4.2.2-18) to over 160 mg/L downstream of the confluence of Second Creek (Barr 2011a). A summary of existing water quality at several locations follows.

Water quality monitoring from 2006 to 2008 as part of the MPCA-issued NPDES Permit MN0042536 (SD026), as shown in Figure 4.2.2-9, shows that Seeps 32 and 33 were generally consistent with surface water standards with the exception of hardness, Total Dissolved Solids (TDS), manganese, cobalt, and fluoride (NTS 2009). Table 4.2.2-20 summarizes the surface water quality monitoring data for Station SD026. The MPCA will evaluate information relative to water quality standards during the NPDES/SDS permitting process as part of its analysis to determine which pollutants in the discharge would have a reasonable potential to cause or contribute to violation of a water quality standard.

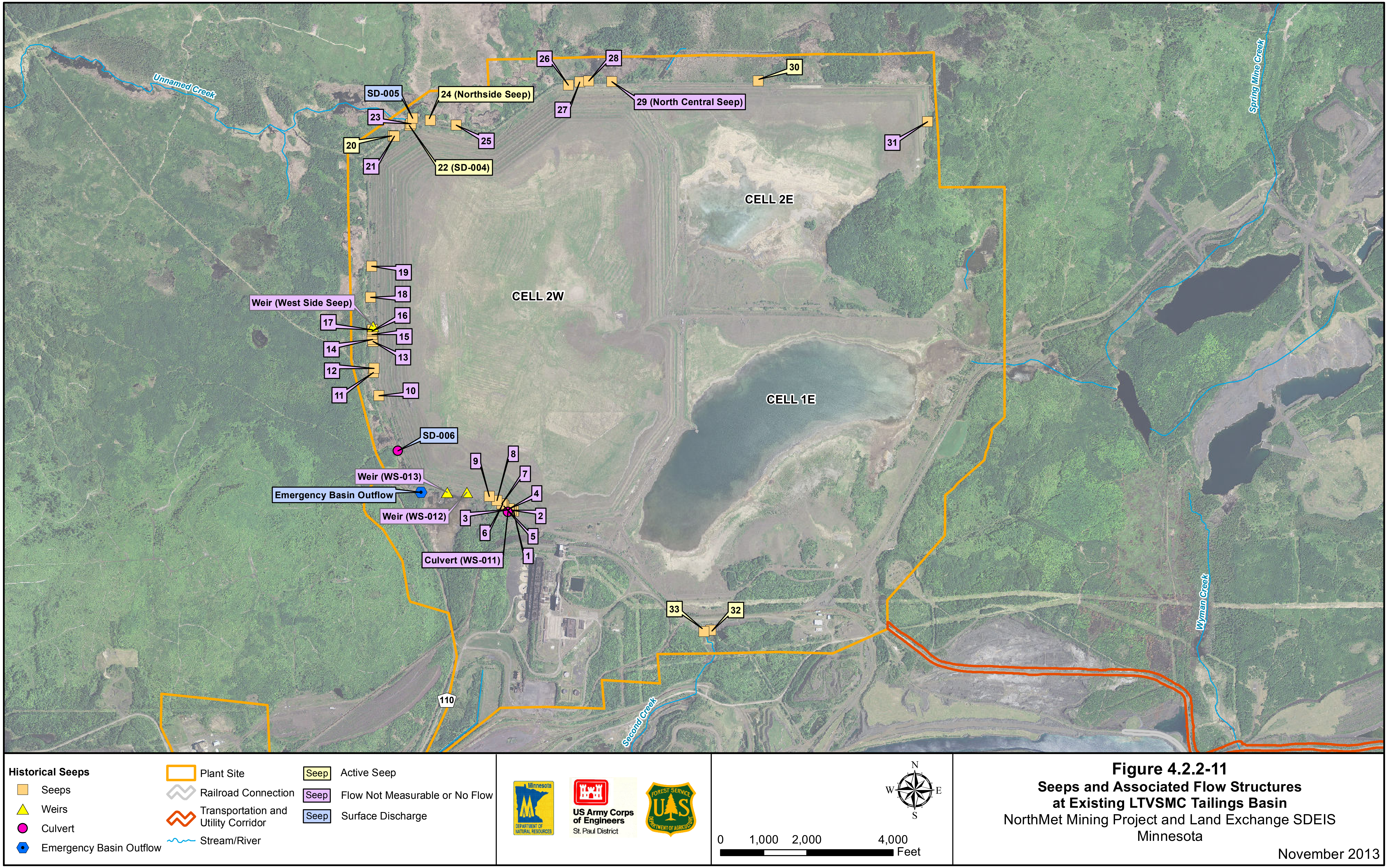

Figure 4.2.2-11
Seeps and Associated Flow Structures at Existing LTVSMC Tailings Basin
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Table 4.2.2-20 Summary of Surface Water Quality Monitoring Data for Station SD026

Constituent	Units	Surface Water Evaluation Criteria	SD026 Surface Discharge (Seeps 32 and 33)		
General Parameters			**Detection**	**Mean**	**Range**
Calcium	mg/L	--	3 of 3	80.7	76.1 to 84.3
Chloride	mg/L	230	19 of 19	14.1	10.3 to 16.7
Fluoride	mg/L	--	35 of 35	2.9	1.5 to 4.2
Hardness	mg/L	500	27 of 27	530	192 to 648
pH	s.u.	6.5-8.5	62 of 62	8.0	7.0 to 8.5
Sulfate	mg/L	--	19 of 19	193	149 to 216
TDS	mg/L		19 of 19	713	485 to 825
Metals – Total					
Aluminum	µg/L	125	--	--	--
Antimony	µg/L	5.5	--	--	--
Arsenic	µg/L	2.0	--	--	--
Barium	µg/L	2,000	--	--	--
Beryllium	µg/L	4.0	--	--	--
Boron	µg/L	500	33 of 33	250	158 to 304
Cadmium	µg/L	2.5	--	--	--
Cobalt	µg/L	2.8	0 of 14	3.8	<1 to <25
Copper[1]	µg/L	9.3	--	--	--
Iron	µg/L	--	--	--	--
Lead[1]	µg/L	3.2	--	--	--
Manganese	µg/L	--	33 of 33	535	110 to 1,520
Mercury	ng/L	1.3	9 of 14	1.0	<0.5 to <4
Molybdenum	µg/L		14 of 14	26.3	14.2 to 38.6
Nickel[1]	µg/L	52	--	--	--
Selenium	µg/L	5.0	--	--	--
Thallium	µg/L	0.28	--	--	--
Zinc[1]	µg/L	120	--	--	--

Source: NTS 2009.

Notes: < = less than indicated reporting limit.
[1] Water quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 100 mg/L, which approximates the hardness concentration in Colby Lake.

Limited Lower Partridge River water quality data has also been collected at CR110 (see Figure 4.2.2-1, location 4016000). Table 4.2.2-21 summarizes water quality data from 2008 and 2009 for this location. In general, the concentration of hardness and associated solutes such as calcium, magnesium, and potassium, average two to four times higher in the Lower Partridge River than in the Upper Partridge River at location SW-005. A similar relationship also exists for selected metals such as boron, copper, and nickel, where average concentrations for Lower Partridge River are at least three times those at SW-005. Zinc appears to be an exception, where Lower Partridge River values appear to average about a quarter of those at SW-005.

Concentrations of sulfate are of special concern because the MPCA staff has recommended that this entire reach of the river from the outlet of Colby Lake to its confluence with the St. Louis River is a water used for the production of wild rice (MPCA 2012b). Based on the 2008-2009 data, sulfate concentration in the Lower Partridge River averages about 162 mg/L. For the

NorthMet Project Proposed Action, sulfate concentrations in receiving waters has been identified as an issue for consideration in the EIS.

Table 4.2.2-21 Summary of Surface Water Quality Monitoring Data for Station CR110

Constituent	Units	Surface Water Evaluation Criteria	CR110		
General Parameters			**Detection**	**Mean**	**Range**
Calcium	mg/L	--	10 of 10	28.6	13.6 to 43.7
Chloride	mg/L	230	10 of 10	5.0	2.7 to 7.7
Fluoride	mg/L	--	10 of 10	0.20	0.11 to 0.59
Hardness	mg/L	500	10 of 10	291	82.5 to 546
pH	s.u.	6.5-8.5	12 of 12	7.6	7.3 to 7.9
Sulfate	mg/L	--	10 of 10	164	43.0 to 302
TDS	mg/L	500	10 of 10	375	137 to 650
Metals – Total					
Aluminum	µg/L	125	10 of 10	105	29.3 to 171
Antimony	µg/L	5.5	7 of 8	0.14	<0.5 to 0.50
Arsenic	µg/L	2.0	7 of 10	1.3	<2.0
Barium	µg/L	2,000	10 of 10	15.7	8.1 to 33.0
Beryllium	µg/L	4.0	1 of 8	0.18	<0.20
Boron	µg/L	500	8 of 8	101	59.4 to 150
Cadmium[1]	µg/L	2.5	1 of 8	0.18	<0.20
Cobalt	µg/L	2.8	8 of 8	0.46	0.28 to 0.73
Copper[1]	µg/L	9.3	8 of 8	3.4	1.9 to 4.8
Iron	µg/L	--	10 of 10	942	529 to 1,640
Lead[1]	µg/L	3.2	6 of 8	0.34	<0.05 to 0.60
Manganese	µg/L	--	10 of 10	53.4	11.8 to 106
Mercury	µg/L	1.3	10 of 10	0.00	0.001 to 0.008
Molybdenum	µg/L	--	10 of 10	1.6	0.73 to 2.8
Nickel[1]	µg/L	52	8 of 8	3.6	2.7 to 4.6
Selenium	µg/L	5.0	7 of 8	0.63	0.33 to 1.0
Thallium	µg/L	0.28	0 of 8	0.40	<0.4
Zinc[1]	µg/L	120	8 of 8	3.5	1.0 to 6.5

Source: Barr and HC Itasca 2009.

[1] Water quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 100 mg/L, which approximates the hardness concentration in Colby Lake.

4.2.2.3 Embarrass River Watershed

This section describes the baseline hydrology and water quality for the groundwater and surface water within the Embarrass River Watershed portion of the NorthMet Project area. Most of the Tailings Basin and the Emergency Basin is located within the Embarrass River Watershed.

4.2.2.3.1 Groundwater Resources

Geology and Hydrogeology

Bedrock at the Plant Site and Tailings Basin are Precambrian crystalline and metamorphic rock. The Giants Ridge batholith represents the uppermost bedrock unit that encompasses most of the area, although there are two elevated exposures of bedrock that abut the southeastern corner of Cell 1E at the Tailings Basin that consist of schist of sedimentary and volcanic origin. Hydraulic testing in the bedrock has not been performed in the Tailings Basin area, but the bedrock is believed to have a significantly lower hydraulic conductivity than the overlying drift (Barr 2009f). This is supported by analogy to the bedrock of the Mine Site (Duluth Complex), which, based on hydraulic testing, has been shown to have a significantly lower hydraulic conductivity than the overlying till. The Giants Ridge Granite is mechanically similar the Duluth Complex, which is a gabbro. Assuming relatively similar stress, weathering, and erosional histories, it is likely to have similar hydrogeologic characteristics.

Jennings and Reynolds (2005) mapped the surficial deposits around and beneath the Tailings Basin as Rainy Lobe Till, which functions as the surficial aquifer and is generally a boulder-rich till with high clay content. Data from the 12 monitoring wells installed north and west of the Tailings Basin indicate that the primary lithology in this area is sand with varying amounts of silt and gravel. In a separate geotechnical study of the LTVSMC tailings, several soil borings into the surficial till identified the composition as layers of clay and sand, plus cobbles and boulders that prevented recovery of an intact sample (Pint and Dehler 2009). Near the toe of the Tailings Basin, average depth to bedrock is approximately 25 ft, as reported in site boring logs (Barr 2009f). The area farther northwest of the Tailings Basin is believed to be one of the few areas in the region with significant quantities of outwash (sand and gravel) and thicknesses ranging from 0 ft to greater than 150 ft (Olcott and Siegel 1979) (see Figure 4.2.2-12).

The surficial till is often overlain by wetland/peat deposits. Peat deposits were encountered in some borings, ranging in thickness from less than a foot to several feet, but they are relatively few and discontinuous. Most of the area between the Tailings Basin and the Embarrass River is covered by extensive groundwater fed wetlands and minor surface water features. Unlike the ombrotrophic bogs at the Mine Site, where sphagnum peat has elevated the bog and reduced connection between the surface water and water table, and which describe approximately 50 percent of the wetlands across the Mine Site (Eggers 2011), these wetlands between the Tailings Basin and Embarrass River are assumed to represent surficial expressions of the water table (Barr 2009b) and reflect, at least in part, the increase in groundwater and surface water flow from LTVSMC tailings seepage.

Regionally, groundwater flows primarily northward toward the Embarrass River, although groundwater in some portions of the Tailings Basin flows to the south to form the headwaters of Second Creek, a tributary of the Partridge River (see Figure 4.2.2-5). North of the Tailings Basin, site monitoring wells show an average gradient of 0.0039 feet per foot (ft/ft) with an average groundwater flow direction of 16 degrees west of north. Recent hydrologic investigations indicate that the total groundwater flow through the aquifer downgradient of the Tailings Basin is approximately 210 gpm with an estimated recharge rate of approximately 0.3 in/yr (PolyMet 2013j).

The existing LTVSMC Tailings Basin consists of three cells. Cell 2W is the largest (1,450 acres) and highest (average fill height of 200 ft) and has been closed and revegetated. Cell 1E is located east of Cell 2W and covers approximately 980 acres with an average fill height of 60 ft. Cell 2E is located east of Cell 2W and north of Cell 1E, covers approximately 620 acres, and has an average fill height of 60 ft, although it is at a lower elevation than Cell 1E.

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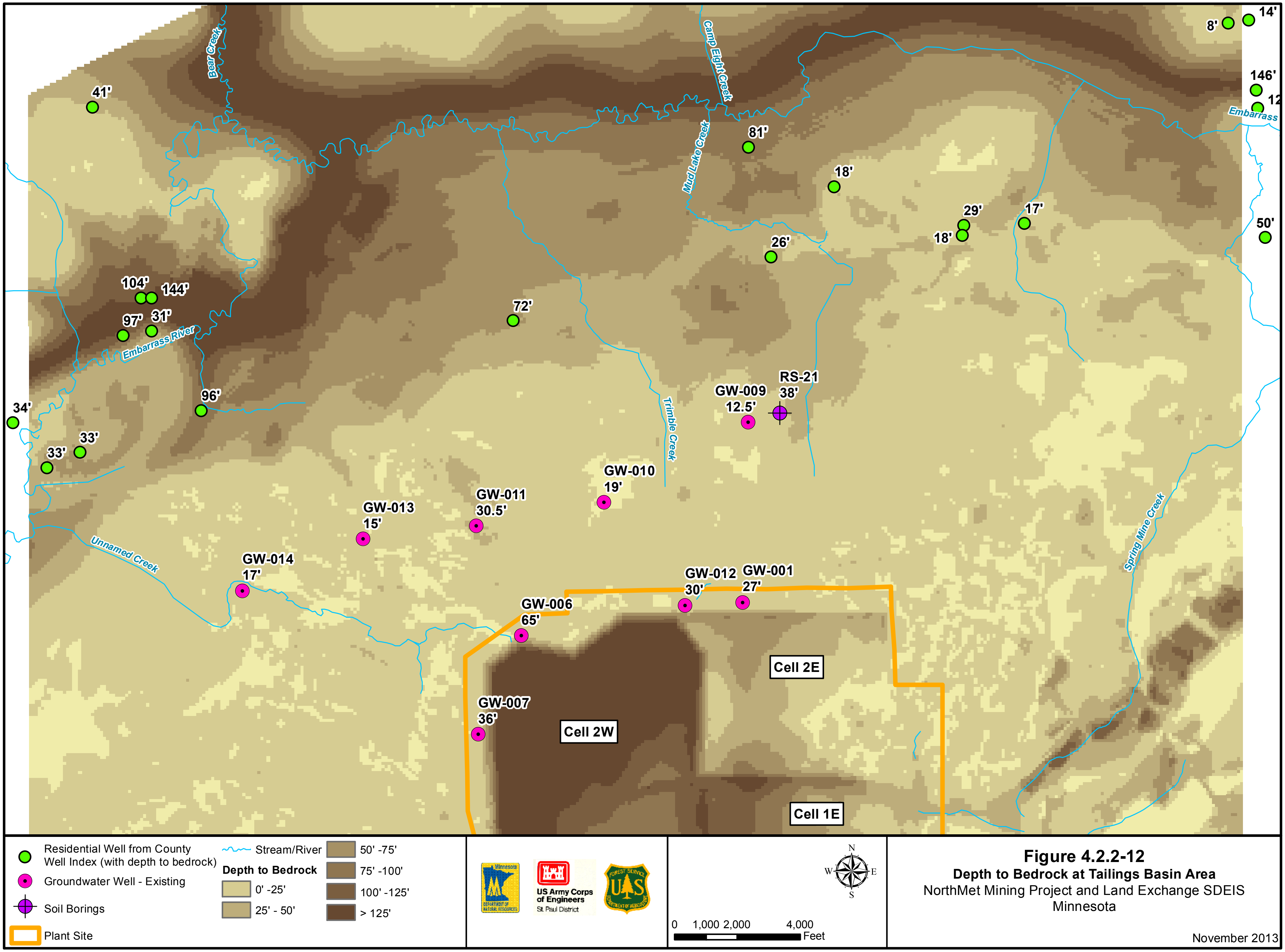

Figure 4.2.2-12

Depth to Bedrock at Tailings Basin Area

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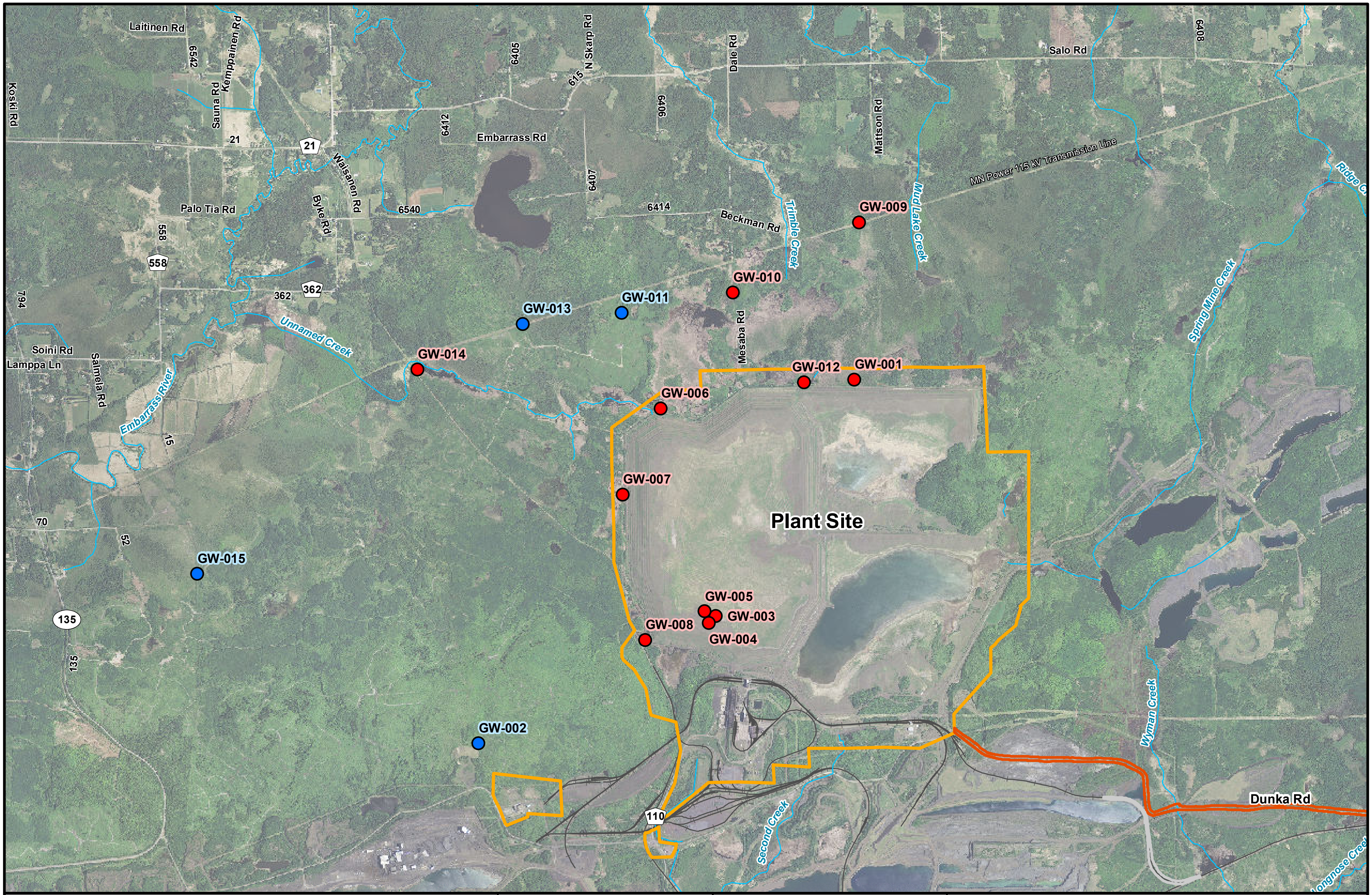
During LTVSMC operations, the LTVSMC Tailings Basin was built up over time, a groundwater mound formed beneath the basin due to seepage from tailings ponds located within the various cells. Surface seeps initially occurred on the southern, western, and northern sides of the Tailings Basin; however, most surface seeps have dried out since January 2001, when LTVSMC terminated tailings deposition in the basin, so that only a few surface seeps (e.g., seeps 32 and 33, which drain to the south of the existing LTVSMC Tailings Basin and toward Second Creek) remain active (see Figure 4.2.2-11). The east side of the Tailings Basin is bounded by low-permeability bedrock uplands and there is likely little water that seeps out in this direction. In addition to these visible surface seeps, groundwater flows from beneath the Tailings Basin into the surrounding unconsolidated deposits to the south, west, and north. Recent groundwater seepage from the existing LTVSMC Tailings Basin to the north toward the Embarrass River was estimated to be approximately 2,020 gpm (PolyMet 2013j). This seepage rate exceeds the capacity of the surficial aquifer to transmit water, resulting in upwelling to the surface of approximately 1,811 gpm of groundwater. This upwelling and historic surface seepage from the LTVSMC tailings created or expanded wetlands immediately downgradient of the existing LTVSMC Tailings Basin, and inundated these same wetlands (see Section 4.2.3). These hydrologic effects on wetlands diminish to the north with little evidence of impacts north of the transmission line (approximately 1 mile north of the Tailings Basin, as shown in Figure 4.2.2-13).

Groundwater elevations across the surficial aquifer north of the existing LTVSMC Tailings Basin were determined from several years of water-level measurements in 15 wells (see Figure 4.2.2-13). These include eight wells that are adjacent to (or within) the existing LTVSMC Tailings Basin (GW-001 through GW-008), which were installed as part of the NPDES permit and monitored as far back as 2001; and seven wells farther from the existing LTVSMC Tailings Basin (GW-009 through GW-015) installed in 2009 and 2010 by PolyMet to support hydraulic characterization of the NorthMet Project Proposed Action (PolyMet 2013j). The water table within the Tailings Basin showed a systematic decrease in water levels following cessation of LTVSMC operations in 2001 as the tailings drained, with water levels stabilizing since 2007. Following the cessation of LTVSMC mine operations, the remaining surface water within Cell 2W was either drained into Cell 1E or infiltrated into the underlying tailings such that no pond remains. Cells 1E and 2E still impound water, but at lower levels than during active LTVSMC operations. Pond and piezometer water levels located within the cells indicate that these cells may have been approaching steady-state conditions prior to the seep pump-backs that are part of the Cliffs Erie Consent Decree.

Although water level data extends back as far as 2001, existing conditions and the assessment of effects from this SDEIS primarily rely on water-level data collected for 2007 through July 2012 (PolyMet 2013j). Since 2007, the measured water table elevations across all monitored wells show that the water table slopes to the north and northwest, producing flow from the LTVSMC tailings toward the Embarrass River (see Figure 4.2.2-10). The fluctuations at individual wells since 2007 have been small. The maximum range in the wells adjacent to the tailings has been 3.8 ft (both GW-005 and GW-008 had this range), and in the farther downgradient wells, the range in water levels at individual wells ranged from 0.33 to 4.6 ft (well GW-011 had the 4.6-ft water level range; Figure 4.2.2-7).

Baseline groundwater elevations, depths to bedrock, and surface water drainage locations have been used to identify four flowpaths (West, Northwest, North, and South) that represent the most direct paths between Tailings Basin facilities and evaluation locations (i.e., property boundaries and surface waters of the state) (MDNR 2011L). There is no East flowpath because bedrock outcrops prevent flow to the surficial aquifer in this direction.



Plant Site	Groundwater Monitoring Well
Railroad Connection	Baseline Water Well
Transportation and Utility Corridor	Stream/River
	Existing Railroad

0 0.25 0.5 1 Miles

Figure 4.2.2-13

Monitoring Locations Near Existing Tailings Basin

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Hydraulic characteristics of the surficial aquifer in the Tailings Basin area are based on the following:

- Eight single-well pumping tests conducted in monitoring wells in the glacial till (Barr 2009e).
- Multiple slug tests performed in standpipe piezometers located in the glacial till downgradient of Cell 2W (Pint and Dehler 2008).

Estimated hydraulic properties of the native units found near the Tailings Basin vary by several orders of magnitude (Barr 2008c). Estimated hydraulic conductivities range from approximately 0.0002 ft/day for the Giants Ridge bedrock to approximately 70 ft/day for the glacial till (Barr 2009f). Single well pumping tests conducted in eight of the monitoring wells located within the glacial till found an average permeability of 14 ft/day within a range of 0.4 to 65 ft/day (Barr 2009e), while slug tests performed in standpipe piezometers located in the glacial till downgradient of Cell 2W found an average permeability of only 1.5 ft/day within a range of 0.25 to 2.1 ft/day (Pint and Dehler 2008). The hydraulic conductivity of the LTVSMC tailings ranges from approximately 0.003 ft/day for the slimes to approximately 7 ft/day for the coarse tailings.

Groundwater Quality

Groundwater quality in the Plant Site is based on the analyses of water collected from the following wells:

- Eight groundwater monitoring wells sampled for water quality (i.e., wells GW-001 through GW-008) and monitored since at least 1999 (see Figure 4.2.2-13). GW-002 is considered a baseline well for the Tailings Basin, as it is located distant from the Tailings Basin groundwater flowpaths. Wells GW-003, GW-004, and GW-005 are located within Cell 2W and were intended to monitor the high sulfide Virginia Formation hornfels waste rock that was placed in this cell in 1993. The remaining wells—GW-001, GW-006, GW-007, and GW-008—are located at or very near the toe of the Tailings Basin embankment.
- Seven additional wells installed and monitored since 2009:
  - one at the toe of the Tailings Basin (GW-012);
  - three downgradient of the Tailings Basin (GW-009, GW-010, and GW-011);
  - Three new downgradient wells installed July 2010, after issuance of the 2009 DEIS (GW-013, GW-014, and GW-015) (PolyMet 2013j); and
- Fifteen residential wells located between 1.6 and 3.8 miles north of the Tailings Basin (see Figure 4.2.2-14).

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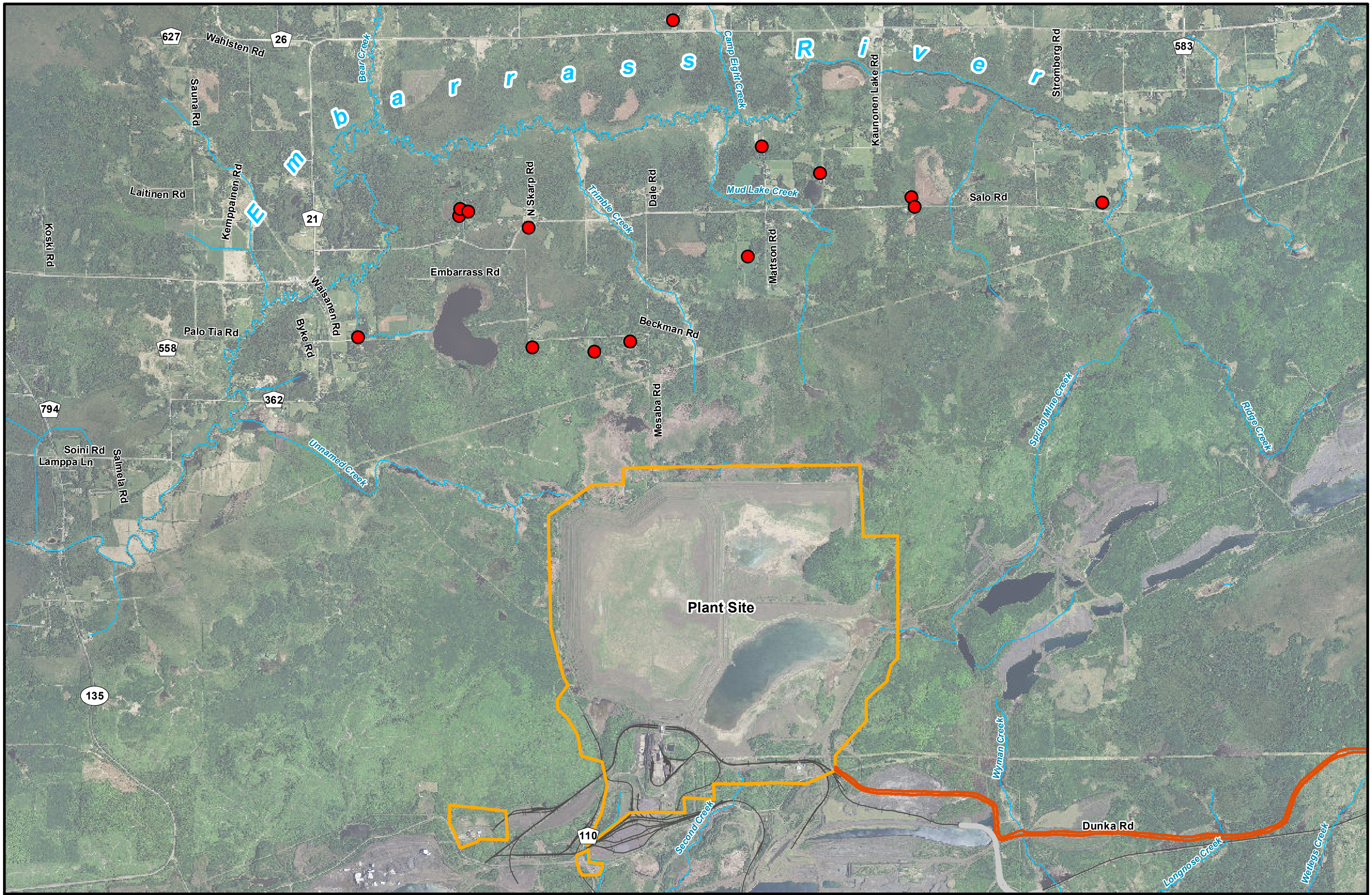

Plant Site

Transportation and Utility Corridor

Railroad Connection

Residential Wells - Sampled

Stream/River

Existing Railroad

0 0.25 0.5 1 Miles

Figure 4.2.2-14

Residential Well Locations Between the Tailings Basin and the Embarrass River

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The discussion of Tailings Basin area groundwater quality in this SDEIS groups the available wells into three categories: baseline wells that best approximate groundwater quality that is unaffected by the LTVSMC tailings; Tailings Basin wells, which include wells within the Tailings Basin and close to the toe of the tailings; and downgradient wells.

Baseline Groundwater Quality in the Surficial Aquifer

In the period since release of the 2009 DEIS, an updated review of available groundwater quality data concluded that natural water quality in the Tailings Basin area was reflected by wells GW-002, GW-011, GW-013, and GW-015. These four wells were selected primarily based on their low chloride concentrations (ranging from below detection up to 4.8 mg/L), which are consistent with regional values for background chloride concentrations, and clearly distinct from chloride concentrations in discharge from the existing LTVSMC tailings (~30 mg/l; PolyMet 2013j).

Baseline groundwater in the Tailings Basin area (considering total and dissolved concentrations) exceeds the groundwater evaluation criteria for some constituents (see Table 4.2.2-22). For example, at well GW-002, groundwater within the surficial aquifer has elevated concentrations (i.e., at or higher than the groundwater evaluation criteria) of aluminum, iron, and manganese. The manganese levels were within the range of baseline concentrations found by MPCA in northeastern Minnesota (MPCA 1999) and in the Regional Copper-Nickel Study (Siegel and Ericson 1980), but the aluminum and iron values were above the range of concentrations found in these two studies. In addition, beryllium did not meet the groundwater criterion. Although the interpretation of beryllium is complicated because the detection limits exceeded the evaluation criteria, beryllium was detected in some groundwater samples at concentrations above the evaluation criteria. Aluminum, iron, and manganese concentrations are heavily influenced by natural processes, particularly chemically reducing conditions and the presence of dissolved organic acids, both of which can arise in aquifer zones enriched in natural organic matter. Further, the analyses for “total” groundwater concentrations included an unknown amount of fine particulates that were then digested in sample preparation and contributed to the reported concentration reported in the analyses. Reported total concentrations could thus include much higher values for elements common in clays and other fine particulates, including aluminum, iron, and manganese. As a result, the dissolved concentrations are generally considered most representative of groundwater. All other parameters met the groundwater evaluation criteria.

Table 4.2.2-22 Summary of Baseline Groundwater Quality Monitoring Data for the Tailings Basin Area and Two Larger Regional Areas

Constituent	Units	Groundwater Evaluation Criteria	Baseline Quality in Surficial Aquifer (GW-002, GW-011, GW-013, and GW-015)				Northeast MN Baseline Surficial Aquifer	Copper-Nickel Study Baseline Surficial Aquifer
General Parameters			**Detection**	**Mean[1]**	**Range**	**# Exceed**	**Range**	**Range**
Ammonia as Nitrogen	mg/L	--	8 of 35	0.07	<0.03 to 0.5	NA	--	--
Calcium	mg/L	--	35 of 35	15.38	3.1 to 41.4	NA	--	--
Carbon, total organic	mg/L	--	34 of 35	2.95	<0.5 to 7.4	NA	--	--
Chloride	mg/L	250	23 of 35	0.89	<0.25 to 4.8	0		0.4 to 35
Fluoride	mg/L	2	10 of 35	0.1	<0.05 to 0.6	0	0.2 to 0.57	--
pH	s.u.[3]	6.5 – 8.5	34 of 34	6.8	5.3 to 8.3	**12**	6.0 to 8.4	5.7 to 8.0
Sulfate	mg/L	250	35 of 35	7.7	2.6 to 38.6	0	<0.3 to 14.2	1.8 to 450
TDS	mg/L	500	29 of 29	103	28 to 226	0	28 to 482	--
Metals – Total								
Aluminum	µg/L	200	35 of 35	5,730	21.9 to 63,500	**28**	<0.1 to 30	0 to 200
Antimony	µg/L	6	0 of 35	0.25	<0.25	0	<0.01 to 0.04	--
Arsenic	µg/L	10	16 of 35	1.5	<0.25 to 18	**1**	<0.1 to 9.1	--
Barium	µg/L	2,000	35 of 35	107	15.8 to 703	0	1.6 to 191	--
Beryllium	µg/L	0.08	5 of 35	0.24	<0.1 to 2.7	0[(2)]	<0.01 to 0.41	--
Boron	µg/L	1,000	0 of 35	30.7	<25 to 100	0	<13 to 41	--
Cadmium	µg/L	4	9 of 35	0.21	<0.1 to 1.7	0	<0.02 to 0.2	0 to 8.4
Chromium	µg/L	100	29 of 35	17.6	<0.5 to 258	**1**	0.09 to 4.7	0 to 5.5
Cobalt	µg/L	--	31 of 35	5.20	<0.1 to 87.1	NA	0.05 to 0.63	0.3 to 28.0
Copper	µg/L	1,000	35 of 35	19.7	0.56 to 300	0	<5.5 to 22	0.6 to 190
Iron	µg/L	300	35 of 35	7,047	53.4 to 82,600	**28**	7 to 7,816	0 to 3,100
Lead	µg/L	--	25 of 35	3.3	<0.25 to 56.2	NA	<0.03 to 2.0	0.1 to 6.4
Manganese	µg/L	50	35 of 35	291	1 to 2,140	**22**	0.9 to 1,248	10 to 7,190
Mercury	ng/L	2,000	30 of 33	4.8	<0.25 to 43.1	0	--	--
Mercury, Methyl	ng/L	--	2 of 30	0.05	<0.03 to 0.1	NA	--	--
Molybdenum	µg/L	--	25 of 35	2.0	<0.1 to 17.1	NA	<4.2 to 12	--
Nickel	µg/L	100	33 of 35	19.4	<0.25 to 316	**1**	<6.0 to 16	--
Selenium	µg/L	30	1 of 35	0.57	<0.1 to 2.50	0	<1.0 to 4.7	--
Silver	µg/L	30	1of 35	0.11	<0.1 to 0.46	0	<0.01 to 0.05	--
Thallium	µg/L	0.6	3 of 35	0.15	<0.1 to 0.59	0	<0.005 to 0.01	--
Zinc	µg/L	2,000	21 of 35	24.2	<3 to 366	0	<2.7 to 138	3.9 to 170
Dissolved/Filtered Metals								
Aluminum	µg/L	200	20 of 35	48.8	<10 to 352	**1**	--	--
Arsenic	µg/L	10	5 of 29	0.48	<0.25 to 1	0	--	--
Boron	µg/L	1,000	0 of 16	29.7	<25 to 100	0	--	--
Cadmium	µg/L	4	4 of 35	0.15	<0.02 to 1.3	0	--	--

Constituent	Units	Groundwater Evaluation Criteria	Baseline Quality in Surficial Aquifer (GW-002, GW-011, GW-013, and GW-015)				Northeast MN Baseline Surficial Aquifer	Copper-Nickel Study Baseline Surficial Aquifer
General Parameters			**Detection**	**Mean[1]**	**Range**	**# Exceed**	**Range**	**Range**
Chromium	µg/L	100	18 of 35	0.95	<0.50 to 2.40	0	--	--
Copper	µg/L	1,000	29 of 35	2.4	<0.35 to 6.5	0	--	--
Manganese	µg/L	50	28 of 30	141	<5 to 617	**8**	--	--
Nickel	µg/L	100	31 of 35	1.6	<0.25 to 5.6	0	--	--
Selenium	µg/L	30	0 of 35	0.49	<0.1 to 0.5	0	--	--
Silver	µg/L	30	0 of 35	0.10	<0.10	0	--	--
Zinc	µg/L	2,000	15 of 35	6.3	<3 to 17.8	0	--	--

Source: Barr 2013b; NTS 2009; MPCA 1999; and Siegel and Ericson 1980.

Groundwater evaluation criteria: The maximum allowed concentrations (or for some less toxic substances, the maximum recommended concentrations) of various constituents in groundwater. The specific thresholds are either the USEPA primary Maximum Contaminant Levels (MCLs), the MDH Health Risk Limits (HRLs), or the USEPA sMCLs (sMCLs are used to set thresholds for aluminum, iron, and manganese). These thresholds are considered when determining whether alternatives considered in this SDEIS are expected to have a significant environmental effect.
Bold (e.g., 0.014) indicates exceeds evaluation criteria.

1 Where non-detects occur, the mean was calculated using half the detection limit.
2 Detection limit is greater than water quality standard.
3 pH: s.u. stands for Standard Unit.
4 See Section 5.2.2.1.1.

Baseline Groundwater Quality within the Tailings Basin Pond and at the Toe of the Tailings Basin

Ponds remain within Cells 1E and 2E of the existing LTVSMC Tailings Basin (no pond remains in Cell 2W). Table 4.2.2-23 summarizes the results of surface water quality monitoring of the Cell 2E pond (mean values for data collected from 2001 to 2004) and groundwater quality monitoring at several monitoring wells located along the northern toe of the Tailings Basin. The existing LTVSMC Tailings Basin is a disposal facility and is not a natural surface water body or a point of compliance pursuant to Cliffs Erie's NPDES/SDS permit. Therefore, comparison of these data with surface or groundwater evaluation criteria is not appropriate; however, these criteria are listed for informational purposes.

Table 4.2.2-23 Existing Pond Water and Groundwater Quality at the Tailings Basin

Constituent	Units	Pond Water Quality (Cell 2E)	Toe of Tailings Basin (GW-001,GW-006, GW-007, GW-008, GW-012 Surficial Aquifer)			
General Parameters		**Mean**	**Groundwater Evaluation Criteria**	**Detection**	**Mean[1]**	**Range**
Calcium	mg/L	30	--	62 of 62	83	21 to 211
Chloride	mg/L	23	250	61 of 61	18	1 to 30
Fluoride	mg/L	5.2	2	47 of 61	1	<0.05 to 3
pH	s.u.	8.4	6.5 – 8.5	58 of 58	7	6.0 to 8.0
Sulfate	mg/L	109	250	61 of 61	228	15 to 556
TDS	mg/L	381	500	42 of 42	793	151 to 1,550
Metals – Total						
Aluminum	µg/L	--	200	42 of 62	1,994	<10 to 29,000
Antimony	µg/L	--	6	0 of 59	0	<0.25
Arsenic	µg/L	5.0	10	30 of 59	2.0	<0.25 to 7
Barium	µg/L	--	2,000	61 of 62	136	<5 to 452
Beryllium	µg/L	--	0.08	4 of 59	0	<0.1 to 1
Boron	µg/L	278	1,000	50 of 62	318	<25 to 554
Cadmium	µg/L	--	4	10 of 59	0	<0.1 to 2
Chromium	µg/L	--	100	28 of 59	6	<0.5 to 68
Cobalt	µg/L	1.0	--	54 of 59	2	<0.1 to 18
Copper	µg/L	2.0	1,000	58 of 59	10	<0.35 to 205
Iron	µg/L	--	300	55 of 62	5,259	<25 to 31,000
Lead	µg/L	--	--	17 of 59	1	<0.25 to 8
Manganese	µg/L	100	50	62 of 62	1,327	12 to 4,130
Mercury	ng/L	1.4	2,000	39 of 51	6.40	<0.25 to 153
Mercury, Methyl	ng/L	--	--	6 of 50	0.06	<0.03 to 0.28
Molybdenum	µg/L	113	--	56 of 59	20	<0.1 to 47
Nickel	µg/L	2.1	100	55 of 59	9	<0.25 to 91
Selenium	µg/L	--	30	3 of 59	<1	<0.5 to 5
Silver	µg/L	--	30	2 of 59	0	<0.2 to 0.23
Thallium	µg/L	--	0.6	3 of 59	0	<0.1 to 1
Zinc	µg/L	--	2,000	17 of 59	12	<3 to 95
Dissolved/Filtered Metals						
Aluminum	µg/L	--	200	5 of 59	13	<5 to 40
Arsenic	µg/L	--	10	17 of 42	1	<0.25 to 7
Boron	µg/L	--	1,000	21 of 27	300	<25 to 531
Cadmium	µg/L	--	4	4 of 59	0	<0.1 to 1
Chromium	µg/L	--	100	10 of 59	1	<0.5 to 3
Copper	µg/L	--	1,000	56 of 59	2	<0.35 to 11
Manganese	µg/L	--	50	43 of 43	1,142	9 to 3670
Nickel	µg/L	--	100	51 of 59	3	<0.25 to 12
Selenium	µg/L	--	30	0 of 59	1	<1.0
Silver	µg/L	--	30	0 of 59	0	<0.1
Zinc	µg/L	--	2,000	25 of 59	8	<3 to 51

Sources: Barr 2013b; Barr 2006f.

[1] Where non-detects occur, the mean was calculated using half the detection limit.

Comparing existing pond water quality with water quality at the toe of the Tailings Basin helps define the effect passage through the existing LTVSMC tailings has on seepage water quality. Based on the parameters that were monitored in the Cell 2E pond, it appears that passage through the LTVSMC tailings reduces the average concentrations of arsenic, fluoride, and molybdenum, although it is difficult to determine to what extent these reductions are simply attributable to the effects of dilution. The concentrations of several other parameters, such as calcium, manganese, nickel, and TDS, increase as they seep from the tailings pond to the toe of the Tailings Basin.

The limited amount of pond water quality data generally show fluoride concentrations that are elevated relative to the groundwater evaluation criteria. This could be attributable to the historic use of wet scrubbers for emission control at the former LTVSMC furnaces. These scrubbers removed highly soluble hydrogen fluoride gas (Jiang et al. n.d.) resulting in elevated fluoride concentrations in the scrubber water, which was disposed of in the Tailings Basin.

Groundwater quality monitoring at several wells completed in the surficial aquifer at or near the toe of the Tailings Basin (GW-001, GW-006, GW-007, GW-008, and GW-012) found neutral tending toward basic pH (mean of 7.4), and elevated concentrations for several parameters (see Table 4.2.2-23). As with the baseline wells these wells exhibited elevated aluminum, iron, and manganese concentrations, but also exhibited elevated sulfate, fluoride, molybdenum, and TDS concentrations relative to the baseline wells (see Table 4.2.2-22). Based on these results, NTS (2009) concluded that groundwater has been impacted by the Tailings Basin. NTS noted, however, that there does not appear to be an overall trend, either increasing or decreasing, in the concentration of the constituents monitored.

Baseline Groundwater Quality Downgradient from the Existing LTVSMC Tailings Basin

PolyMet conducted between 8 and 12 rounds of groundwater sampling during 2009 through 2012 at three monitoring wells (GW-009, GW-010, and GW-011) located approximately 1 mile north of the Tailings Basin (see Figure 4.2.2-7), and a single round of sampling at 15 residential wells located between 1.6 miles and 3.8 miles north of the Tailings Basin (see Figure 4.2.2-14). Water quality in these three downgradient monitoring wells and 15 residential wells is summarized in Table 4.2.2-24 (Barr 2013b). As with the baseline well, the three downgradient monitoring wells also exhibited elevated aluminum, iron, and manganese concentrations, with the concentrations higher than those found at the toe of the Tailings Basin.

In terms of the residential wells located farther from the Tailings Basin, the samples from several wells indicated that manganese concentrations exceeded the groundwater evaluation criteria (i.e., sMCL). Localized high manganese concentrations can naturally occur under a range of conditions. The measured concentrations are within the range found in the Regional Copper-Nickel Study. One well had aluminum concentrations slightly above the evaluation criteria and four wells had pH concentrations below the minimum of the range (pH of 6.5), but again, these values are within the neutral range found in the Regional Copper-Nickel Study. The samples from the residential wells (Barr 2009d) and the downgradient wells sampled for the NorthMet Project Proposed Action (compared in Table 4.2.2-24) include analyses for total (unfiltered) and dissolved (filtered) concentrations for manganese and aluminum, so the maximum reported concentrations of these constituents probably includes the effect of sediment included in the samples. Residential wells have had more time and pumping to flush out sediment and, therefore, samples from them would be expected to have little if any sediment and lower unfiltered analytical results than samples from a monitoring well at the same location.

Table 4.2.2-24 Summary of Existing Groundwater Quality Monitoring Data Downgradient from the Existing LTVSMC Tailings Basin

Constituent	Units	Groundwater Evaluation Criteria	Downgradient Wells (GW-009, GW-010, GW-011) Surficial Aquifer				Downgradient Residential Wells Bedrock and Surficial Aquifers			
General Parameters			**Detection**	**Mean[1]**	**Range**	**# Exceed**	**Detection**	**Mean[1]**	**Range**	**# Exceed**
Ammonia as Nitrogen	mg/L	--	12 of 28	0.11	<0.05 to 0.36	--	--	--	--	--
Calcium	mg/L	--	28 of 28	41.7	7.70 to 66	--	15 of 15	25	11.7 to 51.4	--
Carbon, total organic	mg/L	--	27 of 28	10.8	<0.05 to 25.5	--	--	--	--	--
Chloride	mg/L	250	28 of 28	8.1	0.81 to 19.7	0	14 of 15	4.2	<0.5 to 12.5	0
Fluoride	mg/L	2	17 of 28	0.13	<0.05 to 0.28	0	11 of 15	0.2	<0.1 to 0.6	0
pH	s.u.	6.5 – 8.5	26 of 26	6.8	5.5 to 8.3	**7**	15 of 15	6.9	5.7 to 7.9	**4**
Sulfate	mg/L	250	28 of 28	44.3	1.74 to 235	0	11 of 15	6.1	<1 to 20.9	0
TDS	mg/L	500	22 of 22	287	65 to 417	0	15 of 15	125	83 to 243	0
Metals – Total										
Aluminum	µg/L	200	26 of 28	**9,902**	<10 to 63,500	**18**	2 of 15	30.2	<25 to 83	**1**
Antimony	µg/L	6	0 of 28	0.25	<0.25	0	0 of 15	<0.5	<0.5	0
Arsenic	µg/L	10	20 of 28	2.7	<0.25 to 18	**1**	3 of 15	2.8	<2 to 7.5	0
Barium	µg/L	2,000	28 of 28	560	18.5 to 1,620	0	--	--	--	--
Beryllium	µg/L	0.08	9 of 28	**0.39**	<0.10 to 2.72	NA[2]	--	--	--	--
Boron	µg/L	1,000	19 of 28	93.3	<25 to 250	0	3 of 15	79	<50 to 459	0
Cadmium	µg/L	4	8 of 28	0.22	<0.1 to 0.91	0	--	--	--	--
Chromium	µg/L	100	20 of 28	35.4	<0.5 to 287	**3**	--	--	--	--
Cobalt	µg/L	--	27 of 28	11.9	<0.1 to 87.1	--	--	--	--	--
Copper	µg/L	1,000	28 of 28	34.9	1.2 to 300	0	13 of 14	38	<0.7 to 155	0
Iron	µg/L	300	28 of 28	**19,584**	53.4 to 83,900	**26**	--	--	--	--
Lead	µg/L	--	14 of 28	5.8	<0.25 to 56.20	--	--	--	--	--
Manganese	µg/L	50	28 of 28	**1,617**	5.50 to 4,220	**26**	15 of 15	**579**	0.66 to 4,710	**7**
Mercury	ng/L	2,000	25 of 26	14.0	<0.25 to 69.70	0	--	--	--	--
Mercury, Methyl	ng/L	--	4 of 24	0.05	<0.05 to 0.11	--	--	--	--	--

Constituent	Units	Groundwater Evaluation Criteria	Downgradient Wells (GW-009, GW-010, GW-011) Surficial Aquifer				Downgradient Residential Wells Bedrock and Surficial Aquifers			
Molybdenum	µg/L	--	27 of 28	3.1	<0.1 to 10.1	--	12 of 15	0.6	0.2 to 2.8	--
Nickel	µg/L	100	28 of 28	37.2	0.59 to 316	**2**	14 of 15	1.9	<0.6 to 5.5	0
Selenium	µg/L	30	2 of 28	0.57	<0.5 to 1.82	0	--	--	--	--
Silver	µg/L	30	3 of 28	0.12	<0.1 to 0.46	0	--	--	--	--
Thallium	µg/L	0.6	5 of 28	0.18	<0.1 to 0.60	**1**	--	--	--	--
Zinc	µg/L	2,000	12 of 28	41.5	<6 to 366	0	--	--	--	--
Dissolved/Filtered Metals										
Aluminum	µg/L	200	8 of 28	21.8	<10 to 125	0	2 of 15	28	<25 to 71	**1**
Arsenic	µg/L	10	11 of 22	1.2	<0.25 to 3.8	0	3 of 15	2.7	<2 to 7.5	0
Boron	µg/L	1,000	7 of 10	107	25 to 250	0	3 of 15	80	<50 to 461	0
Cadmium	µg/L	4	1 of 28	0.10	<0.1 to 0.2	0	--	--	--	--
Chromium	µg/L	100	13 of 28	0.91	<0.5 to 2	0	--	--	--	--
Copper	µg/L	1,000	24 of 28	3.3	<0.35 to 20.7	0	14 of 15	19.3	<0.7 to 64.5	0
Manganese	µg/L	50	22 of 22	**1,183**	1.89 to 3,550	**15**	15 of 15	**579**	0.63 to 4,850	**7**
Nickel	µg/L	100	28 of 28	3.7	0.78 to 9.2	0	12 of 15	1.6	<0.6 to 5	0
Selenium	µg/L	30	0 of 28	0.50	<0.5	0	--	--	--	--
Silver	µg/L	30	0 of 28	0.10	<0.1	0	--	--	--	--
Zinc	µg/L	2,000	14 of 28	6.4	<3 to 18.4	0	--	--	--	--

Source: Barr 2013b; Barr 2009d.

Bold (e.g., 0.014) indicates exceeds evaluation criteria.
[1] Where non-detects occur, the mean was calculated using half the detection limit.
[2] Detection limit is greater than water quality standard.

Legacy Groundwater Quality Issues

In 2002, Cliffs Erie commissioned a Phase I ESA of the former LTVSMC property and improvements (NTS 2002), which identified 62 potential AOCs. Designation as an AOC does not necessarily mean that contamination occurred in the past or is currently present, but simply that these are areas requiring further investigation. The AOCs are discussed further in Section 4.2.1.

In May 2009, Cliffs Erie conducted a detailed assessment of both surface and groundwater quality at the existing LTVSMC Tailings Basin that included testing for VOCs, SVOCs, PCBs, and other parameters to determine if there was any organic contamination that could be transported off-site via stormwater runoff or groundwater seepage. The laboratory analyses showed no evidence of organic contamination leaving the site (Cliffs Erie 2009). Based on the investigations and laboratory analyses to date, which includes sampling at seven monitoring wells, 14 surface discharges, 12 internal waste streams, and six downstream surface water monitoring stations, and visual observation and limited field analyses at 33 seeps at or near the existing LTVSMC Tailings Basin, there has not been any documentation of off-site contamination for these pollutants.

As noted above, groundwater quality monitoring at several wells completed in the surficial aquifer at or near the toe of the Tailings Basin found elevated aluminum, iron, and manganese concentrations, similar to the baseline wells (see Table 4.2.2-23), but also exhibited elevated sulfate, fluoride, molybdenum, and TDS concentrations relative to the baseline wells (see Table 4.2.2-22). Based on these results, NTS (2009) concluded that groundwater had been impacted by the Tailings Basin. NTS noted, however, that there did not appear to be an overall trend, either increasing or decreasing, in the concentration of the constituents monitored.

Baseline Groundwater Quality in the Bedrock

No bedrock groundwater samples are available from the Plant Site/Tailings Basin. Although some of the residential wells are drilled into bedrock, based on well completion records, these wells were not constructed as monitoring wells to distinguish the bedrock from the surficial aquifer. Siegel and Ericson (1980) report that iron and manganese concentrations up to 500 µg/L are common in the Giants Ridge batholith.

Groundwater Use

There are 27 known domestic wells between the Tailings Basin and the Embarrass River, with the closest being approximately 1.6 miles from the toe of Cell 2E. Characteristics of the wells are presented in Table 4.2.2-25. Locations for the 15 residential wells that were sampled for this SDEIS are shown in Figure 4.2.2-14, and analytical results for the water collected from these 15 residential wells are summarized in Table 4.2.2-24.

Table 4.2.2-25 Existing Domestic Wells Located Between the NorthMet Project Proposed Action Tailings Area and the Embarrass River

Unique Well No.	Direction From Site	Surface Elev. (ft)	Depth (ft)	Depth Cased (ft)	GWL (ft bgs)	Casing Diameter (in)	Aquifer
476480	NW	1445	63	63	8	6	Alluvium
584595	N	1468	30	30	8.3	6	Alluvium
144818	N	1467	45	28	--	6	Bedrock
668955	N	1459	50	50	15.3	6	Alluvium
658445	N	1436	83	81	-2	6	Bedrock
693384	W	1423	325	20	22	6	Bedrock
151880	NW	1433	103	96	--	6	Multiple
189325	NW	1430	97	97	7	6	Alluvium
519773	NW	1417	42	42	5	6	Alluvium
169958	NW	1443	223	33	23	6	Bedrock
411142	NW	1445	229	34	35	6	Bedrock
409338	NW	1429	43	43	25	6	Alluvium
563293	N	1459	325	18	--	6	Bedrock
555048	NNE	1459	45	29	0	6	Bedrock
620123	NNE	1461	65	18	8.2	6	Bedrock
555023	NNE	1459	100	19	--	6	Bedrock
716183	NNE	--	325	29	20.5	6	Bedrock
174550	NE	1445	60	50	8	7	Bedrock
447031	N	1451	86	86	15	6	Alluvium
701452	N	--	125	40	8	6	Unknown
735554	N	--	205	31	14	6	Bedrock
576439	NNW	1447	80	80	7.7	6	Alluvium
187853	NNW	1465	90	90	--	6	Alluvium
529149	NNW	1468	42	42	22	6	Alluvium
620143	NNW	1469	61	61	34.4	6	Alluvium
409060	NNW	--	100	60	40	6	Unknown
741400	NNW	--	41	41	21	6	Unknown

Source: MDH 2013a and Barr 2009d.

GWL = groundwater level

4.2.2.3.2 Surface Water Resources

This section describes the existing surface water resources in the Embarrass River Watershed that could be affected by the NorthMet Project Proposed Action. These resources include the Embarrass River, several small streams draining the Tailings Basin that are tributaries of the Embarrass River (i.e., Mud Lake Creek, Trimble Creek, and Unnamed Creek—see Figure 4.2.2-4), and the Embarrass River chain of lakes. Note that Mud Lake Creek is an unofficial name given the Unnamed Creek that flows north from the northeast corner of the Tailings Basin. It was given this name because of Mud Lake near the headwaters of the stream, and to distinguish it from the other Unnamed Creek that flows northwest from the northwest corner of the Tailing Basin. It is referred to as Mud Lake Creek throughout the SDEIS.

Since publication of the DEIS, additional surface water quality data has been collected at many locations within the Embarrass River Watershed. These new data have been summarized below to better describe existing conditions. The surface water hydrology of the Embarrass River and its tributaries was not evaluated using the XP-SWMM model, but rather using a spreadsheet model.

Embarrass River

This section describes the baseline water quality of the mainstem of the Upper Embarrass River, several streams that receive drainage from the Tailings Basin and are tributaries of the Embarrass River, and the Lower Embarrass River as it flows through an area referred to as the chain of lakes.

Embarrass River Hydrology

The Embarrass River originates just south of the City of Babbitt and flows southwest approximately 23.2 miles to its confluence with the St. Louis River, draining 171 square miles as measured at McKinley, near the confluence with the St. Louis River. The Embarrass River Watershed is dominated by upland forests (44 percent), lowland forest and aquatic environments (23 percent), crop/grassland (8 percent), and scrub/shrub (21 percent), with little development (4 percent). Most of the Tailings Basin seepage drains to the Embarrass River via three tributary streams.

There were two USGS gaging stations located within the Embarrass River Watershed (#04017000 located about three miles northwest of the Tailings Basin and #04018000 located about seven miles southwest of the Tailings Basin). Table 4.2.2-26 provides flow data for the nearest gaging station at Embarrass (see Figure 4.2.2-1 for location).

Table 4.2.2-26 Monthly Statistical Flow Data for USGS Embarrass Gaging Stations

Station:	04017000 Embarrass River at Embarrass		
Period of Record:	1942–1964		
Drainage Area:	88.3 mi^2		
Month	**Monthly Average (cfs)**	**Daily Minimum (cfs)**	**Daily Maximum (cfs)**
October	46	2.6	453
November	33	4.9	166
December	14	3.4	50
January	6.7	0.90	22
February	5.0	0.90	14
March	22	1.4	774
April	190	2.6	1,490
May	194	21	1,720
June	114	5.2	1,090
July	63	3.6	790
August	31	1.8	284
September	50	2.2	789

Source: USGS 2008.

Flow characteristics for different reaches of the Embarrass River and selected tributaries were estimated by extrapolating flows from USGS gaging station 04017000 (located just downstream of PM-12.3) on a unit-area basis. A summary of the flow results for different stations on Embarrass River, Mud Lake Creek, Trimble Creek, and Unnamed Creek is provided in Table 4.2.2-27.

Table 4.2.2-27 Plant Site Surface Water Flows for Existing Conditions including Tailings Basin Seepage and Flowpath Discharge Based on Embarrass River Stream Gaging Results Applied to Contributing Watersheds

Stream	Station	Estimated Baseflow	20-Year Annual Low Flow	Average Annual Low Flow	Average Annual Flow	Average Annual High Flow	20-Year Annual High Flow
		cfs	cfs	cfs	cfs	cfs	cfs
Embarrass River	PM-12	0.9	0.2	0.7	14	145	370
	PM-12.2	1.6	0.4	1.4	26	268	684
	PM-12.3	7.1	4.2	6.6	65	644	1,638
	PM-12.4	7.6	4.3	7.0	73	731	1,860
	PM-13	9.4	5.6	8.7	83	824	2,096
Mud Lake Creek	MCL-3	0.5	0.5	0.5	1.5	11	28
	MLC-2	0.7	0.6	0.7	3.2	28	70
Trimble Creek	TC-1	2.7	2.6	2.7	4.2	19	45
	PM-19	2.9	2.8	2.9	5.6	33	80
Unnamed Creek	UC-1a	1.1	1.0	1.1	2.6	18	46
	PM-11	1.1	1.0	1.1	3.4	27	67

Source: Barr, Pers. Comm., March 8, 2013

PolyMet has collected data from a monitoring station (PM-12), as shown in Figure 4.2.2-1, upstream of all NorthMet Project area influences with a drainage area of 18.9 square miles.

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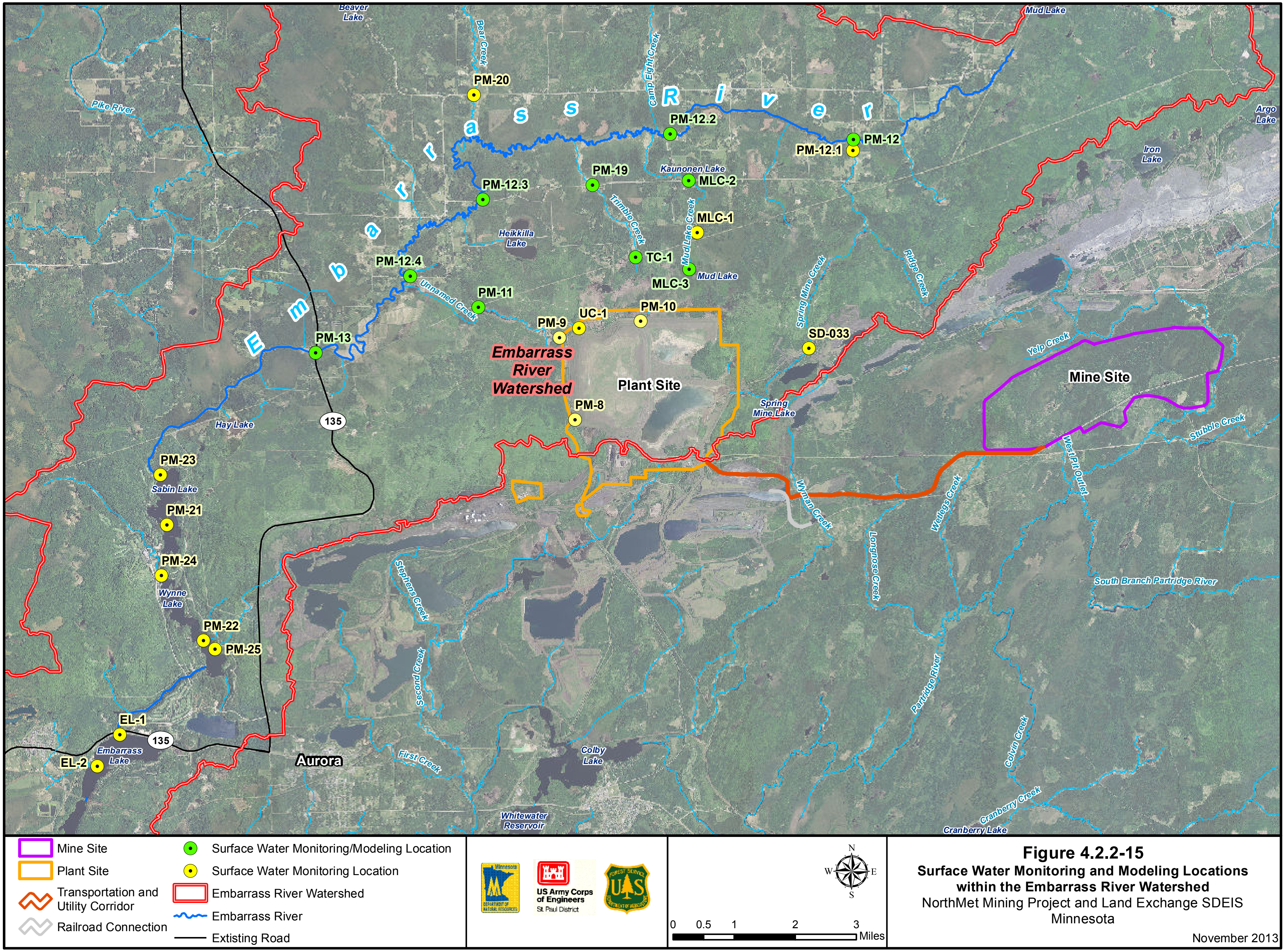

Figure 4.2.2-15
Surface Water Monitoring and Modeling Locations within the Embarrass River Watershed
NorthMet Mining Project and Land Exchange SDEIS
Minnesota

November 2013

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PolyMet has collected data from surface water monitoring station PM-13, as shown in Figure 4.2.2-1, which is along the Embarrass River just downstream of the Heikkila Lake tributary that has a drainage area of 111.8 square miles. PolyMet estimated low (i.e., average annual 30-day minimum flow), average (i.e., mean annual flow), and high (i.e., average annual 1-day maximum flow) flows at this station as 9.4, 82.8, and 824 cfs, respectively (Barr Pers. Comm., March 8, 2013). Overflow and seepage from several former mining facilities, including the Area 5 NW Pit overflow upstream of the Tailings Basin, contribute to the flow farther downstream in the Embarrass River, as shown in Table 4.2.2-28 and Figure 4.2.2-9. Based on bi-monthly flow measurements between 2001 and 2007, an average of approximately 1.85 cfs (830 gpm) overflows from Pit 5NW to Spring Mine Creek where it flows north about 5 miles before joining the Embarrass River just downstream of monitoring station PM-12 (see Figure 4.2.2-1).

Table 4.2.2-28 NPDES/SDS Discharges to the Embarrass River Watershed

NPDES/SDS Permit Number	Permit Number	Outfalls ID	Outfall Description	Receiving Waters	Flow (cfs) Avg.[1]	Flow (cfs) Max.
Mesabi Mining LLC	MN0069078	SD-022	Pit 9 Dewatering Pipe	Wynne Lake	7.7	11.1
Cliffs Erie LLC	MN0042536	SD-033	Pit 5NW overflow	Spring Mine Creek	1.9	--
Mesabi Mining LLC	MN0069078	SD-004	Pit 1 dewatering discharge	Wynne Lake	8.4	18.3
Cliffs Erie LLC	MN0054089	SD-001	NW seepage collection ditch	Unnamed creek	--	--
		SD-002	NE seepage collection ditch	Trimble Creek	--	--
		SD-004	Tailings Basin Cell 2W Seep A	Unnamed creek	0.28	3.00
		SD-005	Tailings Basin Cell 2W Seep B	Kaunonen Creek	--	0.46
		SD-006	Power line access road culvert	Unnamed creek	5.0	6.2

Source: MPCA 2013a.

[1] Average flow when discharging. Many of these discharges only occur intermittently and may be currently inactive.

There are no large surface water withdrawals or water appropriation permits issued for the Embarrass River in the NorthMet Project area. The headwaters of the Embarrass River Watershed include a portion of the City of Babbitt, but are otherwise relatively undeveloped and unaffected by any mining. The City of Babbitt WWTP has an annual average discharge of approximately 0.33 cfs to the headwaters.

Embarrass River Water Quality

PolyMet collected water quality data from five locations that can be used to establish baseline water quality along the Embarrass River. Samples from two primary locations, PM-12 and PM-13, were subject to evaluation for all water quality parameters, while samples from locations 12.2, 12.3, and 12.4 were analyzed for a more limited set of parameters. The locations of the samples, all along the main branch of the Embarrass River are shown in Figure 4.2.2-15. Table 4.2.2-29 summarizes the water quality data for the two primary sites.

Surface water monitoring station PM-12 does receive a small discharge from the City of Babbitt WWTP, but is otherwise upstream of all NorthMet Project Proposed Action activities and therefore serves as a control location.

Immediately downstream from PM-12, Spring Mine Creek flows into the Embarrass River. Limited water quality data were collected at PM-12.1 on Spring Mine Creek, which receives drainage from Pit 5NW (see Figure 4.2.2-1). Pit 5NW is completely flooded and has been overflowing since before 2001 with an annual average flow of about 2 cfs to the Embarrass River via Spring Mine Creek. This discharge has sulfate concentrations that average 1,042 mg/L (PolyMet 2013j). As noted in Table 4.2.2-2, Spring Mine Creek was listed by the MPCA as impaired for invertebrates and fish while the Embarrass River Watershed from the headwaters to Embarrass Lake was listed as impaired for fish.

In addition, six samples of limited water quality data were collected at PM-12.2, PM-12.3, and PM-12.4 along the mainstem of the Embarrass River during 2010 and 2011. Analysis of these samples indicated that chloride appeared relatively constant with location, varying from an average of 2.0 mg/L at PM-12.1 to 3.6 mg/L at PM-12.4. pH also appeared relatively constant, from an average of 7.7 at PM-12.1 to 7.0 at PM-12.2. Sulfate, however, decreased substantially, from an average of 262 mg/L at PM-12.1 (just downstream of the Pit 5 northwest overflow) to 13.7 mg/L at PM-12.4, likely due to dilution and other processes.

Solute loadings from groundwater and surface seepage from the existing LTVSMC Tailings Basin reach the Embarrass River via several small tributaries including Mud Lake Creek and Trimble Creek, which enter upstream of station PM-12.3, and Unnamed Creek, which enters upstream of station PM-13 (see Figure 4.2.2-1). These tributaries are described in more detail below.

The effects of Pit 5NW, the existing LTVSMC Tailings Basin, and groundwater seepage and surface runoff from elsewhere within the watershed are reflected in the water quality at station PM-13, which is located downstream of these and all NorthMet Project area sources of pollution within the Embarrass River Watershed (see Table 4.2.2-29). Higher concentrations for several parameters, especially aluminum and sulfate, are found at PM-13 relative to PM-12. Since PM-13 is downstream of all Tailings Basin seepage, it will be used to evaluate NorthMet Project Proposed Action effects on flow and water quality in the Embarrass River.

Table 4.2.2-29 Average Existing Water Quality in the Embarrass River, 2004-2012[1]

Parameter	Units	Evaluation Criteria	PM-12			PM-12.1 Spring Mine Creek			PM-12.2			PM-12.3			PM-12.4			PM-13		
			Detection	**Mean**	**Range**	**Detection**	**Mean**	**Range**	**Detection**	**Mean**	**Range**	**Detection**	**Mean**	**Range**	**Detection**	**Mean**	**Range**	**Detection**	**Mean**	**Range**
General																				
Calcium	mg/L	--	31 of 31	13.3	4.6 to 23.6	1 of 1	39.6	39.6 to 39.6	--	--	--	--	--	--	--	--	--	29 of 29	19.9	7.0 to 33.4
Chloride	mg/L	230	46 of 46	4.3	1.3 to 10.4	14 of 14	2.0	0.62 to 3.6	12 of 12	2.6	1.3 to 3.7	12 of 12	3.1	1.5 to 5.6	12 of 12	3.6	1.6 to 4.8	43 of 43	5.6[2]	2.0 to 94.8
Fluoride	mg/L	--	11 of 21	0.10	<0.05 to 0.20	--	--	--	--	--	--	--	--	--	--	--	--	18 of 21	0.37	<0.05 to 2.3
Hardness	mg/L	500	30 of 30	57.2	18.6 to 171	2 of 2	380	330 to 429	--	--	--	--	--	--	--	--	--	28 of 28	111	35.6 to 228
Potassium	mg/L	--	9 of 11	0.89	<0.25 to 2.0	2 of 2	15.3	12.7 to 17.8	--	--	--	--	--	--	--	--	--	9 of 9	2.3	1.5 to 3.1
Sodium	mg/L	--	13 of 13	3.3	2.2 to 6.0	2 of 2	27.7	23.0 to 32.4	--	--	--	--	--	--	--	--	--	11 of 11	11.8	5.2 to 28.3
Sulfate	mg/L	--[4]	38 of 50	6.8	<0.50 to 116	14 of 14	262	81.6 to 438	12 of 12	67.1	30.4 to 124	12 of 12	14.9	5.6 to 36.1	12 of 12	13.7	5.7 to 24.9	47 of 47	31.8[3]	7.6 to 688
Metals																				
Aluminum	µg/L	125	25 of 25	106	44.3 to 210	7 of 8	71.4	<12.5 to 210	8 of 8	107	36.0 to 174	8 of 8	114	26.8 to 367	7 of 8	113	<12.5 to 318	25 of 25	**211**	43.9 to 505
Antimony	µg/L	31	0 of 9	0.81	<0.25 to 1.5	0 of 1	0.25	<0.25 to 0.25	--	--	--	--	--	--	--	--	--	0 of 8	0.88	<0.25 to 1.5
Arsenic	µg/L	53	5 of 10	2.1	0.53 to 5.0	0 of 2	0.38	<0.25 to 0.50	--	--	--	--	--	--	--	--	--	4 of 8	1.6	<1.0 to 2.5
Barium	µg/L	--	8 of 11	16.1	<5.0 to 29.9	2 of 2	19.5	18.5 to 20.4	--	--	--	--	--	--	--	--	--	9 of 9	31.3	14.3 to 57.4
Beryllium	µg/L	--	0 of 8	0.10	<0.10 to 0.10	0 of 2	0.10	<0.10 to 0.10	--	--	--	--	--	--	--	--	--	0 of 6	0.10	<0.10 to 0.10
Boron	µg/L	500	0 of 9	20.8	<17.5 to 25.0	1 of 2	37.7	<25.0 to 50.4	--	--	--	--	--	--	--	--	--	3 of 6	37.9	<17.5 to 68.9
Cadmium	µg/L	2.5[5]	1 of 11	0.09	<0.01 to 0.10	0 of 2	0.06	<0.01 to 0.10	--	--	--	--	--	--	--	--	--	1 of 9	0.09	0.04 to 0.10
Cobalt	µg/L	5.0	10 of 29	0.80	0.13 to 4.1	0 of 2	0.10	<0.10 to 0.10	--	--	--	--	--	--	--	--	--	6 of 27	0.51	<0.10 to 0.84
Copper	µg/L	9.3[5]	25 of 31	1.3	<0.33 to 2.8	1 of 2	0.61	<0.35 to 0.86	--	--	--	--	--	--	--	--	--	25 of 29	1.5	<0.35 to 2.5
Iron	µg/L	--	13 of 13	3,659	1.7 to 11,200	6 of 6	357	172 to 749	4 of 4	2,398	1,640 to 3,280	4 of 4	4,355	1,530 to 6,620	4 of 4	3,580	1,310 to 5,790	11 of 11	2,122	2.1 to 5,610
Lead	µg/L	3.2[5]	4 of 18	0.27	0.08 to 0.50	1 of 2	0.15	0.04 to 0.25	--	--	--	--	--	--	--	--	--	3 of 16	0.32	<0.15 to 0.63
Manganese	µg/L	--	16 of 16	343	19.0 to 1,490	6 of 6	181	118 to 301	4 of 4	979	559 to 1,440	4 of 4	1,097	402 to 1,660	4 of 4	595	263 to 1,050	13 of 14	219	<0.25 to 757
Mercury	ng/L	1.3	24 of 30	**4.8**	<1.0 to 9.9	--	--	--	--	--	--	--	--	--	--	--	--	19 of 31	**4.0**	<1.0 to 12.4
Nickel	µg/L	52[5]	27 of 31	1.7	0.68 to 2.8	2 of 2	1.2	0.88 to 1.43	--	--	--	--	--	--	--	--	--	24 of 29	1.8	<0.30 to 2.7
Selenium	µg/L	5.0	1 of 14	1.3	0.09 to 5.0	1 of 1	0.10	0.10 to 0.10	--	--	--	--	--	--	--	--	--	0 of 13	1.1	<0.50 to 1.8
Silver	µg/L	1.0[5]	0 of 13	0.23	<0.10 to 0.50	0 of 2	0.10	<0.10 to 0.10	--	--	--	--	--	--	--	--	--	0 of 11	0.25	<0.10 to 0.50
Thallium	µg/L	0.56	2 of 15	0.35	<0.0002 to 1.0	0 of 2	0.10	<0.10 to 0.10	--	--	--	--	--	--	--	--	--	1 of 13	0.39	<0.0002 to 1.0
Zinc	µg/L	120[5]	9 of 31	12.4	2.7 to 104	0 of 2	3.0	<3.0 to 3.0	--	--	--	--	--	--	--	--	--	6 of 29	10.3	<3.0 to 51.2

Source: Barr 2013b.

Note: Values in bold indicates an exceedance of surface water quality standards.
1 2010 data not collected for all parameters. Includes non-detects at half the detection limit.
2 Excludes 94.8 mg/L value from November 8, 2006.
3 Excludes 688 mg/L value from November 8, 2006.
4 Sulfate standard of 10 mg/l applies to designated "waters supporting the production of wild rice."
5 Water quality standard for this metal is hardness-dependent. Listed value assumes a concentration of 100 mg/L.

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Water quality data collected from 1955 to 2012 are available for various parameters at six locations along the main branch of the Embarrass River (see Table 4.2.2-30). As was the case along the Partridge River, these data do not allow a detailed assessment of water quality trends, seasonal effects, or relationship to flow, but collectively can be used to generally characterize water quality in the watershed and draw some comparisons with surface water standards.

Table 4.2.2-30 Available Surface Water Quality Monitoring Data in the Embarrass River Main Branch (see Figure 4.2.2-1)

Sample Location	Source	Sampling Period
Mainstem Embarrass River		
PM-12[1]	PolyMet / C-N Study / Cliffs Erie	1976, 2001–2005, 2004, 2006, 2008–2011
CN120	USGS/C-N Study	1955–1963, 1976–1977
PM-12.2	PolyMet	2010–2012
PM-12.3	PolyMet	2010–2012
PM-12.4	PolyMet	2010–2012
PM-13	PolyMet / Cliffs Erie	2001–2005, 2004, 2006, 2008–2012

Source: Barr 2007i; PolyMet 2013j.

C-N Study – Regional Copper-Nickel Study (Siegel and Ericson 1980)

[1] Monitoring station formally designated as CN121.

The Regional Copper-Nickel Study (Siegel and Ericson 1980) considered monitoring station PM-12 (formally designated as CN121) as representative of “undisturbed” conditions. Under current (2012) conditions, this monitoring station receives stormwater runoff and WWTP discharges (0.33 cfs of predominantly domestic wastewater) from the City of Babbitt, but is otherwise unaffected by mining or other significant development. Table 4.2.2-31 compares 1976 data from the Regional Copper-Nickel Study with recent data from PolyMet for monitoring station PM-12. These data show that mean water quality at this monitoring station currently meets surface water quality standards for the parameters monitored. Most of the measured parameters exhibit relatively little change over the 30-year period, although concentrations of several constituents (notably iron, manganese, and zinc) have increased, while concentrations of cobalt appear to be decreasing slightly.

Table 4.2.2-31 Comparison of Historic and Recent Mean Water Quality Data for Selected Parameters at PM-12 on the Embarrass River

General Parameter	Units	Evaluation Criteria	1976	2004–2012[1]
Hardness	mg/L	500	50[4]	57.2
pH	s.u.	6.5-8.5	6.9	7.0
Sulfate	mg/L	--[2]	6.1	6.8
Metals – Total				
Aluminum	µg/L	125	127	105.9
Arsenic	µg/L	53	0.9	2.1
Cobalt	µg/L	5	2.3[4]	0.8
Copper	µg/L	5.2[3]	0.9[4]	1.3
Iron	µg/L	--	1,121	3,659
Lead	µg/L	1.3[3]	0.2	0.3
Manganese	µg/L	--	234	343
Nickel	µg/L	29[3]	1.0[4]	1.7
Zinc	µg/L	67[3]	1.1[4]	12.4

Source: Siegel and Ericson 1980); Barr 2007i for 1976 data; Barr 2013b for 2004–2012 data.

1 Includes non-detects at half the detection limit.
2 Sulfate standard of 10 mg/l applies to designated “waters supporting the production of wild rice.”
3 Water quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 50 mg/L.
4 Based on fewer than five samples.

Embarrass River Tributary Streams

The existing LTVSMC Tailings Basin, proposed for reuse by PolyMet, was operated from 1953 until it was shut down in January 2001. The Tailings Basin is unlined and the perimeter embankments do not have a clay core or cutoff, which allows for both surface seepage through the embankment and groundwater seepage under the embankment.

Most of the uncontrolled groundwater and surface water seepage from the existing LTVSMC Tailings Basin ultimately reaches the Embarrass River between monitoring stations PM-12 and PM-13. Table 4.2.2-32 summarizes data for the period from 2002 to 2006 for the 33 LTVSMC seeps shown in Figure 4.2.2-11 (Barr 2007g).

As the flow monitoring shows, surface seepage at most locations has declined or stopped since tailings disposal was discontinued in 2001. Only Seep 30, which drains to wetlands north of the Tailings Basin in the Embarrass River Watershed, and Seeps 32/33, which drain to Second Creek in the Partridge River Watershed, still have any significant flow. Seeps 32/33 (outfall SD026) and seepage from the vicinity of outfalls SD006 and SD004 are presently being pumped back into the Tailings Basin under the Consent Decree agreement between the MPCA and Cliffs Erie. In addition to surface Seep 32/33, it is possible that a relatively small amount of seepage may bypass the collection system at outfall SD026 and discharge to groundwater. PolyMet estimates that the current combined groundwater seepage from Cell 1E/2E and Cell 2W is 2,020 gpm (Barr 2008j). The MPCA will evaluate information relative to water quality standards during the NPDES/SDS permitting process as part of its analysis to determine which pollutants in the discharge have a reasonable potential to cause or contribute to violation of a water quality standard.

PolyMet began collection of water quality data at four locations along the toe of the tailings embankment (PM-8, PM-9, PM-10, and UC-1), three locations along Trimble Creek (PM-19, TC-1, and (TC-1A), one location along Unnamed Creek (PM-11), and three locations along Mud Lake Creek (MLC-1, MLC-2, and MLC-3A). Table 4.2.2-33 lists the sampling periods for each location and Figure 4.2.2-15 shows the monitoring locations. Table 4.2.2-34 and Table 4.2.2-35 contain a summary of the data from these locations. For the parameters monitored, data show compliance with water quality standards except for exceedances of hardness and pH near the toe of the embankment; exceedances of aluminum, boron, cobalt, copper, and lead at PM-10; and exceedances for mercury at all locations.

Table 4.2.2-32 Summary of Existing LTVSMC Tailings Basin Surface Seeps (see Figure 4.2.2-11)

Seep ID	Description	Range of Flow (gpm)	
		5/02 – 10/06	October 2008[1]
Seep 1	Emergency Basin area seep	0-1	0
Seep 2	Emergency Basin area seep	~0	0
Seep 3	Emergency Basin area seep	0-12	0
Seep 4	Emergency Basin area seep	0-42	0
Culvert	Combined flow of seeps 1-4 (WS-011)	0-21.8	0
Seep 5	Emergency Basin area seep	0-0.8	~0
Seep 6	Emergency Basin area seep	0-1.6	~0
Seep 7	Emergency Basin area seep	0-1.6	~0
Seep 8	Emergency Basin area approx. 4 seeps	0-35	~0
Seep 9	Emergency Basin area seep	~0	~0
Weir	Combined flow of seeps 5 thru 9 (WS-012)	0-94	0
Seep 10	West side of Tailings Basin	0->750	0
Seep 11	West side of Tailings Basin	0-0.5	0
Seep 12	West side of Tailings Basin	0-0.5	0
Seep 13	West side of Tailings Basin	0-1.5	0
Seeps 14-17	West side of Tailings Basin	0-0.8	0
Weir	Combined flow of seeps 11 thru 17	0-25	0
Seep 18	West side of Tailings Basin	0-2	0
Seep 19	West side of Tailings Basin	0-22	0
Seep 20	Northwest side of Tailings Basin pipe flow	0-5.0	2.5
Seep 21	Northwest side of Tailings Basin	0-1.5	0
Seep 22	Northwest side of Tailings Basin (SD-004)	1.0-7.0	3.0
Seep 23	No pipe present	0-6.0	0
Seep 24	Flow from pipe (North Side seep)	1-21	10
Seep 25	Flow from pipe	2.5-29	0
Seep 26	North Side of Tailings Basin	0-1.0	0
Seep 27	Flow from pipe	0-<1	0
Seep 28	Flow from pipe	0-0.25	0
Seep 29	Flow from pipe	0-30	0
Seep 30	Three seeps in one small area, no pipe present.	1.5-127	100
Seep 31	Various seeps along northeast side of Tailings Basin	0->60	0
Seeps 32-33	Drains to Second Creek	0-554	600

Source: Barr 2007i; NTS 2008.

[1] Most recent flow data.

Table 4.2.2-33 Water Quality Monitoring Locations for Tailings Basin Surface Seepage and Receiving Streams (see Figure 4.2.2-15)

Sample Location	Source	Sampling Period
Tailings Basin		
PM-8	PolyMet	2004, 2006
PM-9	PolyMet	2004, 2006
PM-10	PolyMet	2004, 2006–2007
UC-1	PolyMet	2012
PM-11	PolyMet	2004, 2006, 2008–2012
PM-19	PolyMet	2009–2012
MLC-1	PolyMet	2011-2012
MLC-2	PolyMet	2011-2012
MLC-3	PolyMet	2012
TC-1	PolyMet	2012

Source: Barr 2007i; PolyMet 2013j.

Table 4.2.2-34 Summary of Surface Water Quality Monitoring Data for the Tailings Basin Surface Seeps (see Figure 4.2.2-15)

Constituent	Units	Surface Water Evaluation Criteria	PM-8[6] Surface Discharge				PM-9[6] Surface Discharge				PM-10[6] Surface Discharge				PM-11 Surface Discharge				UC-1 Surface Discharge			
General Parameters			Detection	Mean[5]	Range	# Exceed	Detection	Mean[5]	Range	# Exceed	Detection	Mean[5]	Range	# Exceed	Detection	Mean[5]	Range	# Exceed	Detection	Mean[5]	Range	# Exceed
Ammonia as Nitrogen	mg/L	--	0 of 4	0.1	<0.1	0	0 of 4	0.1	<0.1	0	0 of 4	0.1	<0.1	0	2 of 15	0.07	<0.05 to 0.21	--	1 of 2	0.15	<0.05 to 0.24	--
Calcium	mg/L	--	47 of 47	42.4	9.2 to 73.9	--	124 of 124	53.9	33.0 to 98.9	--	132 of 132	66.4	17.5 to 92.4	--	30 of 30	43.1	19.0 to 76.2	--	6 of 6	57.9	51.9 to 63.0	--
Carbon, total organic	mg/L	--	8 of 8	5.4	2.6 to 6.9	--	8 of 8	8.4	1.7 to 18.5	--	15 of 15	7.5	5.2 to 9.4	--	32 of 32	12.3	6.5 to 22.1	--	6 of 6	13.3	9.4 to 18.0	--
Chloride	mg/L	230	19 of 19	20.3	3.1 to 30	0	122 of 122	28.1	12.6 to 66.5	0	130 of 130	27.7	7.2 to 33.6	0	43 of 43	17.2	3.9 to 33.0	0	6 of 6	23.2	11.0 to 29.5	0
Fluoride	mg/L	--	42 of 42	2.9	1.0 to 5.8	--	128 of 128	2.4	0.6 to 5.8	--	136 of 136	2.3	0.5 to 4.8	--	11 of 11	1.5	0.84 to 2.2	--	--	--	--	--
Hardness	mg/L	500	36 of 36	431	230 to 721	**9**	41 of 41	452	268 to 818	**11**	48 of 48	438	327 to 649	**7**	30 of 30	358	109 to 643	**5**	6 of 6	507	456 to 547	**3**
Nitrate as Nitrogen	mg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	1 of 21	0.05	<0.05 to 0.11	--	0 of 2	0.05	<0.05 to <0.05	--
pH	s.u.	6.5 – 8.5	81 of 81	7.9	6.8 to 8.7	**1**	130 of 130	7.8	6.4 to 8.8	**7**	136 to 136	6.7	6.4 to 8.9	**5**	38 of 38	7.6	6.9 to 8.3	0	6 of 6	7.5	6.97 to 7.75	0
Sulfate	mg/L	--[2]	61 of 61	161	27.1 to 312	--	125 of 125	159	56.8 to 344	--	133 of 133	182	8.1 to 473	--	47 of 47	123	17.1 to 233	--	6 of 6	123	67.5 to 180	--
Metals – Total																						
Aluminum	µg/L	125	3 of 5	25.7	<10 to 40.7	0	4 of 5	29.9	<25 to 48.4	0	4 of 12	39.6	<10 to 230	**1[4]**	17 of 28	28.2	<10.0 to 72.7	0	3 of 6	20.8	<10.0 to 30.6	0
Antimony	µg/L	31	0 of 5	3	<3	0	0 of 5	3	<3	0	0 of 5	3	<3	0	0 of 20	0.50	<0.25 to 1.5	0	0 of 6	0.25	<0.25 to <0.25	0
Arsenic	µg/L	53	5 of 12	3.0	<2 to 7.2	0	1 of 12	2.1	<2 to 2.7	0	2 of 12	2.1	<2 to 2.7	0	13 of 22	0.98	<0.25 to 2.3	0	5 of 6	1.1	<0.25 to 1.6	0
Barium	µg/L	--	15 of 15	25.6	11 to 76.4	--	15 of 15	41.6	18.3 to 140	--	22 of 22	86.7	39.5 to 148	--	15 of 15	30.1	13.4 to 43.7	--	2 of 2	52.4	45.3 to 59.5	--
Beryllium	µg/L	--	0 of 5	1.64	<0.2 to <2	--	0 of 5	1.64	<0.2 to <2	--	0 of 5	1.64	<0.2 to <2	--	0 of 12	0.10	<0.10 to <0.10	--	0 of 2	0.10	<0.10 to <0.10	--
Boron	µg/L	500	37 of 37	351	164 to 483	0	127 of 127	337	115 to 452	0	135 of 135	379	85 to 517	**3**	12 of 12	227	129 to 307	0	2 of 2	281	228 to 333	0
Cadmium	µg/L	2.5[3]	0 of 5	1.6	<0.2 to <2	0	0 of 5	1.6	<0.2 to <2	0	0 of 5	1.6	<0.2 to <2	0	4 of 15	0.07	<0.015 to 0.10	0	0 of 2	0.10	<0.10 to <0.10	0
Cobalt	µg/L	5.0	4 of 43	1.2	<1 to <2.5	0	3 of 81	1.1	<1 to 4.9	0	7 of 82	1.3	<1 to 16.8	**1**	9 of 28	0.24	<0.10 to 0.50	0	3 of 6	0.17	<0.10 to 0.24	0
Copper	µg/L	9.3[3]	5 of 32	2.1	<0.7 to 5.4	0	19 of 84	2.5	<0.7 to 12	**1**	16 of 92	2.3	<1 to 24.2	**1**	24 of 30	1.1	<0.33 to 2.5	0	4 of 6	0.64	<0.25 to 1.1	0
Iron	µg/L	--	23 of 23	410	<30 to 4,500	--	18 of 19	673	<30 to 5,100	--	23 of 25	501	<30 to 4,020	--	25 of 25	477	0.21 to 1,270	--	6 of 6	474	188 to 1,590	--
Lead	µg/L	3.2[3]	9 of 10	0.7	<0.3 to <1	0	9 of 10	0.7	<0.3 to <1	0	10 of 10	1.3	<0.3 to 7.1	**1**	6 of 24	0.23	0.03 to 0.5	0	0 of 6	0.25	<0.25 to <0.25	0
Manganese	µg/L	--	40 of 40	3,039	70 to 110,000	--	95 of 98	631	<10 to 50,000	--	93 of 93	100,192	20 to 2,950,000	--	28 of 28	196	19.3 to 1,270	--	6 of 6	442	78.2 to 1,520	--
Mercury	ng/L	1.3	17 of 28	2.6	<0.5 to <10	**11**[1]	16 of 28	3.1	<0.5 to <10	**10**[1]	22 of 35	3.6	<2 to <10	**13**[1]	21 of 27	2.0	<0.25 to 5.0	**17**[1]	2 of 2	1.2	1.0 to 1.4	**1**
Mercury, Methyl	ng/L	--	--	--	--	--	--	--	--	--	--	--	--	--	9 of 9	0.26	0.15 to 0.46	--	--	--	--	--
Molybdenum	µg/L	--	12 of 12	50.5	13.9 to 81.6	--	110 of 112	43.2	<5 to 96.8	--	119 of 121	21.5	<5 to 47.6	--	24 of 24	13.0	5.1 to 29.3	--	2 of 2	4.8	4.4 to 5.2	--
Nickel	µg/L	52[3]	3 of 27	2.5	<2 to <5	0	3 of 64	2.3	<2 to <5	0	11 of 72	2.3	<2 to 5.9	0	15 of 30	0.93	<0.25 to 2.5	0	1 of 6	0.32	<0.25 to 0.69	0
Selenium	µg/L	5.0	0 of 10	2.5	<1.0 to <3.6	0	0 of 10	2.5	<1.0 to <3.6	0	0 of 10	2.5	<1.0 to <3.6	0	3 of 20	0.85	0.24 to 1.8	0	0 of 6	0.50	<0.50 to <0.50	0
Silver	µg/L	1.0[3]	0 of 10	0.6	<0.2 to <1	0	0 of 10	0.6	<0.2 to <1	0	0 of 10	0.6	<0.2 to <1	0	0 of 17	0.20	<0.10 to 0.50	0	0 of 2	0.10	<0.10 to <0.10	0

Constituent	Units	Surface Water Evaluation Criteria	PM-8[6] Surface Discharge				PM-9[6] Surface Discharge				PM-10[6] Surface Discharge				PM-11 Surface Discharge				UC-1 Surface Discharge			
General Parameters			**Detection**	**Mean[5]**	**Range**	**# Exceed**	**Detection**	**Mean[5]**	**Range**	**# Exceed**	**Detection**	**Mean[5]**	**Range**	**# Exceed**	**Detection**	**Mean[5]**	**Range**	**# Exceed**	**Detection**	**Mean[5]**	**Range**	**# Exceed**
Thallium	µg/L	0.56	0 of 10	1.2	<0.4 to <2	0[1]	0 of 10	1.2	<0.4 to <2	0[1]	0 of 10	2.7	<0.4 to <2	0[1]	1 of 26	0.21	<0.0002 to 1.0	0[1]	0 of 6	0.0009	<0.0002 to 0.0025	0
Zinc	µg/L	120[3]	2 of 27	13.6	<10 to <25	0	2 of 12	10.3	<10 to 12.7	0	3 of 19	16.2	<10 to 32.5	0	5 of 30	5.1	1.6 to 41.2	0	0 of 6	3.0	<3.0 to <3.0	0

Source: Barr 2007i; Barr 2006f; PolyMet 2013j.

Note: Values in bold indicates an exceedance of surface water quality standards.

1 Minimum detection limit exceeds evaluation criteria; Barr 2006f. Data reported as less than such a detection limit is not included in the number of exceedances.

2 Sulfate standard of 10 mg/l applies to designated "waters supporting the production of wild rice."

3 Water Quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 100 mg/L.

4 Predicted values represent total aluminum concentrations, while the water quality standard is for dissolved aluminum. Since aluminum has a very low solubility in water under relatively neutral pH conditions, it is expected that the predicted aluminum concentration would meet the surface water standard (see discussion in Section 4.1.2.2).

5 Includes non-detects at half the detection limit.

6 Seepage at PM-8 is presently being pumped back into the Tailings Basin in accordance with the Consent Decree between the MPCA and Cliffs Erie. Seepage at PM-9 and PM-10 are discharging to tributaries of the Embarrass River. PM-11 is downstream from PM-9 on the same unnamed tributary.

Table 4.2.2-35 Summary of Surface Water Quality Monitoring Data for Tailings Basin Streams Tributary to the Embarrass River (see Figure 4.2.2-15)

Constituent	Units	Surface Water Evaluation Criteria	PM-19 Trimble Creek				TC-1 Trimble Creek				TC-1A Trimble Creek				MLC-1 Mud Lake Creek				MLC-2 Mud Lake Creek				MLC-3A Mud Lake Creek			
General Parameters			**Detection**	**Mean[4]**	**Range**	**# Exceed**	**Detection**	**Mean[4]**	**Range**	**# Exceed**	**Detection**	**Mean[4]**	**Range**	**# Exceed**	**Detection**	**Mean[4]**	**Range**	**# Exceed**	**Detection**	**Mean[4]**	**Range**	**# Exceed**	**Detection**	**Mean[4]**	**Range**	**# Exceed**
Ammonia as Nitrogen	mg/L	--	2 of 11	0.10	<0.05 to 0.39	--	0 of 1	0.05	<0.05 to <0.05	--	0 of 1	0.05	<0.05 to <0.05	--	2 of 3	0.11	<0.05 to 0.18	--	2 of 11	0.26	<0.05 to 2.1	--	0 of 1	0.05	<0.05 to <0.05	--
Calcium	mg/L	--	18 of 18	48.3	28.5 to 73.6	--	4 of 4	43.6	38.2 to 49.8	--	2 of 2	45.2	37.4 to 52.9	--	5 of 5	34.0	14.5 to 58.6	--	15 of 15	19.2	11.7 to 31.7	--	2 of 2	47.2	34.5 to 59.8	--
Carbon, total organic	mg/L	--	18 of 18	19.4	11.1 to 33.7	--	4 of 4	23.0	14.8 to 31.8	--	2 of 2	11.2	11.0 to 11.3	--	5 of 5	27.3	12.1 to 43.8	--	15 of 15	27.7	12.9 to 48.0	--	2 of 2	14.7	14.3 to 15.0	--
Chloride	mg/L	230	31 of 31	14.8	6.8 to 30.2	0	4 of 4	11.7	7.5 to 17.2	0	2 of 2	25.4	22.8 to 27.9	0	5 of 5	6.8	3.1 to 18.6	0	16 of 16	5.7	1.7 to 12.7	0	2 of 2	18.0	13.2 to 22.8	0
Fluoride	mg/L	--	2 of 2	0.91	0.87 to 0.95	--	--	--	--	--	--	--	--	--	2 of 2	0.23	0.15 to 0.31	--	4 of 4	0.25	0.20 to 0.33	--	--	--	--	--
Hardness	mg/L	500	17 of 17	311	173 to 489	0	4 of 4	273	231 to 299	0	2 of 2	318	265 to 370	0	5 of 5	210	93 to 383	0	14 of 14	112	72.8 to 178	--	2 of 2	315	236 to 394	0
Nitrate as Nitrogen	mg/L	--	0 of 14	0.05	<0.05 to <0.05	--	0 of 1	0.05	<0.05 to <0.05	--	0 of 1	0.05	<0.05 to <0.05	--	0 of 3	0.05	<0.05	--	2 of 11	0.06	<0.05 to 0.12	0	0 of 1	0.05	<0.05 to <0.05	--
pH	s.u.	6.5 – 8.5	23 of 23	7.3	6.1 to 7.7	0	4 of 4	7.5	7.4 to 7.7	0	2 of 2	7.4	7.0 to 7.8	0	3 of 3	7.1	7.0 to 7.3	0	17 of 17	7.1	6.5 to 7.7	0	2 of 2	7.3	7.1 to 7.6	0
Sulfate	mg/L	--[1]	29 of 31	26.8	<0.50 to 94.1	--	4 of 4	12.4	1.3 to 36.6	--	2 of 2	84.7	75.3 to 94.1	--	3 of 5	9.8	<0.50 to 35.1	--	12 of 16	3.2	<0.50 to 12.3	--	2 of 2	35.3	17.3 to 53.2	--
Metals – Total																										
Aluminum	µg/L	125	8 of 16	25.6	<10.0 to 63.5	0	3 of 4	44.9	<20.0 to 82.5	0	0 of 2	15.0	<10.0 to 20.0	0	3 of 5	32.9	<12.5 to 58.3	0	12 of 16	44.3	<10.0 to 112	0	0 of 2	10.0	<10.0 to <10.0	0
Antimony	µg/L	31	0 of 16	0.25	<0.25 to <0.25	0	0 of 4	0.25	<0.25 to <0.25	0	0 of 2	0.25	<0.25 to <0.25	0	--	0.25	<0.25	0	0 of 15	0.25	<0.25 to <0.25	0	0 of 2	0.25	<0.25 to <0.25	0
Arsenic	µg/L	53	14 of 18	1.3	<0.25 to 3.9	0	4 of 4	2.6	0.98 to 5.2	0	0 of 2	0.25	<0.25 to <0.25	0	4 of 4	3.9	0.84 to 7.0	0	12 of 15	1.3	<0.25 to 3.1	0	1 of 2	0.42	<0.25 to 0.59	0
Barium	µg/L	--	8 of 8	75.1	52.0 to 107	--	1 of 1	95.2	95.2 to 95.2	--	1 of 1	88.1	88.1 to 88.1	--	3 of 3	25.9	11.0 to 34.1	--	7 of 7	25.6	10.5 to 61.6	--	1 of 1	37.3	37.3 to 37.3	--
Beryllium	µg/L	--	0 of 8	0.10	<0.10 to <0.10	--	0 of 1	0.10	<0.10 to <0.10	--	0 of 1	0.10	<0.10 to <0.10	--	0 of 3	0.10	<0.1	--	0 of 7	0.10	<0.10 to <0.10	--	0 of 1	0.10	<0.10 to <0.10	--
Boron	µg/L	500	8 of 8	133	111 to 149	0	1 of 1	137	137 to 137	0	1 of 1	142	142 to 142	0	1 of 3	40.2	<25 to 70.5	0	0 of 7	25.0	<25.0 to <25.0	0	1 of 1	160	160 to 160	0
Cadmium	µg/L	2.5[2]	0 of 8	0.07	<0.01 to 0.10	0	0 of 1	0.10	<0.10 to <0.10	0	0 of 1	0.10	<0.10 to <0.10	0	0 of 3	0.04	<0.02	0	1 of 7	0.06	<0.015 to 0.10	0	0 of 1	0.10	<0.10 to <0.10	0
Cobalt	µg/L	5.0	12 of 18	0.29	<0.10 to 0.98	0	4 of 4	0.62	0.25 to 1.4	0	0 of 2	0.10	<0.10 to <0.10	0	3 of 5	0.52	<0.1 to 1.1	0	8 of 15	0.41	<0.10 to 1.2	0	1 of 2	0.15	<0.10 to <0.10	0
Copper	µg/L	9.3[2]	14 of 18	0.52	<0.25 to 0.98	0	1 of 4	0.32	<0.25 to <0.25	0	2 of 2	0.54	0.53 to 0.55	0	2 of 5	0.36	<0.25 to 0.64	0	9 of 15	0.44	0.20 to 1.1	0	2 of 2	0.56	0.53 to 0.59	0
Iron	µg/L	--	18 of 18	1,489	226 to 5,830	--	4 of 4	3,233	941 to 8,330	--	2 of 2	275	232 to 317	--	5 of 5	8,123	817 to 19,900	--	15 of 15	4,632	501 to 27,100	--	2 of 2	280	275 to 284	--
Lead	µg/L	3.2[2]	1 of 12	0.19	<0.01 to 0.25	0	0 of 4	0.25	<0.25 to <0.25	0	0 of 2	0.25	<0.25 to <0.25	0	1 of 5	0.17	<0.01 to 0.25	0	4 of 11	0.20	0.06 to 0.25	0	0 of 2	0.25	<0.25 to <0.25	0

Constituent	Units	Surface Water Evaluation Criteria	PM-19 Trimble Creek				TC-1 Trimble Creek				TC-1A Trimble Creek				MLC-1 Mud Lake Creek				MLC-2 Mud Lake Creek				MLC-3A Mud Lake Creek			
General Parameters			**Detection**	**Mean[4]**	**Range**	**# Exceed**	**Detection**	**Mean[4]**	**Range**	**# Exceed**	**Detection**	**Mean[4]**	**Range**	**# Exceed**	**Detection**	**Mean[4]**	**Range**	**# Exceed**	**Detection**	**Mean[4]**	**Range**	**# Exceed**	**Detection**	**Mean[4]**	**Range**	**# Exceed**
Manganese	µg/L	--	18 of 18	873	24.2 to 3,990	--	4 of 4	1,305	202 to 3,670	--	2 of 2	102	46.6 to 157	--	5 of 5	526	44 to 1,040	--	15 of 15	291	11.4 to 1,310	--	2 of 2	211	19.1 to 402	--
Mercury	ng/L	1.3	11 of 11	1.4	0.50 to 3.9	**4**	1 of 1	1.1	1.1 to 1.1	0	1 of 1	0.90	0.90 to 0.90	0	3 of 3	2.2	1.3 to 3.8	**3**	11 of 11	2.9	0.90 to 6.5	**8**	1 of 1	0.99	0.99 to 0.99	0
Mercury, Methyl	ng/L	--	1 of 2	0.11	<0.05 to 0.16	--	--	--	--	--	--	--	--	--	--	--	--	--	3 of 4	1.3	<0.05 to 3.7	--	--	--	--	--
Molybdenum	µg/L	--	14 of 14	1.4	0.39 to 2.5	--	1 of 1	0.89	0.89 to 0.89	--	1 of 1	1.4	1.4 to 1.4	--	3 of 3	0.70	0.35 to 1.06	0	11 of 11	0.46	0.21 to 0.75	--	1 of 1	1.7	1.7 to 1.7	--
Nickel	µg/L	52[(2)]	7 of 18	0.53	<0.25 to 1.4	0	2 of 4	0.52	<0.25 to <0.25	0	0 of 2	0.25	<0.25 to <0.25	0	2 of 5	0.49	<0.3 to 0.92	0	5 of 15	0.52	<0.25 to 1.7	0	1 of 2	0.42	<0.25 to 0.59	0
Selenium	µg/L	5.0	3 of 11	0.49	0.37 to 0.59	0	0 of 4	0.50	<0.50 to <0.50	0	0 of 1	0.50	<0.50 to <0.50	0	1 of 5	0.43	<0.1 to 0.53	0	3 of 11	0.40	<0.10 to 0.50	0	0 of 2	0.50	<0.50 to <0.50	0
Silver	µg/L	1.0[(2)]	0 of 8	0.10	<0.10 to <0.10	0	0 of 1	0.10	<0.10 to <0.10	0	0 of 1	0.10	<0.10 to <0.10	0	0 of 3	0.10	<0.1	0	0 of 7	0.10	<0.10 to <0.10	0	0 of 1	0.10	<0.10 to <0.10	0
Thallium	µg/L	0.56	2 of 17	0.03	<0.0002 to 0.10	0	0 of 4	0.001	<0.0002 to 0.003	0	0 of 2	0.0006	<0.0002 to 0.001	0	0 of 4	0.00	<0.001	0	4 of 14	0.01	<0.0002 to 0.016	0	0 of 2	0.001	<0.0002 to 0.003	0
Zinc	µg/L	120[(2)]	0 of 18	3.0	<3.0 to <3.0	0	1 of 4	4.5	<3.0 to 8.9	0	0 of 2	3.0	<3.0 to <3.0	0	1 of 5	4.2	<3 to 9.0	0	3 of 15	7.0	<3.0 to 42.4	0	0 of 2	3.0	<3.0 to <3.0	0

Source: Barr 2013b.

Note: Values in bold indicates an exceedance of surface water quality standards.

[1] Sulfate standard of 10 mg/l applies to designated "waters supporting the production of wild rice."

[2] Water Quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 100 mg/L.

[3] Predicted values represent total aluminum concentrations, while the water quality standard is for dissolved aluminum. Since aluminum has a very low solubility in water under relatively neutral pH conditions, it is expected that the predicted aluminum concentration would meet the surface water standard (see discussion in Section 4.1.2.2).

[4] Mean includes non-detects at half the detection limit.

[5] Results from *Additional Baseline Monitoring for Sulfate and Methyl Mercury in the Embarrass River Watershed* (July – November 2009, Table 1).

Lower Embarrass River

Approximately 4 miles downstream from monitoring station PM-13, the Embarrass River flows through the Sabin, Wynne, Embarrass, and Esquagama lakes, known locally as the chain of lakes. In addition to the previously discussed Embarrass River monitoring, PolyMet also conducted limited water quality monitoring for sulfate and chloride in Sabin Lake (PM-21 and PM-23), Wynne Lake (PM-22 and PM-24), and Embarrass Lake (EL-1 and EL-2) in 2010 and 2011 (see Figure 4.2.2-1). Samples were taken at the inlet to each lake and near the center of each lake at multiple depths: surface, middle, and near-bottom. Additional monitoring was performed at PM-21 for total and dissolved aluminum (PolyMet 2013j).

The average surface sulfate concentration in Sabin Lake was 12.4 mg/L with concentrations increasing with depth. The northernmost tip of Wynne Lake is subject to the 10 mg/L sulfate standard for waters used for the production of wild rice. The monitoring shows that the lake exceeds this standard (average surface concentration 16.0 mg/L at PM-22 and PM-24) and that concentrations increase with depth. Embarrass Lake is also subject to the 10 mg/L sulfate standard for waters used for the production of wild rice. The monitoring shows that the lake exceeds this standard (average surface concentration 19.9 mg/L at EL-1 and EL-2). The data generally shows little fluctuation through the sampling period for all three lakes. The increasing sulfate concentrations through the chain of lakes suggest that there is additional sulfate coming from other sources; however, monitoring did not identify specific sources (PolyMet 2013j). Section 4.2.2.1.3 discusses additional sulfate monitoring conducted as part of wild rice and water quality monitoring surveys.

Several lakes downstream of the NorthMet Project area within the chain of lakes are on the 303(d) list for “mercury in fish tissue” impairment, including Sabin, Wynne, Embarrass, and Esquagama lakes (see Figure 4.2.2-1). Further downstream, most of the St. Louis River is also listed for “mercury in fish tissue” impairment. These lakes and the St. Louis River are not covered by the Statewide Mercury TMDL, but are impaired waters that are still in need of a TMDL pollution reduction study. These waters are not included in Minnesota’s regional mercury TMDL because the mercury concentrations in the fish are considered too high to be returned to Minnesota’s mercury water quality standard. Similar to other lakes in Minnesota, the main source of the mercury is atmospheric mercury deposition. A TMDL study of these waters is needed to determine what actions are required to reduce the mercury concentration in fish.

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4.2.3 Wetlands

Wetlands in Minnesota are protected under federal and state laws, including Section 404 of the federal Clean Water Act (CWA), the State of Minnesota's Wetland Conservation Act (WCA), the MDNR's Public Waters Work Permit Program, and the MPCA's Wetland Standards and Mitigation Rules (*Minnesota Rules*, part 7050.0186). In addition, a DA permit pursuant to Section 404 of the CWA is not valid until the state has either certified under Section 401 of the CWA that the discharges comply with state water quality standards or waived the 401 certification requirements. For metallic mineral mining, WCA requirements are addressed under the MDNR Permit to Mine.

The state and federal programs that regulate effects on wetlands differ with respect to the types of resources over which each agency will assert jurisdiction. For example, under the state WCA, "incidental" wetlands are not jurisdictional, but those wetlands may be subject to the permitting requirements of Section 404 of the CWA at the federal level. Under the federal CWA, wetlands that do not have a continuous surface connection or a significant nexus to a traditionally navigable water are not regulated under the CWA but those wetlands may be regulated under the WCA. Although there are wetlands within the NorthMet Project area that may be regulated exclusively under state law, or conversely, exclusively under federal law, all of the wetlands in the NorthMet Project area would be regulated under either the CWA or the WCA, with the exception of two wetland areas that would not be regulated by either program as a result of being located within an actively permitted waste storage facility. These two wetland areas are discussed under Section 4.2.3.2 below.

The required public notice to fulfill requirements for Section 404 permitting and Section 401 certification was originally issued by the USACE in May of 2005. MPCA did not exercise its right to review the NorthMet Project Proposed Action under Section 401 of the CWA at that time; therefore, certification of the original NorthMet Project Proposed Action was waived by default. However, due to the revised NorthMet Project Proposed Action, PolyMet will submit a revised permit application, and the public notice for the Section 404 application will be reissued when the SDEIS becomes available. MPCA will have the opportunity to conduct a Section 401 certification review of the revised application during the reissued public notice.

The wetland section for the NorthMet Project Proposed Action includes a discussion of the Mine Site and Plant Site, as well as Area 1 and Area 2. Area 1 and Area 2 represent the wetland boundaries that were developed and evaluated in 2010 and 2011 for the indirect effects on wetlands and are exclusive to this environmental resource section. The USACE determined that there was a need to evaluate and classify wetland types in the areas surrounding the Mine Site (Area 1) and the Plant Site (Area 2) with the potential for indirect hydrologic wetland effects (Barr 2011d). The Area 1 boundary extends beyond the Mine Site boundary and includes 23,927.4 acres. Area 1 encompasses the Mine Site, the federal lands, and the majority of the Transportation and Utility Corridor, as well as adjacent lands. Area 2 encompasses 19,396.7-acre area just north and northwest of the Plant Site.

Detailed wetland field delineation/mapping was performed in 2004, and supplemented in 2005, 2006, 2007, 2008, and 2010 (Barr 2006d; Barr 2007c; Barr 2008k; Barr 2011d; PolyMet 2013b). These investigations delineated and mapped the portion of each wetland located within the Mine

Site, Area 1, Area 2, Plant Site, and the adjoining federal lands (see Section 4.3.3.1.1 for the federal lands discussion).

The NorthMet Project area includes 177 wetlands covering 1,584.9 acres (see Figure 4.2.3-1). The percentage of wetland types identified in the NorthMet Project area include: coniferous bog (55 percent); shrub swamp (12 percent), which includes alder thicket and shrub-carr; shallow marsh (12 percent); coniferous swamp (9 percent); deep marsh (7 percent); sedge/wet meadow (3 percent); open bog (1 percent); hardwood swamp (1 percent); and open water (less than 1 percent) (PolyMet 2013b). Within the NorthMet Project area, 105 of the 177 wetlands (59 percent) are rated as high-quality, 12 wetlands (7 percent) are rated as moderate-quality, and 60 wetlands (34 percent) are rated as low-quality. The low-quality wetlands are located at the Hydrometallurgical Residue Facility, existing LTVSMC Tailings Basin, and Colby Lake water pipeline corridor. The moderate-quality wetlands are located at the Mine Site, existing LTVSMC Tailings Basin, and Colby Lake Water Pipeline Corridor. Wetlands at the Mine Site, and Transportation and Utility Corridor are ranked as high-quality.

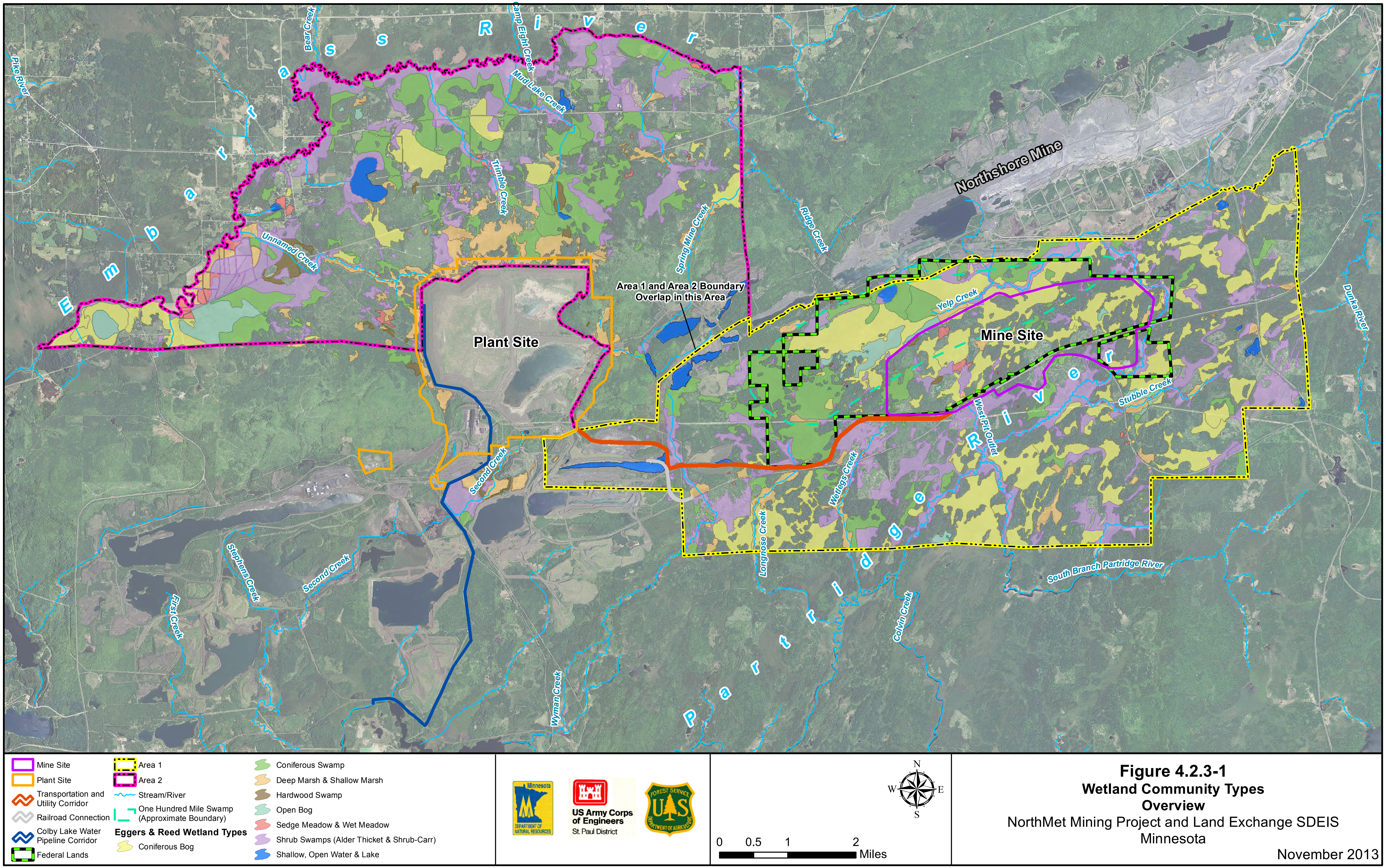

Figure 4.2.3-1
Wetland Community Types
Overview
NorthMet Mining Project and Land Exchange SDEIS
Minnesota
November 2013

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4.2.3.1 Mine Site and Transportation and Utility Corridor

The Mine Site is 3,014.5 acres (see Figures 4.2.3-1, 4.2.3-2, and 4.2.3-3) and is located in the Partridge River drainage, about 3 miles south of Iron Lake and the Laurentian Divide. The Partridge River is located in the East St. Louis River Watershed, which discharges into Lake Superior. The Transportation and Utility Corridor (120.1 acres), which includes the Railroad Connection Corridor, is discussed below (see Figures 4.2.3-1 and 4.2.3-4). The following sections provide baseline information on the Mine Site, Transportation and Utility Corridor, and Area 1.

4.2.3.1.1 Wetland Delineation and Classification

Wetland characterization, mapping, and surveys for the Mine Site, Transportation and Utility Corridor, and Area 1 were conducted between 2004 and 2010 (Barr 2006d; Barr 2007c; Barr 2008k; Barr 2011d; PolyMet 2013b). Wetland acreages were determined using USGS topographic and USFWS National Wetlands Inventory (NWI) maps, aerial photographs, soil survey data, and field investigations.

Wetlands on the Mine Site were initially mapped in June 2004 based on a general field survey of the area for wetland and upland habitats potentially used by various species of fish and wildlife. Wetland and upland plant communities were mapped on 1997 infrared aerial photographs of the site. A wetland delineation of the Mine Site and lands surrounding the Mine Site was subsequently conducted in August 2004, June 2005, and July 2006. Wetland boundaries were identified using the 1987 USACE Wetland Delineation Manual (USACE 1987) routine wetland delineation procedures. Wetland boundaries were field-mapped using Global Positioning System (GPS), aerial photographic interpretation, topography, and soils information.

Along Dunka Road and other possible transportation routes, field studies were conducted to determine wetland boundaries, vegetation cover types, and plant species composition of identified wetlands. For areas outside of Dunka Road and possible transportation routes, wetlands were mapped primarily based on the presence of photographic signatures with limited field-truthing and GPS locating.

Subsequent to publication of the DEIS, baseline wetland types were re-evaluated. Additional field visits were conducted from April to October 2010, in addition to further mapping efforts. A Wetland Impact Assessment Planning (IAP) Workgroup was formed and facilitated the refinement of the wetland resource mapping efforts. In addition to the ground surveys, wetlands were evaluated during a helicopter reconnaissance in October 2010. Photographs were taken during the aerial reconnaissance using a GPS-equipped digital camera from a distance of 20 to 100 ft above the ground.

In 2010 and 2011, a baseline wetland evaluation was conducted using information from studies and surveys undertaken between 2004 and 2010. Wetlands were evaluated and classified in the areas around the Mine Site and the existing LTVSMC Tailings Basin to determine the potential for indirect hydrologic wetland effects using the Eggers and Reed (1997) community classification system, as determined by the wetland workgroup. This system classifies the wetlands into 15 unique plant communities (see Table 4.2.3-1).

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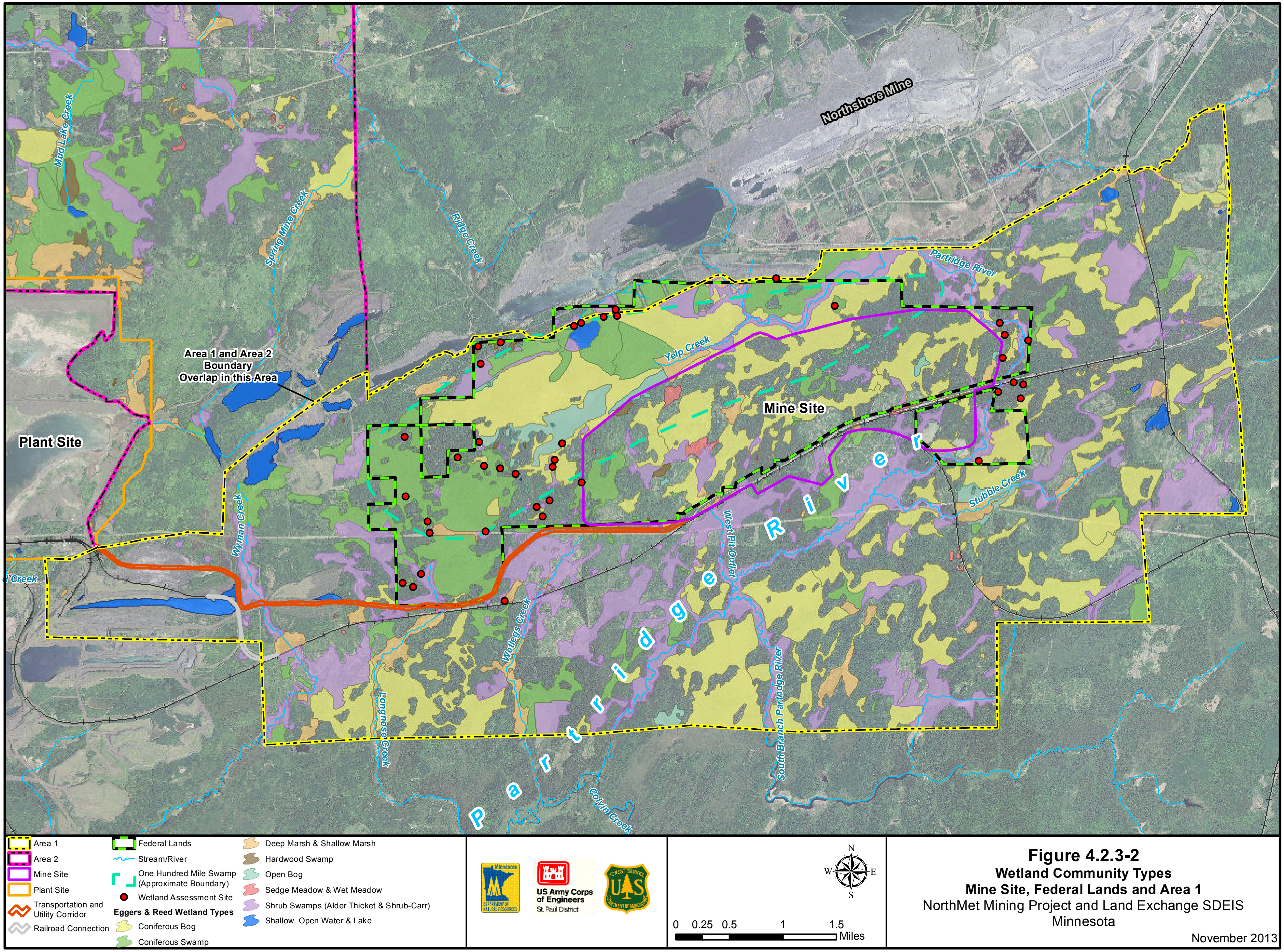

Figure 4.2.3-2
Wetland Community Types
Mine Site, Federal Lands and Area 1
NorthMet Mining Project and Land Exchange SDEIS
Minnesota

November 2013

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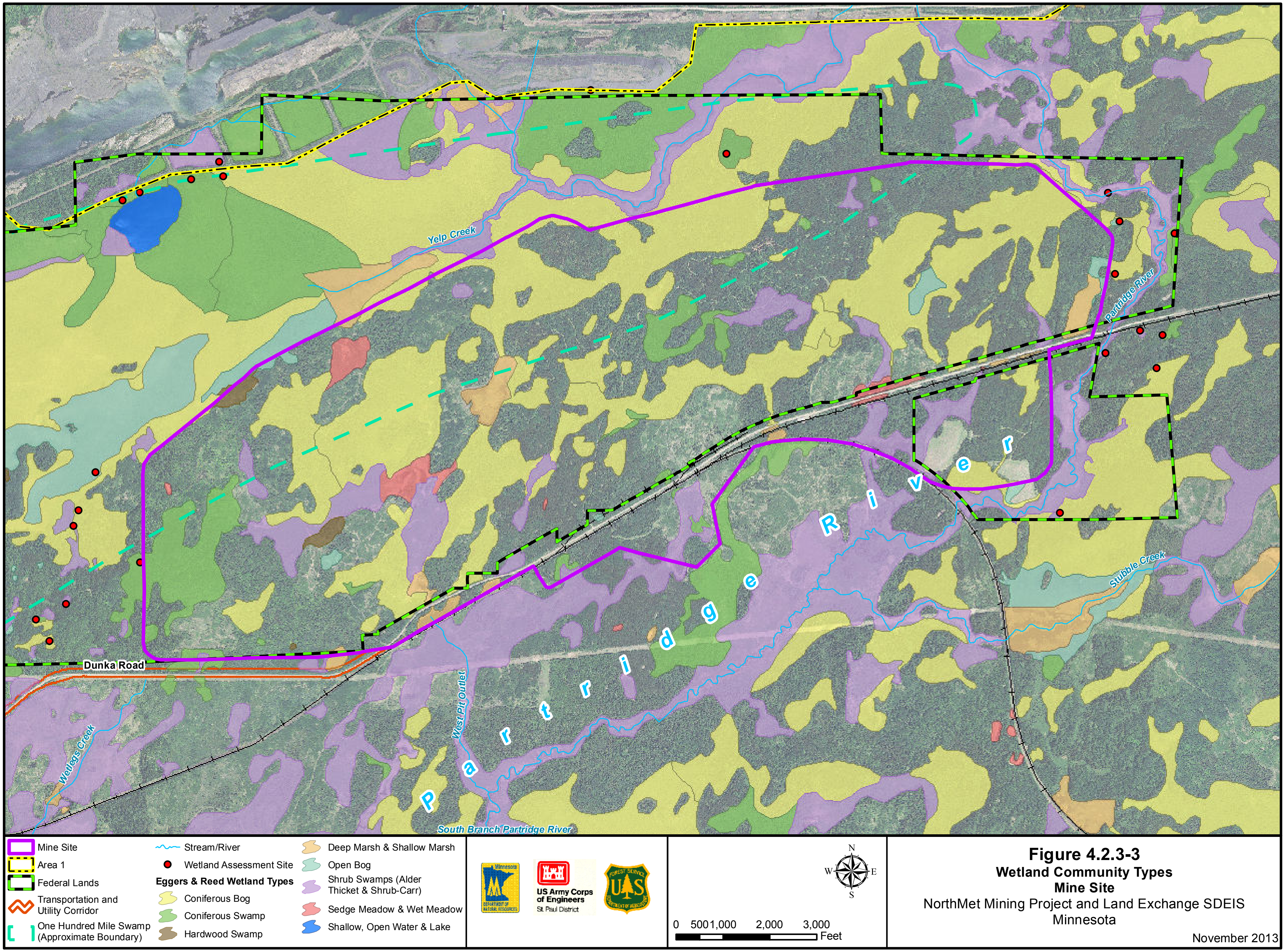

Figure 4.2.3-3
Wetland Community Types
Mine Site
NorthMet Mining Project and Land Exchange SDEIS
Minnesota
November 2013

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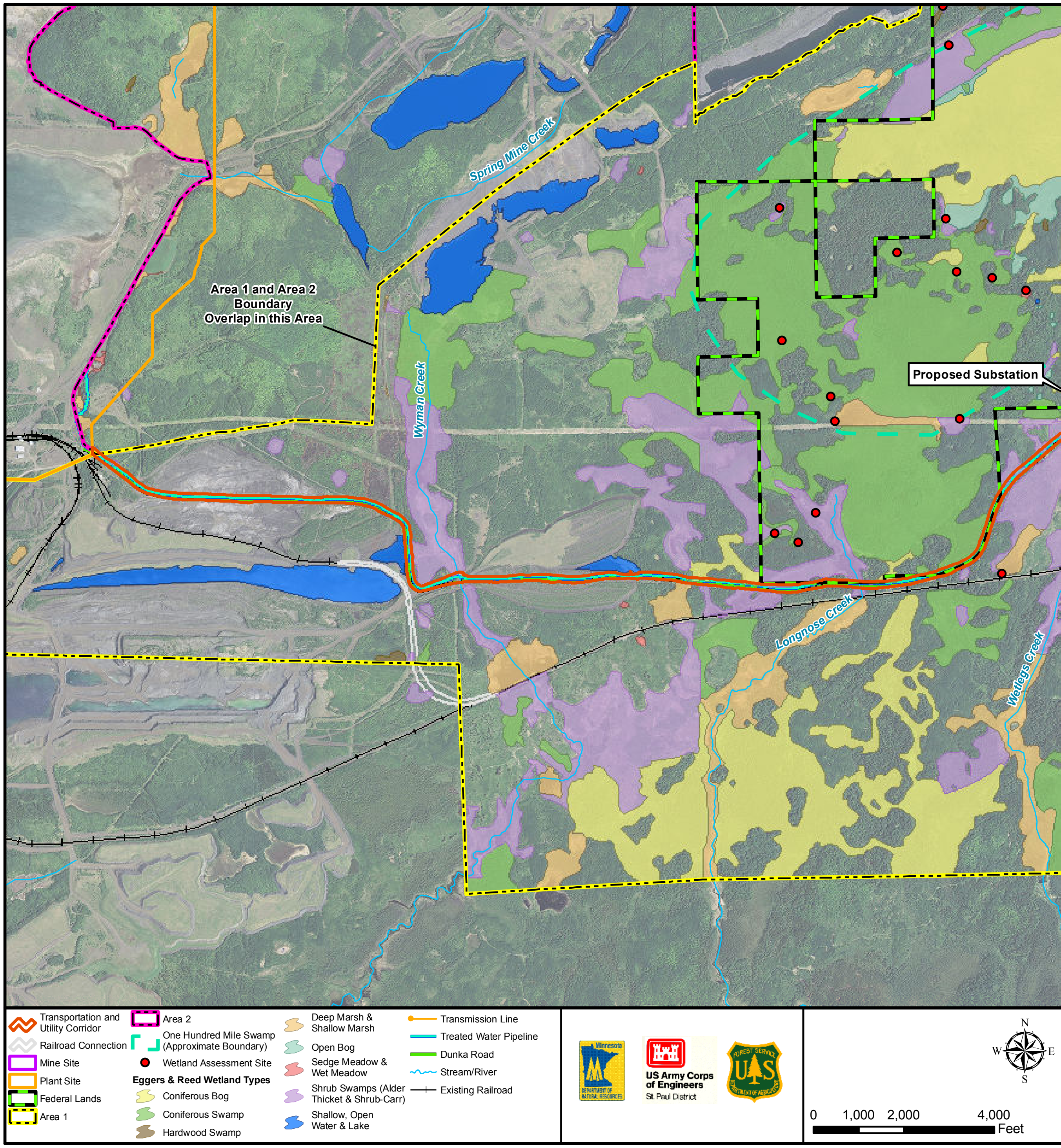

Figure 4.2.3-4
Wetland Community Types
Transportation and Utility Corridor
NorthMet Mining Project and Land Exchange SDEIS
Minnesota

November 2013

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Table 4.2.3-1 Wetland Classification System Descriptors

Wetland Plant Community Types[1]	Water Depth	Soils	Common Vegetation
Shallow, open water	6.6' deep; permanently inundated	Lacustrine deposits and sediments	Pondweed, duckweed, coontail, water milfoil, water lily
Deep marsh	6" to > 3' deep; permanently to semi-permanently inundated	Lacustrine deposits	Cattail, reed, bulrush, pickerelweed, giant bur-reed, Phragmites, spikerush, wild rice, pondweed, naiad, coontail, water milfoil, waterweed, duckweed, water lily, spatterdock
Shallow marsh	Saturated soils to < 6" deep	Organic or mineral	Manna grass, spikerush, cattail, arrowhead, lake sedge, pickerelweed, smartweed
Sedge meadow	Saturated soils	Organic	Sedges-dominant; spike rush, bulrush, nut grass, Canada blue-joint grass, true rush, forbs
Fresh (wet) meadow	Saturated soils	Mineral or organic	Grass and forbs-dominant; redtop, reed canary grass, manna grass, prairie cordgrass, mint
Wet to wet-mesic prairie	High groundwater table < 12" during portion of growing season	Mineral	Native grasses and forbs-dominant; prairie cordgrass, big bluestem, aster, culver's root, sunflower
Calcareous fen	Upwelling, calcareous, groundwater discharge	Organic alkaline	Calciphiles-dominant; shrubby cinquefoil, sterile sedge, wild timothy, beaked spike rush, Riddell's goldenrod, common valerian, lesser fringed gentian
Open bog	Saturated	Organic acid	Continuous sphagnum moss mat present; scattered immature (dbh < 6 in) black spruce or tamarack, ericaceous shrubs, sedges and forbs, such as pitcher plants
Coniferous bog	Saturated	Organic acid	Continuous sphagnum moss mat present; mature (dbh > 6 in) black spruce or tamarack, ericaceous shrubs, sedges and forbs such as pitcher plants
Shrub-carr	Saturated to seasonally flooded	Organic or mineral	Woody vegetation < 20 ft high and dbh < 6 in dominated by willows and/or dogwoods with various sedges, grasses and forbs
Alder thicket	Saturated to seasonally flooded	Organic or alluvial	Woody vegetation < 20 ft high and dbh < 6 in dominated by speckled alder with various sedges, grasses and forbs
Hardwood swamp	Saturated to < 12" deep during most of growing season	Organic alkaline	Continuous sphagnum moss mat absent; black ash, red maple, yellow birch, silver maple, aspen, American elm, dogwood, alder and various sedges, grasses and forbs
Coniferous swamp	Saturated to < 12" deep during most of growing season	Organic ranging from acid to alkaline	Continuous sphagnum moss mat absent; northern white cedar, tamarack, balsam fir, birch, black ash, alder and various sedges, grasses and forbs

Wetland Plant Community Types[1]	Water Depth	Soils	Common Vegetation
Floodplain forest	Inundated during flood events; somewhat well-drained during growing season	Alluvial	Silver maple, green ash, river birch, plains cottonwood, American elm, black willow, jewelweed, nettle
Seasonally flooded basin	Poorly drained; inundated for a few weeks during the growing season	Mineral	Smartweed, beggartick, nut-grass, wild millet and other annual species

Source: Eggers and Reed 1997; Barr 2011d.

dbh = Diameter at breast height

[1] All wetland classification systems have some limitations; however, wetlands identified as open bogs or coniferous bogs under the Eggers and Reed (1997) classification system were further subcategorized as either ombrotrophic (hydrology and mineral inputs entirely from direct precipitation) or somewhat minerotrophic (some degree of mineral inputs from groundwater and/or surface water runoff) (Eggers 2011a; PolyMet 2013b). See Section 4.2.3.1.2 and Section 5.2.3 for more information.

Wetlands were evaluated within Area 1 and Area 2 (see Figures 4.2.3-1). The boundaries for each evaluation area generally follow the St. Louis County section lines and large streams, including portions of the Partridge and Embarrass rivers. The baseline wetland type evaluation was deemed final by the USACE at the wetland workgroup meeting on March 30, 2011 (Barr 2011d). Updates to previous wetland delineations were made between April 2011 and the fall of 2012 as a result of additional site visits and aerial photograph review. Wetland boundaries and types were further refined (PolyMet 2013b).

Prior to conducting the various field delineations, numerous sources of existing information were gathered and reviewed to assist in developing a strategy for evaluating wetlands within the NorthMet Project area. Wetlands within Area 1 and Area 2 that were not delineated between 2004 and 2010 were also identified and classified using the following sources:

- Farm Service Administration true color aerial photographs between 2003 and 2010;
- Farm Service Administration color infrared aerial photographs (2003 and 2008);
- USFWS NWI maps;
- Superior National Forest USFS stand data GIS shapefile (Area 1 only);
- USFS Ecological Land Type (ELT) soils data (where available);
- Natural Resources Conservation Service (NRCS) soils data for St. Louis County (where available);
- USGS topographic maps and digital elevation models; and
- MDNR 2005 color infrared photography stereo pairs with 60 percent overlap (Barr 2011d).

During the field surveys, data were collected for the functions and values of the wetlands within the Mine Site. Wetland functions and values were rated using the guidelines in the Minnesota Routine Assessment Method (MnRAM) for Evaluating Wetland Functions, Versions 3.0 to 3.2. Final wetland locations and wetland functional assessment areas are shown on Figure 4.2.3-2.

4.2.3.1.2 Hydrology, Wetland Vegetation, and Community Types

The NorthMet Project area is located near the headwaters of the Partridge River and Embarrass River watersheds. The Partridge River is a tributary to the St. Louis River, which is located within the Lake Superior Basin. The Mine Site and Transportation and Utility Corridor are located within the Upper Partridge River Watershed. See Section 4.2.2 for more information on water resources.

Currently, 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. The Partridge River hydrology is affected by the periodic and variable dewatering of the NorthShore Mine pits near the headwaters of the Partridge River, upstream of the proposed Mine Site.

The vegetation types located at the Mine Site are indicative of pre-settlement conditions and lack hydrologic disturbance. The hydrology of the wetlands at the Mine Site has been stable over time (Barr 2008h). Factors contributing to this stability include: 1) the general lack of continuity between the bedrock and surficial aquifers within the perched wetlands, 2) slow water movement through heterogeneous soils, 3) a slow lateral groundwater flow component that helps sustain downgradient wetlands with a continual supply of groundwater over time, 4) recharge from surrounding uplands slowly providing local groundwater discharge to wetlands over time, 5) relatively flat topography across most of the site, and 6) the high water-holding capacity of the soils (Barr 2008h). However, monitoring would detect connectivity trends and reveal potential drawdown issues, which would then be mitigated as direct effects.

The hydrogeologic setting of the Partridge River watershed consists of a thin veneer of heterogeneous unconsolidated deposits (glacial till) underlain by fractured bedrock (Duluth Complex in most of the Mine Site and Virginia Formation in the northern portion of the Mine Site). In the Mine Site, saturated conditions exist within the unconsolidated deposits and bedrock and the depth to groundwater is typically less than 10 ft. The water table is generally a subdued replica of the land surface, with groundwater divides in the Mine Site expected to roughly coincide with surface water divides. Wetlands cover approximately 43 percent of the Mine Site.

Because of the general lack of interaction between the surficial and bedrock aquifers, the hydrology of many wetlands at the Mine Site is primarily supported by direct precipitation with some variable surficial groundwater components from the uplands. Organic and mineral soils at the Mine Site are typically perched over the dense till or a local sandy textured surficial aquifer, resulting in perched wetlands. The primary method for water to move across the landscape towards the Partridge River is either by lateral flow that is either on the surface or within the subsurface soil. Surface flow laterally across the wetland complexes is negligible because of the flat slopes and surface roughness. The wetlands on the site receive minimal surficial runoff from the upland areas because the soil texture allows rapid infiltration (Barr 2008h). The bedrock has low primary permeability, so groundwater flow within the bedrock is through fractures or other secondary porosity features. Because of the low permeability of the bedrock, the interaction between the surficial deposits and the bedrock aquifers is assumed to be insignificant, according to Siegel and Ericson (1980) (Barr 2010d).

Lateral flow within the soils is typically very slow. Fibric peat at the surface allows infiltration of surficial water; however, the more highly decomposed sapric peat has greatly reduced lateral and vertical hydraulic conductivity compared to the fibric peat. Therefore, water tends to stay perched and stored within the large peat complexes, which typically exhibit only subtle variations in the water tables over time. The silty sand or clay that typically underlies the organic soil has low hydraulic conductivity and, therefore, is a contributing factor that helps maintain the hydrology of the wetlands. The silty sands are sands mixed with clay and silt that are not permeable enough to be used as drainage sands (Barr 2008h).

The soils and hydrology at the Mine Site support stable wetland systems comprised in large part by open and coniferous bogs, as well as shrub carr/alder thickets dominated by alder and willow species, and forested wetland communities comprised of hardwood swamps and coniferous swamps. Most of the wetland vegetation present at the Mine Site (69 percent) is indicative of acid peatland systems (i.e., open and coniferous bogs) that are dependent on precipitation rather than groundwater for hydrologic inputs and reflect a perched water table. Potential effects are discussed in Section 5.2.3.

The soils at the Mine Site have been mapped by the USFS using the Superior National Forest Ecological Classification System (ECS). This system utilizes ELTs. ELTs present at the Mine Site include Lowland Loamy Moist (ELT 1), Lowland Loamy Wet (ELT 2), Lowland Organic Acid to Neutral (ELT 6), and Upland Shallow Loamy Dry (ELT 16). With the exception of the Wahlsten-Eaglenest-Rock outcrop complex (ELT 16), all the soils associated with these ELTs are listed as hydric soils (USDA 2012). These ELTs have been cross-correlated by the University of Minnesota with the NRCS classification as follows:

- ELT 1 – Babbitt-Bugcreek complex 0 to 2 percent slope;
- ELT 2 – Bugcreek stony loam;
- ELT 6 – Rifle-Greenwood; and
- ELT 16 – Wahlsten-Eaglesnest-Rock outcrop complex, 2 to 8 percent slopes and Eveleth-Conic Rock complex.

Pre-NorthMet Project Proposed Action wetland hydrology monitoring reports, to meet reporting requirements, have been compiled and document 5 years of pre-project planning and monitoring at the Mine Site (2005 to 2009). PolyMet has continued to conduct wetland hydrology monitoring at the Mine Site since 2009. Future wetland hydrology monitoring reports would be submitted in accordance with any permit issued. The degree of hydraulic connection between the wetland areas and adjacent unconsolidated deposits and bedrock at the Mine Site is expected to be variable, depending on the characteristics of the wetlands and the localized hydraulic conductivity and degree of bedrock fracturing. The hydraulic conductivity of the bedrock and surficial deposits have been estimated at the Mine Site by a variety of methods, including conducting aquifer tests and using grain-size distribution data from soil borings and ranges over several orders of magnitude. Data collected during a 30-day pumping test at the Mine Site showed a small amount of drawdown in the deep wetland piezometer nearest to the pumping well, but there was no detectable drawdown at other water table or deep wetland piezometers, indicating that the connection between the bedrock, unconsolidated deposits, and wetlands may be relatively weak. Virtually all water movement in peat wetlands occurs horizontally in the upper layers of peat. The deeper, more decomposed peat soils limit vertical seepage because of the low hydraulic conductivities (approximately 0.0028 ft/day) and the wetland hydrology is simply perched on the relatively impermeable peat layer. Vertical seepage losses from wetlands without peat soils would only have the potential to occur in isolated areas of contiguous, high hydraulic conductivity bedrock faults and fracture zones located under isolated areas of high hydraulic conductivity glacial till and aligned with wetlands containing high hydraulic conductivity soils (Barr 2010d; Barr 2011j). There is a surface drainage divide oriented generally from southwest to northeast near the northern border of the Mine Site. The majority of the Mine Site, approximately 80 percent, drains south to the Partridge River through extensive wetland complexes. The remaining 20 percent of the Mine Site drains north to the One Hundred Mile Swamp and the Partridge River or northeast to the Partridge River. The 2005 to 2009 wetland hydrology monitoring has determined the following (Barr 2010d):

- The four full years of monitoring wetland well data indicated that the large fluctuations in water levels exhibited within the majority of the wetlands are indicative of wetlands supported primarily by precipitation and local surface runoff. The hydrology of these wetlands tends to fluctuate in a pattern that closely mirrors weather patterns. The shrub swamp wetlands located near the downstream portion of the project generally show more stable water levels due to larger watershed areas and some apparent groundwater inflow. The groundwater flowpaths are generally short with recharge areas (uplands) located close to the discharge areas (wetlands). Surface water runoff and local groundwater contributions from uplands can cause increased mineral content within the water in adjacent wetlands. Wetlands that are solely dependent on precipitation for their hydrology are classified as ombrotrophic and would likely not be susceptible to effects from groundwater drawdown associated with mining operations (Eggers 2011a). Potential effects are discussed in Section 5.2.3.

- There is a general lack of connectivity between the shallow water table in the wetlands and the deeper bedrock aquifer. The depth of soil and till overlying the bedrock ranges up to 33 ft, with bedrock outcrops present that alter local groundwater flowpaths. A pumping and isotope test conducted in 2006 indicated that the groundwater pumped during a 30-day pump test was derived from aquifer recharge rather than surface water seepage from surface water features such as the Northshore Mine Pit or wetlands. The variability of the bedrock and soil surface, along with the location of the surface water divide, creates localized, short, surficial groundwater flowpaths within the watersheds on the Mine Site.

- From 2005 to 2009, the maximum water level fluctuation was less than 12 inches in two wetlands (58 and 114) and between 12 and 18 inches in all other wetlands. Wells located in the southwest and south-central areas of the Mine Site show the greatest range of water table fluctuations, while wells in the northwest area of the Mine Site show the least fluctuation. The wetlands on the Mine Site exhibit stable year-to-year water levels and elevations. Water levels in all wells fluctuated in direct response to precipitation events, with the exception of one well in 2008 and 2009 and one well in 2009. These two wells showed stability indicative of contributing discharge from the larger upstream watersheds.

- The hydrographs in the monitored black spruce and tamarack dominated wetlands (coniferous bogs) exhibited a stable water table with some fluctuations indicative of saturated, precipitation-driven hydrology (i.e., rapid response to precipitation with mid-summer drawdown).

Wetlands were found to consist predominantly of coniferous bog, shrub swamp, and coniferous swamp. Other wetlands include shallow marsh, sedge/wet meadow, open bog, and hardwood swamps. The largest wetland complex near the Mine Site is the One Hundred Mile Swamp (see Figure 4.2.3-2). The swamp is drained by Yelp Creek, which flows east into the Partridge River. The Partridge River flows to the north of the Mine Site and then through the eastern and southeastern portions of the adjoining federal lands. In addition, several impounded wetlands associated with past mine workings and detention ponds were found during the field work along the northern boundary of the adjoining federal lands. These wetlands are best classified as precipitation-driven wetlands on low-permeability soils. Several wetlands have been enlarged due to damming of streams by beaver dams, and other obstructions along the Partridge River have helped to raise water levels that resulted in stands of dead and dying spruce along portions of the river (AECOM 2011a).

The coniferous bog communities have a tree canopy of black spruce and tamarack with occasional balsam fir, while stunted forms of these species may exist in open bog communities. White cedar and deciduous swamp birch are also occasionally found in this community. Shrubs are usually ericaceous (belonging to the heath family) species such as leatherleaf, bog-Labrador tea, and cranberry. Sphagnum moss comprises an almost continuous mat with interspersed, non-dominant forbs such as bunchberry and blue bead lily along with sedges and grasses. Hydrologically, this complex is characterized by a relatively stable year-to-year water table (Barr 2006e; Barr 2010d). All but one of the coniferous bogs identified at the Mine Site are rated as high-quality in accordance with the MnRAM for Evaluating Wetland Functions. This wetland has some fill and therefore was rated as moderate quality.

Wetlands hydrology can be driven by precipitation, or by groundwater, or a combination or both. Wetlands identified as open bogs or coniferous bogs under the Eggers and Reed (1997) classification system can be further subcategorized as either ombrotrophic (hydrology and mineral inputs entirely from direct precipitation) or somewhat minerotrophic (some degree of mineral inputs from groundwater and/or surface water runoff). This is important because ombrotrophic bogs would likely not be affected by groundwater drawdowns associated with proposed mining operations, whereas more minerotrophic bogs would have a higher likelihood of being affected (Eggers 2011a).

An assessment of wetland types within the NorthMet Project area was conducted to distinguish between open and coniferous bogs that are entirely precipitation driven (ombrotrophic peatlands) versus those with some degree of mineral inputs from groundwater and/or surface water runoff (minerotrophic peatlands). Ombrotrophic peatlands develop from minerotrophic peatlands when conditions allow *Sphagnum* peat to accumulate to levels above the groundwater table. Once the peat is above the water table, surface water flows away from or around the elevated peat surface, which reduces inputs of minerals and nutrients (Eggers 2011a). Of the 149 coniferous and open bogs within the Mine Site/Area 1 boundaries, 144 are ombrotrophic and five are minerotrophic (PolyMet 2013b).

The shrub communities generally have a sparse tree canopy and are mostly alder thickets, with some willow and raspberry. Occasionally, balsam fir and paper birch were observed along the perimeter of the wetlands. Grasses, sedges, rushes, and some ferns comprise most of the herb stratum with some areas of sphagnum moss. Hydrologically, this community can be characterized by prolonged periods of shallow inundation with the water table dropping 6 to 12 inches below the ground surface during dry periods (Barr 2006e). Soils are typically fibric (i.e., the least decomposed of the peats and containing un-decomposed fibers) and hemic peat (i.e., peat that is somewhat decomposed) at the surface underlain by bedrock or mineral soils. All of these wetlands are rated as high-quality.

The forested swamp communities (coniferous swamps and hardwood swamps) are dominated by a mix of coniferous (conifers) and deciduous (hardwood) forest complexes. Common trees include black spruce, tamarack, and balsam fir, with some white cedar, black ash, paper birch, and aspen present. The shrub canopy is comprised of speckled alder, willows, and raspberry. Grasses and sedges comprise a majority of the ground story stratum with occasional sphagnum moss. Soils include organic and mineral soils. Some hydrologic observations indicate a greater level of hydrologic fluctuation in the forested swamp community than in the larger bog wetlands, with saturation near the surface early in the growing season and a lower water table in late summer (Barr 2006e). All of these wetlands are rated as high-quality.

Sedges, grasses, and bulrushes dominate wet meadow and sedge meadow communities. Soils are organic at the surface and underlain with mineral soils. These plant communities typically have saturated or inundated water levels for prolonged periods during the growing season (Barr 2006e). Two of these communities, situated between Dunka Road and the railroad, are rated moderate-quality, while the others are rated as high-quality.

Approximately one-half of the shallow marsh communities at the Mine Site have resulted from artificial impoundments by roads, railroads, and beavers. These wetlands are dominated by cattails, bulrushes, sedges, and grasses. Soils are usually organic at the surface underlain by mineral soils. Inundation with 1 to 4 inches of water is common throughout most of the growing season except during dry periods. Eight of these shallow marshes are rated as high-quality and four as moderate-quality. Hydrologic disturbance in these four wetlands is primarily responsible for the moderate-quality rating.

The wetland delineation identified 87 wetlands covering 1,297.8 acres (43 percent) within the 3,014.5-acre Mine Site (see Figure 4.2.3-3) (PolyMet 2013b). Table 4.2.3-2, below, summarizes the wetland areas within the Mine Site represented by each Eggers and Reed (1997) wetland community type. A large portion of the wetlands to the west of the Mine Site on the federal lands is located in the floodplains of Yelp Creek and the Partridge River or one of their associated tributaries. The most common wetland types within the Mine Site are coniferous bogs (approximately 67 percent); shrub swamps (approximately 14 percent), which includes alder thicket and shrub-carr; and coniferous swamps (10 percent). A total of seven wetlands, each over 50 acres in size within the Mine Site, comprise 773.7 acres of wetlands within the Mine Site. There are an additional five wetlands, each over 20 acres in size within the Mine Site that comprise 164.5 acres of wetlands. Together, these 12 wetlands make up 72 percent of the wetland areas within the Mine Site (PolyMet 2013b). A total of 79 percent of the wetlands in the Mine Site are coniferous swamp, coniferous bog, and open bog communities.

Other wetland community types present at the Mine Site include shallow marshes, sedge/wet meadows, open bogs, hardwood swamps, and deep marshes. The sedge/wet meadows may receive some portion of their hydrology from groundwater while the shallow marsh community generally results from artificial impoundment by beaver dams, roads, and railroads and is primarily dependent on surface waters for hydrology.

Table 4.2.3-2 Wetland Acreage by Wetland Community Type for Mine Site, Transportation and Utility Corridor, and Area 1

Eggers and Reed Class[1]	Mine Site: Mine Site Federally Managed		Mine Site: Mine Site Private Lands		Mine Site: Mine Site Total		Transportation and Utility Corridor		Area 1[2]	
	acres	%	acres	%	acres	%	acres	%	acres	%
Coniferous bog	869.2	71	4.2	6	873.4	67	0.9	12	4,581.2	41
Coniferous swamp	122.0	10	6.6	10	128.6	10	1.6	22	2,071.9	18
Deep marsh	0.0	0	5.0	7	5.0	<1	0.0	0	220.5	2
Hardwood swamp	12.8	1	0.0	0	12.8	1	0.0	0	26.8	<1
Open bog	17.8	1	0.5	<1	18.3	1	0.0	0	283.1	3
Open Water (includes shallow, open water, and lakes)	0.0	0	0.0	0	0.0	0	0.0	0	245.0	2
Sedge/wet meadow	34.9	3	4.6	7	39.5	3	0.0	0	46.0	<1
Shallow marsh	36.5	3	7.5	11	44.0	3	0.6	8	358.7	3
Shrub swamp (includes alder thicket and shrub-carr)	136.0	11	40.0	58	176.0	14	4.1	57	3,368.0	30
Total	1,229.2	100	68.4	100	1,297.8	100	7.2	100	11,201.2	100

Source: PolyMet 2013b.

1 Eggers and Reed 1997.
2 Area 1 acreage is inclusive of the other project area components (e.g., Mine Site, federal lands).

A total of 25 wetlands, encompassing 7.2 acres, have been identified within the Transportation and Utility Corridor (see Figure 4.2.3-4 and Table 4.2.3-2). The wetlands in the corridor include shrub swamps (57 percent), coniferous swamps (22 percent), coniferous bogs (12 percent), and shallow marshes (8 percent). Some of the wetlands adjacent to Dunka Road have been previously logged. Wetlands in the western half of the Dunka Road and Transportation and Utility Corridor are located within areas previously disturbed by mining activities of the former LTVSMC operations (PolyMet 2013b).

Overall, Area 1 encompasses 465 wetlands covering 11,201.2 acres (see Figure 4.2.3-2), and these 465 wetlands represent approximately 47 percent of the overall area. The total number of wetlands and the amount of wetlands within Area 1 is inclusive of the other project area components (e.g., Mine Site, federal lands wetlands). Table 4.2.3-2, above, summarizes the wetland areas represented by each Eggers and Reed (1997) wetland community type for Area 1 (PolyMet 2013b).

Coniferous bogs are the dominant wetland type present within Area 1, comprising approximately 41 percent of the overall wetland area, while open bogs represent only a small component (approximately 3 percent). Coniferous bogs generally have a tree cover greater than 50 percent, which is typically made up of black spruce and/or tamarack. Forested wetlands that are acid peatlands dominated by dense cover of black spruce and/or tamarack with a more or less continuous carpet of Sphagnum mosses have been classified as coniferous bogs in the Eggers and Reed (1997) classification system. Occasionally, there are areas with balsam fir, jack pine, and northern white cedar present within the large coniferous bog complexes. The open bogs do not support a dense tree cover and it was observed that typically only a scattering of immature black spruce and/or tamarack are present (Barr 2011d).

The shrub layer and ground layer of coniferous bogs and open bogs have similar composition. The shrub layer is typically dominated by ericaceous shrubs such as leatherleaf, bog-Labrador tea, and cranberry. The ground layer herb stratum commonly includes a continuous sphagnum moss mat with various sedges and other herbaceous vegetation also observed. Northern pitcher plants are abundant in the large bog areas that surrounded Mud Lake. Soils in the coniferous bogs and open bogs generally consist of fibric peat that is usually saturated to the surface throughout much of the growing season (Barr 2011d).

Shrub swamps, which include both alder thicket and shrub-carr community types, represent the second most dominant wetland type within Area 1, comprising approximately 30 percent of the overall wetland area. These shrub swamps are dominated by either alder or willow species, with some dogwoods also present. The ground layer was made up of Canada bluejoint grass and various sedge species, with woolgrass, rushes, and ferns also present. Sphagnum mosses may be present but do not typically form a continuous mat within these shrub swamps. Soils in the shrub swamps are usually fibric and hemic peat at the surface underlain by bedrock or mineral soil (Barr 2011d).

Coniferous swamps represent the third-most dominant wetland type within Area 1, comprising approximately 18 percent of the overall wetland area. These swamps are dominated by black spruce and/or tamarack, with balsam fir and northern white cedar. Deciduous tree species, such as aspen, birch and, on a few occasions, black ash, are also observed in some areas. The shrub layer is observed to be typically dominated by alder and willows. The ground layer commonly includes Canada bluejoint grass, sedges, bunchberry, wild sarsaparilla, and starflower. Sphagnum mosses are also present in the ground layer; however, a continuous sphagnum mat is usually absent. Soils in the coniferous swamps are generally organic and are usually saturated to the surface throughout much of the growing season (Barr 2011d).

Although shallow and deep marshes are present within Area 1, they represent a relatively small percentage of the overall wetland area. These wetlands are dominated by cattails, with sedges and Canada bluejoint grass also present. Soils in the shallow and deep marshes are typically organic at the surface and underlain by mineral soils. The shallow marshes are typically inundated with up to 6 inches of water throughout the entire growing season, while the deep marshes are inundated with over 6 inches of water throughout the entire growing season. These wetlands are often associated with disturbances, such as beaver activity (Barr 2011d).

Hardwood swamps are present but not abundant in Area 1. The hardwood swamps that are present are dominated by black ash, aspen, and birch. Coniferous trees, such as balsam fir, black spruce, and northern white cedar are occasionally present in these hardwood swamps. The shrub layer is generally dominated by alder and young trees while the ground layer species present includes Canada bluejoint grass, sedges, and ferns. Sphagnum mosses were also observed; however, they typically did not form a continuous mat. Soils in the hardwood swamps vary between organic or mineral and are usually saturated throughout much of the growing season (Barr 2011d).

Sedge meadow and wet meadow communities are present within Area 1 but represent a very small portion of the total wetland area. These wetlands are dominated by sedges, Canada bluejoint grass, woolgrass, manna grass, and bulrushes. Soils in the sedge meadow and wet meadow communities are typically organic at the surface underlain by mineral soils. These wetlands are generally saturated close to the ground surface or have shallow inundation for prolonged periods during the growing season (Barr 2011d).

4.2.3.1.3 Wetlands Functional Assessment

Wetlands can serve many functions, including groundwater recharge/discharge, flood storage and alteration/attenuation, nutrient and sediment removal/transformation, toxicant retention, fish and wildlife habitat, wildlife diversity/abundance for breeding migration and wintering, shoreline stabilization, production export, aquatic diversity/abundance, vegetative diversity/integrity, and support of recreational activities. Both the USACE and MDNR use MnRAM for rating wetland functions in Minnesota.

MnRAM is an assessment tool designed to assess functions and values of Minnesota wetlands. MnRAM versions 3.0, 3.1, and 3.2 were used to assess wetland functions and values on the Mine Site (Barr 2006d) and the federal lands (AECOM 2011d; AECOM 2011a). Information on the overall functions and values of the wetland and vegetative quality of each wetland community at the Mine Site was obtained during wetland surveys in 2005 and 2006 and included: 1) plant cover and types, 2) plant community diversity and interspersion, 3) outlet characteristics, 4) watershed and adjacent upland land uses and condition, 5) soil condition, 6) erosion and sedimentation, and 7) past and present human disturbance (Barr 2006d).

Landscape characteristics are also important for evaluating wetland functions within the NorthMet Project area. Key landscape wetland characteristics considered in rating functional quality in the MnRAM assessment are provided in Table 4.2.3-3.

Table 4.2.3-3 Key Landscape Factors Influencing Wetland Functional Scores in MnRAM 3.0

MnRAM 3.0 Factor	Role in Wetland Function and Quality
Wetland or Lake Outlet Characteristics	Outlets influence flood attenuation, downstream water quality, and other hydrologic processes
Watershed and Adjacent Land Uses and Condition	Adjacent land uses influence wetland hydrology, sediment and nutrient loading to wetlands, connectivity for wildlife habitat, and other factors
Soil Condition	Soil condition influences plant community type, vegetative diversity, overall wetland quality and productivity (trophic state)
Erosion and Sedimentation	Influences downstream water quality, trophic state of wetlands, vegetative diversity, and overall wetland quality
Wetland Vegetative Cover and Vegetation Types	Influences vegetative diversity and wildlife habitat as well as hydrologic characteristics (e.g., evapotranspiration or resistance to flow in floodplain wetlands)
Wetland Community Diversity and Interspersion	Influences the vegetative diversity and overall wetland quality as well as value for wildlife habitat
Human Disturbance (both past and present)	Mining, logging, road-building, stream channelization, and other alterations to the landscape

Source: MnRAM 3.0.

These broader landscape factors were applied and evaluated on a larger scale than a single wetland because there are soil and vegetation similarities within the sub-watersheds that are characteristic of large groups of similar wetland types. Human disturbance factors were also similar across broad areas, notably that the majority of the Mine Site is relatively undisturbed by humans and the limited disturbance that does exist is due to logging. Other local factors were considered for each wetland or small groups of wetlands.

Approximately 92 percent of the wetlands in the Mine Site are of high overall wetland quality, and 8 percent of wetlands are of moderate overall wetland quality. High-quality wetlands have low disturbance levels and high vegetative diversity and integrity. Moderate-quality wetlands have impounded open water because of beaver dams and downstream culverts under Dunka Road or the railroad, are adjacent to USFS roads, the Dunka Road corridor, or the railroad corridor (PolyMet 2013b). Summaries of the 87 wetlands evaluated for vegetative diversity/integrity and overall functional quality rating (low, moderate, or high) for wetlands at the Mine Site are presented in Table 4.2.3-4. The overall wetland quality rating was based on professional judgment and considered several wetland functions and the overall degree of human disturbance (Barr 2006d). The plant community diversity/integrity ratings incorporate two principal components, integrity and diversity (MnRAM). Diversity refers to species richness (i.e., number of plant species). The more floristically diverse a community is, the higher the rating. Integrity refers to the condition of the plant community in comparison to the reference standard for that community. The degree and type of disturbance typically play an important role in the diversity/integrity rating.

Table 4.2.3-4 Wetland Functions and Value Assessment for the Mine Site from 2004 and 2006

Wetland Functions and Values Rating	Vegetative Diversity/Integrity (%)	Overall Wetland Quality (%)	Existing Disturbance Level (%)
High	75	92	8
Moderate	8	8	5
Low	0	0	70
Not Available	17	0	17
Total	100	100	100

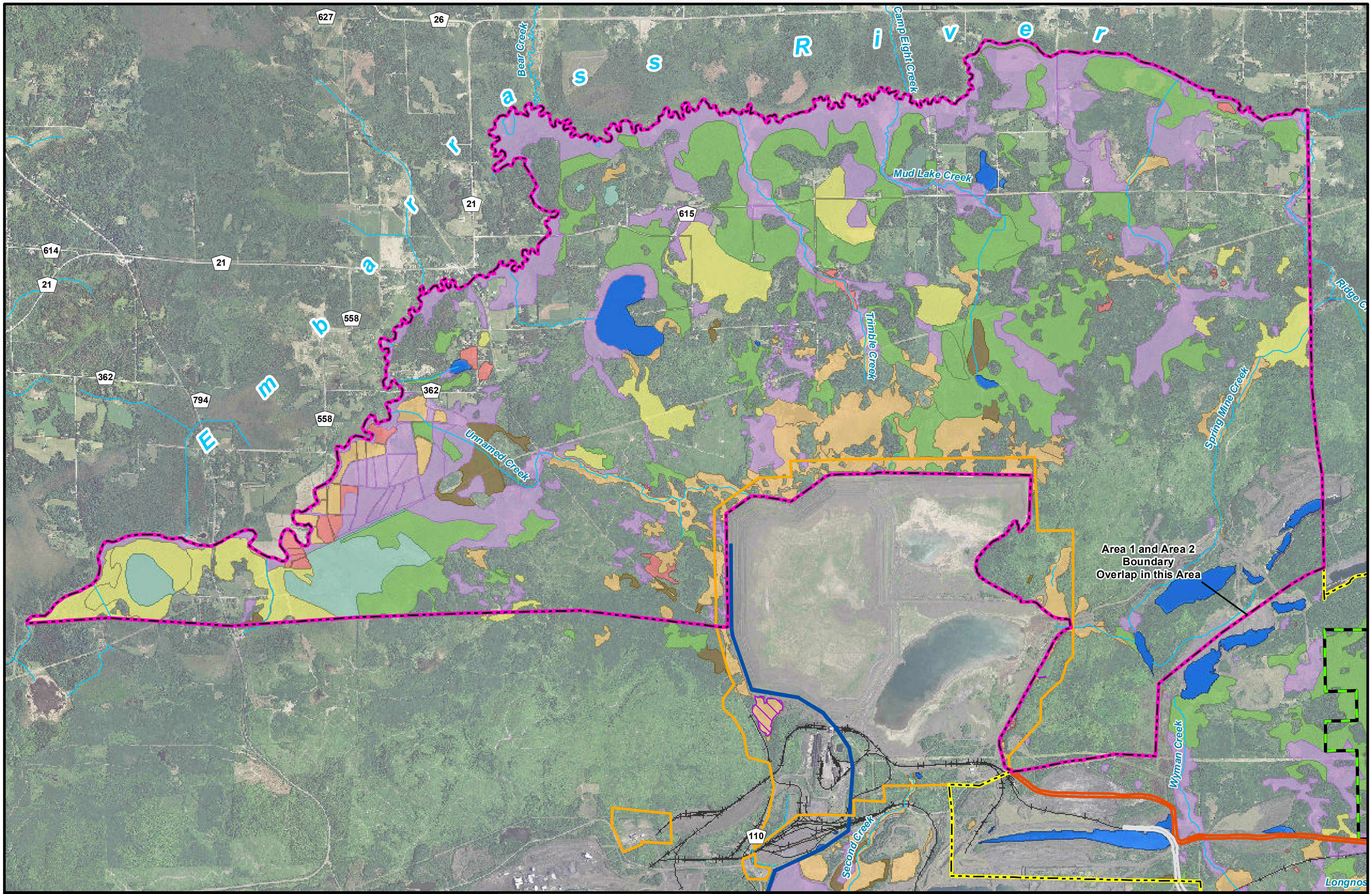
Source: Barr 2006d.

The wetlands along the Transportation and Utility Corridor have all been rated as high-quality. While the wetlands along the Railroad Connection Corridor are moderately affected by either a haul road or an existing railroad, they have a high vegetative diversity/integrity (PolyMet 2013b).

4.2.3.2 Plant Site

4.2.3.2.1 Wetland Delineation and Classification

The Plant Site and Area 2 were delineated and classified using the same methodology as discussed in Section 4.2.3.1.1 above. The Plant Site encompasses 4,514.0 acres, which includes the former LTVSMC processing plant, the existing LTVSMC Tailings Basin, Area 1 Shops, the Hydrometallurgical Residue Facility, and the administration buildings. Area 2 encompasses about a 19,396.7-acre area just north and northwest of the existing LTVSMC Tailings Basin (see Figures 4.2.3-1, 4.2.3-5, and 4.2.3-6). In addition, the Colby Lake water pipeline corridor (50.6 acres) is included within this discussion (see Figure 4.2.3-7).



Area 1
Area 2
Plant Site
Transportation and Utility Corridor
Colby Lake Water Pipeline Corridor
Federal Lands
Stream/River
Exempt Wetland

Eggers & Reed Wetland Types
Coniferous Bog
Coniferous Swamp
Deep Marsh & Shallow Marsh
Hardwood Swamp
Open Bog
Sedge Meadow & Wet Meadow
Shrub Swamps (Alder Thicket & Shrub-Carr)
Shallow, Open Water & Lake

Minnesota Department of Natural Resources
US Army Corps of Engineers St. Paul District
Forest Service U.S. Department of Agriculture

0 0.25 0.5 1 1.5 Miles

Figure 4.2.3-5
Wetland Community Types
Area 2 and Plant Site
NorthMet Mining Project and Land Exchange SDEIS
Minnesota

November 2013

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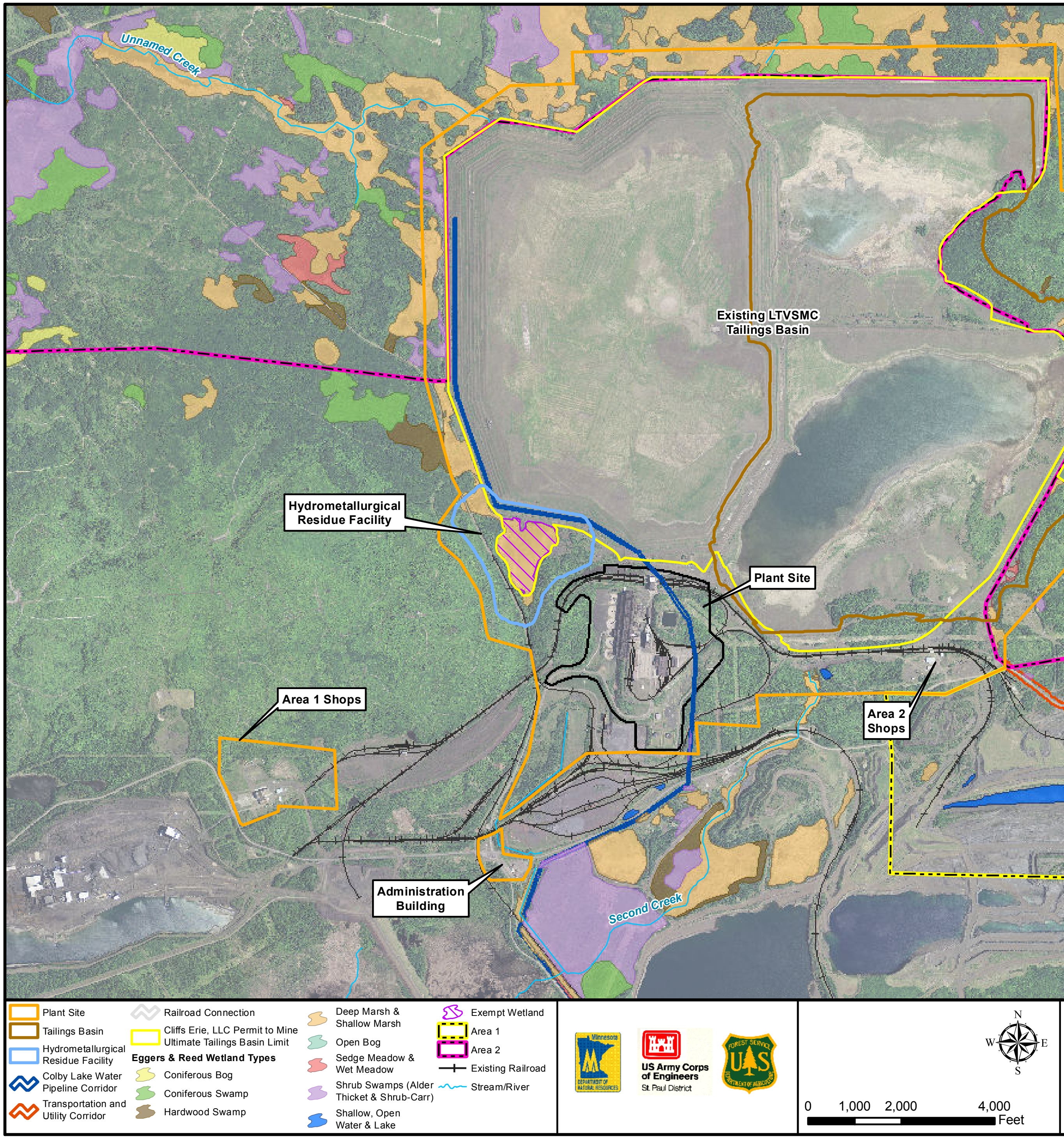

Figure 4.2.3-6
Wetland Community Types
Plant Site
NorthMet Mining Project and Land Exchange SDEIS
Minnesota

November 2013

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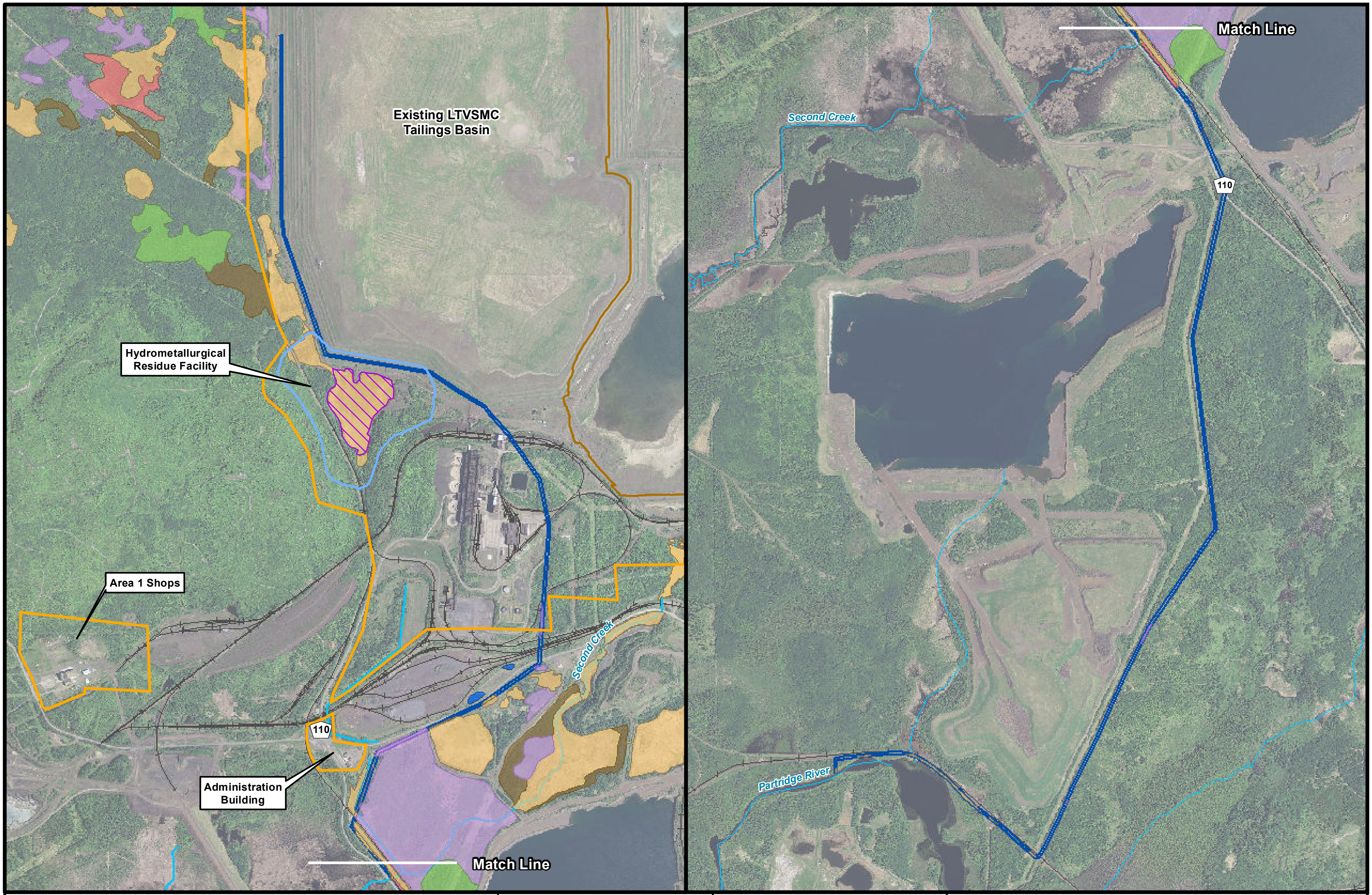

Colby Lake Water Pipeline Corridor
Plant Site
Hydrometallurgical Residue Facility
Stream/River
Exempt Wetland

Eggers & Reed Wetland Types

Deep Marsh & Shallow Marsh
Shrub Swamps (Alder Thicket & Shrub-carr)
Sedge Meadow & Wet Meadow
Shallow, Open Water & Lake
Coniferous Bog
Coniferous swamp
Hardwood swamp
Open bog

US Army Corps of Engineers
St. Paul District

N
W E
S

0 500 1,000 2,000 3,000
Feet

Figure 4.2.3-7
Wetland Community Types
Colby Lake Water Pipeline Corridor
NorthMet Mining Project and Land Exchange SDEIS
Minnesota

November 2013

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4.2.3.2.2 Hydrology, Wetland Vegetation, and Community Types

The NorthMet Project area is located near the headwaters of the Partridge River and Embarrass River watersheds. The Partridge River and the Embarrass Rivers are both tributary to the St. Louis River, which is located within the Lake Superior Basin. A portion of the Plant Site and the Colby Lake Water Pipeline Corridor are located within the Upper Partridge River Watershed, while the majority of the Plant Site and the remaining portion of the Colby Lake Corridor are located in the Embarrass River watershed. See Section 4.2.2 for more information on water resources.

Currently, groundwater and surface water seepage from the Tailings Basin drain towards Mud Lake Creek to the north, Trimble Creek to the northwest, and Unnamed Creek to the west. Runoff from the outer slopes of the Tailings Basin is tributary to the surrounding creeks and precipitation falling within the Tailings Basin is contained in the basin.

The hydrogeologic setting of the Embarrass River watershed is generally similar to the Partridge River watershed, although the unconsolidated deposits are generally thicker and more continuous north of the Plant Site area along the Embarrass River valley. The Plant Site is located north of the Laurentian Divide and the area is underlain by granitic rocks of the Giants Range batholith. Although these rocks may be fractured to some extent, they are expected to have significantly lower hydraulic conductivity than the bedrock units at the Mine Site. There are some wetlands located within the Plant Site and saturated conditions generally exist less than 10 ft below the ground surface, like the Mine Site. Similar to the Mine Site, the degree of hydraulic connection between the wetland areas and adjacent unconsolidated deposits and bedrock at the Plant Site is expected to be variable, depending on the characteristics of the wetlands and the localized hydraulic conductivity and degree of bedrock fracturing. Given the very low hydraulic conductivity of the underlying bedrock, there is minimal potential for hydraulic connection between bedrock and wetlands.

The southwest corner of the Plant Site, the former LTVSMC processing plant, has almost entirely been disturbed by past mining activities. Although there is a plant reservoir located east of the concentrator, the plant reservoir is not regulated as a wetland and is exempt (see Figure 4.2.3-6) (PolyMet 2013b). Wetland hydrology at the Plant Site has been affected by the operation of the existing LTVSMC Tailings Basin. Evidence suggests that hydrologic changes from seepage originating from the Tailings Basin, along with beaver dams, have resulted in inundation of wetland areas immediately north of the Tailings Basin (Barr 2008b). Wetlands within the Plant Site are presented in Table 4.2.3-5 and Figure 4.2.3-6.

The existing wetlands differ from the wetlands that occupied the area prior to the construction of the existing LTVSMC Tailings Basin. Historical aerial photographs (1940 and 1948) indicate the presence of large wetland complexes that were a mixture of forested and shrub swamp wetlands, which were primarily saturated to the surface with relatively few open water areas. Past disturbances that have affected the hydrology and vegetative characteristics of the wetlands in the vicinity of the existing LTVSMC Tailings Basin include seepage from the basin along with beaver dams, culverts, road construction, parking areas, railroad embankments, and diversion of flowages (Barr 2008k).

Both the Plant Site and the Colby Lake water pipeline corridor contain wetland resources (see Table 4.2.3-5). Portions of the existing LTVSMC Tailings Basin and the Hydrometallurgical

Residue Facility are located within the LTVSMC Permit to Mine Ultimate Tailings Basin Limit Boundary. When LTVSMC ceased production in January 2001, the mining-related assets were transferred to Cleveland Cliffs, Inc., which formed Cliffs Erie LLC. Wetlands (28.6 acres) located within the Cliffs Erie (formerly LTVSMC) Permit to Mine Ultimate Tailings Basin Limit Boundary are not regulated by state and federal wetland regulations, as it is an actively permitted waste storage facility (see Figure 4.2.3-6) (PolyMet 2013b).

The regulated wetlands within the Plant Site include a total of 51 wetlands covering 244.3 acres. Wetlands located within the Plant Site are presented in Table 4.2.3-5 and Figure 4.2.3-6. A 0.03-acre area of sedge/wet meadow within the Tailings Basin and a 28.6 acre area of shallow marsh within the Hydrometallurgical Residue Facility are exempt from state and federal wetland regulations as they are both located within the Cliffs Erie Permit to Mine Ultimate Tailings Basin Limit Boundary. Existing wetland resources within the Plant Site consist largely of deep marshes and shallow marshes with dead black spruce trees scattered throughout, which is primarily attributable to seepage from the basin (Barr 2008l; PolyMet 2013b). Other smaller wetland areas are coniferous swamps, hardwood swamps, sedge/wet meadows, and shrub swamps.

There will be no construction within the Colby Lake water pipeline corridor as the existing pipeline will be used to provide water for the NorthMet Project Proposed Action. A total of 14 wetlands covering 7.0 acres were identified within the Colby Lake water pipeline corridor (see Figure 4.2.3-7 and Table 4.2.3-5). The wetlands in the corridor include shallow marshes (37 percent), shrub swamps (29 percent), sedge/wet meadows (19 percent), and deep marshes (14 percent). The wetlands are adjacent to an unpaved, gravel road and within a previously disturbed corridor (PolyMet 2013b).

Overall, Area 2 contains 373 wetlands covering 8,621.9 acres of the 19,396.7-acre area, or approximately 44 percent of Area 2. The wetlands are shown on Figure 4.2.3-5. Table 4.2.3-5, below, summarizes the wetland areas represented by each Eggers and Reed (1997) wetland community type classification system (Barr 2011d; PolyMet 2013b).

Shrub swamps, which include both alder thicket and shrub-carr wetland types, represent the most abundant wetland type within Area 2 comprising approximately 34 percent of the overall wetland area. These shrub swamps are dominated by either alder or willow species, with some dogwoods also present. The ground layer is dominated by Canada bluejoint grass and sedges, woolgrass, rushes, and ferns are also present. Sphagnum mosses may also be present but do not typically form a continuous mat within these shrub swamps. Soils in shrub swamps are usually fibric and hemic peat at the surface underlain by bedrock or mineral soil (Barr 2011d; PolyMet 2013b).

Coniferous swamps within Area 2 are the second most abundant wetland type, comprising approximately 29 percent of the overall wetland area. These swamps are made up of black spruce and/or tamarack, with balsam fir and northern white cedar present in some areas. Deciduous tree species, such as aspen, birch and, to a minor extent, black ash, are also present in some locations. The shrub layer is observed to be typically dominated by alder and willow species. The ground layer commonly includes Canada bluejoint grass, sedges, bunchberry, wild sarsaparilla, and starflower. Sphagnum mosses are also present in the ground layer; however, a continuous sphagnum mat is usually absent. Soils in the coniferous swamps are generally organic and are usually saturated to the surface throughout much of the growing season (Barr 2011d; PolyMet 2013b).

Coniferous bogs are the third-most abundant wetland type within Area 2, representing approximately 12 percent of the overall wetland area, while open bogs represent only a small component of wetlands in Area 2 (approximately 4 percent). Coniferous bogs generally have a tree cover greater than 50 percent, which is typically dominated by black spruce and/or tamarack. Forested wetlands that are acid peatlands dominated by dense cover of black spruce and/or tamarack with a more or less continuous carpet of Sphagnum mosses have been classified as coniferous bogs in the Eggers and Reed (1997) classification system. Occasionally, there are areas with balsam fir, jack pine, and northern white cedar present within the large coniferous bog wetland complexes. The open bogs do not support a dense tree cover and it was observed that typically only a scattering of immature black spruce and/or tamarack are present (Barr 2011d; PolyMet 2013b).

The shrub layer and ground layer of coniferous bogs and open bogs have similar composition. The shrub layer is typically dominated by ericaceous shrubs such as leatherleaf, bog Labrador-tea, and cranberry. The ground layer commonly includes a continuous sphagnum moss mat with various sedges and herbaceous vegetation also observed. Northern pitcher plants are abundant in the large bog areas that surround Mud Lake. Soils in the coniferous bogs and open bogs generally consist of fibric peat that is usually saturated to the surface throughout much of the growing season (Barr 2011d; PolyMet 2013b).

Shallow and deep marshes are present within Area 2, and together represent about 14 percent of the wetland area. These wetlands are dominated by cattails, with sedges and Canada bluejoint grass also present. Soils in the shallow and deep marshes are typically organic at the surface and underlain by mineral soils. The shallow marshes present are typically inundated with up to 6 inches of water throughout the entire growing season, while the deep marshes are inundated with over 6 inches of water throughout the entire growing season. These wetlands are often associated with disturbances, such as beaver activity (Barr 2011d; PolyMet 2013b).

Hardwood swamps are present but not abundant in Area 2. The hardwood swamps that are present are dominated by black ash, aspen, and birch. Coniferous trees, such as balsam fir, black spruce, and northern white cedar are occasionally present in these hardwood swamps. The shrub layer is generally dominated by alder and young saplings while the ground layer species present include Canada bluejoint grass, sedges, and ferns. Sphagnum mosses are also observed; however, they do not typically form a continuous mat. Soils in the hardwood swamps are either organic or mineral and are usually saturated throughout much of the growing season (Barr 2011d; PolyMet 2013b).

Sedge meadow and wet meadow communities are present within Area 2 but represent only a small proportion of the total wetland area. These wetlands are populated by sedges, Canada bluejoint grass, woolgrass, manna grass, and bulrushes. Soils in the sedge meadows and wet meadow communities are typically organic at the surface and underlain by mineral soils. These wetlands are generally saturated close to the ground surface or have shallow inundation for prolonged periods during the growing season (Barr 2011d; PolyMet 2013b).

Table 4.2.3-5 Total Wetland Acreage by Wetland Type for Plant Site, Colby Lake Water Pipeline Corridor, and Area 2

	Plant Site		Colby Lake Water Pipeline Corridor		Area 2	
Eggers and Reed Class[1]	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**
Coniferous bog	0.0	0	0.0	0	1017.9	12
Coniferous swamp	14.4	5	0.0	0	2,536.9	29
Deep marsh	106.1	39	1.0	14	513.0	6
Hardwood swamp	0.7	<1	0.0	0	161.2	2
Open bog	0.0	0	0.0	0	353.6	4
Open water (includes shallow, open water, and lakes)	0.9	<1	0.0	0	285.4	3
Sedge/wet meadow	1.5[(2)]	<1	1.4	19	137.52	2
Shallow marsh	135.3[(3)]	50	2.6	37	654.0	8
Shrub swamp (includes alder thicket and shrub-carr)	14.1	5	2.1	29	2,961.6	34
Total[4]	272.9	100	7.0	99	8,621.9	100

Source: PolyMet 2013b.

[1] Eggers and Reed 1997.
[2] A 0.03-acre area of this wetland type is classified as exempt from state and federal wetlands regulations.
[3] A 28.56-acre area of this wetland type is classified as exempt from state and federal wetlands regulations.
[4] Percent totals are greater than 100 percent due to rounding.

4.2.3.2.3 Wetlands Functional Assessment

Wetlands within the Tailings Basin have been previously affected by the LTVSMC tailings deposition, roads, and impoundment. The majority (92 percent) of the wetlands within this area are currently rated as low-quality with low vegetative diversity/integrity. Eight percent of the wetlands within the Tailings Basin are rated as moderate quality. The wetlands within the Hydrometallurgical Residue Facility are located on the south side of an unpaved, gravel road with small buildings and associated facilities used in the former LTVSMC operations. These wetlands are currently rated as low-quality (PolyMet 2013b).

The majority of wetlands within the Colby Lake Corridor, which are located adjacent to an unpaved, gravel road and within a previously disturbed corridor, are rated as low-quality (93 percent), with the remaining wetlands rated as moderate-quality (7 percent) (PolyMet 2013b).

4.2.4 Vegetation

This section describes the existing cover type categories, plant communities, and individual plant species in the NorthMet Project area. Cover type categories and plant communities are defined for each parcel, and their geographic locations are presented on the corresponding figures. Minnesota Biological Survey (MBS) Sites of Biodiversity Significance, Scientific and Natural Areas (SNAs), and culturally important plant species are also discussed for each parcel. Species are grouped into two partially overlapping categories: state-listed Endangered, Threatened, or Special Concern (ETSC) species; and the USFS's Regional Foresters Sensitive Species (RFSS). There are no federally listed plant species within the NorthMet Project area.

Additional information beyond what the MDNR Natural Heritage Information System (NHIS) contained, such as species conservation ranking, distribution, and habitat, were obtained from NatureServe, an online public database that utilizes sources such as scientific literature, web sites, expert knowledge, and information from local data centers. The Bell Museum of Natural History, which maintains an herbarium vascular plant collection database, was also consulted.

Several vegetation surveys have been conducted on the federal lands (including part of the Mine Site) and the non-federal lands. These studies gathered information on dominant plant species within various habitats, as well as the presence or absence of ETSC species.

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013. The FEIS will consider any new listings, or changes in the previous listings, associated with the updated list. The FEIS will also consider any federal listing changes, should they occur. A Biological Evaluation (containing further information about RFSS species) have been prepared and are posted on the USFS website (http://www.fs.usda.gov/goto/superior/northmet).

4.2.4.1 Regional Setting

The Mine Site, Transportation and Utility Corridor, and Plant Site are located in the MDNR-designated Nashwauk Uplands and Laurentian Uplands subsections of the Northern Superior Uplands section of the Laurentian Mixed Forest Province ecoregion, corresponding roughly to the Arrowhead region of northeastern Minnesota (MDNR 2006a; MDNR 2011e). Most of the vegetative cover types in these subsections grow in acidic to neutral glacial materials over Precambrian bedrock (MDNR 2011f; MDNR 2011i). Soils vary from medium to coarse texture, and they support forest communities of aspen-birch, jack pine (*Pinus banksiana*), balsam fir (*Abies balsamea*), white spruce (*Picea glauca*), red pine (*Pinus resinosa*), and white pine (*Pinus strobus*) on the uplands and conifer bogs and swamps on the lowlands.

4.2.4.2 Mine Site

The Mine Site includes a single contiguous 3,014.5 acre tract of land. It is located on both private lands (295.2 acres) and federal lands (2,719.3 acres) within the Superior National Forest.

4.2.4.2.1 Cover Types

Cover types are of several classifications, including MDNR Gap Analysis Program (GAP) land cover types, specific plant communities identified through surveys, MBS Sites of Biodiversity Significance, native plant communities, and SNAs.

Habitat Types

The MDNR uses a hierarchical land classification system called the GAP land cover system, which organizes vegetation communities into 1-acre blocks. The primary GAP land cover types at the Mine Site are upland conifer forest (40 percent) and lowland conifer forest (26 percent), in addition to upland deciduous forest (see Table 4.2.4-1 and Figure 4.2.4-1). Some of the least represented cover types on the Mine Site include cropland/grassland or upland conifer-deciduous mixed forest types. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.2.4-1 NorthMet Mine Site Cover Types

Cover Types	Total Acres	Percent of Area
Upland coniferous forest[1]	1,195.5	40
Lowland coniferous forest[2]	781.2	26
Upland deciduous forest[3]	648.0	21
Shrubland	241.7	8
Disturbed	128.0	4
Aquatic environments	12.7	<1
Cropland/Grassland	4.9	<1
Upland conifer-deciduous mixed forest[4]	2.4	<1
Lowland deciduous forest[5]	0.1	<1
Total	**3,014.5**	**100**

Source: MDNR 2006b.

1 Includes pine and spruce/fir forest cover types.
2 Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
3 Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
4 Includes all mixed coniferous-deciduous forest cover types.
5 Includes black ash forest cover types.

Plant Community Surveys

The primary cover types at the Mine Site are mixed pine-hardwood forests on the uplands and black spruce (*Picea mariana*) swamp/bog in the wetlands (ENSR 2005). USFS stand data and field verification indicate that northern white cedar also occurs at the Mine Site in lowland conifer forests (Barr 2010b). The remaining forest on the Mine Site is made up of aspen (*Populus* spp.), aspen-birch, jack pine, and mixed hardwood swamp. The relatively small amount of grass/brushland habitat that is present is land recovering from past logging through natural succession. There are also small areas of open water and disturbed ground that were previously cleared for logging roads and log landings. Of the wetlands that are located on the Mine Site, the majority (92 percent) is rated as having a high overall wetland quality and 8 percent are of moderate overall wetland quality. Vegetation diversity and integrity are rated moderate to high for all wetlands because recent human contact and alteration are minimal and the wetlands have a relatively constant supply of water. Section 4.2.3 provides a more detailed discussion on wetlands.

Many of the upland forest areas on the Mine Site have been harvested in the last 20 to 60 years. The oldest forest at the Mine Site includes approximately 297 acres of 40- to 80-year-old trees within the mixed pine-hardwood forest in the southwest portion of the Mine Site (ENSR 2005).

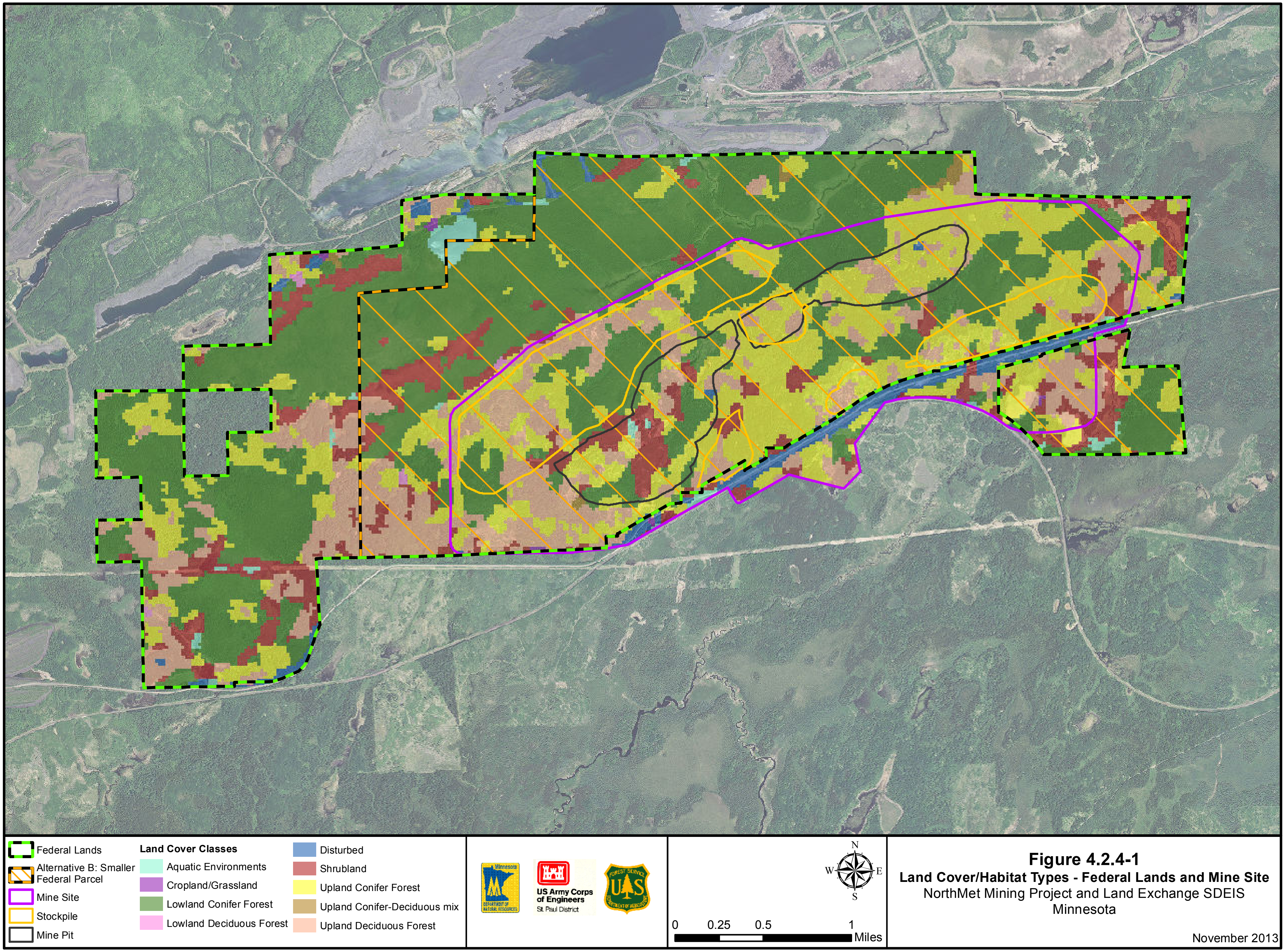

Figure 4.2.4-1

Land Cover/Habitat Types - Federal Lands and Mine Site

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Minnesota Biological Survey

The MDNR operates the MBS program, which includes spatial information from survey reports on native plant communities and rare species. Sites of Biodiversity Significance are designated and ranked by the MDNR based on the environmental conditions present, including native plant communities, rare species, and unique habitat. The MBS utilizes a four-tiered ranking system: Outstanding, High, Moderate, and Below (from highest to lowest). Sites of High Biodiversity Significance contain very good-quality occurrences of the rarest species, high-quality examples of rare native plant communities, and/or important functional landscapes (MDNR 2008a). The entire 3014.5-acre Mine Site has been characterized by the MBS as various Sites of High Biodiversity Significance due to the presence of the One Hundred Mile Swamp site, which covers 15 percent of the Mine Site, and the Upper Partridge River site, which is 85 percent of the Mine Site (MDNR 2008a).

Native plant communities are also ranked by the MDNR by their quality and abundance in a given area. “Imperiled” or “vulnerable” designations indicate that the communities have high ecological value, are rare in a given area, and/or could face danger of extirpation. Those with “apparently secure” designations are uncommon in a given area, but are not rare. Those with “widespread and secure” designations are fairly common and in no immediate risk of extirpation. Native plant communities are identified by their name and a unique code assigned to them by the MDNR (e.g., FDn32c). Two native plant communities, black spruce-jack pine woodlands (FDn32c; 34 percent of Mine Site) and rich black spruce swamp (FPn62a; 7 percent of Mine Site), have been characterized by the MBS as “imperiled/vulnerable” and “vulnerable,” respectively (MDNR 2008b). Poor tamarack-black spruce swamps (APn81b) and black spruce bogs (APn80a1) are ranked as “apparently secure” based on abundance, distribution, trends, and threats (MDNR 2008b). Aspen-birch forests: balsam fir subtype (FDn43b1), alder (*Alnus* spp.) swamps (FPn73a), poor black spruce swamps (APn81a), and low shrub poor fens (APn91a) are all considered “widespread and secure.”

Scientific and Natural Areas

The MDNR SNA program designates and preserves areas that have outstanding rare resources or features. There are no lands designated or nominated for designation as SNAs on the Mine Site (MDNR 2006c; Wilson, MDNR, Pers. Comm., February 14, 2012).

Culturally Important Plants

Wild rice is an important plant species to the Bands, as well as an important wildlife food source. MPCA staff have recommended three segments within the Partridge River watershed as waters used for the production of wild rice; the closest segment is about 2 miles from the Mine Site and includes the lower portion of the Upper Partridge River just upstream of the railroad bridge near Allen Junction to where it enters Colby Lake (MPCA 2012b) (see Figures 4.2.2-3 and 5.2.2-1). There were no observations of wild rice in Colby Lake itself or the tributary stream Wyman Creek (Barr 2009b; Barr 2011a; MPCA 2012b). The MPCA’s draft staff recommendation identifies the portion of the Partridge River from Colby Lake to its confluence with the St. Louis River as a water used for production of wild rice. Small populations of wild rice have been observed in Second Creek from First Creek to its confluence with the Partridge River (Barr 2011a).

Natural resources culturally important to the Bands are discussed in Section 4.2.9.

National Hierarchical Framework of Ecological Units

The National Hierarchical Framework of Ecological Units (NHFEU) is a land classification system that uses a nested hierarchy of eight levels of ecological units (Cleland et al. 1997). Units are differentiated using a combination of physical and biological factors, such as geology, topography, soils, and vegetation. The Landscape scale contains the Land Type Association (LTA) level, which is defined using several factors, including bedrock types, lake and stream distributions, wetland patterns, and pre-European settlement vegetation (MDNR 2011g). The Land Unit scale contains the ELT level, which is a subtype of the LTA level. The MDNR and USFS also have an ECS that identifies and classifies lands in a similar fashion according to provinces, sections, subsections, and LTAs (MDNR 2011g).

The portion of the One Hundred Mile Swamp that is on the federal lands, including part of the Mine Site, has been identified as a Site of High Biodiversity Significance and was aerially surveyed by Chel Anderson in 1997. The One Hundred Mile Swamp comprises approximately 3,028 acres located within LTA 8A – Big Rice Outwash (MDNR 1997), which has since been reclassified as LTA 212Le11 – Big Lake-Bird Lake End Moraines. Two other sites besides the One Hundred Mile Swamp site were surveyed on the ground and by air in LTA 212Le11. These sites provide a good representation of most of the LTA's biological and physical attributes at the ELT level, as mentioned above. Inclusion of the One Hundred Mile Swamp site would likely complete representation of prominent ELTs in LTA 212Le11.

4.2.4.2.2 Invasive Non-native Plants

Invasive non-native plants are a concern because they can quickly form self-sustaining monocultures that out-compete native plants or reduce the quality of wildlife habitat, particularly in disturbed areas. "Non-native" species are those that have been introduced, or moved, by human activities to a location where they do not naturally occur (MDNR 2011b). "Invasive" species are non-native species that cause ecological or economic problems (e.g., out-competing indigenous species or altering the existing ecological community through rapid development of monocultures). In general, few invasive non-native plants have been observed on the federal lands because wetland disturbance has been minimal, upland disturbance has been restricted to timber harvests, and human access has been limited, thereby reducing the spread of these plants (AECOM 2011a; ENSR 2005). No known occurrences of invasive species on the federal lands are listed in the Superior National Forest invasive plant geodatabase, but no inventories have been performed in the NorthMet Project area (USFS 2010a). The majority of representative wetland locations surveyed on the federal lands yielded 100 percent native plants with no occurrences of non-native species at those sites according to MnRAM 3.2 worksheets (AECOM 2011d). Field surveys indicate that disturbed upland areas on the federal lands contain occurrences of yellow sweetclover and bladder campion, both of which are invasive non-native species. Yellow sweetclover invades grasslands and early successional habitats by overtopping and shading out native species (MDNR 2011b). Bladder campion is a prolific seed-producer and can spread vegetatively, as well.

A vegetation survey of mines on the Mesabi Iron Range (Apfelbaum et al. 1995) identified a large number of invasive non-native plant species that could invade the Mine Site, and some species are estimated to be currently present (see Table 4.2.4-2). Some of these species are grasses and legumes that were planted on mines and other sites to reduce erosion and to fix nitrogen into the soil as part of a reclamation effort (e.g., redtop, smooth brome, birdsfoot trefoil, yellow sweetclover, white sweetclover, alfalfa, timothy, Kentucky bluegrass, Canada bluegrass, and white clover). In addition, a road weed survey by the Superior National Forest (USFS 2011k) documented several invasive species (species tracked by the USFS and Minnesota Class 2 invasive species) within 3 miles of the Mine Site, primarily along roadways (see Table 4.2.4-3). Species with a high percentage of occurrences in the surveys (e.g., common tansy) are more likely to occur on the Mine Site.

Table 4.2.4-2 Invasive Non-native Plant Species Found on Mine Sites in the Mesabi Iron Range

Scientific Name	Common Name	Percent Occurrence[1]	Wetland/ Upland	Estimated Abundance at NorthMet Mine Site
Bromus inermis	Smooth brome	60	U	Uncommon
Tanacetum vulgare	Common tansy	60	U	Uncommon
Taraxacum officinale	Dandelion	60	U	Common
Cirsium arvense	Canada thistle	40	U	Uncommon
Phleum pratense	Timothy	40	U	Common
Poa pratensis	Kentucky bluegrass	40	U	Common
Leucanthemum vulgare	Oxeye daisy	30	U	Common
Lotus corniculatus	Birdsfoot trefoil	30	U	Common
Hieracium pratense	Yellow hawkweed	20	U	Uncommon
Lychnis alba	Bladder campion	20	U	Uncommon
Melilotus officinalis	Yellow sweetclover	20	U	Uncommon
Agrostis alba	Redtop	10	W/U	Uncommon
Cirsium vulgare	Bull thistle	10	U	Uncommon
Hieracium aurantiacum	Devil's hawkweed	10	U	Common
Medicago lupulina	Black medic	10	U	Common
Trifolium repens	White clover	10	U	Common

Source: Apfelbaum et al. 1995.

[1] Percent occurrence is the percentage of mine areas in the Mesabi Iron Range with reported observations based on 3-minute surveys at 10 mine areas. Three-minute surveys report the most abundant plant species observed during a 3-minute time period and provide a rough estimate of species abundance.

Table 4.2.4-3 Invasive Non-native Plant Species Found Within 3 Miles of the Mine and Plant Sites by the USFS Road Weed Survey

Scientific Name	Common Name	Percent Occurrence Near Plant and Mine Sites[1]	Wetland/ Upland
Tanacetum vulgare[3]	Common tansy	35	U
Hypericum perforatum[2]	St. John's wort	29	U
Cirsium arvense[3]	Canada thistle	24	U
Cirsium vulgare	Bull thistle	6	U
Centaurea stoebe (*C. maculosa*)[3]	Spotted knapweed	5	U

Source: USFS 2011k.

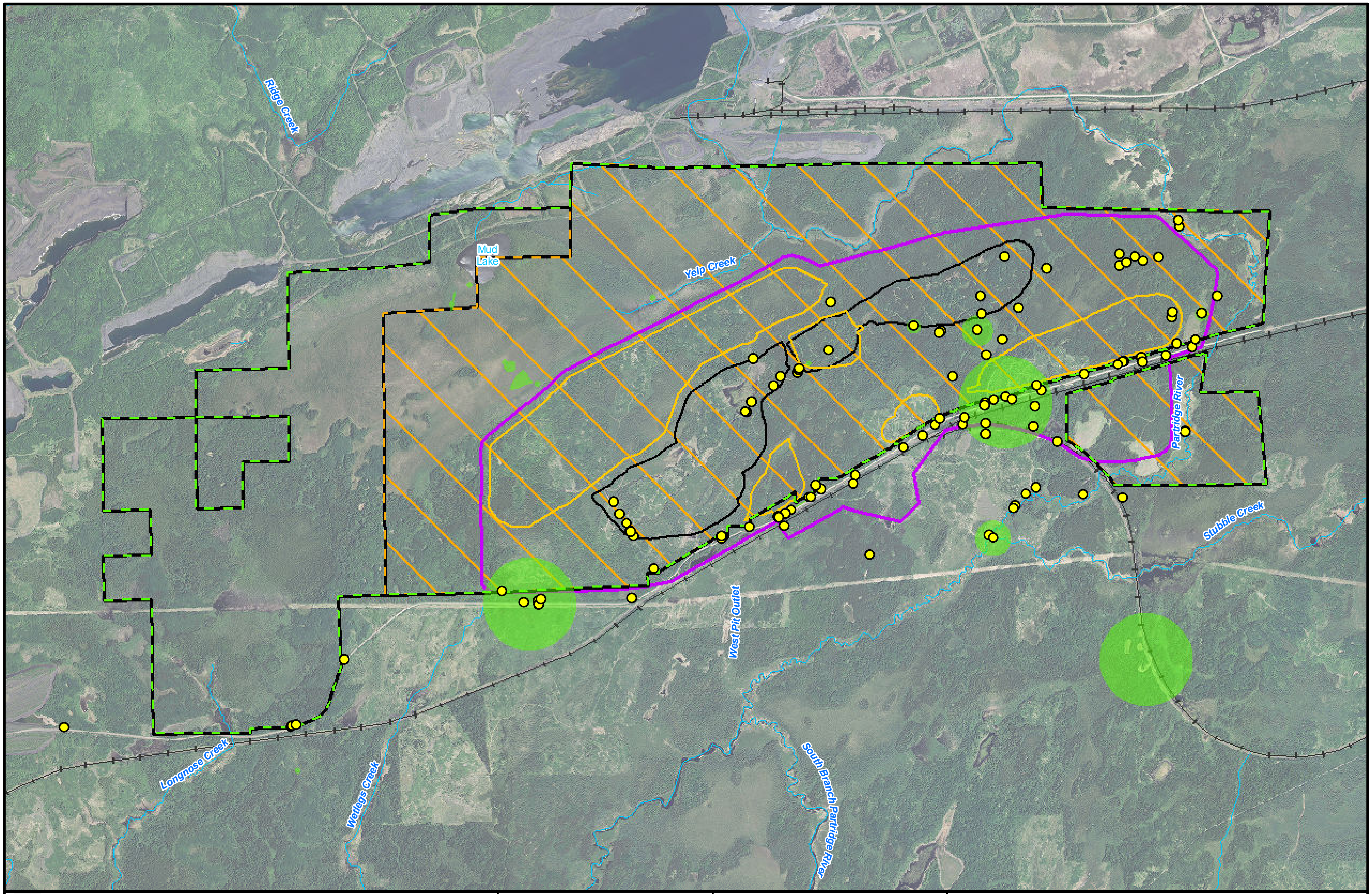
[1] Percent occurrence is the observed number of populations of the species divided by the 96 total plant populations identified within 3 miles of the Mine and Plant Sites.
[2] Tracked by USFS.
[3] Minnesota Class 2 - Controlled noxious weed as identified by the 2012 Minnesota Noxious Weed Law.

4.2.4.2.3 Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

No federally listed threatened and endangered plant species are known to occur on the federal lands, including the Mine Site. However, eleven state-listed ETSC plant species are known to occur in the vicinity of the Mine Site. Based on a review of the MDNR NHIS and field investigations (AECOM 2009b; Barr 2007j; Johnson-Groh 2004; Pomroy and Barnes 2004; Walton 2004), two state endangered species, two state threatened species, and seven state species of special concern have been identified on the Mine Site (see Table 4.2.4-4 and Figure 4.2.4-2). No other state-listed species are known to occur and no appropriate habitat for other species occurs on the Mine Site. Minnesota's endangered species law (*Minnesota Statute*, § 84.0895) and associated rules (*Minnesota Rules,* part 6212.1800 to 6212.2300 and 6212.6134) impose a variety of restrictions, permits, and exemptions pertaining to ETSC species. Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013. The FEIS will consider any new listings, or changes in the previous listings, associated with the updated list.

Population numbers correspond to the MDNR Element Occurrence within the NHIS database (Joyal, MDNR, Pers. Comm., February 13, 2012). According to the 2011 MDNR NHIS training notes, Element Occurrences may have multiple observations in a given area, but are considered one population if they are "within close enough proximity to one another to allow for gene flow and there are no known barriers to movement." These clusters of observations are described here as colonies for given populations. An individual is defined as a single plant of a species. A colony is a group of individual plants of one species in a distinct geographic location. A population is a group of individuals or colonies of one species that may be separated geographically, but are close enough to interbreed and persist over time.



Federal Lands
Alternative B: Smaller Federal Parcel
Mine Site
Rare Species - Pomroy, Johnson - Groh, Barr Reports
Vicinity of Endangered, Threatened, and Special Concern Vegetation Species
Stockpile
Mine Pit
Stream / River
Existing Railroad

US Army Corps of Engineers
St. Paul District

N
W E
S

0 0.25 0.5 1 Miles

Figure 4.2.4-2
ETSC Vegetation - NorthMet Project Area
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Table 4.2.4-4 Endangered, Threatened, and Special Concern Plant Species Identified on the Mine Site [5]

Scientific Name	Common Name	State Status[1]	No. of Populations[2]	No. of Individuals[2,3]	Habitat and Location
Botrychium campestre	Prairie moonwort	SC	1	Unknown	Dry soils along the Dunka Road.
Botrychium pallidum	Pale moonwort[4]	E	1	21	Full to shady exposure, edge of alder thicket, along Dunka Road.
Botrychium rugulosum (*ternatum*)	Ternate or St. Lawrence grapefern[4]	T	1	4	Early successional habitats, fields, open woods, forests, and along Dunka Road.
Botrychium simplex	Least grapefern[4]	SC	3	~1,580	Full to shady exposure, edge of alder thicket, forest roads, along Dunka Road.
Caltha natans	Floating marsh marigold[4]	E	1	56	Shallow water in ditches and streams, alder swamps, shallow marshes, beaver ponds, and Partridge River mudflat.
Eleocharis nitida	Neat spikerush[4]	T	1	~1,562 ft^2	Full exposure, moist ditches along Dunka Road, wet area between railroad grades, and railroad ditch.
Juncus stygius var. *americanus*	Bog rush[4]	SC	1	Unknown	Open-patterned peatlands, rich and poor fens, northern spruce bog within the One Hundred Mile swamp.
Platanthera clavellata	Club-spur orchid	SC	1	Unknown	Black spruce and/or tamarack swamps, northern spruce bog within the One Hundred Mile swamp.
Ranunculus lapponicus	Lapland buttercup	SC	1	~919 ft^2	On and adjacent to Sphagnum hummocks in black spruce stands, up to 60 percent shaded with alder also dominant.
Sparganium glomeratum	Clustered bur-reed	SC	1	78	Shallow pools and channels up to 1.5 feet deep in Sphagnum at edge of black spruce swamps, beaver ponds, wet ditches, shallow marshes.
Torreyochloa pallida	Torrey's manna-grass	SC	1	~25 ft^2	In muddy soil along shore and in water within shallow channels, beaver ponds, shallow marshes, along Partridge River.

Sources: AECOM 2009b; Barr 2007j; Johnson-Groh 2004; MDNR 2005; MDNR 2011m; MDNR 2013a; Pomroy and Barnes 2004; Walton 2004.

1 E = Endangered, T = Threatened, SC = Species of Concern.
2 Note that the number of populations may differ from those given in the NHIS data because of populations found during other surveys; additional populations may be present in more marginal, secondary habitat that was not surveyed or in wetter areas.
3 Where the number of individuals could not be determined without damaging the population, patch size (square feet) was used as a representative abundance measure.
4 These species are also RFSS as tracked by the USFS.
5 Data included here were provided by the Division of Ecological Resources, MDNR, and were current as of March 13, 2013. These data are not based on an exhaustive inventory of the state. The lack of data for any geographic area shall not be construed to mean that no significant features are present.

Species Life Histories

The following summary provides descriptions of the life histories, statewide distributions, and sensitivity to disturbance for each of the 11 ETSC species found on the Mine Site.

Prairie moonwort (*Botrychium campestre*) is listed as a species of special concern in Minnesota; it is not listed as an RFSS in the Superior National Forest. It occurs primarily in prairies, dunes, grassy railroad sidings, and fields over limestone bedrock. *B. campestre* is a perennial fern that emerges in early spring and matures in late spring to early summer (eFlora 2011). This species is among the smallest moonworts and is difficult to observe when occurring among prairie vegetation; therefore, it is likely more widespread and abundant within its range than is typically apparent. It is now known to occur in several counties throughout Minnesota and even across the continent (MDNR 2011m). *B. campestre* is less frequently associated with disturbance than many moonwort species. On the Mesabi Iron Range of Minnesota, however, *B. campestre* has been found growing abundantly on sparsely vegetated mineral soil developed from sediments of iron mine tailings ponds.

Pale moonwort (*Botrychium pallidum*) is listed as an endangered species in Minnesota and as an RFSS in the Superior National Forest. *B. pallidum* was only first identified in Minnesota in 1992 and new populations are documented each year in a variety of habitats across northern Minnesota (MDNR 2011m). It occurs in open early successional habitats, log landings, roadsides, sandy gravel pits, and mine tailings within the Mesabi Iron Range of northeastern Minnesota. This diminutive perennial fern emerges in the late spring, produces spores, and matures within 3 to 4 weeks. Like many of the moonworts, *B. pallidum* may be sensitive to changes in soil mycorrhizae, herbivory from introduced earthworms, vegetative cover (i.e., increased vegetative competition and shading), soil moisture, or other environmental factors affecting suitable microhabitats. Disturbances such as vegetation clearing, mining, soil scarification, reduction of vegetative competition, decreased canopy cover, or fire likely play an important role in the preservation and proliferation of this species.

St. Lawrence grapefern (*Botrychium rugulosum*) (Synonym: *B. ternatum*, ternate grapefern) is listed as a threatened species in Minnesota and as an RFSS in the Superior National Forest. The name “rugulosum” refers to the tendency of the segments to become wrinkled and convex. Relatively little is known about the overall distribution, genetics, and life history requirements of *B. rugulosum*, and some taxonomists question whether *B. rugulosum* is a distinct species. It is a perennial semi-evergreen fern that occurs in the northern and south-central portions of Minnesota (MDNR 2011m). In northern Minnesota, *B. rugulosum* prefers partially shaded mine tailings, sandy conifer forests and plantations, and shaded vernal pool margins in rich deciduous hardwood forests. It also occurs in wetland areas within habitats subject to past clearing or cultivation (NatureServe 2011). *B. rugulosum* is similar morphologically and in its life history requirements to *B. multifidum* (leathery grapefern), and these two species are often confused in the field. *B. rugulosum* is most easily distinguished from similar species in the late summer and early autumn when the trophophore (i.e., photosynthetic branch) has matured. Like *B. pallidum*, *B. rugulosum* may be associated with soil mycorrhizae and may be sensitive to increased competition, earthworms, changes in soil moisture, and other environmental factors affecting microhabitats. *B. rugulosum* is often found in small stands of 5 to 10 individuals, though larger populations can also occur (eFlora 2011). Disturbance also likely plays an important long-term role in the proliferation of this species.

Least grapefern (*Botrychium simplex*) is listed as a species of special concern in Minnesota and as an RFSS in the Superior National Forest. Least grapefern occurs throughout northern and central Minnesota, with no occurrences documented in southern Minnesota (Bell Museum of Natural History 2011). Least grapefern was first described as a species in 1823 (eFlora 2011) and has been extensively surveyed and studied for over a century. *B. simplex* is a perennial fern that produces a single leaf each year and occurs in a variety of natural and disturbed habitats, including brushy fields (often with other species of *Botrychium*), moist or dry woods, edges of forested vernal pools and swamps, mine tailings, and edges of sand/gravel/exposed forest roads. The morphology of the species is quite variable, and the many environmental forms and juvenile stages of *B. simplex* have resulted in the naming of numerous intraspecific taxa (eFlora 2011). Like the other *Botrychium* species, disturbance likely plays an important role in the proliferation of this species.

Floating marsh marigold (*Caltha natans*) is listed as an endangered species in Minnesota and as an RFSS in the Superior National Forest. *C. natans* was first collected in Minnesota in 1889 from Vermilion Lake in St. Louis County (Coffin and Pfannmuller 1988). All subsequent collections have been from St. Louis County (Bell Museum of Natural History 2011). Very few populations are known in Minnesota. Habitat loss is largely the reason behind recent local extirpations of this species in Minnesota (MDNR 2011m). Floating marsh marigold is a perennial aquatic forb and occurs within shallow open water or on moist mud within northern ponds, lakes, slow-moving rivers, streams, ditches, and wet meadows. The species flowers in late spring-summer (i.e., June to August). *C. natans* is found in relatively stable aquatic systems and may be sensitive to disturbances, including alteration of hydrology or hydro-period, water quality, water chemistry, and non-native species invasion, although a few populations are found in disturbed habitats.

Neat spike-rush (*Eleocharis nitida*) is listed as a threatened species in Minnesota and as an RFSS in the Superior National Forest. Neat spike-rush's distribution in Minnesota is limited to the northeastern counties of the Arrowhead region and west to Itasca County. *E. nitida* was first collected in Minnesota in 1946 from various wetland habitats in Cook and St. Louis counties. Despite the long collection record for this species in Minnesota, relatively few populations have been documented and little is known about the overall distribution of the species throughout the state. *E. nitida* occurs within various wetland habitats of northern Minnesota, including acid bog pools, small streams, areas of seasonal water drawdown (mucky/peaty flats), disturbed wetland edges, and along roads and trails (MDNR 2011m). *E. nitida* is a perennial plant that flowers in late spring and develops fruit in early to mid-summer. Mature achenes (i.e., seed-containing fruit) are often necessary to positively identify *E. nitida* to species (both in the field and herbarium). This rooted perennial species may be intolerant of hydrologic fluctuations and alterations to water quality and chemistry associated with landscape and wetland alteration and development. However, roadside distributions suggest the species may be semi-tolerant to disturbance and at least mild alterations in water quality in the short term.

Bog rush (*Juncus stygius* var. *americanus*) is listed as a species of special concern in Minnesota and as an RFSS in the Superior National Forest. Within Minnesota, bog rush is distributed across the northern and northeastern Arrowhead counties in large patterned peatlands and calcareous fens. It was first documented in St. Louis County in 1886 (Bell Museum of Natural History 2011). It is generally not a dominant species; even in ideal, large-patterned peatland settings, it occurs in isolated colonies with scattered individuals (MDNR 2011m). Bog rush is a perennial graminoid species that occurs in full sun, and, generally, it is restricted to narrow wet zones of bogs and fens where it can exploit small gaps in surrounding vegetation. Since it often grows in calcareous fens, it is influenced in some way by mineralized groundwater. It flowers and bears fruit in mid to late summer (eFlora 2011). Threats to *J. stygius* var. *americanus* include climate warming, water diversion (since it cannot compete well without vegetation gaps caused by inundation), and invasion of non-native species.

Club-spur orchid (*Platanthera clavellata*) (synonyms: *Habenaria clavellata*, *Gymnadeniopsis clavellata*) is listed as a species of special concern in Minnesota; it is not listed as an RFSS in the Superior National Forest. Club-spur orchid was first recorded in Ramsey County in 1886 and has since been documented in several counties across the northeast Arrowhead region and south to Ramsey and Hennepin counties (Bell Museum of Natural History 2011). It generally occurs in swamp forests with a canopy of black spruce and tamarack, and in non-forested fens with hummocks of *Sphagnum* moss species (MDNR 2011m). *P. clavellata* is a perennial orchid with a root/tuber system that is usually confined to growing within the living moss layer rather than the peat below it. The species flowers in mid-summer (from early to late July), and is insect-pollinated. Germination of the wind-borne seeds requires the presence of certain habitat-specific mycorrhizal fungi. Club-spur orchid may be sensitive to habitat alterations and changes in hydrology. It is suggested that activities several miles from a site could disrupt the hydrological processes (through groundwater and surface water) that are needed to sustain habitat for *P. clavellata* (MDNR 2011m).

Lapland buttercup (*Ranunculus lapponicus*) is listed as a species of special concern in Minnesota; it is not listed as an RFSS in the Superior National Forest. Lapland buttercup occurs throughout much of northern Minnesota, with the exception of extreme northwestern Minnesota. This species was first documented in 1928 in Minnesota from a *Sphagnum* bog in Aitkin County (Bell Museum of Natural History 2011). *R. lapponicus* is a perennial forb species that occurs amongst *Sphagnum* moss hummocks and pools in rich forested swamps in Minnesota, usually under a canopy of northern white cedar (MDNR 2011m). No populations have been found on disturbed sites. Lapland buttercup is sensitive to changes in conifer forest canopy, wetland hydrology/hydro-period, water chemistry, and other environmental factors affecting optimal conifer forest pools and hummock micro-sites.

Clustered bur-reed (*Sparganium glomeratum*) is listed as a species of special concern in Minnesota; it is not listed as an RFSS in the Superior National Forest. This species was originally listed as endangered by the MDNR in the mid-1980s (Coffin and Pfannmuller 1988); however, numerous new populations have since been documented and the species was down-listed from endangered to special concern in the mid-1990s. Within Minnesota, clustered bur-reed is distributed throughout the northeastern Arrowhead counties (including the Chippewa National Forest and Superior National Forest), west to north central Minnesota (Becker County), and in central Minnesota (Todd County) (Bell Museum of Natural History 2011). *S. glomeratum* is a perennial wetland macrophyte that occurs in partial to full sun within a variety of northern wetland habitats, including edges of floating bog mats in emergent wetland habitats, ephemeral emergent stream channels, along beaver-impounded wetland edges, and disturbed emergent wetland edges. It is locally common in sedge-marshes and black ash (*Fraxinus nigra*) swamps near the western end of Lake Superior (eFlora 2011). Though it is considered a circumboreal species, there are more records of *S. glomeratum* from Minnesota than from the rest of North America combined (MDNR 2011m). Though it can sometimes be found in disturbed habitats, *S. glomeratum* may be sensitive to pronounced water level fluctuations and prolonged inundation, changes in water chemistry, competition from introduced/invasive species (e.g., *Typha angustifolia*, *Typha* x *glauca*, *Lythrum salicaria*, *Phragmites australis*, *Phalaris arundinacea*), and other environmental factors affecting suitable wetland microhabitats.

Torrey's manna grass (*Torreyochloa pallida*) (synonym: *Puccinellia pallida*) is listed as a species of special concern in Minnesota; it is not listed as an RFSS in the Superior National Forest. Torrey's manna grass was first collected in 1886 from Vermilion Lake in St. Louis County (Bell Museum of Natural History 2011). Within Minnesota, *T. pallida* occurs throughout the Arrowhead Region south to Chisago County (along the St. Croix River drainage). Torrey's manna grass is a perennial graminoid species that occurs in various wetland habitats in northern Minnesota. Habitats include shallow muck-bottomed pond and stream shores, bogs, and beaver meadows. Some populations occur within roadside ditches, suggesting the species may be somewhat tolerant of disturbance; however, this rooted perennial wetland species is sensitive to alterations in wetland hydro-period, water level fluctuations, sedimentation, changes in water chemistry associated with landscape alteration, and development and competition from introduced invasive wetland species (e.g., *Typha angustifolia*, *Typha* x *glauca*, *Lythrum salicaria*, *Phragmites australis*, *Phalaris arundinacea*).

Regional Foresters Sensitive Species

The Mine Site is located within the current boundaries of the Superior National Forest; however, following the Land Exchange Proposed Action, the federal lands including a portion of the Mine Site would no longer be National Forest System land. The USFS currently manages 58 vascular and non-vascular plant species that are listed as RFSS in the Superior National Forest (see Table 4.2.4-5). The list of these species was approved in late 2011. The assessment of effects to RFSS species would be detailed in the Biological Evaluation; this section provides a summary based on RFSS plants that could exist on the NorthMet Project area lands. The Biological Evaluation is an assessment of the likely effects on species with viability concerns and their suitable habitat as a result of the NorthMet Project Proposed Action.

Eight of the RFSS species are state-listed ETSC species relevant to the NorthMet Project Proposed Action (*Botrychium pallidum*, *Botrychium rugulosum*, *Botrychium simplex*, *Caltha natans*, *Eleocharis nitida*, *Juncus stygius*, *Pyrola minor*, and *Saxifraga paniculata*) and are discussed above or in Section 4.3.4. All of these species, except *Pyrola minor* and *Saxifraga paniculata*, occur at the Mine Site. The RFSS plant species are grouped according to predominant habitat types/natural communities in which they occur, specifically Management Indicator Habitat (MIH) types if available. Additionally, more specific suitable habitat descriptions within each MIH type are provided for each species, and whether that habitat is present at the Mine Site.

Table 4.2.4-5 USFS RFSS Plant Species within Superior National Forest

Species Name	Common Name	Habitat Description	Suitable Habitat
Upland Forest - MIH 1			
Adoxa moschatellina	Muskroot	Shaded damp cliffs and slopes in upland mature northern hardwood forest on North Shore	No
Botrychium lanceolatum	Triangle grapefern	Mature northern hardwood forests	No
Botrychium lanceolatum var. *angustisegmentum*	Lanceleaf grapefern	Northern hardwood forest, old fields, old logging roads, trails	No
Botrychium lunaria	Common moonwort	Open habitats such as old log landings, sawmill sites, old building sites	Yes
Botrychium michiganense (hesperium) [3]	Michigan moonwort	Open habitats such as old log landings, old dirt roads, gravel pits, power line corridors, borrow pits, old fields, trails, and dredge spoil dumps	Yes
Botrychium mormo	Little goblin moonwort	Mesic northern hardwood forest with thick leaf litter layer	No
Botrychium pallidum [1,2]	Pale moonwort	Open disturbed habitats, log landings, roadsides, dunes, sandy gravel pits	Yes
Botrychium rugulosum [1,2]	Ternate or St. Lawrence grapefern	Generally open habitats, such as old log landings and edges of trails	Yes
Botrychium simplex [1,2]	Least grapefern	Generally open habitats, such as old log landings, roadside ditch, trails, open fields, base of cliff, railroad rights-of-way	Yes
Carex novae-angliae	New England sedge	Moist woods with sugar maple, also with birch, aspen, tall shrubs; yellow birch and white spruce-dominated forest	No
Crataegus douglasii	Douglas' hawthorn	North Shore rocky, gravelly streambeds/ banks and open areas, rocky borders of woods	No
Osmorhiza berteroi	Chilean sweet-cicely	Northern hardwood forest dominated by sugar maple on North Shore	No
Piptatherum (=Oryzopsis) canadense	Canada mountain ricegrass	Sandy/gravelly soil, red pine/jack pine plantations, borders/edges, trail sides, openings	Yes
Polystichum braunii	Braun's holly fern	Cool, shady cliffs and slopes in northern hardwoods in North Shore Highlands subsection	No
Prosartes trachycarpa (syn=*Disporum trachycarpum)*	Roughfruit fairybells	Semi-open jack pine forest with aspen, birch, shallow rocky soils, in east Border Lakes subsection	No
Taxus canadensis	Canada yew	Wide variety of uplands and lowlands, including cedar/ash swamps, talus and cliffs, northern hardwoods, aspen/birch forest	Yes
Waldsteinia fragarioides	Barren strawberry	Upland coniferous and deciduous forests, in recently harvested areas, established plantations	Yes
Lowland Black Spruce-tamarack Forest - MIH 9			
Caloplaca parvula	Lichen spp.	Smooth bark of young black ash in moist, humid old-growth black ash stand	No

Species Name	Common Name	Habitat Description	Suitable Habitat
Calypso bulbosa	Fairy slipper	Hummocks in northern white cedar swamps, moist to wet lowland conifer swamps, and to lesser extent in upland coniferous forests	Yes
Cetraria (=Ahtiana) aurescens	Lichen spp.	Conifer bark in lowland conifer swamps (old cedar/black spruce)	Yes
Cypripedium arietinum	Ram's-head lady's-slipper	White cedar swamps, forests dominated by jack pine, red pine, or white pine	Yes
Drosera linearis	Slenderleaf sundew	Minerotrophic water tracks in patterned peatlands	Yes
Frullania selwyniana	Selwyn's scalewort	Lowland cedar swamps on bark of white cedar	Yes
Menegazzia terebrata	Honey-combed lichen	Cedar swamps, especially old growth, base of cedar trees	Yes
Polemonium occidentale ssp. *lacustre*	Western Jacob's-ladder	White cedar swamps, also mixed conifer swamps, thrives in openings	Yes
Pyrola minor [2]	Snowline wintergreen	Black spruce swamps, and ecotone between uplands and lowland alder/conifer swamp, prefers closed canopy	Yes
Ramalina thrausta	Cartilage lichen	Cedar swamps, especially old growth	Yes
Rubus chamaemorus	Cloudberry	Black spruce/sphagnum forest, acidic; Superior National Forest at southern edge of species range	Yes
Sticta fuliginosa	Spotted felt lichen	On hardwood trees in humid, old growth cedar or ash bogs	No
Usnea longissima	Beard lichen	On old conifer trees in moist situations, often in or near a conifer or hardwood swamp	Yes
Aquatic Habitats – MIH 14			
Astragalus alpinus	Alpine milkvetch	Sandy, gravelly fluctuating shorelines with sparse vegetation	No
Caltha natans [1,2]	Floating marsh-marigold	Shallow water of pools, ditches, sheltered lake margins, slow-moving creeks, sloughs/oxbows, pools in shrub swamps	Yes
Juncus subtilis	Creeping rush	Sandy lakeshore – only known occurrence in BWCAW	No
Listera auriculata	Auricled twayblade	On alluvial- or lake-deposited sands or gravels, with occasional seasonal flooding, associated with riparian alder or spruce/fir forest	Yes
Littorella uniflora (=L. americana)	American shoregrass	Shallow margins of nutrient-poor lakes, seepage lakes, sandy substrate, may have fine gravel/organic soil	No
Nymphaea leibergii	Dwarf water-lily	Slow-moving streams, rivers, beaver impoundments 1 to 2 meters deep	Yes
Potamogeton oakesianus	Oakes' pondweed	Quiet, acidic waters of bogs, ponds, and lakes	No
Subularia aquatica	Awlwort	Beach zone of sandy nutrient-poor lakes, shallow lake margins, 15- to 45-centimeter-deep water	No

Species Name	Common Name	Habitat Description	Suitable Habitat
Other - Emergent wetland habitats			
Bidens discoidea	Swamp beggarticks	Silty shores, hummocks in floating mats and swamps, partly submerged logs	No
Eleocharis nitida [1,2]	Neat spikerush	Mineral soil of wetlands, often with open canopy and disturbance, such as logging roads/ditches through wetlands	Yes
Juncus stygius [1,2]	Moor rush	Shallow pools in non-forested peatlands, often in a sedge-dominated community	No
Muhlenbergia uniflora	Bog muhly	Wet sandy beaches, floating peat mats	No
Viola lanceolata	Bog white violet	Sandy to peaty lakeshores, borders of marshes and bogs, damp sand ditches	No
Other - Cliff, Talus Slopes, and Exposed Rock Habitat			
Arctoparmelia centrifuga	*Arctoparmelia* lichen	Sunny rocks and open talus slopes	No
Arctoparmelia subcentrifuga	*Arctoparmelia* lichen	Sunny rocks and open talus slopes	No
Arnica lonchophylla	Northern arnica	Cool and moist cliffs and ledges on North Shore	No
Asplenium trichomanes	Maidenhair spleenwort	In crevices of moist, mostly east-facing cliffs, ledges, and talus, Rove formation	No
Carex rossii	Short sedge	Rocky summits, dry exposed cliff faces, rocky slopes, in east Border Lakes subsection	No
Cladonia wainioi	Wain's cup lichen	On rock outcrops and thin soil, exposed sites with lots of light	No
Huperzia appalachiana	Appalachian clubmoss	Shelves and crevices on cliff/talus/rock outcrops, and shrub dominated talus piles	No
Moehringia macrophylla	Largeleaf sandwort	Cliffs/rock outcrops, talus, conifer sites on shallow soils, pine plantation with rocky outcrops, usually semi-open shrub or tree canopy	No
Oxytropis borealis var. *viscida*	Viscid locoweed	Slate cliffs and talus slopes in east Border Lakes subsection	No
Saxifraga cernua	Nodding saxifrage	Cliffs, ledges, diabase cliff (calcium-based feldspars)	No
Saxifraga paniculata [2]	White mountain saxifrage	Cliffs, sheltered crevices, and ledges of north-facing cliffs	No
Tofieldia pusilla	Scotch false asphodel	Sedge mats at edges of shoreline rock pools along Lake Superior	No
Woodsia glabella	Smooth woodsia	Moist, north-facing cliffs along Lake Superior	No
None Specified			
Pseudocyphellaria crocata	*Pseudocyphellaria* moss	Mossy rocks, trees in partially shaded, moist, frequently foggy habitats	Yes
Peltigera venosa	Felt lichen	Soil and moist cliffs, exposed root wads	No

Source: NatureServe 2011; USFS 2004a; USFS 2011d; USFS 2010d.

[1] Listed as a state ETSC species and located at the Mine Site.
[2] Listed as a state ETSC species and located on the federal or non-federal lands.
[3] Known to occur on the federal lands.

Six state-listed ETSC plant species (*Botrychium pallidum*, *Botrychium rugulosum*, *Botrychium simplex*, *Caltha natans*, *Eleocharis nitida*, and *Juncus stygius*) are also RFSS plants and are located on the Mine Site, as discussed in Section 4.2.4.2.3. *Botrychium michiganense* is also located on the Mine Site, according to MDNR NHIS data, and is an RFSS plant (see Table 4.2.4-5). The USFS designates and maintains data about MIH types on federal lands; MIH types are categories of forest types, including dominant species, stand age class, and stand condition. A smaller subset of all MIH types was used for this RFSS discussion, including upland forest (MIH 1), upland conifer forest (MIH 5), lowland black spruce-tamarack forest (MIH 9), and aquatic habitats (MIH 14). Upland forest (MIH 1) and lowland black spruce-tamarack forest (MIH 9) are almost equally prevalent in the federal lands portion of the Mine Site (see Table 4.3.4-3 and Figure 4.2.4-3), indicating that the 17 RFSS species associated with MIH 1 and the 13 RFSS species associated with MIH 9 have the highest probability of occurring on the federal lands, including the Mine Site. Upland conifer forest (MIH 5) occurs in smaller acreage; however, there are no RFSS species associated with MIH 5. Since this category overlaps MIH 1, the 17 RFSS species associated with MIH 1 may also occur within this category. The lowland emergent habitat type occurs on the federal lands portion of the Mine Site, as well, and the five associated RFSS species may be present.

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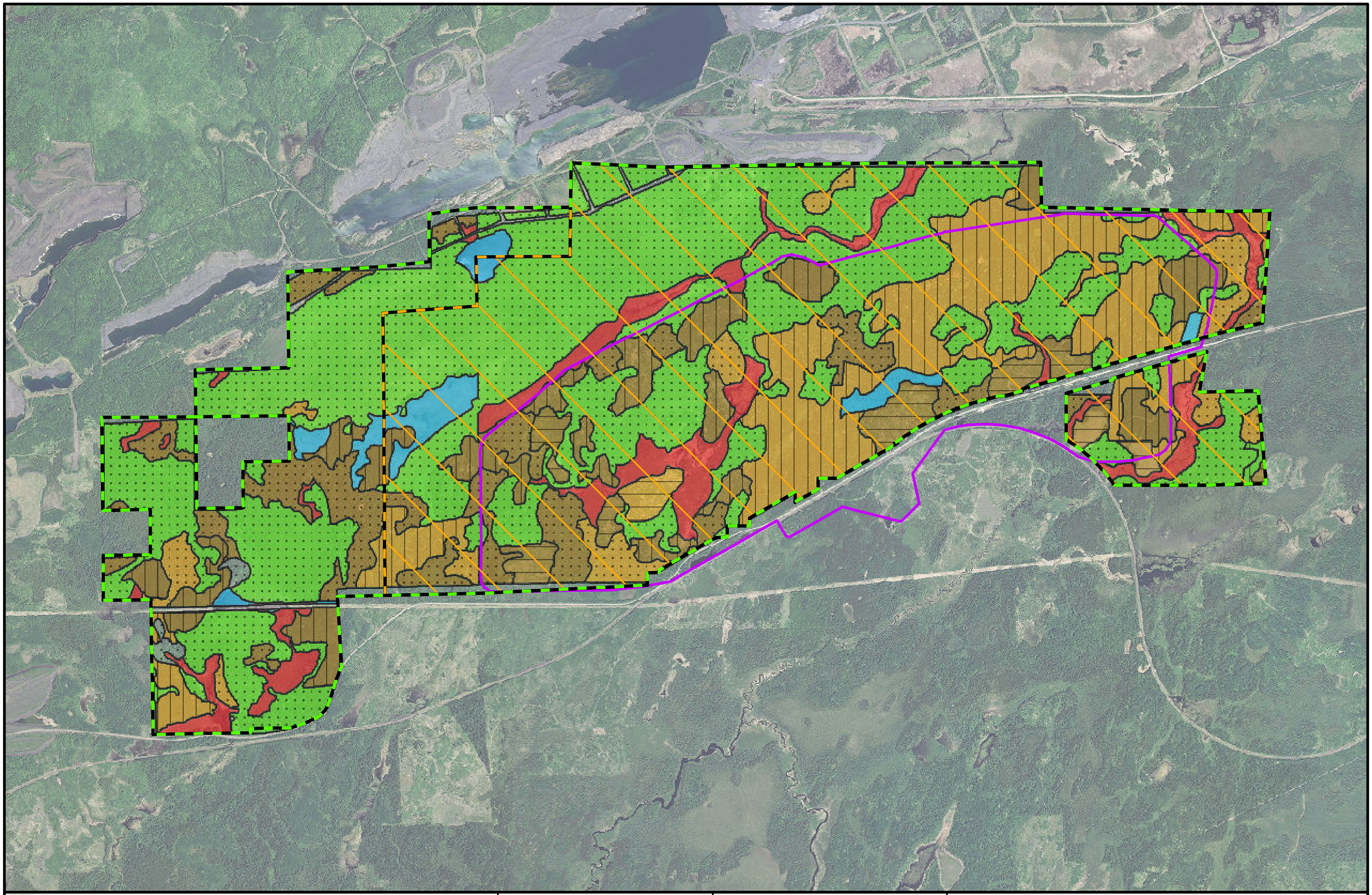

Federal Lands
Alternative B: Smaller Federal Parcel
Mine Site

Management Indicator Habitat

- 1 - Upland forest
- 5 - Upland conifer forest
- 9 - Lowland black spruce-tamarack forest
- 14 - Aquatic habitats
- Other Lowland Emergent
- Other Lowland Shrub
- Other Upland Grass

Age Classes

- N/A
- Young
- Immature
- Mature

N E S W

0 0.25 0.5 1 Miles

Figure 4.2.4-3
Management Indicator Habitat Types and Age Classes - Federal Lands and Mine Site
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4.2.4.3 Transportation and Utility Corridor

The Transportation and Utility Corridor includes the existing private Dunka Road, an existing private PolyMet railroad grade, a Minnesota Power Company 138-kV electric transmission line, a proposed treated water pipeline, a proposed 13.8-kV electric distribution line, and a proposed railroad connection between the Cliffs Erie railroad track and existing PolyMet track.

4.2.4.3.1 Cover Types

Habitat Types

Because of prior use during the former LTVSMC taconite mining operation, the Transportation and Utility Corridor is now defined as having a “disturbed” cover type (see Table 4.2.4-6). The remaining MDNR GAP land cover types that are not disturbed include cropland/grassland (8 percent of the Corridor), shrubland (6 percent of the Corridor), and smaller acreages of the remaining types. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.2.4-6 NorthMet Transportation and Utility Corridor Cover Types

Cover Types	Total Acres	Percent of Area
Disturbed	94.4	79
Cropland/Grassland	9.8	8
Shrubland	7.7	6
Aquatic environments	2.7	2
Upland deciduous forest[4]	2.7	2
Upland coniferous forest[3]	2.6	2
Lowland coniferous forest[1]	0.2	<1
Lowland deciduous forest[2]	0.0	0
Upland conifer-deciduous mixed forest[5]	0.0	0
Total	**120.2[(6)]**	**100**

Source: MDNR 2006b.

1 Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
2 Includes black ash forest cover types.
3 Includes pine and spruce/fir forest cover types.
4 Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
5 Includes all mixed coniferous-deciduous forest cover types.
6 Total acres may be more or less than presented due to rounding.

Minnesota Biological Survey

There are two MBS Sites of High Biodiversity Significance (18.8 acres) located within the Transportation and Utility Corridor, including the One Hundred Mile Swamp (2 percent of the Corridor) and the Upper Partridge River (13 percent of the Corridor) (MDNR 2008a).

There are several native plant communities occupying the Transportation and Utility Corridor, most of which have no assigned conservation status rank. The aspen-birch forest: balsam fir subtype (FDn43b1) native plant community (1 percent of the Corridor) is ranked as “widespread and secure” (MDNR 2008b).

Scientific and Natural Areas

There are no SNAs located within the Transportation and Utility Corridor.

Culturally Important Plants

As with the Mine Site discussion, Section 4.2.9 provides a discussion of natural resources culturally important to the Bands.

4.2.4.3.2 Invasive Non-native Plants

According to the Superior National Forest invasive plant geodatabase, there are no known occurrences of invasive species within the Transportation and Utility Corridor, but no inventories have been performed in the NorthMet Project area (USFS 2010a). USFS roadside surveys indicate that several invasive non-native species (e.g., common tansy, spotted knapweed, etc.) could be located within the Corridor (see Table 4.2.4-3). A field survey indicated that hawkweeds, red and white clover, oxeye daisy, smooth brome, bluegrass, and timothy were observed along the Transportation and Utility Corridor (Barr 2012w).

4.2.4.3.3 Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

Based on a review of the MDNR NHIS and field investigations, no federally listed plant species occur on the Transportation and Utility Corridor. However, three state-listed ETSC plant species (*Botrychium pallidum*, *B. simplex*, *Sparganium glomeratum*) have been identified within the Transportation and Utility Corridor area (see Figure 4.2.4-2). The species populations that occur along Dunka Road immediately adjacent to or overlapping the Mine Site were discussed previously in the review of the Mine Site to avoid repetition. The species populations that occur along Dunka Road, farther away from and not overlapping the Mine Site, are discussed separately below (see Table 4.2.4-7).

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013. The FEIS will consider any new listings, or changes in the previous listings, associated with the updated list.

Table 4.2.4-7 Endangered, Threatened, and Special Concern Plant Species Identified within the Transportation and Utility Corridor

Scientific Name	Common Name	State Status[1]	No. of Populations	No. of Individuals	Habitat and Location
Botrychium pallidum	Pale moonwort[2]	E	3	16	Full to shady exposure, edge of forests along Dunka Road

Sources: Barr 2012w.

[1] E = Endangered
[2] These species are also RFSS as tracked by the USFS.

Species Life History

Section 4.2.4.2.3 discusses the life history of *Botrychium pallidum*.

4.2.4.4 Plant Site

The Plant Site includes the Beneficiation Plant, Area 1 Shops, Area 2 Shops, Hydrometallurgical Residue Facility and Plant, and the Tailings Basin (PolyMet 2013c). The Plant Site itself comprises 4,514.0 acres, but including the surrounding buffer lands that PolyMet owns or has leased surface rights to, the Plant Site consists of approximately 15,000 acres, one-third of which is estimated to have been disturbed by previous LTVSMC operations. The Colby Lake Water Pipeline Corridor is also included in this section. The pipeline connects the Plant Site to Colby Lake, which is south of the Plant Site.

4.2.4.4.1 Cover Types

Plant Site

Habitat Types

Because of use during the former LTVSMC taconite mining operation, the majority of the Plant Site is now defined as having a "disturbed" cover type (see Table 4.2.4-8 and Figure 4.2.4-4). The remaining MDNR GAP land cover types include approximately equal areas of aquatic environments (14 percent of the Plant Site) and upland deciduous forests (14 percent of the Plant Site), and smaller areas of shrubland, upland conifer forest, and lowland conifer forest. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

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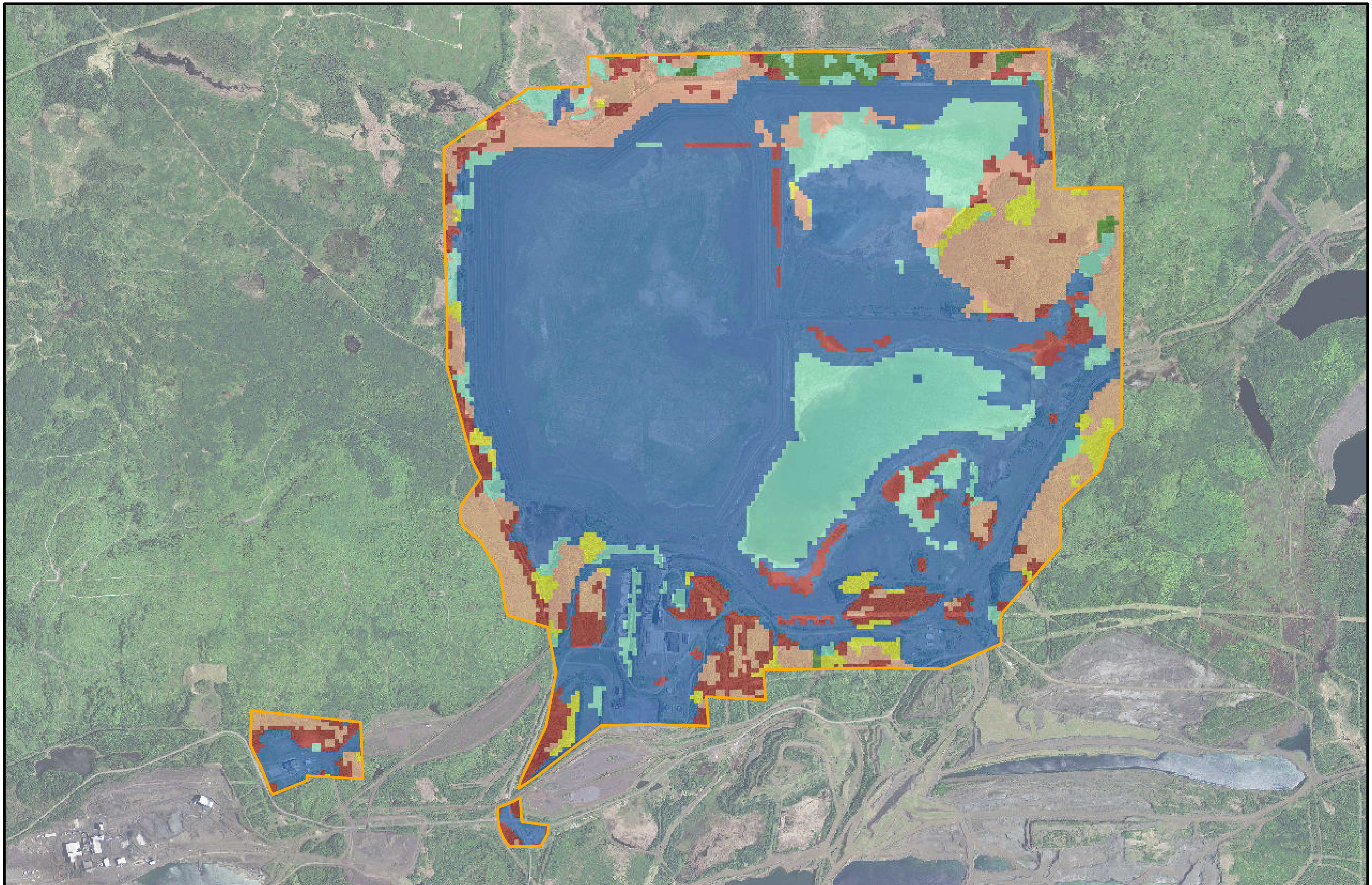

Plant Site

Land Cover Classes

- Aquatic Environments
- Lowland Conifer Forest
- Disturbed
- Shrubland
- Upland Conifer Forest
- Upland Deciduous Forest

US Army Corps of Engineers
St. Paul District

Figure 4.2.4-4
Land Cover/Habitat Types - Plant Site
NorthMet Mining Project and Land Exchange SDEIS
Minnesota

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Table 4.2.4-8 NorthMet Plant Site Cover Types

Cover Types	Total Acres	Percent of Area
Disturbed	2,755.5	61
Upland deciduous forest[4]	646.7	14
Aquatic environments	636.7	14
Shrubland	333.4	7
Upland coniferous forest[3]	99.8	2
Lowland coniferous forest[1]	41.9	1
Cropland/Grassland	0.0	0
Lowland deciduous forest[2]	0.0	0
Upland conifer-deciduous mixed forest[5]	0.0	0
Total	**4,514.0**	**99[(6)]**

Source: MDNR 2006b.

1 Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
2 Includes black ash forest cover types.
3 Includes pine and spruce/fir forest cover types.
4 Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
5 Includes all mixed coniferous-deciduous forest cover types.
6 Percent totals are less than 100 percent due to rounding.

Minnesota Biological Survey

There are no MBS Sites of Biodiversity Significance located on the Plant Site (MDNR 2008a). Native plant community rankings are not available for the Plant Site.

Scientific and Natural Areas

There are no SNAs located on or near the Plant Site.

Culturally Important Plants

The most upstream portion of the Embarrass River Watershed, recommended as a water used for production of wild rice, is from the MN-135 highway bridge to the inlet of Sabin Lake (MPCA 2012b). The former Wild Rice Valley Farms is located adjacent to the Embarrass River, but no wild rice was observed within this area or the adjacent portion of the Embarrass River during field surveys, and it is not recommended as a water used for production of wild rice (MPCA 2012b). Hay Lake, located along the upper stretch of the Embarrass River, is recommended as a water used for production of wild rice, but Sabin and Wynne lakes are not recommended as waters used for production of wild rice except for the northern-most tip of Wynne Lake (MPCA 2012b). Embarrass Lake is recommended as a water used for production of wild rice (MPCA 2012b). Though low-density beds of wild rice were observed on Embarrass Lake in 2009 and 2010, no rice was observed in 2011 (Barr 2012a). No wild rice was observed in Spring Mine Creek, Trimble Creek, or Unnamed Creek near the Plant Site and they are not recommended as waters used for production of wild rice (Barr 2009b; Barr 2011a; Barr 2012a; MPCA 2012b). Section 4.2.2 provides a discussion on wild rice survey results and water quality standards (see Figure 4.2.2-3).

A discussion of natural resources culturally important to the Bands is presented in Section 4.2.9.

Colby Lake Water Pipeline Corridor

Habitat Types

Extending south from the Plant Site is the Colby Lake Water Pipeline Corridor. There would be no construction within this pipeline corridor, as an existing pipeline would be used for the NorthMet Project Proposed Action. The corridor consists of 50.6 acres (see Table 4.2.4-9), and the MDNR GAP land cover types are dominated by disturbed areas (42 percent) and cropland/grassland (23 percent).

Table 4.2.4-9 NorthMet Colby Lake Water Pipeline Corridor Cover Types

Cover Types	Total Acres	Percent of Area
Disturbed	21.4	42
Cropland/Grassland	11.5	23
Shrubland	8.4	17
Upland deciduous forest[4]	6.5	13
Aquatic environments	1.4	3
Lowland deciduous forest[2]	0.6	1
Upland coniferous forest[3]	0.5	1
Lowland coniferous forest[1]	0.2	<1
Upland conifer-deciduous mixed forest[5]	0	0
Total	**50.5[(6)]**	**100**

Source: MDNR 2006b.

1 Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
2 Includes black ash forest cover types.
3 Includes pine and spruce/fir forest cover types.
4 Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
5 Includes all mixed coniferous-deciduous forest cover types.
6 Total acres may be more or less than presented due to rounding.

4.2.4.4.2 Invasive Non-native Plants

The Tailings Basin at the Plant Site is severely disturbed and already contains invasive non-native plants such as smooth brome grass, reed canary-grass, and yellow sweet clover. These species are tolerant of a wide variety of conditions, and can spread vegetatively or reproductively (MDNR 2011b). They often grow on disturbed lands, roadsides, and ditches. According to the Superior National Forest invasive plant geodatabase, there are no known occurrences of invasive species on the Plant Site, but no inventories have been performed in the NorthMet Project area (USFS 2010a). Similar to the Mine Site, the Plant Site could also have the species listed in Table 4.2.4-3, including common tansy, spotted knapweed, or thistle species.

4.2.4.4.3 Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

Based on a review of the MDNR NHIS, no federally listed or state-listed ETSC plant species are known to occur on the Plant Site or within Colby Lake Water Pipeline Corridor. A detailed ETSC plant species survey was not conducted at the Plant Site because suitable habitat for these species is not present at this predominantly disturbed and developed site. ETSC species that are disturbance-adapted may exist along the rail line or roads. Consequently, the federal lands (including the Mine Site), Transportation and Utility Corridor, and non-federal lands are the focus of this SDEIS vegetation analysis.

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4.2.5 Wildlife

This section describes the existing wildlife species and habitat which are or may be present in the NorthMet Project area. These species or their sign, such as tracks or droppings, have been observed during surveys, were identified as historically present, and/or typically use habitat present in the NorthMet Project area. Species are grouped in four partially overlapping categories: federally and state-listed ETSC (seven species); SGCN (95 species); the USFS's RFSS (18 species, excluding aquatic species); and other wildlife species, including wildlife species important to the Bands.

Seven federally and state-listed ETSC wildlife species that were identified in scoping as potentially present in the NorthMet Project area are described in Section 4.2.5.1.1. Federally listed species records are maintained by the USFWS and the state-listed species records are maintained in the Minnesota NHIS. The NHIS is the most complete source of data on Minnesota's rare or otherwise significant wildlife species, but it is not a comprehensive statewide inventory. It is based on historical museum records, published information, and field work, and is continually updated as new information becomes available. Therefore, the lack of a species occurrence in the NHIS database does not necessarily confirm the absence of a particular species in that area (MDNR 2013a). A county-by-county survey of rare natural features is being conducted by the MDNR as part of the Minnesota Biological Survey.

Additional information—such as species conservation ranking, distribution, and habitat—was obtained from NatureServe, an online public database that utilizes sources such as scientific literature, web sites, experts, and information from local data centers.

Several wildlife surveys have been conducted on the federal lands (including the Mine Site), Plant Site, Transportation and Utility Corridor, and non-federal lands. These studies gathered information on general wildlife utilization of the area, presence or absence of species of concern, and identification of habitat used by wildlife.

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013. The FEIS will consider any new listings, or changes in the previous listings, associated with the updated list. The FEIS will also consider any federal listing changes, should they occur.

A Biological Assessment (with further information on federally listed species) and a Biological Evaluation (containing further information about RFSS species) have been prepared and are posted on the USFS website (http://www.fs.usda.gov/goto/superior/northmet).

4.2.5.1 Mine Site

4.2.5.1.1 Federally and State-listed Species and Species of Special Concern

Canada Lynx

Canada lynx (*Lynx canadensis)* populations in the continental United States are protected under the ESA as a federally listed threatened species. However, the species is not listed as an ETSC species in Minnesota and is considered globally secure by NatureServe (NatureServe 2012). Lynx population cycles are related to snowshoe hare populations, and therefore, lynx are predominantly found in boreal forests, specifically spruce and fir. This habitat type corresponds to USFS MIH types 5, 6, and/or 9. Lynx mortality due to starvation and declining reproduction rates have been documented during periods of hare scarcity (Poole 1994; Slough and Mowat 1996). Hunger-related stress, which induces dispersal, may increase exposure of lynx to other forms of mortality such as trapping and vehicle collisions (Brand and Keith 1979; Ward and Krebs 1985; Bailey et al. 1986). Between 2001 and 2013, the USFWS has documented two lynx killed by trains and seven lynx killed by road traffic in Minnesota (USFWS 2013). Lynx may also be subject to competition and predation from species such as bobcat and cougar (Buskirk et al. 2000).

Lynx have been described as generally tolerant of humans (Sunde et al. 1998). Reports suggest that lynx are not displaced by human activity, including moderate levels of snowmobile traffic (Mowat et al. 2000) and ski resort activities (ENSR 2006). In an area with sparse roads in north-central Washington State, logging roads did not appear to affect habitat use by lynx (McKelvey et al. 2000). By contrast, lynx in the southern Canadian Rocky Mountains, where road density is higher, crossed highways within their home ranges less than would be expected (Apps 2000).

Over three-quarters of lynx records in Minnesota are from the northeastern portion of the state (McKelvey et al. 2000). Research in Minnesota confirmed a resident breeding population of lynx. Of the 426 sightings reported to the MDNR Division of Ecological Resources between 2000 and 2006, 76 percent were in St. Louis, Lake, and Cook counties. Approximately 113 lynx were sighted in St. Louis County between 2000 and 2006 and 8 percent of these lynx showed evidence of reproductive activity (MDNR 2012d).

Current conditions for this species in the NorthMet Project area were determined through review of existing data sources, including various lynx sighting databases (Moen et al. 2006; MDNR 2012d; USFS 2013), project-specific studies during the summer season (ENSR 2005), and a winter tracking survey (ENSR 2006). The winter tracking survey also included interviews with experts, private conservation groups, and the public, who are familiar with lynx use of the survey area.

On February 25, 2009, the USFWS published the *Final Rule for Revised Designation of Critical Habitat for the Contiguous United States Distinct Population Segment of the Canada Lynx* (50 CFR 17). Portions of the Mine Site lie within the revised boundaries of federally designated lynx critical habitat, which includes most of northeastern Minnesota. A recovery plan has not yet been issued for the Canada lynx.

The USFS designates Lynx Analysis Units (LAUs) within the Superior National Forest that include landscape-scale analysis areas for lynx management. These LAUs were developed in consultation with the USFWS. The federal lands, including the Mine Site, are located within LAU 12, a 70,980-acre area in the southwest portion of the Superior National Forest. According to the USFS (USFS 2013), approximately 69,131 acres, or 96 percent, of LAU 12 currently provide suitable lynx habitat.

Lynx sign has been observed at the Mine Site. Moen et al. (2006) found that at least 20 different individual lynx sightings have occurred within 18 miles of the NorthMet Project area, including several radio-collared and reproductive individuals. During this study, the nearest reported sighting was approximately 6 miles from the Mine Site (Moen et al. 2006). The majority of sightings are clustered along roads and other places frequented by people.

An ENSR 2006 lynx winter tracking survey covered a 250-square-mile area centered around the NorthMet Project area. The survey did not find any signs of lynx at the Mine Site or federal lands, but DNA analysis of scat indicated four unrelated females within the 250-square-mile survey area (ENSR 2006). Track surveys suggest that two individuals made most of the trails found. Although preferred cover types for the snowshoe hare exist on the Mine Site (i.e., Jack pine, fir-aspen-birch, aspen-birch), the forest may be too old for there to be appreciable hare densities, as snowshoe hare generally favor sapling or young pole stands (ENSR 2006). The USFS observed lynx tracks at the Mine Site in 2010, and multiple observations of lynx sign within 5 miles of the federal lands are noted in the USFS lynx tracking database (USFS 2013). Lynx density may increase as the snowshoe hare population cycles from a low point.

Areas of blow down or logging slash where there is both vertical and horizontal cover may be used by lynx for denning sites (Moen 2009). Some logging slash is located on the west end of the Mine Site.

Gray Wolf

On July 1, 2009, a U.S. District Judge signed a settlement agreement that remanded an April 2009 USFWS decision to delist the western Great Lakes population of gray wolves. As a result, the gray wolf (*Canis lupus*) was again a federally listed threatened species. On May 4, 2011, the USFWS once again proposed to reinstate the 2009 decision to delist the gray wolf population in the western Great Lakes. This decision was finalized on December 26, 2011 and was made effective on January 27, 2012. Therefore, the gray wolf is not currently listed as a threatened species, but is listed as a Minnesota Species of Special Concern and a Superior National Forest RFSS. Though Minnesota is no longer divided into the five federal wolf management “zones” due to the federal delisting, these management zones will be reinstated if the wolf is relisted.

Populations of gray wolves have been re-established in several western states from their low point in the mid-1970s when only northeast Minnesota, among the lower 48 states, had a reproducing population. Gray wolf populations in the western Great Lakes Region (i.e., Minnesota, Wisconsin, and Michigan) are expanding and have exceeded recovery goals for several years (Erb and Benson 2004). A 2007 to 2008 winter survey by the MDNR (Erb 2008) estimated that 2,921 gray wolves live in Minnesota, which is second only to Alaska in wolf populations across the United States. The MDNR considers the gray wolf population fully recovered, as it has surpassed the federal delisting goal of 1,251 to 1,400 wolves (MDNR 2012e). Surveys and studies conducted in the winter of 2012 to 2013 estimate the Minnesota wolf population to be approximately 2,211 animals (Erb and Sampson 2013). In the fall of 2012, the MDNR established a designated wolf hunt with an overall quota of 400 wolves. A total of 413 wolves were harvested during the hunt. The MDNR has set a 2013 hunting season quota of 220 wolves.

In northern Minnesota, the principal prey of the gray wolf includes white-tailed deer, moose, beaver, hare, and muskrat, with occasional small mammals, birds, and large invertebrates. Most wolves live in two- to 12-member family packs and defend territories of 20 to 214 square miles. In Minnesota, the average pack size is 5.5 individuals (Erb and Benson 2004). The forest and brush habitats at the federal lands and Mine Site are typical wolf habitat (MIHs 1 to 14).

Radio-collared wolves have been observed in the vicinity of the federal lands and the Mine Site. Additionally, tracks and scat have been observed along Dunka Road and the roads within the Mine Site. The surrounding area is likely to support a pack of at least three individuals (ENSR 2005).

Bald Eagle

The bald eagle (*Haliaeetus leucocephalus*) was removed from the federal threatened species list on June 28, 2007. After a period of decline due to hunting and widespread use of dichlorodiphenyltrichloroethane (DDT), bald eagle populations in the lower 48 states rose dramatically beginning in 1972. The bald eagle continues to be listed by the State of Minnesota as a Species of Special Concern and as an RFSS by the USFS. According to NatureServe, it is globally secure (NatureServe 2012). In addition, the bald eagle is federally protected by the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act.

The Minnesota NHIS (MDNR 2013a) contains records of 18 nesting areas, some with multiple nests, within 12 miles of the federal lands and Plant Site. Some of these areas contained nests in close proximity and were assumed to be used by a single pair (Guinn 2004). No nests were recorded at the Mine Site and field surveys found no evidence of any nests (ENSR 2005). The five closest bald eagle nesting territories were 2.4 to 7.3 miles from the Mine Site or Plant Site (averaging 5.7 miles apart). Bald eagles are typically associated with large lakes surrounded by mature forest where large trees provide suitable nest sites and a perch while searching for fish and other prey. No large lakes are located at the Mine Site and it is unlikely that bald eagles would use these areas.

The NorthMet Project area was also reviewed to evaluate whether it may provide wintering habitat for bald eagles. Eagles generally winter where there is available food at or near open water, and where carrion is available. Animal-vehicle collisions on Dunka Road and/or natural deer mortality are not likely to produce sufficient carrion to sustain bald eagles at the Mine Site (ENSR 2005). While bald eagles have been observed utilizing dead trees on other tailings basins in the Mesabi Iron Range for nesting and perching, no nests have been observed in the NorthMet Project area. Eagles may use standing dead trees at the existing LTVSMC Tailings Basin for perching.

MIH 7, which is primarily red and white pine forest, is considered indicative of bald eagle habitat by the USFS. No stands of MIH 7 were specifically observed on the federal lands or proposed Mine Site; however, MIH 7 is a subset of the broader MIH 5, which was observed at the Mine Site (see Figure 4.2.4-3).

Wood Turtle

The wood turtle (*Glyptemys insculpta*) is listed as a threatened animal species in Minnesota and as an RFSS by the USFS. The wood turtle is not federally listed, but is considered globally vulnerable (imperiled in Minnesota) by NatureServe (NatureServe 2012). The species' range extends from Virginia to Nova Scotia and westward to Minnesota and northeast Iowa. The NorthMet Project area is located at the western edge of its range in Minnesota. Significant wood turtle populations, however, are unlikely to be found at the Mine Site because it prefers a habitat of sandy-gravelly streams and bars, used for hibernating, mating, and nesting (Bradley et al. 2002), which are not present at the Mine Site.

The Minnesota NHIS records indicate the northernmost population in the state was observed immediately south of the Mine Site. Given this proximity, it is possible that wood turtles may potentially occur along the southern fringes of the Mine Site.

Eastern Heather Vole

The eastern heather vole (*Phenacomys ungava*) is listed as a species of special concern by Minnesota and as an RFSS by the USFS. It is not federally listed or globally sensitive according to NatureServe (NatureServe 2012). The eastern heather vole is a habitat generalist, but typically inhabits the coniferous zones in upland forests and brushlands and meadows with low shrub species, usually near water. Habitats of this type may occur on the federal lands or at the Mine Site; however, the Minnesota NHIS does not contain any eastern heather vole records within 10 miles of the NorthMet Project area. It was also not found in nearby surveys of small mammals on the Chippewa National Forest (Christian 1993) and in Cook County (Jannett 1998). The NorthMet Project area is at the southern edge of the eastern heather vole's home range in far northern Minnesota and only a few collections of the species occur within Minnesota. The USFS MIH 8, which is primarily jack pine forest, is considered indicative of eastern heather vole habitat. No significant stands of MIH 8 were observed on the federal lands or the proposed Mine Site.

Yellow Rail

The yellow rail (*Coturnicops noveboracensis*) is a state-listed species of special concern. It is not federally listed, and its global rank is considered secure, although vulnerable in Minnesota (NatureServe 2012). Habitat for yellow rail includes lowland sedge meadows. Several small patches (totaling 39.5 acres) of wet meadow/sedge meadow occur at the Mine Site. The Minnesota NHIS has no records of the yellow rail occurring within 10 miles of the NorthMet Project area and field surveys did not identify any yellow rail (ENSR 2005).

Laurentian Tiger Beetle

The Laurentian tiger beetle (*Cicindela denikei*) is listed as a threatened species by the State of Minnesota. It is not federally listed, and its global rank is considered vulnerable (imperiled in Minnesota) (NatureServe 2012). Although it was not searched for during field surveys, the NHIS has no records of Laurentian tiger beetle occurring within 10 miles of the NorthMet Project area. This species inhabits openings in northern coniferous forests, specifically abandoned gravel and sand pits, undisturbed corners of active gravel and sand pits, sand and gravel roads, and sparsely vegetated rock outcrops (MDNR 2012g). Conifer forests occur on the Mine Site, but field surveys did not detect sandy or rocky openings in the forest (ENSR 2005). Rock exposures are evident in areas disturbed by past mining, but conifer forests do not surround these areas.

4.2.5.1.2 Species of Greatest Conservation Need

The Minnesota Comprehensive Wildlife Conservation Strategy (MCWCS), an ecoregion-based wildlife management strategy (MDNR 2006d) identifies SGCN by ecoregion subsections based on a statewide approach. The MCWCS was created with input from multiple stakeholders and expert panels to cover issues of regional, as well as statewide, concern. The Mine Site and Plant Site are located within the Nashwauk and Laurentian Upland subsections and include five key habitat types. The SGCN species associated with these habitat types at the Mine Site are identified below in Table 4.2.5-1.

Mature upland and lowland forest is the most common habitat type at the NorthMet Project area (primarily at the Mine Site). Section 4.2.4 provides a more detailed discussion of vegetation cover and habitat types. Northern goshawk, spruce grouse, black-backed woodpecker, and boreal owl were observed in these forests (ENSR 2005). These species represent a group that generally requires large forested blocks and/or minimal human intrusion.

Brush/grassland and very early successional forest are uncommon at the Mine Site (ENSR 2005) and, where present, are typically small patches resulting from recent logging. The USFS has indicated that American woodcock has been observed at the Mine Site and the least weasel may occur as well. Most of the other SGCN species in Table 4.2.5-1 are generally associated with large patches of grassland and savanna habitats that are not present at the Mine Site.

Table 4.2.5-1 Key Habitat, Cover Types, and Associated Species in the Nashwauk and Laurentian Uplands Subsections at the NorthMet Project Area

Key Habitat Type, Cover Types, and Management Indicator Habitats	**Associated Wildlife Species[1]**	**Plant Site (Acres)**	**Mine Site (Acres)**	**Transportation and Utility Corridor (Acres)**
1. Mature Upland Forest, Continuous Upland/Lowland Forest: aspen forest/aspen-birch forest, jack pine forest, mixed pine-hardwood forest (MIH 1-13)	Veery, whip-poor-will, eastern wood-pewee, yellow-bellied sapsucker, ovenbird, Canada warbler, Cape May warbler, **spruce grouse**, winter wren, boreal chickadee, wood thrush, **black-backed woodpecker**, *bald eagle[2]*, **boreal owl (MIH 4, 5, and 9)**, *bay-breasted warbler*, *black-throated blue warbler*	788.4	2,627.2	5.5
2.Open Ground, Bare Soils: disturbed/ developed (no MIH)	None	2,755.5	128.0	94.4
3.Grassland and Brushland, Early Successional Forest (no MIH)	Eastern meadowlark, Franklin's ground squirrel, brown thrasher, white-throated sparrow, sharp-tailed grouse, golden-winged warbler, *American woodcock*, northern harrier, sedge wren, common nighthawk, black-billed cuckoo, red-headed woodpecker, tawny crescent, *least weasel*	333.4	246.6	17.5
4. Aquatic Environments: Tailings Basin, Partridge River, Embarrass River, former LTVSMC mine pits, wetlands (MIH 14)	Common loon, red-necked grebe, common snapping turtle, northern rough-winged swallow, American white pelican, common tern, Wilson's phalarope, black tern, trumpeter swan, Black duck, American bittern, swamp sparrow, Eastern red-backed salamander, bog copper, taiga alpine, *marbled godwit*	636.7	12.7	2.7
5. Multiple Habitats (MIH 1-14)	**Gray wolf[2]** (1-4[3]), ***Canada lynx**[2]* (1-4), rose-breasted grosbeak (1, 3), Macoun's arctic (1, 3), **least flycatcher** (1, 3), *Connecticut warbler* (1, 3), *olive-sided flycatcher (1, 4)*, grizzled skipper (2, 3), Nabokov's blue (2, 4), wood turtle[2] (1, 3, 4)			
Total		4,514.0	3,014.5	120.1

Source: MDNR 2006d.

[1] Bold text indicates SGCN species observed at Mine Site and/or Plant Site (ENSR 2005); italicized text indicates SGCN species targeted by ENSR (2005) that were not found; plain text indicates SGCN species identified as likely to be present at the Mine Site or Plant Site but not targeted in surveys.

[2] Canada lynx, gray wolf, bald eagle, and wood turtle are or have recently been listed as ETSC species, as discussed in detail in the ETSC species section.

[3] Numbers refer to the Key Habitat Types (1-5) where those species may occur or are known to occur.

The Mine Site and adjacent federal lands contain a large expanse of wetland habitat consisting primarily of coniferous bogs and coniferous swamps. No wetland SGCN species have been observed in this area. Marbled godwit was not found likely because its preferred habitat of graminoid wetlands and shallow marshes near extensive upland grassland are not present at the Mine Site. Currently, there are no bodies of open water at the Mine Site.

Multiple habitats are not mapped as such, but are made up of combinations of other key habitat types. This category is used for SGCN species that are known to use multiple habitats during a season. The gray wolf, Canada lynx, least flycatcher, and wood turtle were observed in the general vicinity of the Mine Site and are known to utilize multiple key habitat types, including mature and early-successional upland forest and wetlands. The Connecticut warbler, which also uses mature and early-successional upland forest and wetlands, was searched for, but not found. Similarly, the olive-sided flycatcher was surveyed for in both lowland forest and wetlands, but was not found, most likely because it prefers more open and mature conifer and mixed conifer-deciduous stands. The butterfly species grizzled skipper and Nabokov’s blue are not found within 12 miles of the Mine Site or Plant Site.

4.2.5.1.3 Regional Forester Sensitive Species

RFSS are not protected but their needs are taken into consideration by the USFS when planning natural resource management on USFS lands. The majority of the Mine Site (and adjacent federal lands) is located in the Superior National Forest. Currently, 18 RFSS of terrestrial wildlife are included on the Superior National Forest RFSS list, which was approved in late 2011.

Four of these RFSS species are state-listed ETSC species (i.e., gray wolf, bald eagle, wood turtle, and eastern heather vole) and are discussed above. Seven other species are on the SGCN list and are discussed by habitat type in Table 4.2.5-1. These species include the boreal owl (*Aegolias funereus*), olive-sided flycatcher (*Contopus cooperi*), bay-breasted warbler (*Dendroica castanea*), Connecticut warbler (*Oporornis agilis*), taiga alpine (*Erebia disa mancinus*), Freija’s grizzled skipper (*Pyrgus centaureae freija*), and the Nabokov’s blue (*Plebejus idas nabokovi*). The remaining seven species are discussed briefly below.

The northern myotis (*Myotis septentrionalis*) is not federally or state-listed. It is considered vulnerable by NatureServe (NatureServe 2013). Its preferred habitat includes forests and riparian areas. It may hibernate in caves, mines, overhangs, crevices, drill holes, and similar sites. This habitat may be found near the Mine Site.

The eastern pipistrelle (*Perimyotis subflavus*) is not federally or state-listed. It is considered vulnerable by NatureServe (NatureServe 2013). Its preferred habitat includes open areas with large trees and woodland edges. It avoids open fields and deep woods. It may hibernate in caves and mines and roosts in trees and man-made structures. Tree roost habitat can be found at the Mine Site, though the species is more common in the southern half of Minnesota.

The little brown myotis (*Myotis lucifugus*) is not federally or state-listed. A habitat generalist, its preferred habitat includes boreal forests, bogs and fens, open fields, shrublands, and urban areas. It may hibernate in caves, tunnels, and abandoned mines and roosts in trees and man-made structures. This tree-roost habitat may be found at the Mine Site.

The northern myotis, eastern pipistrelle and little brown myotis bat species were added to the 2011 RFSS list due to the spread of white-nose syndrome, which is a fungal disease impacting bats. The disease carries a high mortality rate for all bat species, and the Superior National Forest is closely watching the RFSS bat species to identify signs of white-nose syndrome.

The northern goshawk (*Accipiter gentilis*) is not federally or state-listed. It is considered globally secure by NatureServe (NatureServe 2012). Its preferred habitat includes older forests, particularly aspen. This habitat is found in the NorthMet Project area. Calling surveys did not identify northern goshawk at the Mine Site (ENSR 2005); however, a goshawk nest was identified at the Mine Site. Two goshawk territories have been identified at or near the Mine Site, as goshawk have nested on the Mine Site and adjacent federal lands in 2000, 2009, 2011, and 2013 (USFS 2013). The One Hundred Mile Swamp goshawk territory, which is within the Mine Site, is no longer considered active. The Wetlegs Creek goshawk territory, located on the federal lands adjacent to the Mine Site, is still considered active and is being monitored.

The great gray owl (*Strix nebulosa*) is not federally or state-listed, nor is it tracked in the Minnesota NHIS. It is considered globally secure by NatureServe (NatureServe 2012). Its preferred habitat includes coniferous and mixed forests and boreal bogs, which include MIHs 4, 5, and 9. These habitats are found in the NorthMet Project area. Calling surveys did not identify great gray owls at the Mine Site or Plant Site (ENSR 2000 and 2005); however, 2009 surveys identified a great gray owl hunting along Dunka Road south of the Mine Site, and the USFS has records of a great gray owl nesting in the NorthMet Project area in 2006 (AECOM 2009a), 2010, and 2011 (USFS 2013).

The three-toed woodpecker (*Picoides tridactylus*) is not federally or state-listed and is globally secure according to NatureServe (NatureServe 2012). It is not tracked in the Minnesota NHIS. This species was identified during winter field surveys (ENSR 2000); however, it was not identified during summer field surveys (ENSR 2005). A limiting factor for this species is foraging habitat where sufficient insects can be found to feed its young during the breeding season. Three-toed woodpeckers prefer and are most abundant in large tracts of old growth coniferous forest near recent burns where they forage on dead and dying trees for bark beetles (Burdett and Niemi 2002). MIH 9 and MIH 12 are considered habitat for the three-toed woodpecker. No old growth coniferous habitat or recent burns are present at the Mine Site or adjacent federal lands. A three-toed woodpecker was observed at the Mine Site by USFS personnel in 2007; however, the birds are unlikely to be common due to a lack of suitable habitat.

The Quebec emerald (*Somatochlora brevicincta*), a dragonfly, is not federally or state-listed, but it is considered globally vulnerable by NatureServe (NatureServe 2012). Field surveys for this species were not completed, and this information is not tracked in the Minnesota NHIS. The Minnesota Odonata Survey Project, however, found an individual in northern Lake County approximately 30 miles north of the NorthMet Project area in 2006. This species' habitat requirements are not well-understood in Minnesota. Reports suggest that it inhabits poor fens found in the NorthMet Project area and wet meadow/sedge meadow habitat such as at the Mine Site. The likelihood of observing Quebec emerald individuals or populations in the vicinity of the federal lands and Mine Site is low.

4.2.5.1.4 Other Wildlife Species

Other wildlife species common to the area may be present at the Mine Site and surrounding NorthMet Project area. Species of interest include the northern leopard frog, common loon, hooded merganser, osprey, red-tailed hawk, ruffed grouse, spruce grouse, American woodcock, killdeer, belted kingfisher, pileated woodpecker, American three-toed woodpecker, black-backed woodpecker, brown creeper, golden-crowned kinglet, Swainson's thrush, magnolia warbler, pine warbler, savannah sparrow, beaver, porcupine, white-tailed deer, and moose. Sections 4.2.9 and 5.2.9 discuss species of importance to the Bands.

Game species such as deer, bear, and moose are found in and near the NorthMet Project area, and are of importance to the Bands. The NorthMet Project area is located within bear management unit 31. The 5-year harvest average is 350 animals within unit 31 (MDNR 2013b). Similarly, the NorthMet Project area is within the hunting zone for deer area 176. The 5-year average is 2.3 deer harvested per square mile in this deer area (MDNR 2013c). Moose, which have been observed in the NorthMet Project area (ENSR 2005), are a species of specific importance to the Bands. Due to decreased population levels in the state of Minnesota, there will not be a 2013 moose hunting season. In previous years, when moose hunting was open, the NorthMet Project area would have been outside of the hunting zone, though moose zone 30 is located to the south of the Transportation and Utility Corridor. In 2012, two moose were harvested in zone 3. The overall moose population in Minnesota declined approximately 35 percent from 2012 to 2013 (MDNR 2013d).

4.2.5.2 Plant Site and Transportation and Utility Corridor

4.2.5.2.1 Federally and State-listed Species and Species of Special Concern

Canada Lynx

The Plant Site is not on USFS land, and therefore is not located within an LAU. The western edge of the Plant Site borders a critical lynx habitat zone but not an LAU. The lynx winter tracking survey (ENSR 2006) did not identify any signs of lynx at the Plant Site.

The eastern portion of the Transportation and Utility Corridor, directly south of the federal lands, is included in LAU 12 and in lynx critical habitat zone. The western portion of the Transportation and Utility Corridor is not located in a LAU or habitat area. The Transportation and Utility Corridor is located along areas of potential for moderate and high quality wildlife travel corridors, including surveyed wildlife corridors (Emmons and Oliver 2006; Barr 2009a). Section 6.2.3.6 includes further discussion of wildlife travel corridors.

Gray Wolf

As previously mentioned, collared wolves and wolf signs have been observed in the vicinity of the NorthMet Project area, including the Plant Site.

Gray wolf tracks and scat have been observed along Dunka Road, and radio-collared individuals and call survey responses indicate that gray wolves may be present along the Transportation and Utility Corridor. As noted previously, the area near the federal lands and Mine Site, including the eastern end of the Transportation and Utility Corridor, may support a pack of three or more individual gray wolves.

Bald Eagle

Typical bald eagle habitat is not present at the Plant Site. There are no large nesting trees or waterbodies that are open year-round near the NorthMet Project area. Similarly, there is no bald eagle habitat along the Transportation and Utility Corridor. As previously mentioned, animal-vehicle collisions on Dunka Road and/or natural deer mortality are not likely to produce sufficient carrion to sustain bald eagles (ENSR 2005).

Wood Turtle

No wood turtles were observed during wildlife surveys of the NorthMet Project area. Given the lack of sandy-gravelly streams and bars, which is the preferred habitat for the wood turtle, it is unlikely that the wood turtle would be found at the Plant Site. There are no NHIS records of wood turtles at the Plant Site (MDNR 2013a). The NHIS records indicate that the northernmost population of wood turtle in the state was observed immediately south of the Mine Site. Given the proximity of the Transportation and Utility Corridor, it is possible that wood turtles could be present along the eastern portion of the corridor and southern fringes of the Mine Site.

Eastern Heather Vole

The eastern heather vole is a habitat generalist, but typically inhabits the coniferous zones in upland forests and brushlands and meadows with low shrub species, usually near water. Habitats of this type occur at the Plant Site or along the Transportation and Utility Corridor; however, the Minnesota NHIS does not contain any eastern heather vole records within 10 miles of the NorthMet Project area. The NorthMet Project area is at the southern edge of the eastern heather vole’s home range in far northern Minnesota and only a few collections of the species occur within Minnesota.

Yellow Rail

Yellow rail prefer sedge meadow, which is present in a very small amount (1.5 acres) at the Plant Site and in small patches adjacent to the Transportation and Utility Corridor. The Minnesota NHIS has no records of the yellow rail occurring within 10 miles of the NorthMet Project area and field surveys did not identify any yellow rail (ENSR 2005).

Laurentian Tiger Beetle

The Laurentian tiger beetle prefers rocky or sandy areas adjacent to conifer forests. This habitat is found at the Plant Site and along the Transportation and Utility Corridor, though there were no Minnesota NHIS records of occurrences of the species near the Plant Site or Transportation and Utility Corridor.

4.2.5.2.2 Species of Greatest Conservation Need

As with the federal lands and Mine Site, the Plant Site is located along the border of the Nashwauk Uplands and Laurentian Uplands subsections. The habitat types and associated species are summarized in Table 4.2.5-1.

Areas of open ground and bare soils are rare at the Mine Site but are abundant at the Plant Site due to LTVSMC operations or deposition in the existing Tailings Basin. Both open ground and bare soils are considered non-natural habitats. No SGCN are associated with this habitat type.

Natural brush/grassland and very early successional forest are uncommon at the Plant Site (ENSR 2005). The existing Tailings Basin revegetation is counted as grassland, though it is disturbed habitat and is unlikely to be heavily used by wildlife species. Most of the SGCN species in Table 4.2.5-1 are generally associated with large patches of grassland and savanna habitats that are not present at the Plant Site.

Open water and aquatic communities are confined to the existing LTVSMC Tailings Basin at the Plant Site. The Tailings Basin attracts Canada geese, ducks, loons, and other waterfowl, though the NorthMet Project area does not otherwise appear to provide good habitat for waterfowl or waterbirds. Common loon, American white pelican, common tern, Wilson's phalarope, black tern, and trumpeter swan were surveyed for, but not found (ENSR 2000 and 2005). The common loon has been observed at the existing LTVSMC Tailings Basin.

As previously discussed, multiple habitats are made up of combinations of other key habitat types. Section 4.2.5.1 and Table 4.2.5-1 provide more discussion on species commonly found in multiple habitat types.

As with the federal lands (including the Mine Site) and the Plant Site, the Transportation and Utility Corridor is in the Laurentian Uplands and Nashwauk Uplands subsections. Section 4.2.5.1.2 and Table 4.2.5-1 provide more discussion of the habitat and species which may be present.

4.2.5.2.3 Regional Forester Sensitive Species

Section 4.2.5.1.3 provides a discussion of the RFSS species associated with the NorthMet Project area.

4.2.5.2.4 Other Wildlife Species

Other wildlife species common to the region may be present on and around the Plant Site. Section 4.2.5.1.4 provides more discussion on these species.

4.2.6 Aquatic Species

The NorthMet Project area encompasses several waterbodies that provide a variety of habitats for fish and aquatic macroinvertebrates. This section describes the known existing conditions of the fish and aquatic macroinvertebrate communities associated with waterbodies found in the Partridge River and Embarrass River watersheds and potentially affected by the NorthMet Project Proposed Action. For purposes of this SDEIS, the Strahler Order (USEPA 2011a) is used to describe the hierarchical ordering of streams, where a first-order stream describes a headwater type stream with no branching. Where two first-order streams meet, they become larger, second-order streams, and where two second-order streams meet, they become third-order streams, etc.

The majority of the streams are low velocity; exhibit glide pool characteristics; meander through emergent, scrub-shrub, and forested wetlands; and have silty to boulder substrates.

The riparian edge along these streams is predominantly vegetated, which supports quality habitat for aquatic biota with little evidence of human disturbance. Baseline surveys are indicative of habitat supporting fish communities that are comparable to communities in similar waterbodies in the region. Macroinvertebrate habitat degradation from biological stressors is minimal and fair macroinvertebrate habitat exists. Habitat for several freshwater mussel species likely exists in the vicinity of the NorthMet Project area; however, only two species of mussels were observed in two years of baseline freshwater mussel surveys.

No federally or state-listed threatened or endangered, SGCN, or RFSS aquatic special status species or invasive species were found in the NorthMet Project area during surveys. According to available data, however, there are nine RFSS species, three SGCN species, and three state-listed special concern species known to occur in the general vicinity of the NorthMet Project site. Of these, suitable habitat likely exists for five special status species: headwaters chilostigman caddisfly, Quebec emerald, ebony boghaunter, creek heelsplitter, and northern brook lamprey. However, no occurrences of these species have been documented in baseline surveys in the NorthMet Project area.

Based on Minnesota's fish tissue mercury standard, the MDH has issued fish consumption advisories for the state. Waterbodies within the vicinity of the NorthMet Project area with fish consumption advisories include Colby Lake, Whitewater Reservoir, and the St. Louis River. No advisories have been issued for stream features within the NorthMet Project area; however, fish have not been tested for mercury content in these stream features and these streams are tributaries of the St. Louis River, which does have fish consumption advisories.

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013. The FEIS will consider any new listings, or changes in the previous listings, associated with the updated list. The FEIS will also consider any federal listing changes, should they occur. A Biological Evaluation (containing further information about RFSS species) have been prepared and are posted on the USFS website (http://www.fs.usda.gov/goto/superior/northmet).

4.2.6.1 Upper Partridge River Watershed

This section describes the aquatic resources found primarily within the Upper Partridge River Watershed portion of the NorthMet Project area generally described as the Partridge River headwaters, downstream to Colby Lake, as well as Second Creek, a tributary of the Lower Partridge River downstream of Colby Lake.

4.2.6.1.1 Surface Water Features and Habitat

The surface water features within the Upper Partridge River include Mud Lake, Partridge River, and several tributaries of the Partridge River (e.g., Yelp Creek, Longnose Creek, Wetlegs Creek, Wyman Creek). The limnological features include a range of aquatic biota habitats consisting of an undeveloped natural environmental lake to a river system with several headwater tributaries each combining to form a fourth-order river.

The 30.5-acre Mud Lake is located in the One Hundred Mile Swamp northwest of the Mine Site but within the federal parcel (see Figure 4.2.6-1). It has a shoreline of 4,550.0 ft and a lake frontage index of 0.7 ft per acre (see Table 4.2.6-1). Review of aerial photography indicates the lake is entirely surrounded by a vegetated wetland riparian area with no apparent development, which should provide adequate undeveloped shoreline for quality fish and macroinvertebrate habitat. The lake also has extensive shallow, emergent vegetated areas throughout, which would also provide quality habitat. Mud Lake may be susceptible to winterkill, which would minimize fish habitat.

Yelp Creek is a first order, headwater stream that flows through the One Hundred Mile Swamp where it connects with the Partridge River, forming a second-order stream at the confluence of Yelp Creek and Partridge River (see Figure 4.2.6-1). Both streams combine to encompass 5.3 miles of river stream through the federal parcel with a frontage index of 8.6 ft per acre. No apparent development and a wide vegetated wetland riparian buffer are exhibited from aerial photograph review, which indicates that quality fish and macroinvertebrate habitat is likely present throughout the entire Yelp Creek and Partridge River wetted water course.

Second Creek is a headwater stream located south of the Plant Site and is joined by several unnamed tributaries as it flows southwest, forming a second-order tributary prior to connecting with the Partridge River (see Figure 4.2.6-1). The riparian zone of Second Creek is characterized by reed canarygrass, grasses, willows and alder shrubs, birch, and other larger trees. Second Creek, upstream of CR 666, is characterized by open-water wetland and numerous beaver ponds, while the lower portion is characterized by riparian woods. Portions of Second Creek are channelized or otherwise altered due to mining activity, particularly between CR 666 and CR 110.

A total of seven habitat assessment surveys were conducted at six locations within the Partridge River Watershed in the vicinity of the NorthMet Project area that describe in-stream channel characteristics and habitat within select study reaches (see Figure 4.2.6-1; Table 4.2.6-2). Five locations (four sites on the Upper Partridge River and one site on Second Creek) were in the direct vicinity of the NorthMet Project area. The site located on the South Branch of the Partridge River is considered a reference site. These survey sites were established as baseline sampling sites for the DEIS in order to analyze habitat and aquatic biota within select study reaches. Data from these and other sampling sites from various MPCA programs are summarized below. Sites PR-B1 and PR-B2 scored near the upper range of the Qualitative Habitat Evaluation Index (QHEI) (Rankin 1989) scale, which indicates good fish habitat was present. The scores for PR-B3, PR-west, and PR-east sites scored lower in the QHEI range, which is likely a function of the dominant silt substrate found at these sites.

Tables 4.2.6-1 and 4.2.6-2 provide information regarding those waterbodies located within the federal parcel and those within the larger Partridge River Watershed, respectively. The USFS tracks MIHs, which are categories of habitat types. One of the MIH categories used by USFS includes MIH 14, which is defined as the wide variety of lakes, rivers, streams, ponds, marshes, or pools (permanent, intermittent, or seasonal) that provide habitat to wildlife (USFS 2004b). The MIH represented within the boundaries of the federal parcel includes 30.5 acres for Mud Lake and 55,968.0 linear ft for Partridge River and Yelp Creek (see Table 4.2.6-1). Based on the in-stream channel characteristics and habitat, these streams and headwater tributaries should support warmwater game fish species such as northern pike, yellow perch, and bass, as they function as important spawning and rearing areas. Maintaining the seasonal variation in hydrological regime is important, especially during the spring when high flows cue spawning activity and provide access to traditional fish spawning and rearing habitat. The wetlands adjacent to all surface water features on the federal lands were not scored for fish habitat during the wetland functions and values assessment, since water levels were inadequate for most of the year to support fish habitat (AECOM 2011d).

Table 4.2.6-1 Federal Land Parcel Surface Water Characteristics

Surface Water	Size on Parcel	Approximate Shoreline Frontage (ft)	MIH Size	Frontage Index (ft/acre)
Mud Lake	30.5 acres	4,555.0	30.5 acres	0.7
Partridge River and Yelp Creek	5.3 miles	55,968.0	55,968.0 linear ft	8.6

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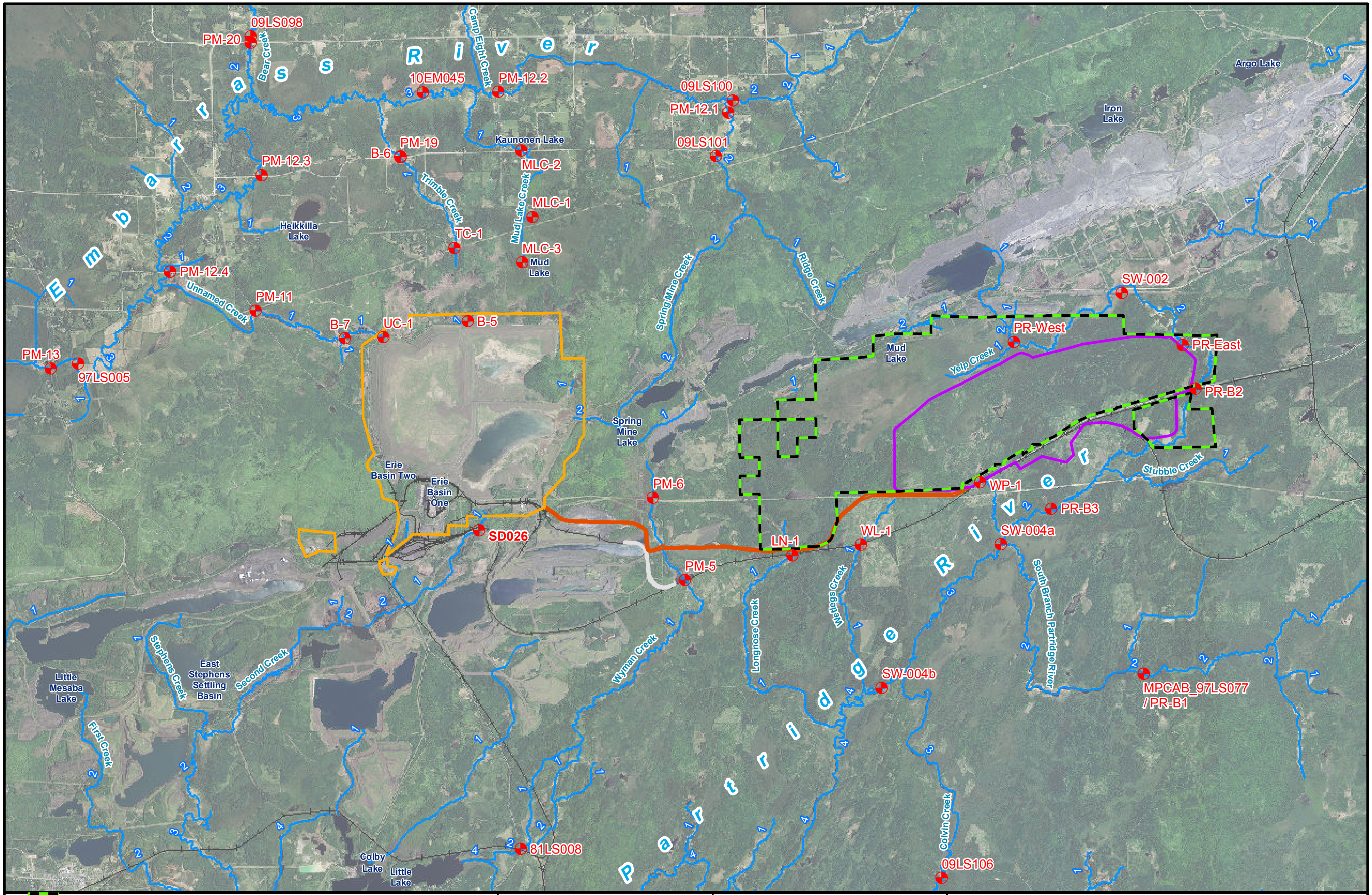

Federal Lands
Mine Site
Plant Site
Transporatioin and Utility Corridor
Monitoring Station
Railroad Connection
Existing Railroad
Stream / River
Stream Order Number

Minnesota Department of Natural Resources
US Army Corps of Engineers St. Paul District
Forest Service U.S. Department of Agriculture

N W E S

0 0.5 1 2 Miles

Figure 4.2.6-1

Monitoring Sample Site Locations

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Table 4.2.6-2 Major Channel Characteristics at Biological Survey Stream Sites in the Partridge River Watershed

	Channel Characteristics								
Water Body/ Reference	**Study Year**	**Site Location**	**Stream Order[2]**	**Catchment (mi^1)**	**Dominant Substrate**	**Width (m)**	**Depth (cm)**	**Velocity (cm/s)**	**QHEI[2]**
Partridge River (Barr 2011b)	2009	PR-west site	2	na	Silt	4.9	79.25	na	40
Partridge River (Barr 2011b)	2009	PR-east site	2	na	Silt	4.0	88.39	na	41
South Branch Partridge River[3] (Breneman 2005)	2004	PR-B1	2	14.0	Boulder	7.5	26.74	6.90	70
South Branch Partridge River[3] (MPCA 2011c)	2009	MPCAB_ 97LS077	2	14.0	Boulder	7.0	21.1	na	na
Partridge River (Breneman 2005)	2004	PR-B2	2	15.2	Boulder	9.5	20.67	15.13	79
Partridge River (Breneman 2005)	2004	PR-B3	2	23.0	Silt	7.2	72.23	7.03	65
Second Creek (Barr 2011i)	2011	SD026	1	--	Boulder, gravel, silt, detritus	5.0	37	0.03	69

Source: Adapted from Breneman 2005, Barr 2011b, and MPCA 2011c.

na = Not available
1 Referenced from Figure 4.2.6-1.
2 QHEI is designed to provide an integrated evaluation of physical habitat characteristics important to fish communities and ranges from 0 (low) to 100 (high).
3 South Branch Partridge River reference sites PR-B1 and 7LS077 are the same location.

Watershed Level Riparian Connectivity

Intact riparian areas are an important factor contributing to diverse and productive aquatic ecosystems. The streams present in any watershed are each part of an intricate web of perennial, defined as waterbodies with water present year-round, and non-perennial streams, lakes, and rivers. They are part of a larger watershed where the connections between these surface water features are affected by the vegetated, undisturbed riparian edges bordering these waterbodies. A Riparian Connectivity Index (RCI), developed by the MDNR, measures the percentage of undeveloped, vegetated land within the riparian zone and is typically derived using a GIS analysis of vegetative cover along riparian areas and takes into consideration agriculture and land development affected natural riparian vegetative cover (MDNR 2012k). The Partridge River is a tributary to the larger St. Louis Watershed where the score for the St. Louis Watershed was rated at 0 percent agriculture in the riparian zone, 5 percent development in the riparian zone, and a total RCI of 95. Localized GIS analysis of the Partridge River within the boundary of the federal lands indicates the score is also representative of this area.

Aquatic Connectivity

Dams, bridges, and culverts in streams, creeks, and rivers may reduce the hydrologic connectivity of watersheds if they become fish barriers and may affect the habitat available for aquatic organisms by influencing stream velocities, sediment deposition, substrate composition, erosion potential, and water quality.

The MDNR has developed an Aquatic Connectivity Index (ACI), which reflects the extent of dams, bridges, and culverts along stream segments. The number of structures that modify aquatic connectivity in Minnesota streams is very high. The vast majority of watersheds score 20 or below on a scale of 0 to 100, where 100 represented the fewest amount of structures per river mile, indicating a high density of bridges, culverts, and dams (MDNR 2012l).

The index exhibited for the St. Louis River Watershed indicated a score of 15 for bridges and culverts and 6 for dams. The overall ACI score for the St. Louis Watershed was 11, which indicates that dams, bridges, and culverts impair the aquatic connectivity of the watershed and limit the available physical habitat for aquatic organisms.

Localized analysis of dams, bridges, and culverts along the Partridge River are limited to one Dunka Road crossing within the vicinity of the Mine Site.

4.2.6.1.2 Existing Water Quality within the Vicinity of the Mine Site

Water quality can have a significant effect on the health of aquatic species. No data were available to evaluate the Mud Lake and Yelp Creek water quality; however, Section 4.2.2 indicates that although a few individual samples within the Partridge River Watershed exceeded surface water quality evaluation criteria, overall in-stream water quality meets state water quality standards. Wyman Creek is included on the 2012 TMDL list for aquatic life based on fishes bioassessment. Additional water quality information is contained in Section 4.2.2. The only consistent exceedance of water quality standards were mercury concentrations in several sampling locations (see Figure 4.2.6-2; Table 4.2.6-3).

Table 4.2.6-3 Average Existing Water Quality Concentrations in the Partridge River

Parameter	Units	Evaluation Criteria	SW-001	SW-002	SW-003	SW-004	SW-004a	SW-004b	SW-005
Mercury	ng/L	1.3	2.4	3.4	2.9	3.3	3.7	4.4	3.8

Source: Section 4.2.2.

4.2.6.1.3 Aquatic Biota Studies

Several aquatic biota surveys are summarized below as referenced from Breneman (2005), Barr (2011b), and MPCA (MPCA 2011c). Breneman conducted biological surveys at two sites in the Upper Partridge River near the Mine Site (PR-B2 and PR-B3) and at a third site on the South Branch Partridge River (PR-B1) during August and September 2004, while Barr conducted surveys at two other sites in the upper Partridge River near the Mine Site (PR-east and PR-west) during September 2009 (see Figure 4.2.6-1). Two additional July 2009 surveys were reported by the MPCA (MPCA 2011c and MPCA 2013c) and were located at the South Branch Partridge River (same site as PR-B1) and at a site upstream of the Wyman Creek and Partridge River confluence (MPCA_09LS105). The main stem Partridge River sites have been previously affected by discharges from the Northshore Mine (Breneman 2005). The site on the South Branch Partridge River (PR-B1/MPCAB_97LS077), identified by Breneman (2005) to be a suitable reference site for the Partridge River, is approximately 4.3 river miles upstream of the

South Branch Partridge River confluence with the Partridge River and is unaffected by any mining discharge (Breneman 2005).

The results of the fish and macroinvertebrate surveys are summarized in Table 4.2.6-4 and 4.2.6-5. The assemblages observed in the survey are typical of those sampled elsewhere in the northeast region of Minnesota (Barr 2011b). No listed SGCN, RFSS, state, federal, or invasive species were observed during these surveys.

Fish Communities

Abundance and diversity of taxa among the Upper Partridge River sampling sites were indicative of a warmwater stream populated by typical warmwater species, including gamefish such as northern pike and yellow perch (see Table 4.2.6-4). The IBI, which is a commonly used metric for assessing stream health related to human disturbance, was not available for many of the Partridge River sites closest to the NorthMet Project area. However, the presence of one or more intolerant or intermediate species in each of these monitoring locations is, however, one indication that quality habitat is present at these sites and chemical and physical stream deterioration is likely negligible. IBI scores were derived from the two MPCA fish surveys conducted at sites MPCA_97LS077 and_09LS105. The scores of 61 and 87, respectively, represent average to good habitat quality. A review of aerial photography reveals similar riparian vegetation cover for all Upper Partridge River sites.

The MPCA collected fish community data during a 2009 sampling event for Wyman Creek, a State of Minnesota-listed trout stream (see Figure 4.2.6-1). MDNR surveys were conducted on Wyman Creek in 1968, 1981, and 2003 (MDNR 1981; MDNR 2003). Based on the latest 2009 survey, a variety of taxa were collected; however, no trout species were collected, which likely contributed to an IBI score of only 33, four points below the minimum threshold for this stream classification (see Table 4.2.6-4). MDNR survey results reference elevated stream temperatures due to warmwater surface runoff from Mine Pit lakes to the east and west of the headwaters, extensive logging in the watershed, and beaver dam and impoundments occurring along the entire length of Wyman Creek. It should be noted that Wyman Creek is not a comparable stream to others in the Upper Partridge River watershed for several reasons. Most notable, Wyman Creek is a designated coldwater trout stream, it is affected by mining activity, and would not be in the direct drainage of the NorthMet Project Proposed Action. It is included in this SDEIS because it contributes to watershed water quality.

No aquatic biota studies have been conducted in Longnose Creek, Wetlegs Creek, or Second Creek, and no fish or macroinvertebrate community or habitat characteristics could be documented, although, like Yelp Creek, all are first-order streams within the vicinity of the NorthMet Project area.

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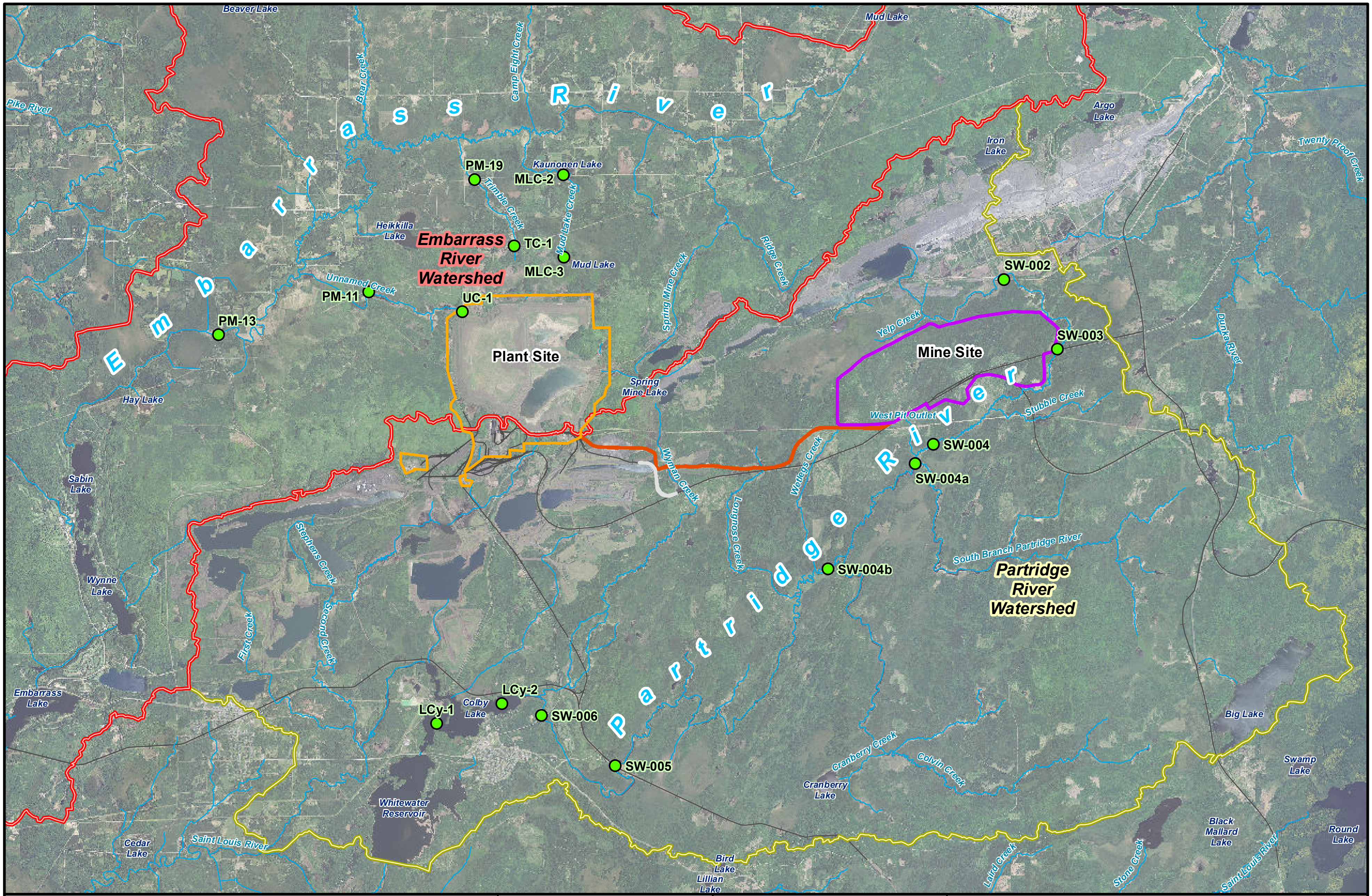

- Water Sampling Location
- Embarrass River Watershed
- Partridge River Watershed
- Stream/River
- Existing Railroad
- Mine Site
- Plant Site
- Transportation and Utility Corridor
- Railroad Connection

N W E S

0 0.5 1 2 3 Miles

Minnesota Department of Natural Resources | US Army Corps of Engineers St. Paul District | Forest Service U.S. Department of Agriculture

Figure 4.2.6-2
Sampling Locations within the Partridge River and Embarrass River Watersheds
NorthMet Mining Project and Land Exchange SDEIS
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Table 4.2.6-4 Fish Species Collected at Six Sites in the NorthMet Project Area

			Site						
			Upper Partridge River Watershed						Wyman Creek Watershed
Scientific Name	**Common Name**	**Tolerance Designation1**	**PR-B22**	**PR-B3**	**PR-east2**	**PR-west2**	**PR-B13**	**MPCAB_ 97LS0773**	**81LS008**
Ameiurus melas	Black bullhead	Intermediate							X
Catostomus commersonii	White sucker	Tolerant	X	X	X	X	X	X	X
Rhinichthys cataractae	Longnose dace	Intolerant	X	X			X	X	X
Luxilus cornutus	Common shiner	Intermediate	X		X		X		X
Etheostoma nigrum	Johnny darter	Intermediate	X		X		X	X	X
Hybognathus hankinsoni	Brassy minnow	Intermediate	X		X		X		
Lota lota	Burbot	Intermediate					X	X	X
Esox lucius	Northern pike	Intermediate					X	X	
Perca flavens	Yellow perch	Intermediate							X
Phoxinus eos	Northern redbelly dace	Tolerant	X		X	X			X
Culaea inconstans	Brook stickleback	Intermediate	X		X	X			
Rhinichthys atratulus	Blacknose dace	Intolerant	X		X				
Semotilus atromaculatus	Creek chub	Tolerant							X
Margariscus margarita	Pearl dace	Intermediate	X		X				X
Noturus gyrinus	Tadpole madtom	Intermediate		X					
Umbra limi	Central mudminnow	Tolerant		X					
Pimephales promelas	Fathead minnow	Tolerant			X				
Cottus bairdii	Mottled sculpin	Intolerant						X	X
Study Year			2004	2004	2009	2009	2004	2009	2009
Species Observed			9	4	9	3	7	6	11
# intolerant species			2	1	1	0	1	2	1
Total Abundance			267	11	1,847	19	36	68	64

			Site						
			Upper Partridge River Watershed						Wyman Creek Watershed
Scientific Name	**Common Name**	**Tolerance Designation1**	**PR-B22**	**PR-B3**	**PR-east2**	**PR-west2**	**PR-B13**	**MPCAB_97LS0773**	**81LS008**
IBI[4]			na	na	na	na	na	61	33
Predominant Substrate			boulder	silt	silt	silt	boulder	boulder	na

Source: Breneman 2005; Barr 2011b; MPCA 2011c; MPCA 2013c; MDNR 1981; and MDNR 2003.

[1] Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish - Second Edition EPA 841-B-99-002 (USEPA 2012b). Tolerance values indicate qualitative tolerances of physical and chemical disturbances.
[2] Federal parcel sites.
[3] South Branch Partridge River reference sites PR-B1 and 7LS077 are the same location.
[4] IBI is the sum of study specific metrics, where 0 represents the worst fish assemblage conditions and 100 represents the best fish assemblage conditions (USEPA 2011b).
-- = no designation assigned
na = Not available

Macroinvertebrate Communities

Aerial photography review and habitat descriptions found in the 2011 studies indicate the reference site (PR-B1) should have no effects from previous mining and quality habitat should exist for macroinvertebrate assemblages. The results of the 2011 macroinvertebrate studies indicate habitats for macroinvertebrate assemblages are just as good or better at the PR-B2 and PR-B3 Partridge River study sites as the percent Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) (%EPT) exhibited better results at the Partridge River sites and similar %Diptera results. The Hilsenhoff Biotic Index (HBI), which measures the pollution tolerance for various benthic macroinvertebrate families, exhibited a fair ranking for both sites, which indicates habitat degradations from biotic stressors are minimal and fair macroinvertebrate habitat exists. %EPT and %Diptera results are also similar to the 2004 results for sites PR-B2 and B3.

Table 4.2.6-5 Composition of Macroinvertebrate Assemblages at Six Sites in the Federal Parcel

Name	Study Year	Site	No. of Samples	Total Taxa	Mean Abundance	%EPT[1]	%Diptera[2]	HBI Scale of 0 - 10[3]	HBI Ranking[3]
South Branch Partridge River (Breneman 2005)	2004	PR-B1	7	90	627	6	58	na	na
Partridge River 1 (Breneman 2005)	2004	PR-B2	6	89	1,261	15	65	na	na
Partridge River 2 (Breneman 2005)	2004	PR-B3	4	82	1,278	16	52	na	na
Partridge River 3 (Barr 2011b)	2009	PR-west	5	27	710	19	66	6.4	Fair
Partridge River 4 (Barr 2011b)	2009	PR-east	5	26	912	22	50.2	6.0	Fair
Second Creek	2011	SD026	na	36	2,534	72	47	na	na

Source: Data and functional group assignments from Breneman 2005, Barr 2011b, and Barr 2011i.

[1] %EPT indicates the percent of mayflies, stoneflies, and caddisflies within the macroinvertebrate sample. High EPT percentages of the population typically indicates degraded habitat conditions are not present.
[2] %Diptera indicates the percent of true flies and bloodworms present within the macroinvertebrate sample. High percentages of the population typically indicates low habitat diversity and predominant silty habitats often present within slow-moving, headwater streams.
[3] HBI is the measure of macroinvertebrate assemblages tolerance toward organic (nutrient) enrichment. Not calculated in Breneman 2005.
na = Not available

Freshwater Mussel Communities and Habitats at Survey Sites

Unionid mussels (*Unionidae*) constitute one of the most imperiled major taxa in the United States (Master et al. 2000), and the MCWCS identifies 26 unionid species within Minnesota as species of special concern. Two of these species, creek heelsplitter (*Lasmigona compressa*) and black sandshell (*Ligumia recta*), are known to exist in the St. Louis River Watershed (see Table 4.2.6-6), but were not identified in areas near the Mine Site. Heath (2011) sampled mussels at

M1 and M2 in 2004 and at PR-upstream and PR-downstream in 2009 (see Figure 4.2.6-3). Only one mussel species was collected in the Partridge River Watershed, the giant floater (*Pyganodon grandis*) (see Table 4.2.6-6), which is a widely distributed feeding generalist, tolerant of silt-dominated substrate, and often found in lakes, ponds, or slow-moving water pools of small to medium-sized creeks and rivers (Cummins and Mayer 1992; Heath 2011).

Some of the unionid species known to exist in the St. Louis River Watershed were not collected by Heath (2011), including the creeper (*Strophitus undulatus*), plain pocketbook (*Lampsilis cardium*), white heelsplitter (*Lasmigona complanata*), and the black sandshell (see Table 4.2.6-6). The creeper, plain pocketbook, and white heelsplitter are typically found in larger streams (Cummins and Mayer 1992) and may only exist farther downstream in the drainage system. It is unlikely that the SGCN-designated black sandshell occurs in the NorthMet Project area given its absence from the sample sites. Habitat for this species (riffles or raceways in gravel or firm sand; Cummins and Mayer 1992) likely only exists in small reaches within the NorthMet Project area.

Other species known to exist in the St. Louis River Watershed, but also not collected by Heath (2011) at all stations included cylindrical papershell (*Anodontoides ferussacianus*) and creek heelsplitter. The SGCN-designated creek heelsplitter is found in sand and fine gravel substrates (Cummins and Mayer 1992). Sand and gravel were minor substrate type at the sites sampled and is therefore unlikely to exist in the Partridge River Watershed (see Table 4.2.6-7).

Table 4.2.6-6 Mussel Species Identified in the Lake Superior Basin, St. Louis River Watershed, Partridge River, and Embarrass River

		Location			
		Sietman (2003)		Heath (2004 and 2009)	
Scientific Name	**Common Name**	**Lake Superior Basin**	**St. Louis River Watershed**	**Partridge River[2]**	**Embarrass River[3]**
Elliptio complanata	Eastern elliptio	X	X		
Anodontoides ferussacianus	Cylindrical papershell	X	X		
Lasmigona complanata	White heelsplitter	X	X		
L. compressa[1]	Creek heelsplitter	X	X		
Pyganodon grandis	Giant floater	X	X	X	X
Strophitus undulatus	Creeper	X	X		
Utterbackia imbecillis	Paper pondshell	X			
Lampsilis cardium	Plain pocketbook	X	X		
L. siliquoidea	Fat mucket	X	X		X
Ligumia recta[1]	Black sandshell	X	X		

Source: Adapted from Heath 2011.

[1] Minnesota Species of Special Concern.
[2] Partridge River sampling sites include M-1, M-2, PR-upstream, and PR-downstream; only one species was found between four sites.
[3] Embarrass River only sampled by Heath as summarized in the Heath 2011 report.

Table 4.2.6-7 Location and Physical Characteristics of Mussel Sample Sites

Name	Site	River Mile[1]	Mean Depth (cm)	Substrate Composition
Partridge River	PR-upstream	25.0	250	100% detritus (peat)
Partridge River	PR-downstream	21.6	150	20% clay 80% detritus (peat)
Partridge River	M1	20.5	80	95% silt 5% boulder
Partridge River	M2	16.7	60	40% silt 30% boulder 15% coarse sand 15% fine sand
Trimble Creek	M3	na	20	50% gravel 50% coarse sand
Embarrass River	M4	na	60	20% boulder 20% rubble 20% coarse sand 20% fine sand 20% clay

Source: Modified from Heath 2011.

[1] River mile indicated is measured from the sample site to the Colby Lake inlet.
na = Not available

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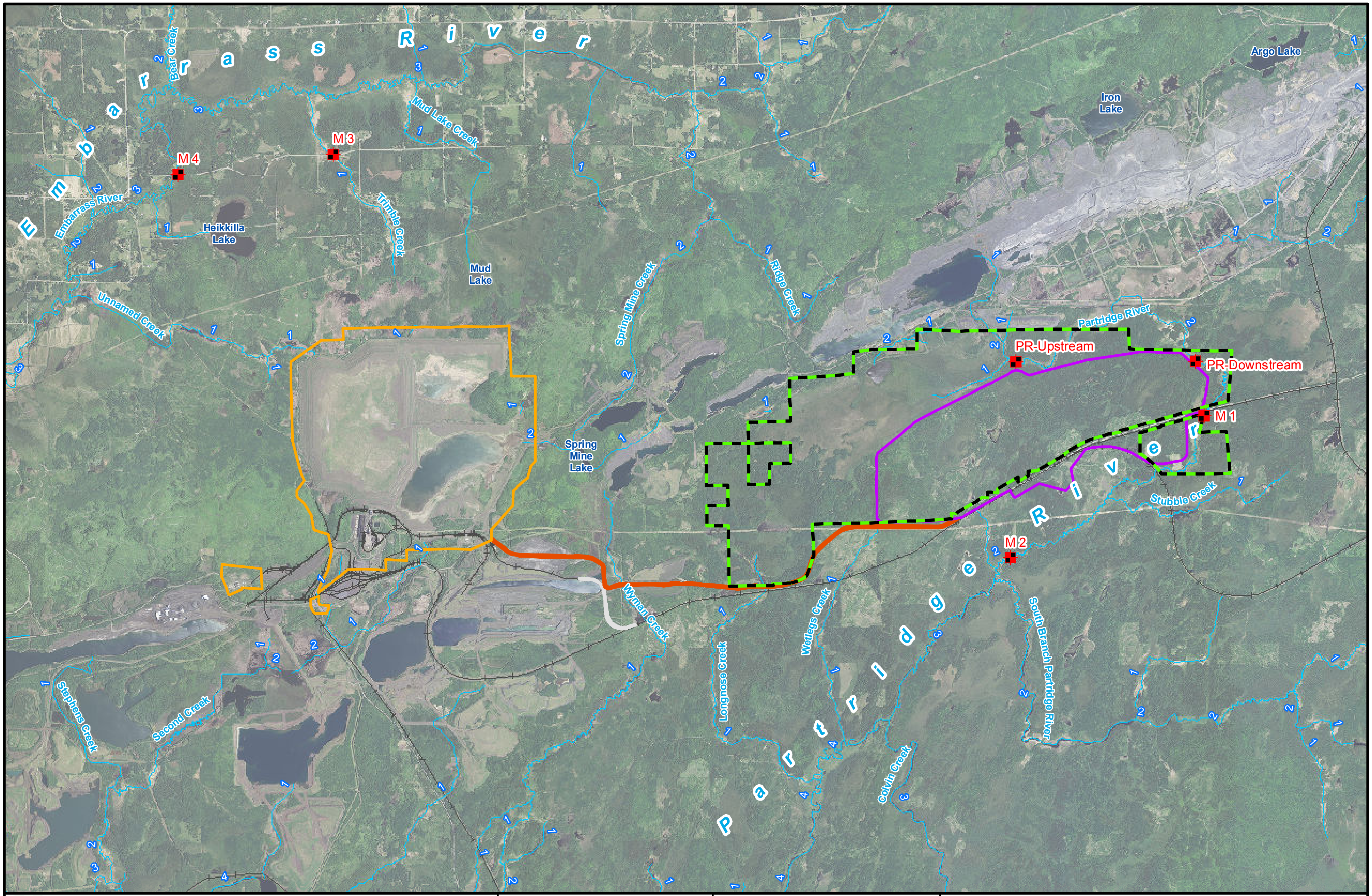

Federal Lands	Freshwater Mussel Sampling Site
Mine Site	Railroad Connection
Plant Site	Existing Railroad
Trasportation and Utility Corridor	Streams and Rivers
	Stream Order Number

US Army Corps of Engineers
St Paul District

0 0.5 1 2 Miles

Figure 4.2.6-3

Freshwater Mussel Sampling Site Locations

NorthMet Mining Project and Land Exchange SDEIS

Minnesota

November 2013

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4.2.6.1.4 Special Status Fish and Macroinvertebrates

There are no federally listed or state-listed threatened or endangered fish or macroinvertebrate species known to occur in the Partridge River (USFWS 2011).

As with wildlife resources, assessment of fish and macroinvertebrates included consideration of the MCWCS (MDNR 2006d) and RFSS species. The MCWCS identifies SGCN by ecoregion subsections based on a statewide approach, and the RFSS species are identified for the potential to be found within the Superior National Forest. SGCN species identified in the Laurentian Uplands and Nashwauk Uplands, where the federal lands overlap these ecoregions, included two unionid mussel species (i.e., creek heelsplitter and black sandshell) and one species of fish (northern brook lamprey, *Ichthyomyzon fossor*). These species also are listed by the state as species of special concern and the USFS as RFSS. In addition to the creek heelsplitter and the black sandshell, USFS also lists seven other species as RFSS for Superior National Forest, including three insects and four fish (see Table 4.2.6-8). Each of these RFSS species are briefly described below. No invasive fish or macroinvertebrate species are known to exist within the federal parcel.

Table 4.2.6-8 SGCN and RFSS Species Identified Within Portions of the Laurentian Uplands – Nashwauk Uplands Ecoregion or Superior National Forest

Scientific Name	Common Name	Laurentian and Nashwauk Uplands Ecoregion SGCN	RFSS
Insects			
Chilostigma itascae	Headwaters chilostigman caddisfly		X
Somatochlora brevicincta	Quebec Emerald		X
Williamsonia flechen	Ebony boghaunter		X
Fish			
Acipenser fulvescens	Lake sturgeon		X
Coregonus nipigon	Nipigon cisco		X
Coregonus zenithicus	Shortjaw cisco		X
Ichthyomyzon fossor	Brook lamprey	X	X
Mussels			
Lasmigona compressa	Creek heelsplitter	X	X
Ligumia recta	Black sandshell	X	X

Source: MDNR 2006d and USFS 2011d.

Headwaters Chilostigman Caddisfly

This species of caddisfly has only been discovered in two locations within Minnesota where it is also listed as a state endangered species. In 1994, it was documented in a slow-moving, silt-dominated headwater stream in Itasca State Park and in 2005 in rich swamp to poor fen habitats within a large, acid to minerotrophic peatland complex in Finland State Forest (MDNR 2011n). Little is known about the headwaters chilostigman caddisfly. Headwater habitats are present at the Mine Site; however, since the distribution of this caddisfly appears to be very limited, it is unlikely to occur in the NorthMet Project area.

Quebec Emerald

The Quebec emerald dragon fly occurs in lentic habitats typically associated with bogs, fens, and heaths near water-saturated or water-suspended sphagnum (USFS 2007a). This species has been found within the Superior National Forest. Little distribution information is known regarding this species due to lack of completed surveys. The known required habitat is likely present within the federal parcel near the bogs associated with the headwater stream, Yelp Creek; however, this species was not found in the benthic macroinvertebrate surveys.

Ebony Boghaunter

The ebony boghaunter shares a similar habitat description with the headwaters chilostigman caddisfly described above; however, the distribution is likely more widespread than the caddisfly (MDNR 2011n). Habitat likely exists for this species in the NorthMet Project area in sphagnum dominated bogs; however, this species has not been identified in the benthic macroinvertebrate surveys conducted to date.

Lake Sturgeon

The lake sturgeon is a large fish that is broadly distributed throughout the Mississippi River, Great Lakes, and Hudson Bay drainages (Scott and Crossman 1973a; Wilson and McKinley 2005). Lake sturgeon typically inhabit large lakes and rivers and are usually found in waters that are 15 to 30 ft deep (Wilson and McKinley 2005). Spawning takes place in swift-flowing water 2 to 15 ft in depth, often at the base of a low waterfall that blocks further migration upstream (Scott and Crossman 1973a). The species has been classified as threatened in both Canada and the United States by a special committee of the American Fisheries Society (Williams et al. 1989) and is a species of special concern in Minnesota.

Historically, lake sturgeon migrated approximately 14 miles upriver from Lake Superior in the St. Louis River (Auer 1996). Spawning occurred between the falls near Fond du Lac, which formed a natural barrier to upstream migration, and Bear Island located a few miles downstream (Goodyear et al. 1982; Kaups 1984; Schram et al. 1999). The lake sturgeon was extirpated from the St. Louis River during the early 1900s (Schram et al. 1999).

The St. Louis River currently is one of 17 tributaries to Lake Superior identified by the Great Lakes Fishery Commission as a priority stream where lake sturgeon rehabilitation should be focused, and the St. Louis is one of only six rivers identified by the Great Lakes Fisheries Commission as a priority for lake sturgeon stocking (Auer 2003). A stocking program was initiated in 1983 to reintroduce lake sturgeon to the St. Louis River; however, stocking was reduced in 1995 and discontinued in 2000 (MDNR 1995). The stocking has resulted in an increase in lake sturgeon abundance in the St. Louis River estuary near Duluth (Schram et al. 1999). Recruitment has not yet been observed (Auer 2003), although MDNR staff recently observed mature sturgeon on the historical spawning grounds at Fond du Lac. Fond du Lac has stocked lake sturgeon into the St. Louis River above the Fond du Lac dam near the confluence with the Cloquet River. There are anecdotal accounts of recaptures by local anglers and Fond du Lac Resource Management personnel have reported occurrences of lake sturgeon upstream of Floodwood, Minnesota (MDNR, Pers. Comm., 2013). Upstream migration of lake sturgeon from the stocking location would be blocked by the dam at Forbes, approximately 14 miles downstream of the Embarrass River confluence with the St. Louis River.

There are no known occurrences of lake sturgeon and no likely habitat for lake sturgeon within the NorthMet Project area.

Nipigon Cisco

The nipigon cisco is found in waters of Lake Nipigon, Black Sturgeon Lake, Saganaga Lake, and other lakes of northwest Ontario and Quebec (Hubbs and Lagler 2007). Saganaga Lake is the only lake in this list shared with Minnesota and Ontario and is a deep, oligotrophic lake covering approximately 13,800 acres (MDNR 2011d). There are no known occurrences or likely habitat for nipigon cisco within the NorthMet Project area.

Shortjaw Cisco

Formerly found in deep waters of several of the Great Lakes (Scott and Crossman 1973c), the shortjaw cisco has been eliminated from Lakes Erie, Huron, and Michigan and is in decline in Lake Superior (COSEWIC 2003). The species is also found in Gunflint and Saganaga lakes (MDNR 2006d), which are two of the deepest natural lakes in Minnesota. Invasive species, habitat degradation, and competition or predation may be factors that are limiting recovery (Pratt and Mandrak 2007). There are no known occurrences or likely habitat for shortjaw cisco within the NorthMet Project area.

Northern Brook Lamprey

The northern brook lamprey is a small, nonparasitic, jawless fish. This species' typical habitat is creeks and small rivers, apparently avoiding small brooks and large rivers (Scott and Crossman 1973b). There are no known occurrences of this species in or near the NorthMet Project area. Cochran and Pettinelli (1987) identified northern brook lamprey at a site south of Cloquet, Minnesota, approximately 75 miles south of the NorthMet Project area. Since 1986, it has been collected from six other sites in the Lake Superior drainage (Hatch et al. 2003). Suitable habitat for northern brook lamprey is likely to exist in the NorthMet Project area; however, the nearest known occurrence of this species is far removed.

Freshwater Mussels

No special freshwater mussel species were observed during the mussel surveys described in Heath (2011). As discussed above, it is unlikely the habitats required for the black sandshell exist in the vicinity of the NorthMet Project area. The habitat for the creek heelsplitter likely exists in portions of the NorthMet Project area, but no creek heelsplitter mussels have been identified in 2 years of baseline survey efforts.

4.2.6.2 Whitewater Reservoir and Colby Lake

This section describes the aquatic resources found in Colby Lake and Whitewater Reservoir. Colby Lake and Whitewater Reservoir are the two lentic (standing) waterbodies potentially affected by water discharges and withdrawals associated with the NorthMet Project Proposed Action. The Partridge River flows through Colby Lake. Whitewater Reservoir is hydraulically connected to Colby Lake by a diversion works, and water moves between the two waterbodies either by controlled gravity-fed flow or by pumps, depending on the relative water levels in the two lakes (see Section 4.2.2 for more details).

Colby Lake is a Class 11 lake with a surface area of 539 acres and a littoral (water depth up to 15 ft) area of 377 acres. Maximum depth is 30 ft. In the most recent habitat characterization, the dominant littoral substrates were boulders (diameter greater than 10 inches), rubble (diameter 3 to 10 inches), and gravel (size unspecified) (MDNR 2010c). Aquatic plants were moderately abundant, dominated by water lilies (*Nympheadeae*), pondweed (*Potamogeton* sp.), and water shield (*Brasenia schreberi*). Average Secchi depth was 2 ft, and submersed plants grew to a maximum depth of 6 ft. The non-native curly-leaf pondweed (*Potamogeton crispus*) was found in the west end of the lake. During the most recent fisheries survey conducted in July 2010 (MDNR 2010c), surface water temperature was 76^{o}F, and the bottom temperature was 53^{o}F. Oxic water (dissolved oxygen concentration greater than 2 parts per million [ppm]) supporting fish extended to a depth of 15 ft where the temperature was 62^{o}F. A heated water plume (greater than or equal to 100^{o}F at the surface) extended from the Laskin Energy Center power plant discharge.

Fish species collected in Colby Lake through the latest July 2010 survey are listed in Table 4.2.6-9. The latest survey found species typically found in a lake Class 11 fish community assemblage, with one exception. Channel catfish were abundant in Colby Lake, which is unique for Class 11 lakes. Channel catfish, by weight, were the most abundant fish sampled in 2010. There was a low-density, quality-sized population of northern pike and a representative array of panfish species including bluegill, black crappie, and yellow perch. Historically, the walleye population has been highly variable. The 2010 catch was the lowest on record and below the 25th percentile value for lake Class 11. There is an MDH consumption advisory for fish in Colby Lake due to high levels of mercury.

Whitewater Reservoir is a Class 7 lake that encompasses a total surface area of 1,210 acres and a littoral area of 564 acres with a maximum depth of 73 ft. The dominant littoral substrate was gravel, rubble, and sand during the most recent habitat characterization (MDNR 2007c). Aquatic plants were moderately abundant along the shore and in shallow bays. The dominate taxa were cattails (*Typha* sp.), sedges (*Cyperaceae*), northern milfoil (*Myriophyllum sibericum*), and pondweed. Average Secchi depth was 12 ft, and submersed plants grow to a maximum water depth of 8 ft. During the more recent MDNR fisheries survey in mid-August 2012, the surface water temperature was 73^{o}F, and the bottom water temperature was 47^{o}F. Oxic water extended to a depth of 23 ft where the water temperature was 69^{o}F.

Walleye were introduced to the reservoir following impoundment in 1955, and stocking continued through 1984. Fish species collected in the Whitewater Reservoir by the MDNR surveys are listed in Table 4.2.6-9. The fish population in 2012 was dominated by walleye, northern pike, and bluegill and the total gillnet catch for each was above average among similar lake classes in northeast Minnesota that share similar ecological characteristics (MDNR 2012m). As is the case for Colby Lake, Whitewater Reservoir contains a similar MDH consumption advisory for fish due to high levels of mercury. Colby Lake water quality is summarized in Section 4.2.2, which identifies water quality exceedances for aluminum, iron, and manganese, which is believed to be naturally occurring. Both Colby Lake and Whitewater Reservoir are listed on the Minnesota 303(d) TMDL list because of high mercury concentrations in fish tissue.

Table 4.2.6-9 Fish Species Collected in Colby Lake and Whitewater Reservoir by MDNR Fisheries Surveys[1]

Scientific Name	Common Name	Colby Lake[2]	Whitewater Reservoir[3]
Ameiurus melas	Black bullhead		X
Pomoxis nigromaculatus	Black crappie	X	X
Lepomis macrochirus	Bluegill	X	X
Ameiurus nebulosus	Brown bullhead		X
Lota lota	Burbot		X
Ictalurus punctatus	Channel catfish	X	
Luxilus cornutus	Common shiner	X	
Lepomis hybrids	Hybrid sunfish		X
Micropterus salmoides	Largemouth bass	X	X
Esox lucius	Northern pike	X	X
Lepomis gibbosus	Pumpkinseed	X	X
Ambloplites rupestris	Rock bass	X	X
Moxostoma macrolepidotum	Shorthead redhorse	X	X
Notropis hudsonius	Spottail shiner	X	
Sander vitreus	Walleye	X	X
Catostomus commersonii	White sucker	X	X
Ameiurus natalis	Yellow bullhead	X	
Perca flavescens	Yellow perch	X	X

1 Collection methods included gillnets, trapnets, and shoreline seining.
2 Surveys conducted in 1968, 1985, 2005, 2010, and 2012.
3 Ten surveys conducted post-impoundment, 1967-2002.

Little information exists on the macroinvertebrate assemblages of Colby Lake and Whitewater Reservoir. Sampling conducted in many lakes in the region (including Colby and Whitewater) as part of the Minnesota State Planning Agency Regional Copper-Nickel Study (MSPA 1979) found that nearly all of the taxa collected in the littoral zone of lakes were also collected in the streams of the region. The littoral zone of the lakes had a more diverse macroinvertebrate fauna than did the profundal (deep water) zone. Gastropods (snails) were collected from the littoral zone of Colby Lake and pelecypods (clams) were collected from the profundal zone (Johnson and Lieberman 1981). The most frequently collected and most abundant taxa collected from the profundal zone of Colby Lake were the phantom midge (*Chaoborus* sp.), a mayfly species (*Hexagenia limbata*), and two midge taxa (*Procladius* sp. and *Chironomus* sp.), similar to other lakes of the region and are characteristic of good water quality (Johnson and Lieberman 1981).

4.2.6.3 Embarrass River Watershed

This section describes the aquatic resources found within the Embarrass River Watershed portion of the NorthMet Project area.

4.2.6.3.1 Surface Water Features

Surface water features within the Embarrass River Watershed and within the NorthMet Project area include the Embarrass River and several of its tributaries draining the existing LTVSMC Tailings Basin including the first-order streams Mud Lake Creek, Trimble Creek, and Unnamed Creek. Mud Lake Creek and Trimble Creek originate from the wetlands and bogs to the north and northwest of the existing LTVSMC Tailings Basin, respectively. Unnamed creek originates from the northwest corner of the existing LTVSMC Tailings Basin.

Aerial photograph review of these streams indicates a mix of disturbed and vegetated riparian buffers with human impact effects on the landscape and stream courses apparent. Major channel habitat and substrate characteristics for these streams are summarized in Table 4.2.6–10. Study locations are included in Figure 4.2.6-1.

Table 4.2.6-10 Major Channel Characteristics at a Biological and Habitat Survey Stations for Streams within the Vicinity of the Plant Site

	Location	Channel Characteristics						
Water Body/ Reference	**Site**	**Stream Order**	**Catchment (mi^2)**	**Dominant Substrate**	**Width (cm)**	**Depth (cm)**	**Velocity (m^3/s)**	**QHEI[1]**
Trimble Creek (Breneman 2005)	B6[2]	1	7.4	Sand and Silt	190	58.70	0.10	65
Trimble Creek (Barr 2011b)	PM-19[2]	1	--	Sand and Silt	250[(3)]	53.3[(3)]	0.09	46
Unnamed creek (Barr 2011b)	PM-11	1	--	Muck and detritus	183	58	0.08	59
Spring Mine Creek	PM-12.1	1	--	Sand and detritus	213[(3)]	29[(3)]	0.01[(3)]	--

Source: Adapted from Breneman 2005, Barr 2011b, Barr 2011i, Barr 2011m. Referenced from Figure 4.2.6-1.
1 QHEI (Rankin 1989) is designed to provide an integrated evaluation of physical habitat characteristics important to fish communities and ranges from 0 (low) to 100 (high).
2 Sample sites B-6 and PM-19 are the same sampling location; however, data was collected in separate years during different studies.
3 Averaged between two study dates (September 2010 and June 2011).

4.2.6.3.2 Existing Water Quality

Water quality sampling has occurred at PM-12 (upstream of all mining influences); PM-12.1 (on Spring Mine Creek); PM-12.2, PM-12.3, and PM-12.4 (between PM-12 and PM-13), and PM-13 (downstream of all NorthMet Project Proposed Action influences), as well as three tributary streams that drain the existing LTVSMC Tailings Basin (Mud Lake Creek, Trimble Creek, and Unnamed Creek) (see Figure 4.2.6-1) (see Section 4.2.2.3.2 for additional sample information). Water quality evaluation criteria exceedances were found for aluminum and mercury at most locations, and elevated concentrations for sulfate, especially at Spring Mine Creek. The Embarrass River, from its headwaters to Embarrass Lake, and Spring Mine Creek, from Ridge Creek to the Embarrass River, are both included on the 2012 TMDL list for aquatic life based on fishes bioassessment and, in the case of Spring Mine Creek, also aquatic macroinvertebrate bioassessment. Section 4.2.2 describes the water quality of the Embarrass River in more detail.

4.2.6.3.3 Aquatic Biota Studies

Breneman (2005) collected fish and macroinvertebrate community information at three sites in the Embarrass River Watershed. Fish and macroinvertebrate data were also collected by Barr at Spring Mine Creek, Trimble Creek, and Unnamed Creek. The results of these sampling events are summarized in Tables 4.2.6-11 and 4.2.6-12.

Fish Communities

Sampling location PM-20 (Bear Creek) was used for a reference or control study site to compare results for aquatic biota sampling locations PM-12.1 (Spring Mine Creek), PM-19 (Trimble Creek), and PM-11 (Unnamed Creek). As part of an additional study, aquatic biota data was collected from two additional sites on Unnamed Creek (B-5 and B-7) and a resampling of the Trimble Creek site (B-6). The MPCA also conducted aquatic biota studies for five locations, one of which was also conducted on Bear Creek near PM-20. A limited number of pollution-intolerant fish were identified among the various sample locations, including the Bear Creek control site. One pollution-intolerant species was found at Spring Mine Creek and one was identified at an Embarrass River sampling location. IBI scores ranged from moderate to poor for the various sampling locations, indicating impairment for aquatic life within these study reaches. Aerial photograph review of the B-5, B-6, and B-7 sampling sites exhibits a mix of disturbed and vegetated riparian buffers with human impact effects in the wetland landscape and stream courses, which likely limits the quality and diversity of the fish habitat present at these locations. Muck and silt were listed as dominant substrates within most of sample locations, which is consistent with headwater stream characteristics in the region. Sampling location PM-12.1 was located within a second-order section of Spring Mine Creek where sand and detritus were the dominant substrate.

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Table 4.2.6-11 Fish Species Collected at Sampling Sites within the Vicinity of the Plant Site and Transportation and Utility Corridor

			Bear Creek		**Unnamed Creek**			**Trimble Creek**		**Spring Mine Creek**			**Embarrass River**				
Scientific Name	**Common Name**	**Tolerance Designation[1]**	**PM-20**	**09LS098**	**PM-11**	**B-7**	**B-5**	**PM-19[2]**	**B-6[2]**	**09LS101**	**09LS101**	**PM-12.1**	**10EM045**	**10EM045**	**97LS005**	**97LS005**	**09LS100**
Catostomus commersonii	White sucker	Tolerant	X	X	X	X		X	X	X	X	X	X	X	X	X	X
Luxilus cornutus	Common shiner	Intermediate				X				X		X			X	X	
Notemigonus crysoleucas	Golden shiner	Tolerant	X	X											X	X	
Lota lota	Burbot	Intermediate		X				X	X	X	X	X			X	X	X
Margariscus margarita	Pearl dace	Intermediate									X	X					
Phoxinus eos	Northern redbelly dace	Intermediate			X	X	X		X							X	
Phoxinus neogaeus	Finescale dace	Intermediate				X	X										
Pimephales promelas	Fathead minnow	Tolerant				X	X										
Etheostoma nigrum	Johnny darter	Intermediate	X	X				X				X			X	X	
Perca flavens	Yellow perch	Intermediate										X	X		X	X	
Esox lucius	Northern pike	Intermediate	X	X										X	X		X
Culaea inconstans	Brook stickleback	Intermediate			X	X	X		X	X	X					X	
Umbra limi	Central mudminnow	Tolerant	X	X	X	X	X	X	X	X	X	X				X	X
Semotilus atromaculatus	Creek chub	Tolerant			X	X		X	X	X	X	X					
Ambloplites rupestris	Rock Bass	Intermediate		X									X		X	X	
Notropis heterolepis	Blacknose Shiner	Intolerant								X	X				X		
Ameiurus melas	Black Bullhead	Intermediate		X													X
Study year			2010	2009	2010	2004	2004	2010	2004	2009	2009	2010	2009	2010	1997	1997	2009
Species observed			5	8	5	8	5	5	6	7	7	8	3	2	9	10	5
# intolerant species[3]			0	0(1)	0	0	0	0	0	1(2)	1(2)	0	0	0	1(2)	0(1)	0(1)
Total Abundance			20	38	121	441	222	13	67	88	22	21	6	8	35	97	31
IBI[4]			--	43	--	--	--	--	--	37	37	--	0	0	50	54	31
Substrate			Muck and detritus	--	Muck and detritus	--	--	Sand and silt	Silt	--	--	Sand and detritus	--	--	--	--	--

Source: Breneman 2005 and MPCA 2011c.

1 Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish - Second Edition EPA 841-B-99-002 (USEPA 2012b). Tolerance values indicate qualitative tolerances of physical and chemical disturbances.
2 Sample sites PM-19 and B-6 are the same sampling location; however, data was collected in separate years during different studies.
3 Number in parentheses represents MPCA classification (MPCA 2011c).
4 IBI is the sum of study specific metrics where 0 represents the worst fish assemblage conditions and 100 represents the best fish assemblage conditions (USEPA 2011b).

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Macroinvertebrate Communities

The assemblages observed in the survey are typical of those sampled elsewhere in the northeast region of Minnesota (Breneman 2005). Total taxa, abundance, %EPT, and %Diptera totals are quite variable among the sites. Most sampling locations exhibited significant percentages of stonefly, mayfly, and caddisfly populations, which, unlike the fish community data, indicate desirable, non-degraded stream characteristics are likely present. Study sites PM-12.1 and PM-19 exhibited 44 and 41 percent EPT, respectively, which indicated some riffle/run habitat was likely present, although this was not reflected from the substrate data provided in Table 4.2.6-11 or least was not a dominant habitat within the study stretch. The HBI scores exhibited variable results, indicating fair to good macroinvertebrate habitat was present within these study stretches. The exception to these results was the impairment for invertebrate life in Spring Mine Creek, which resulted in the MPCA listing of “Impaired” in 2012.

Table 4.2.6-12 Composition of Macroinvertebrate Assemblages for Sites in the Embarrass River Watershed

Name	Year	Site	Total Taxa	Abundance	%EPT[1]	%Diptera[2]	HBI[3]	IBI[4]
Embarrass River wetland (upstream)	2004	B-5	54	2,529	17	47	--	--
Embarrass River	1997	97LS005	21	--	--	8	2.7	55
Embarrass River	2009	97LS005	31	--	--	25	5.7	69
Embarrass River	2009	10EM045	21	--	--	8	2	39
Embarrass River	2010	10EM045	16	--	--	9	1.3	41
Embarrass River	2009	09LS100	24	--	--	29	3.7	61
Spring Mine Creek	2009	09LS101	20	--	--	23	5.7	46
Spring Mine Creek	2010	PM-12.1	33	2,494	44	20	5.3	--
Trimble Creek	2004	B-6[5]	64	654	0.5	27	--	--
Trimble Creek	2010	PM-19[5]	36	6,998	42	49	5.5	--
Unnamed Creek	2004	B-7	37	1,549	2	65	--	--
Unnamed Creek	2010	PM-11	22	2,484	31	25	6.5	--
Bear Creek	2009	09LS098	25	--	--	21	4.3	67
Bear Creek	2010	PM-20	32	2,787	24	30	6.4	--

Source: Data and functional group assignments from Breneman 2005, Barr 2011b, Barr 2011i, Barr 2011m, Barr 2011n, and MPCA 2011c.

[1] %EPT indicates the percent of mayflies, stoneflies, and caddisflies within the macroinvertebrate sample. High EPT percentages of the population typically indicates degraded habitat conditions are not present.

[2] %Diptera indicates the percent of true flies and bloodworms present within the macroinvertebrate sample. High percentages of the population typically indicates low habitat diversity and predominant silty habitats often present within slow-moving, headwater streams.

[3] HBI is the measure of macroinvertebrate assemblages tolerance toward organic (nutrient) enrichment. Decreasing values indicate improving biotic condition. Higher values indicate fewer biological stressors (scale of 100).

[4] IBI derived by the MPCA (MPCA 2011c).

[5] Sample sites B-6 and PM-19 are the same sampling location; however, data was collected in separate years during different studies.

4.2.6.3.4 Special Status Fish and Macroinvertebrates

No special status fish or macroinvertebrates are known to occur within the Embarrass River Watershed, although the same potential SGCN, federal, and RFSS special status species described for the Partridge River Watershed would also apply to these areas. Suitable habitat is likely present for the same species discussed in Section 4.2.6.1.4.

No invasive fish or macroinvertebrate species are known to occur within the Embarrass River or its tributaries near the Plant Site.

4.2.6.4 Mercury Concentrations in Fish

As discussed in Section 4.2.2, Section 303(d) of the CWA requires states to publish a list of waters that are not meeting one or more water quality standards. The Partridge River is not listed as an impaired water body for mercury on the 303(d) list, although Colby Lake, Whitewater Reservoir, and most of the St. Louis River are listed for “mercury in fish tissue” impairment. Similarly, the Embarrass River is not on the 303(d) list for mercury; however, several lakes downstream of the NorthMet Project area (within the Chain of Lakes), through which the Embarrass River flows, are listed for “mercury in fish tissue” impairment. It should be noted that portions of the Embarrass River are listed on the 303(d) list as impaired for “Fishes Bioassessment,” a category not related to mercury. Fish consumption advisories have been issued for these impaired waters by the MDH to provide site-specific consumption guidance on the quantity and frequency of fish species consumed. For waters not listed on the 303(d) list for “mercury in fish tissue,” statewide consumption advisories still apply because these waters have not been tested and it is assumed that fish within these waters do contain unknown amounts of mercury.

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4.2.7 Air Quality

The NorthMet Project Proposed Action is subject to various federal and State of Minnesota air quality regulations. These regulations are designed to protect the general climate and air quality within the affected region of the NorthMet Project area. The USEPA has promulgated National Ambient Air Quality Standards (NAAQS) for seven common pollutants found in the ambient air, known as "criteria" pollutants. These standards are designed to ensure human and environmental health criteria are met for the ambient air quality. Minnesota has also promulgated Minnesota Ambient Air Quality Standards (MAAQS) to further protect human health. Minnesota has been granted air permitting authority by the USEPA, so the NorthMet Project Proposed Action will be issued a single permit by the MPCA.

The affected region can vary depending upon the specific regulations and the federal and state jurisdictions. For the purpose of this section, the extent of the affected region will be bounded by the Federal Land Managers' (FLMs') request to assess effects for all USEPA-defined Class I areas within a 300-kilometer (km) radius of the NorthMet Project area. The remainder of this section summarizes the regional climate, local meteorology, and the existing ambient air quality for the affected region.

4.2.7.1 Regional Climate and Meteorology

The climate for the NorthMet Project area and Minnesota, in general, is defined as continental. The region is subject to continental polar air masses throughout most of the year and, during the cold season, is subject to more frequent Arctic air masses. During the summer months, the southern portion of the state gives way to warm air entering northward from the Gulf of Mexico. As Pacific Ocean air masses move across the western United States, relatively mild and dry weather can be observed throughout the year, depending upon the strength of the air mass.

Based upon surface data taken at the Hibbing Monitoring Station (see Figure 4.2.7-1), predominant winds are from the north-northwest through west-northwest, occurring approximately 25 percent of the time. Winds from the south-southeast through southeast show a secondary predominance, occurring approximately 15 percent of the time. Average monthly temperatures range from 4^{o}F in the coldest month (January in northwest Minnesota) to 85^{o}F in the hottest month (July in southwest Minnesota). Mean annual temperatures range from 36^{o}F in the extreme north to 49^{o}F in the southeast along the Mississippi River. Extreme temperatures throughout the state can vary from 114^{o}F in the summer to -60^{o}F in the winter (NCDC 2010). During the three coldest months (December through February), maximum daily temperatures are below 32^{o}F for 24 days per month. Temperatures in the summer months rarely reach maximum temperatures above 90^{o}F (only 5 to 6 days per year).

Approximately two-thirds of the precipitation occurs between May and September, with annual precipitation ranging from 35 inches in the southeast and gradually decreasing to 19 inches in the extreme northwest. Northeastern Minnesota generally receives approximately 70 inches of snow per year, decreasing to 40 inches per year near the south and eastern border states. Snow cover occurs in Minnesota an average of 110 days per year with 1 inch or more on the ground, although there is a marked difference between the northern (where the NorthMet Project area is located) and southern portions of the state, ranging from 140 days per year to 85 days per year of snow cover, respectively.

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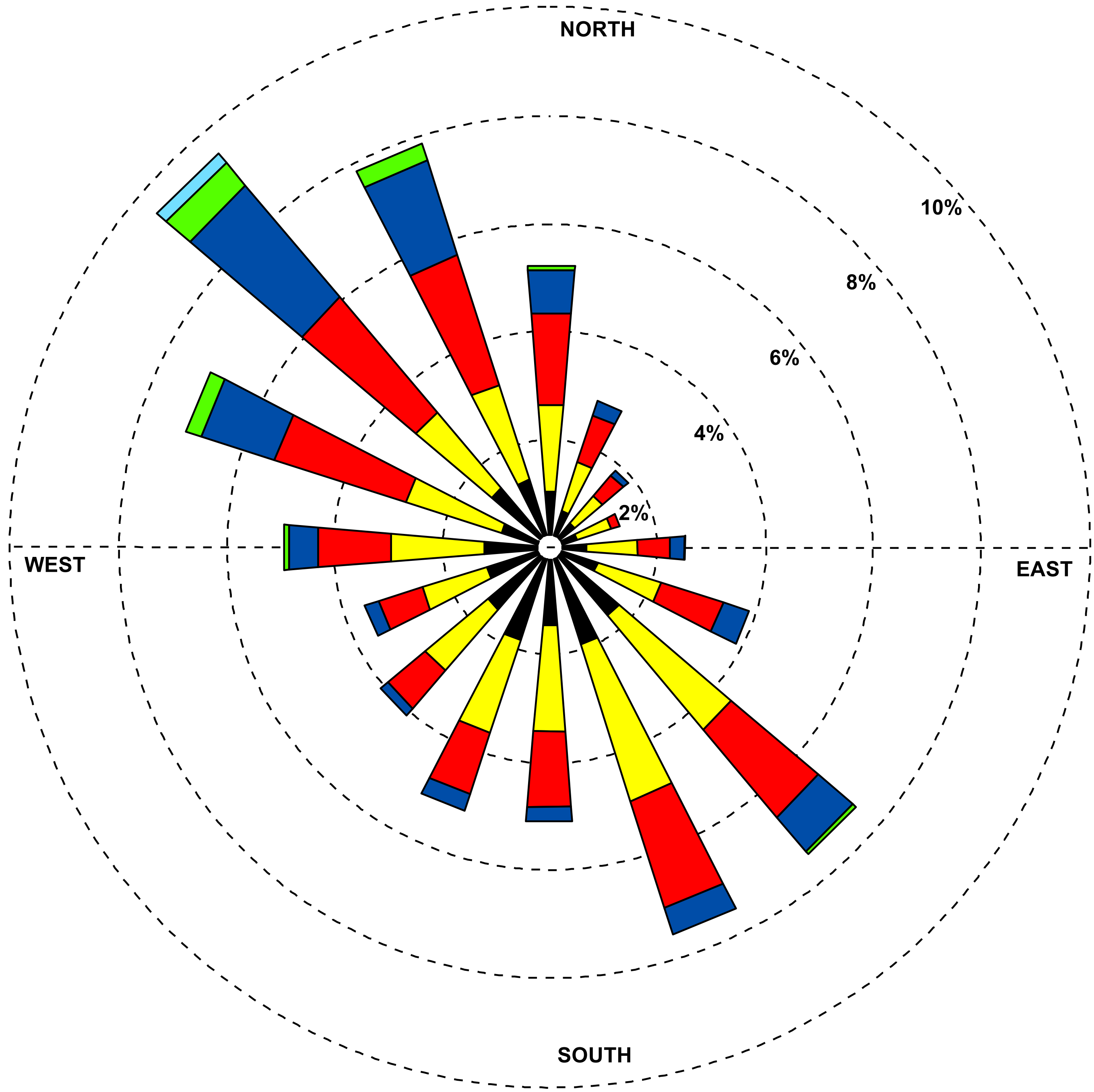

Wind Speed (m/s)

- > 11.1
- 8.8 - 11.1
- 5.7 - 8.8
- 3.6 - 5.7
- 2.1 - 3.6
- 0.5 - 2.1

Figure 4.2.7-1
Wind Frequency Distribution Plot for Hibbing, Minnesota (2001-2005)
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4.2.7.2 Local and Regional Air Quality

The MPCA monitors air quality at a number of stations throughout the state. The data collected helps the state determine major sources of air pollution as well as assess compliance with NAAQS and MAAQS. Per requirements of the federal CAA, monitoring is done for the criteria pollutants. The MPCA also monitors for a range of chemicals, referred to as air toxics, which, like the criteria pollutants, potentially affect human health.

As of 2012, air quality was monitored at 52 locations throughout Minnesota. Not all locations monitor all pollutants; rather, the selection of monitoring locations and parameters reflects consideration of a number of factors including population, pollutants of concern in the area, and wind direction. Table 4.2.7-1 provides the monitored background concentrations for the period 2008 to 2010 at monitoring stations within or close to the 300-km area of the NorthMet Project Proposed Action. Both the Duluth and Virginia locations are considered urban; the Cloquet site is rural, while the Voyageurs site is within Voyageurs National Park. The Virginia monitoring location has been in operation since 1968. In addition to demonstrating compliance with NAAQS and MAAQS, the monitoring site was also established to characterize metals concentrations and identify emissions sources from mining activities. The Cloquet site is three miles west of the city near several large forest products industries. Land use near the Voyageurs site is managed for recreation, timber, and wilderness. Pulp and paper mills in International Falls and Fort Frances, Ontario are approximately 95 miles northwest of the NorthMet Project area.

As seen from the table, all reported air quality data meet the NAAQS and the MAAQS, indicating that existing ambient air quality concentrations are below levels that are known to cause health-based impacts for these pollutants. These levels demonstrate that the general air quality area is considered in attainment under federal regulations.

Table 4.2.7-1 Monitored Background Concentrations (2008–2010)

Pollutant	Averaging Period	Monitored Background Concentration	Standard Value	Standard Type	Monitoring Station
Carbon Monoxide	8-Hour	1.9 ppm	9 ppm	Primary	Duluth – Torrey Building
	1-Hour	4.1 ppm	35 ppm 30 ppm[1]	Primary Primary and Secondary	Duluth – Torrey Building
Nitrogen Dioxide	Annual	0.002 ppm	0.05 ppm[2]	Primary and Secondary	Cloquet
	1-Hour	0.014	0.10 ppm[2]	Primary	Cloquet
Ozone (O_3)	8-Hour	0.072 ppm	0.08 ppm	Primary and Secondary	Voyageurs National Park
Lead	Quarterly	0.005 $\mu g/m^3$	1.5 $\mu g/m^3$	Primary and Secondary	Virginia
Total Suspended Particulate (TSP)[1]	Annual	30 $\mu g/m^3$	75 $\mu g/m^3$ 60 $\mu g/m^3$	Primary Secondary	Virginia
	24-Hour	83 $\mu g/m^3$	260 $\mu g/m^3$ 150 $\mu g/m^3$	Primary Secondary	Virginia

Pollutant	Averaging Period	Monitored Background Concentration	Standard Value	Standard Type	Monitoring Station
PM_{10}[3]	Annual	14 μg/m³	50 μg/m³	Primary and Secondary	Virginia
	24-Hour	36 μg/m³	150 μg/m³	Primary and Secondary	Virginia
$PM_{2.5}$	Annual	5.8 μg/m³	15 μg/m³	Primary and Secondary	Virginia
	24-Hour	16.5 μg/m³	35 μg/m³	Primary and Secondary	Virginia
Sulfur Dioxide	Annual	0.001 ppm	0.03 ppm 0.02 ppm[1]	Primary Secondary	Rosemount
	24-Hour	0.007 ppm	0.14 ppm	Primary and Secondary	Rosemount
	3-Hour	0.021 ppm	0.5 ppm 0.35 ppm	Primary and Secondary[4] Secondary[5]	Rosemount
	1-Hour	0.024 ppm	0.075 ppm[1]	Primary	Rosemount

Source: Gavin, MPCA, Pers. Comm., October 28, 2011.

1 Minnesota State Ambient Air Quality Standard only.
2 Data available for only year 2010.
3 The USEPA revoked the annual PM_{10} standard (effective December 17, 2006). However, it is still reflected in the State of Minnesota's regulations.
4 Secondary standard for Air Quality Control Regions 128, 131, and 133.
5 For Air Quality Control Regions 127, 129, 130, and 132.
μg/m³ = Micrograms per cubic meter

4.2.8 Noise and Vibration

This section addresses baseline noise and vibration conditions at the Mine Site and Plant Site, including a brief introduction to noise concepts and terms.

Noise is generally defined as unwanted sound. Sound travels in a mechanical wave motion and produces a sound pressure level. This sound pressure level, also referred to as loudness or intensity, is measured in decibels (dB). The dB scale is logarithmic such that each 10 dB increase represents a tenfold increase in noise intensity. For example, if sound energy is doubled, there is a 3 dB increase in noise because the two sound levels are added logarithmically, not linearly or arithmetically (e.g., 70 dB plus 70 dB equals 73 dB, not 140 dB). Sound measurement is further refined by using an A-weighted scale that emphasizes the range between 1,000 and 8,000 cycles per second, which is the range of sound frequencies most audible to the human ear. Unless otherwise noted, all dB measurements presented in this SDEIS are A-weighted (dBA) on a logarithmic scale. This measurement is an expression of the relative loudness of sounds in air as perceived by the human ear. In the A-weighted scale, the dB values of sounds at low frequencies are reduced compared with unweighted dB, in which no correction is made for audio frequency. This correction is made because the human ear is less sensitive at low audio frequencies, especially below 1,000 hertz (Hz), than at high audio frequencies. A sound increase of 3 dBA is barely perceptible to the human ear, while a 5 dBA increase is clearly noticeable and a 10 dBA increase is heard as twice as loud (MPCA 2003; Bies and Hansen 2009; IDOT 2011). Noise emissions diminish or attenuate with distance from the source depending on the nature of the source. When distance from a point source, such as a building, is doubled, the sound level decreases by 6 dB. However, when distance from a line source, such as a busy roadway, is doubled, the sound level decreases by 3 dB (MPCA 2003).

The dB levels of common noise sources are shown in Table 4.2.8-1.

Table 4.2.8-1 Decibel Levels of Common Noise Sources

Common Noise Source	dB Levels
Jet Engine (at 25 meters)	140
Jet Aircraft (at 100 meters)	130
Rock Concert	120
Pneumatic Chipper	110
Jackhammer (at 1 meter)	100
Chainsaw, Lawn Mower (at 1 meter)	90
Heavy Truck Traffic	80
Business Office, Vacuum Cleaner	70
Conversational Speech, typical TV Volume	60
Library	50
Bedroom	40
Secluded Woods	30
Whisper	20

Source: MPCA 2003.

A comparison of typical outdoor noise levels by land use category for daytime and nighttime is shown in Table 4.2.8-2.

Table 4.2.8-2 Typical Outdoor Sound Levels by Land Use Category

Land Use Category	L_{dn} (dBA)	L_d (dBA)	L_n (dBA)
Rural and sparsely populated areas	35 - 50	35 - 50	25 - 40
Quiet suburban (630 people/mi^2, remote from large cities and from industrial activity and trucking)	50	50	40
Normal suburban community (2,000 people/mi^2 not located near industrial activity)	55	55	45
Urban residential community (6,300 people/mi^2 not immediately adjacent to heavily traveled roads and industrial areas	60	59	52
Noisy urban residential community (near relatively busy road or industry or 20,000 people/mi^2)	65	62	58
Very noisy urban residential community (63,000 people/mi^2)	70	67	63

Source: USEPA 1974.

L_{dn}, or day-night sound level, is the average equivalent A-weighted sound level during a 24-hour time period with a 10-dB weighting applied to equivalent sound level during the nighttime hours of 10 p.m. to 7 a.m.
L_d, or daytime L_{eq}, is the average equivalent sound level for daytime (7 a.m. to 10 p.m.).
L_n, or nighttime L_{eq}, is the average equivalent sound level for nighttime (10 p.m. to 7 a.m.).
L_d and L_n values were determined from the L_{dn} values using methods described in the 1974 USEPA document referenced above (based on data from 63 sets of background measurements conducted at various land-use areas across the United States).

Vibration is defined as regularly repeated movement of a physical object about a fixed point. Blasting is an activity associated with mining that could result in vibration. There are two types of vibration associated with mine blasting: ground vibration and air vibration or airblast overpressure. The magnitude of ground vibration is expressed in terms of peak particle velocity (PPV) and is measured in inches per second (in/s) or millimeters per second (mm/s). Airblast overpressure is measured in linear-weighted decibels (dBL).

4.2.8.1 Regional Setting

Noise exposure goals for various types of land use reflect the varying noise sensitivities associated with each of these uses. Residences, hospitals, and guest lodging are most sensitive to noise intrusion and therefore have more stringent noise exposure targets than industrial or commercial uses that are not subject to effects such as sleep disturbance. The land use in the Superior National Forest is mostly for forest. The region surrounding the Mine Site has traditionally supported various mining activities, as well as logging, on federal, state, county, and private forest lands. Noise sources associated with logging activities include skidders, feller bunchers, and log loaders. Noise sources associated with mining activities include drills, explosives, dump trucks, excavators, crushers, and power generators. Considering the attenuation effect of the surrounding forest and the fact that most of the mining and logging activities typically occur several thousand feet away from each other, the noise levels are localized (rather than regional) and diminish very quickly with distance due to geometric divergence or spreading losses. In addition to the spreading losses, dense vegetation (foliage) in the Superior National Forest also helps to attenuate noise from the mining and logging activities.

4.2.8.2 Mine Site

The Mine Site is situated mostly on federal land in the Superior National Forest, except for the privately owned land bordering Dunka Road to the south of the Mine Site. As indicated above, the region surrounding the Mine Site has traditionally supported various mining activities, as well as logging, on federal, state, county, and private forest lands. The Northshore Mine and Mesabi Nugget Phase I Plant are located approximately 2 miles north and 8 miles west of the Mine Site, respectively. Dunka Road, which provides access to the Mine Site, is an existing private road located south of the Mine Site, with no public access and little usage. The existing LTVSMC railroad grade is also located south of the Mine Site.

Review of the most up-to-date aerial maps indicates that there are no noise-sensitive areas or receptors (e.g., residences, campgrounds, schools, churches, or wilderness areas) within the Mine Site and surrounding federal lands. However, there are a few receptors outside the Mine Site. The closest noise-sensitive receptor to the Mine Site is the City of Babbitt, located approximately 6 miles to the north. Survey data identified a Boy Scout camp located 5 miles from the Mine Site, but the clerk's office of the City of Hoyt Lakes indicated that the only Boy Scout camp near the Mine Site is located on Colby Lake, approximately 10 miles southwest of the Mine Site. Other noise-sensitive receptors in the general area of the Mine Site include: Skibo (a small residential area), approximately 8 miles to the south; the City of Hoyt Lakes, approximately 9 miles to the southwest; and the City of Aurora, approximately 13 miles to the south. The BWCAW is part of the national wilderness preservation system where sensitivity to human-caused sound and noise effects are important considerations. It is approximately 20 miles (in a northeasterly direction) from the Mine Site to the closest portion of the BWCAW. The cities of Ely and Tower are also located close to the BWCAW and are approximately 21 miles north-northeast and 19 miles northwest of the Mine Site, respectively. The Bois Forte Reservation is located near Tower. In addition to the receptors identified above, other receptors such as recreational sites (family campgrounds, campsites, boating, fishing, swimming, and family picnic areas), wildlife corridors, trails, and MPCA staff-recommended wild rice waters/beds (used by tribal members for harvesting) are also within the Mine Site vicinity. The closest recreational site is a family picnic area located approximately 9 miles south of the Mine Site (near Skibo). The closest wildlife corridor and trail (Stony Spur Snowmobile Trail) are located approximately 1 mile northwest and 6 miles northeast of the Mine Site, respectively. The closest MPCA staff-recommended wild rice waters/beds are located approximately 5.5 miles north (Mud Lake) and 7 miles northeast (Birch Lake) of the Mine Site. Figure 4.2.8-1 shows the locations of the closest receptors to the Mine Site. Though not depicted on Figure 4.2.8-1 due to sensitivity regarding cultural resources and locations, the federal Co-lead Agencies have identified a few archaeological sites in consultation with the SHPO and the Bands. Although barely discernible in some cases, a few well-defined trail segments of the BBLV Trail and two other unnamed trail segments (BBLV Trail Segment #1) represent the trail corridors that cross the Mine Site and Plant Site, as well as the NorthMet Project area (see Section 4.2.9, Cultural Resources).

Since the Mine Site is located in a rural and sparsely populated environment, the existing ambient steady L_{eq} for all nearby sensitive receptors (except the BWCAW), are expected to range from 35 to 50 dBA or approximately 45 dBA (daytime) and 25 to 40 dBA or approximately 35 dBA (nighttime) (see Tables 4.2.8-2 and 4.2.8-3). The ambient L_{eq} assumed for receptors outside the Mine Site area account for existing noise from the Northshore Mine located approximately 2 miles north of the Mine Site. Since the BWCAW is located in a natural environment that is generally quieter than areas outside the wilderness, the existing ambient L_{eq} at the BWCAW area is expected to be lower than the levels for other receptors surrounding the Mine Site area. In February 2011, the USFS Superior National Forest unit conducted an ambient sound level survey at Little Gabbro Lake in the western part of the BWCAW (ambient data provided by USFS staff via email in June 2013). In March 2011, the Superior National Forest unit also conducted an ambient sound level survey at Royal Lake in the eastern part of the BWCAW (USFS 2011m). The ambient data at both sites are comparable, but the data at Royal Lake is slightly lower. For the purpose of the NorthMet Project Proposed Action, the Royal Lake ambient data has been used to provide a conservative natural ambient level at BWCAW (see Table 4.2.8-3). In addition to the fact that the Royal Lake ambient data are more conservative (i.e., lower than Gabbro Lake data), the USFS staff indicated that the measured ambient data at Gabbro Lake has not been reviewed by the National Park Service, but the measured data at Royal Lake has been reviewed and used by the National Park Service soundscape program for some recent work they did to model noise effects on the BWCAW.

Minnesota's noise standards are based on statistical calculations that quantify noise levels according to duration over a 1-hour monitoring period. The L_{10} is the noise level that is exceeded for 10 percent, or 6 minutes, of the hour, and the L_{50} is the noise level exceeded for 50 percent, or 30 minutes, of the hour. There is not a limit on maximum noise (MPCA 2003). For the purposes of this assessment, the estimated baseline L_{eq} levels for the nearest receptors (except for the BWCAW, where measured percentile data were available) were converted to other noise percentile metrics, such as L_{50} and L_{10} using a USEPA calculation methodology (USEPA 1974). The calculation was based on an assumed standard deviation of 3 dB for the sound level statistical distribution. A summary of the estimated existing daytime and nighttime ambient levels (i.e., L_{eq}, L_{50}, and L_{10}) expected at receptors closest to the NorthMet Project area is presented in Table 4.2.8-3. As indicated above, natural ambient levels for the BWCAW were based on measured L_{50} and L_{10} data taken from Royal Lake in the eastern part of the BWCAW (USFS 2011m).

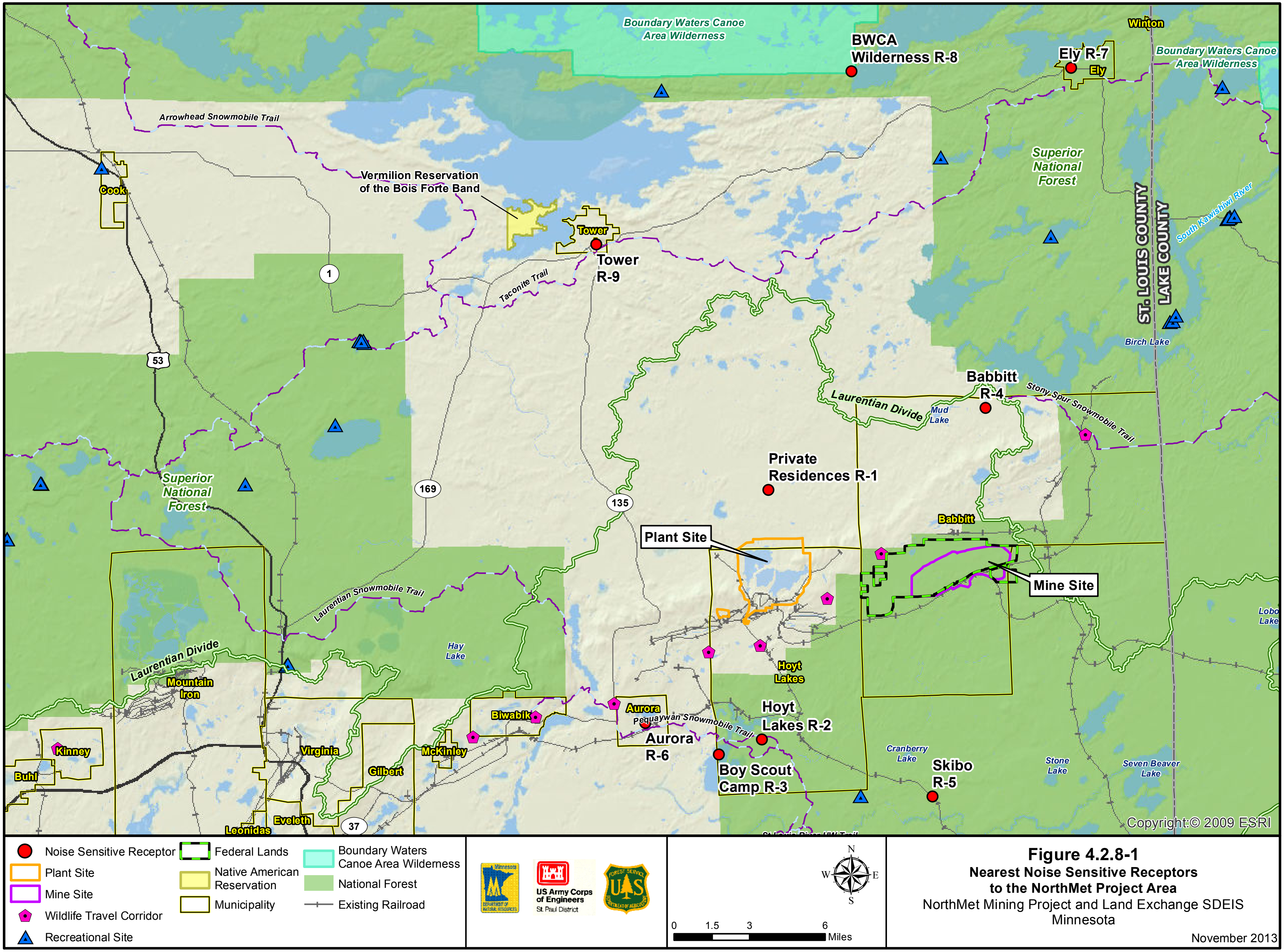

Figure 4.2.8-1
Nearest Noise Sensitive Receptors to the NorthMet Project Area
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Table 4.2.8-3 Summary of Estimated Existing Ambient Noise Levels at the Closest Receptors to the NorthMet Project Area, including the BWCAW

Ambient Noise Levels	Daytime (dBA)	Nighttime (dBA)
All Receptors except the BWCAW[1]:		
L_{eq}	45.0	35.0
L_{50}	44.0	34.0
L_{10}	48.8	37.8
BWCAW[2]:		
L_{eq}	34.0	34.0
L_{50}	23.4	23.4
L_{10}	33.2	33.2

[1] Source: USEPA 1974.
[2] Source: USFS 2011m.

Currently, no ground- or air-vibrating sources or activities (e.g., mine blasting, piling, etc.) occur at the Mine Site. The closest vibration-generating activity is blasting at the Northshore Mine. Like noise emissions, ground and air vibration effects diminish with distance from the source. Because of the distance from the operating mine, existing baseline levels of vibration at the Mine Site and nearby receptors are expected to be negligible.

4.2.8.3 Plant Site

The Plant Site is situated on private land located 8 miles west of the Mine Site. The closest noise-sensitive receptors to the Plant Site include a few private residences located approximately 3.5 miles north; the City of Hoyt Lakes, located approximately 5 miles south; and the City of Aurora, located approximately 8 miles southwest. A Boy Scout camp, which is only used occasionally, is located approximately 10 miles south-southwest. In addition to the receptors identified above, other receptors such as recreational sites, wildlife corridors, trails, archaeological sites (used by tribal members for cultural and spiritual purposes), and sites used by tribal members for harvesting of wild rice are also within the Plant Site vicinity. The closest recreational site is a family picnic area located approximately 9 miles south of the Plant Site (near Skibo). The closest wildlife corridor and trail (Pequaywan Snowmobile Trail) are located approximately 2 miles south and 6 miles southeast of the Plant Site, respectively. The closest MPCA staff-recommended wild rice waters/beds are located approximately 6 miles west (Hay Lake) of the Plant Site. Figure 4.2.8-1 shows the locations of the closest receptors to the Plant Site. Though not depicted on Figure 4.2.8-1 due to sensitivity regarding cultural resources and locations, the federal Co-lead Agencies have identified a few archaeological sites in consultation with the SHPO and the Bands. These archaeological sites include the Spring Mine Lake Sugarbush (a natural maple-basswood stand of cultural significance, less than 1 mile east of the Plant Site) and the *Mesabe Widjiu* (a long, linear landform running the length of the Mesabi Iron Range, and intersecting portions of the Laurentian Divide and northeast of the Plant Site near the Tailings Basin), and possess important spiritual and cultural significance to the Ojibwe people. Although barely discernible in some cases, a few well-defined trail segments of the BBLV Trail and two other unnamed trail segments (BBLV Trail Segment #1) represent the trail corridors that cross the Mine Site and Plant Site, as well as the NorthMet Project area (See Section 4.2.9, Cultural Resources).

Like the Mine Site, the Plant Site is also located in a rural and sparsely populated environment; therefore, the daytime and nighttime ambient levels (i.e., L_{eq}, L_{50}, and L_{10}) for all nearby sensitive receptors, such as residential houses, are expected to be similar to the levels shown in Table 4.2.8-3. The closest noise-generating sources are the coal and flux pulverizer, rotary hearth furnace, and cooling towers at Mesabi Phase I Plant in Hoyt Lakes, which is approximately 1 mile west-southwest of the Plant Site. The baseline noise levels of the identified receptors near the Plant Site (see Table 4.2.8-3) already capture or account for noise from the Mesabi Phase I Plant.

Currently, no ground- or air-vibrating sources or activities (e.g., mine blasting or pile driving) occur at the Plant Site. The closest vibration-generating sources are the coal and flux pulverizer and rotary hearth furnace at the Mesabi Phase I Plant in Hoyt Lakes, which is approximately 1 mile west-southwest of the Plant Site. Since ground and air vibration effects diminish with distance from the source, existing baseline levels of vibration at the Plant Site and the nearest sensitive receptors are expected to be negligible.

4.2.9 Cultural Resources

4.2.9.1 Introduction

MDNR, USACE, and USFS, have prepared a joint state-federal SDEIS for the proposed NorthMet Project Proposed Action and Land Exchange Proposed Action. USEPA, the Fond du Lac Band of Lake Superior Chippewa, the Bois Forte Band of Chippewa, and the Grand Portage Band of Lake Superior Chippewa (herein referred to as the Bands) participated as cooperating agencies based on regulatory authority and/or subject matter expertise. Cooperating agencies have not participated in production or endorsement of any components of the EIS or the NorthMet Project.

4.2.9.2 Cultural Resources

"Cultural resources" is a very general term that includes a wide range of resources. There is no legal or generally accepted definition of "cultural resources" within the federal government, but it is commonly used in connection with the identification of historic properties in compliance with Section 106 of the National Historic Preservation Act (NHPA). However, historic properties are only a subset of cultural resources, and are but one aspect of the "human environment" defined by the NEPA regulations.

Under NEPA, the human environment includes the natural and the physical (e.g., structures) environment, and the relationships of people to that environment. A NEPA review must address the cultural context in which the project effects would occur. Management policies, and guidance within federal and state agencies, seek to identify and consider all types of cultural resources and balance the need for development with the need to protect cultural resources.

The intent of this section is to describe the affected environment within this cultural context. Cultural resources within this context include historic properties, which are considered under the NHPA, and natural resources of cultural significance to the Bands. A discussion of treaty rights under the 1854 Treaty is also provided as part of this cultural context to understand the significance of the Ceded Territory to the Bands.

4.2.9.2.1 National Historic Preservation Act Overview

The NorthMet Project Proposed Action is considered an undertaking as defined in 36 CFR 800, the regulation implementing Section 106 of the NHPA. A more narrow view of cultural resources is necessary for these regulatory requirements. The intent of Section 106, as set forth in the impending regulations, is for federal agencies to take into account the effects of a proposed undertaking on historic properties and to consult with the Advisory Council on Historic Preservation (ACHP), State Historic Preservation Offices (SHPOs), federally recognized tribes, other federal agencies with concurrent undertakings in connection with the project, applicants for federal assistance, local governments, and any other parties with a demonstrated interest in the proposed undertaking and its potential effects on historic properties.

Section 106 establishes a process for identifying historic properties that may be affected by the proposed undertaking; assessing the undertaking's effects on those resources; and engaging in consultation that seeks ways to avoid, minimize, or mitigate adverse effects on properties that are either listed on, or considered eligible for listing on, the National Register of Historic Places

(NRHP). The area in which effects on resources are evaluated is the Area of Potential Effect (APE). The APE is defined as, "… the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The area of potential effects is influenced by the scale and nature of the undertaking and may be different for different kinds of effects caused by the undertaking" (36 CFR § 800.16(d)).

A historic property is defined as any district, site, building, structure, or object that is either listed, or eligible for listing, in the NRHP.

To be eligible for listing in the NRHP, a cultural resource must meet one of the four criteria for eligibility. The criteria (36 CFR 60.4(a–d)) used to evaluate the significance of a cultural resource are as follows:

a) It is associated with events that have made a significant contribution to the broad patterns of history;

b) It is associated with the lives of past significant persons;

c) It embodies the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

d) It has yielded or may be likely to yield, information important in history or prehistory.

Properties also need to exhibit integrity of location, materials, setting, design, association, workmanship, and feeling and must be at least 50 years old. However, under Criteria Consideration G, a property achieving significance within the past 50 years is eligible if it is of exceptional importance.

Historic properties can include properties of traditional religious and cultural significance to Indian tribes; these properties are commonly referred to as Traditional Cultural Properties (TCPs). Because the cultural practices or beliefs that give a TCP its significance are typically still observed in some form at the time the property is evaluated, it is sometimes perceived that the intangible practices or beliefs themselves, not the tangible property, constitute the subject of evaluation. There is naturally a dynamic relationship between tangible and intangible. The beliefs or practices associated with a TCP are of central importance in defining its significance. However, it should be clearly recognized at the outset that the NRHP does not include intangible resources themselves. The entity evaluated must be a tangible property—i.e., a district, site, building, structure, or object. A property must meet several preconditions in order to meet the federal definition of TCP as articulated in National Register Bulletin 38. These conditions include the ongoing use of a property in spiritual practice or other traditional activities. TCPs are defined in National Register Bulletin 38 as a place "eligible for inclusion in the NRHP because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community" (National Register Bulletin 38:1). It is difficult to identify properties of traditional cultural significance, since they are often kept secret. It is through consultation with Native American tribes themselves that historic properties of religious and cultural significance can be properly identified and evaluated (ACHP 2008).

Local, state, tribal, and federal agencies shall be consulted as appropriate in findings and determinations made during the Section 106 process, as specified in 36 CFR 800. This includes any SHPO whose state would physically include any portion of the APE. The SHPO is appointed by each state to protect the interests of its citizens with respect to issues of cultural heritage. In addition to the SHPO, the lead federal agencies have an obligation, as appropriate, to work with state and local governments, and private organizations, applicants, or individuals with a demonstrated interest from initiation to completion of the review under Section 106 of the NHPA.

Once the lead federal agencies have identified the appropriate SHPO, 36 CFR 800.3(f)(2) requires the federal agencies to identify Native American tribes that may attach religious and cultural significance to historic properties within the APE and invite them to be consulting parties.

If a historic property were affected, the USACE and USFS would follow the provisions of 36 CFR 800.5 to determine whether the effect were adverse. If an effect were adverse, the USACE and the USFS would consult with the parties identified above to resolve the adverse effect either through avoidance of the effect or mitigation of the effect pursuant to 36 CFR 800.6. Prior to the federal agencies taking an action, whether it is the issuance of a USACE CWA permit or a USFS land exchange in connection with the NorthMet Project Proposed Action, the federal agencies must comply with Section 106 of the NHPA. Such compliance can be achieved by, among other things, avoiding an adverse effect on historic properties or developing appropriate mitigation measures and executing a Memorandum of Agreement (MOA) requiring such mitigation.

4.2.9.2.2 Identification of Consulting Parties

The USACE invited 15 federally recognized tribes, as listed in the Native American Consultation Database (maintained by the Department of the Interior, National Park Service) for St. Louis County, Minnesota, and select state and federal agencies by letter to consult on the NorthMet Project Proposed Action and notified the consulting parties that the USACE would be the lead federal agency. Another letter from the USACE sent May 2006 invited Native American tribes that had not responded to the initial invitations. Those federally recognized tribes that did not respond to the first or second written invitations were contacted via phone.

As a result of this initial round of consultation, the Bois Forte Band of Chippewa Indians and Fond du Lac Band of Lake Superior Chippewa had requested to be included as cooperating agencies for the NorthMet Project Proposed Action under NEPA. Following this initial round of consultation, the Grand Portage Band of Chippewa requested to be included as a cooperating agency. The USACE and USFS continue consultation with the Bands and the Minnesota SHPO as determinations are made concerning NRHP eligibility of identified cultural resources, effects of the NorthMet Project Proposed Action on historic properties, and resolution of any adverse effects, as required under 36 CFR 800. The USACE and USFS also continue to consult on issues outside of the NHPA, including other issues pertinent to this SDEIS.

4.2.9.2.3 Methods for Identifying Historic Properties

The NorthMet Project Proposed Action is considered an *undertaking* as defined in 36 CFR 800.16. The Co-lead Agencies must consider effects on historic properties before an undertaking were to occur. The intent of Section 106 is for federal agencies to take into account the effects of a proposed undertaking on any historic properties situated within the APE and to consult with the ACHP, SHPOs, federally recognized Native American tribes and their Tribal Historic

Preservation Officers (THPOs), local governments, applicants, and any other interested parties regarding the proposed undertaking and its potential effects on historic properties.

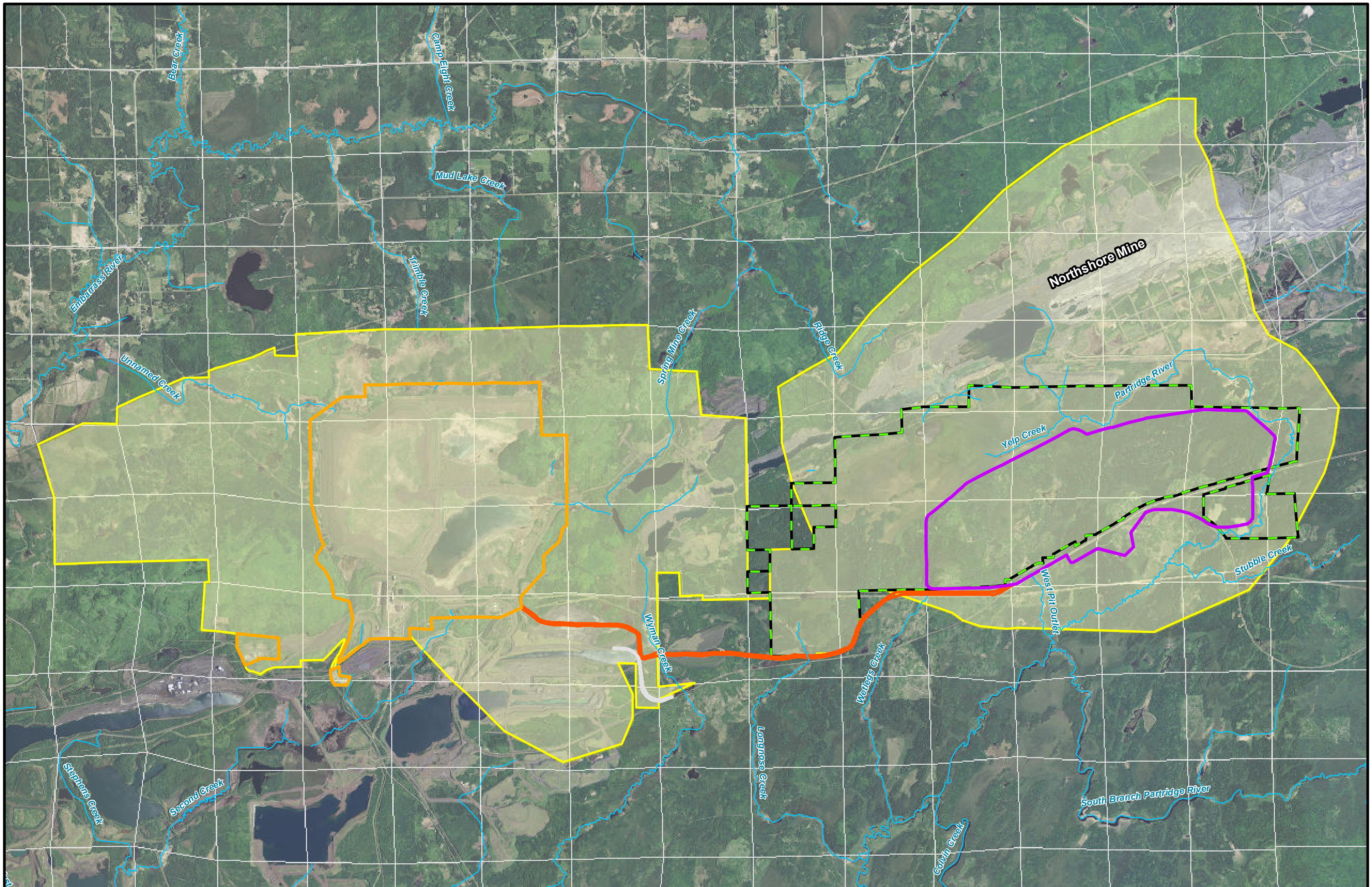
Area of Potential Effect

The APE is the area in which a federal agency has identified historic properties that may be affected by the undertaking. For the purpose of any discussion pertaining to historic properties, direct effects physically alter the historic property in some way and indirect effects are further removed in time or space and diminish some aspect of the historic property, but do not physically alter it. Direct effects on archaeological sites and historic structures would occur in a fairly circumscribed area. Indirect effects could occur within a more geographically expansive area that typically reflects potential effects resulting from visual, audible, or atmospheric changes.

Typically, archaeological surveys are only done within the area where direct effects would occur. However, for the NorthMet Project Proposed Action, the Co-lead Agencies conducted archeological surveys in some areas within the APE where both direct and indirect effects could occur.

The APE for the NorthMet Project Proposed Action was developed using the analysis discussed below and in other resource-specific sections of this SDEIS. The APE includes potential effects areas for both direct and indirect effects (see Figure 4.2.9-1). The purpose of this summary is to address the APE for the NorthMet Project Proposed Action and discuss the rationale behind the areas that were included in the APE. The Co-lead Agencies' consultation concerning the APE is ongoing with the SHPO and the Bands and the APE may be subject to change based on new information vetted through and accepted by the Co-lead Agencies. For the purposes of evaluating effects on cultural resources, the APE discussed in this SDEIS is being used.

The DEIS was issued in October 2009. From 2007 to 2009, archaeological and architectural surveys were conducted for the NorthMet Project Proposed Action, as discussed below. Those surveys focused on the existing Plant Site area and the proposed Mine Site area (see Figure 4.2.9-2).



Federal Lands
Mine Site
Plant Site
Transportation and Utility Corridor
Railroad Connection
Stream/River
Section Boundary
Cultural Resources Area of Potential Effect

US Army Corps of Engineers
St. Paul District

N
W E
S

0 0.5 1 2 Miles

Figure 4.2.9-1
Cultural Resources Analysis - Area of Potential Effect
NorthMet Mining Project and Land Exchange SDEIS
Minnesota

November 2013

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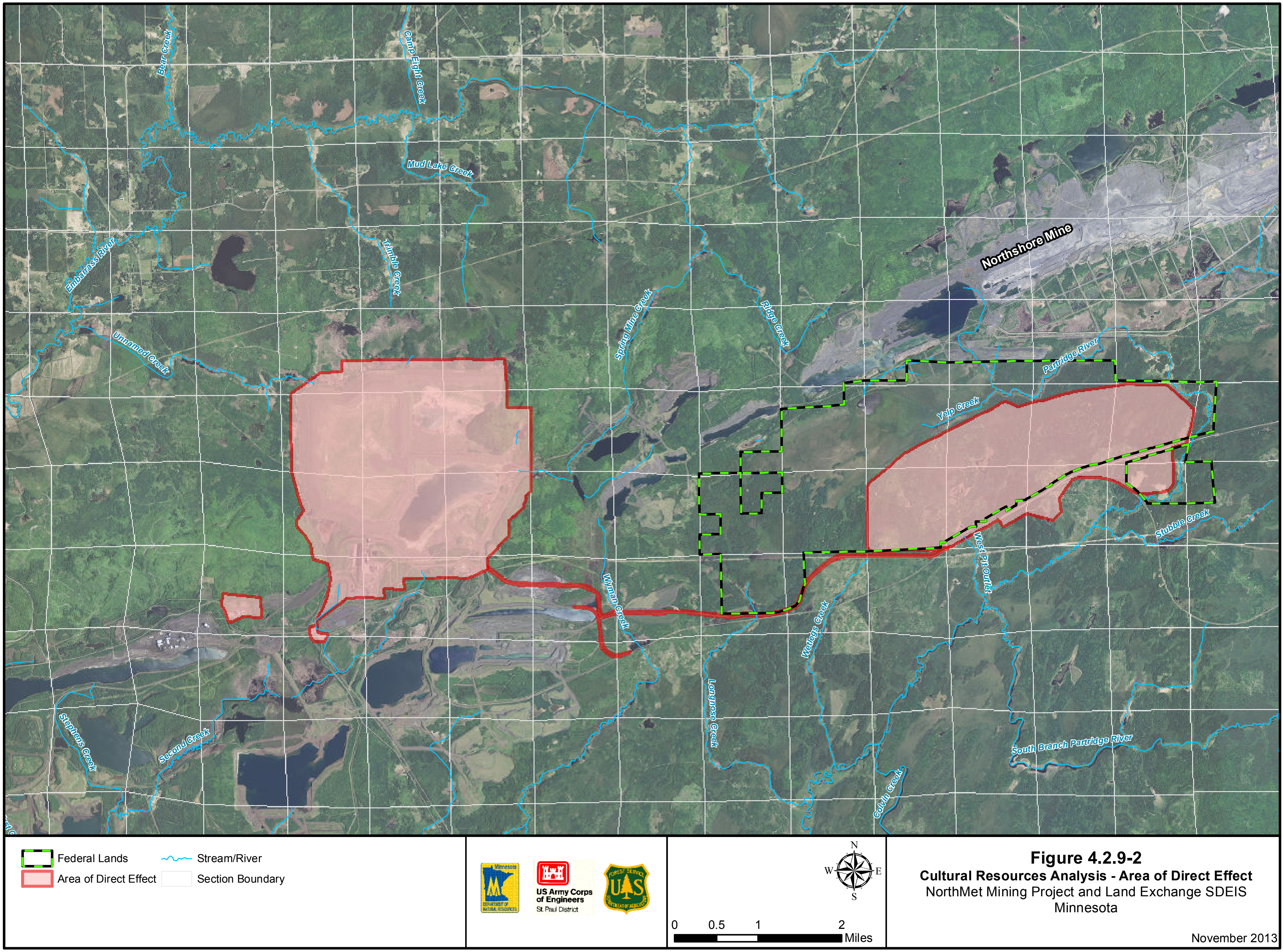

Figure 4.2.9-2

Cultural Resources Analysis - Area of Direct Effect

NorthMet Mining Project and Land Exchange SDEIS

Minnesota

November 2013

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In early 2009, the consulting Bands proposed the 1854 Ceded Territory as a historic property. Prior to that, the Bands reiterated their concerns about effects on water quality and quantity, for both surface water and groundwater. At that point in the NorthMet Project Proposed Action review, data were not available on which to reasonably extrapolate the APE. The result was an APE that included a large area inclusive of portions of the Partridge River and Embarrass River watersheds, extending down the St. Louis River to Lake Superior.

As consultation progressed with the Bands, it became apparent that further identification efforts were warranted. Supplemental field investigations focused on the areas around the proposed Plant Site and Mine Site. Since this initial effort, the Co-lead Agencies have received the results of water quality and quantity modeling. The APE has been revised based on these results.

The NorthMet Project Proposed Action would meet ambient air quality standards at the property boundary. Compliance with ambient air quality standards suggests that there would be no significant effects on vegetation or soils. Therefore, the property boundaries at both the Plant Site and the Mine Site are used to define the maximum extent of NorthMet Project Proposed Action air impacts that would have the potential to affect historic properties (see Section 5.2.7.2.3; Figure 4.2.9-3).

Within the property boundary, modeling shows where fugitive dust from the Plant Site, Tailings Basin, and Mine Site stockpiles is predicted to settle. Outside of these areas, modeling does not indicate potential effects on historic properties from dust deposition. Areas of fugitive dust deposition that extend beyond the property boundary would not exceed the ambient air quality standard (see Section 5.2.7.1.3). The intra-property APE for air is defined by these fugitive dust deposition areas (see Figure 4.2.9-4).

With the proposed design modifications and engineering controls, the water quality model predicts that the NorthMet Project Proposed Action would not cause or increase any exceedances of the groundwater and surface water quality evaluation criteria at the P90 level, with two exceptions: lead and aluminum. Water quality model results indicate that under the NorthMet Project Proposed Action, lead could exceed the evaluation criteria in Unnamed Creek and Trimble Creek north of the Tailings Basin. This would be a side effect of the reduction in surface-water hardness that would result from the capture and removal of dissolved solids by the WWTP and the associated decrease in the hardness-based lead standard. In fact, the lead-loading to these streams would decrease as a result of the NorthMet Project Proposed Action. Aluminum could exceed the evaluation criteria in Unnamed Creek, Trimble Creek, and Mud Lake Creek due to an increase in the proportion of non-contact surface water runoff with higher aluminum concentrations and due to flow augmentation during reclamation using water from Colby Lake with high concentrations of aluminum.

Changes to groundwater quantity due to groundwater drawdown resulting from mine pit dewatering are not predicted to occur beyond 3,200 ft from the mine pit (see Section 5.2.2.3.2). Therefore, this distance around the mine pit will define the APE for changes to groundwater quantity (see Figure 4.2.9-6).

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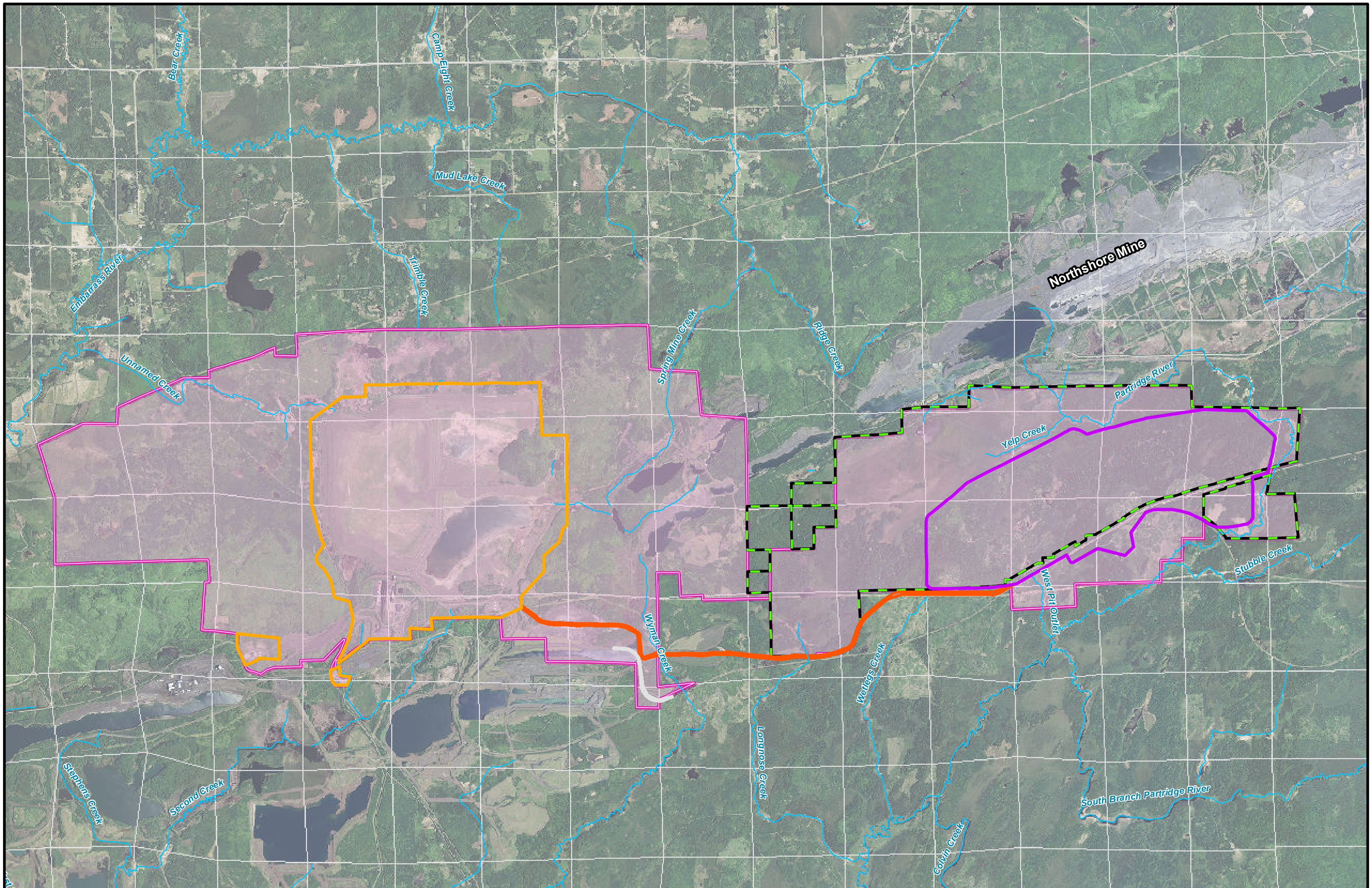

Federal Lands
Mine Site
Plant Site
Transportation and Utility Corridor
Railroad Connection
Stream/River
Section Boundary
Air Quality Area of Potential Effect

US Army Corps of Engineers St. Paul District

N W E S

0 0.5 1 2 Miles

Figure 4.2.9-3
Cultural Resources Analysis - Air Quality Area of Potential Effect
NorthMet Mining Project and Land Exchange SDEIS
Minnesota

November 2013

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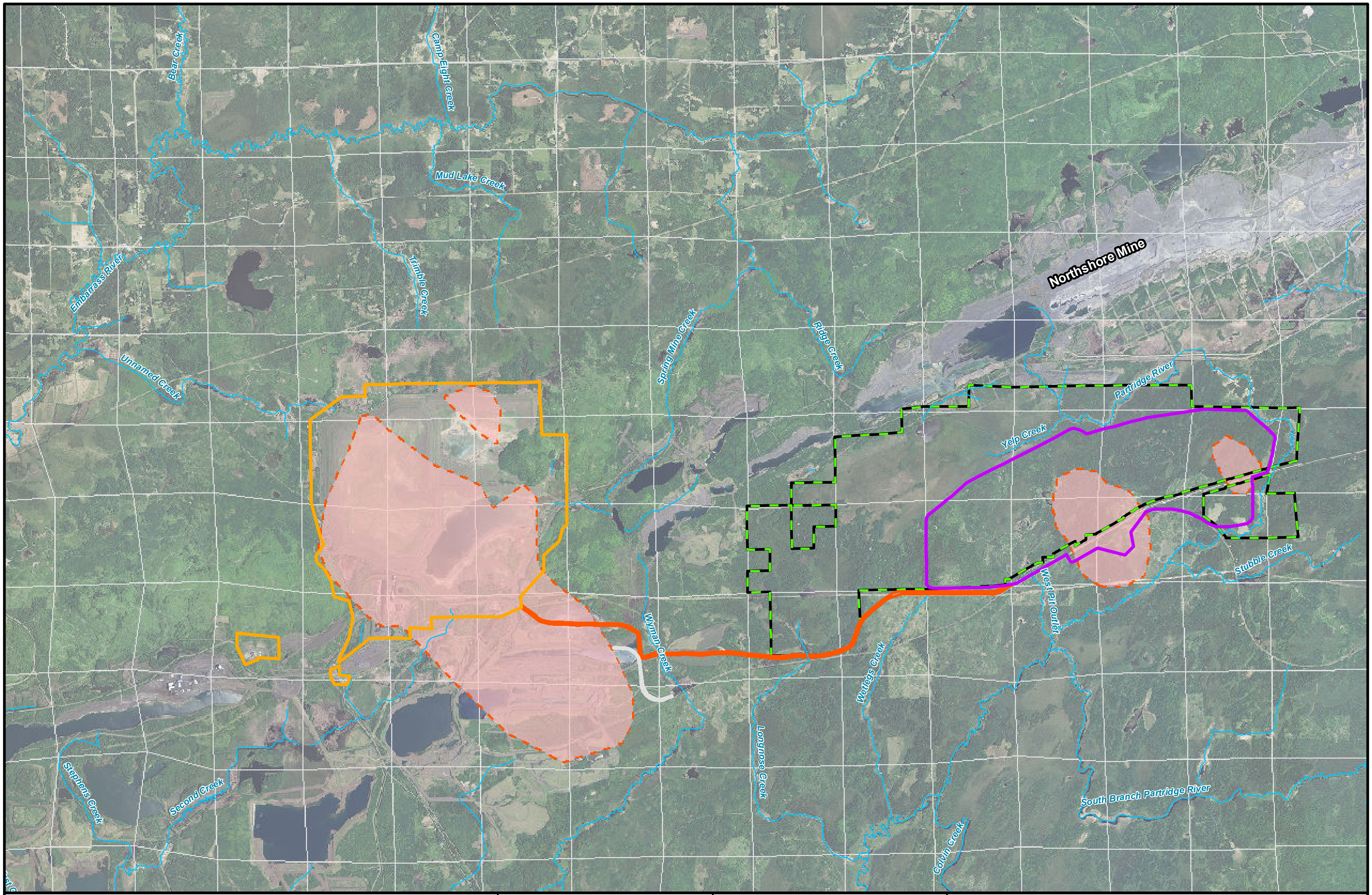

Federal Lands
Mine Site
Plant Site
Transportation and Utility Corridor
Railroad Connection
Stream/River
Section Boundary
Fugitive Dust Area of Potential Effect

US Army Corps of Engineers
St. Paul District

N
W E
S

0 0.5 1 2
Miles

Figure 4.2.9-4

Cultural Resources Analysis - Fugitive Dust Area of Potential Effect

NorthMet Mining Project and Land Exchange SDEIS

Minnesota

November 2013

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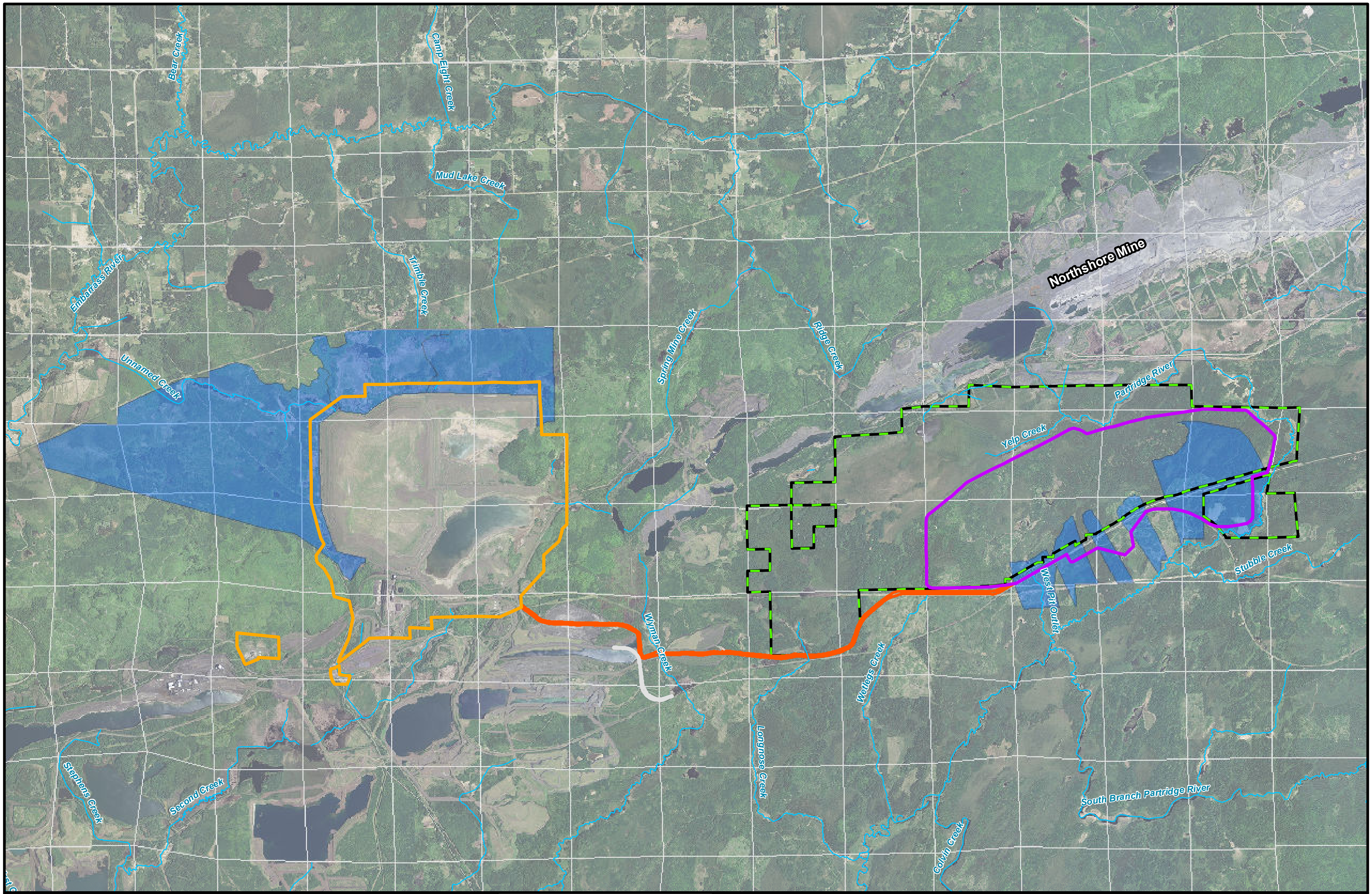

Federal Lands
Mine Site
Plant Site
Transportation and Utility Corridor
Railroad Connection
Stream/River
Section Boundary
Groundwater Quality Area of Potential Effect

US Army Corps of Engineers St. Paul District

0 0.5 1 2 Miles

Figure 4.2.9-5
Cultural Resources Analysis - Groundwater Quality Area of Potential Effect
NorthMet Mining Project and Land Exchange SDEIS
Minnesota

November 2013

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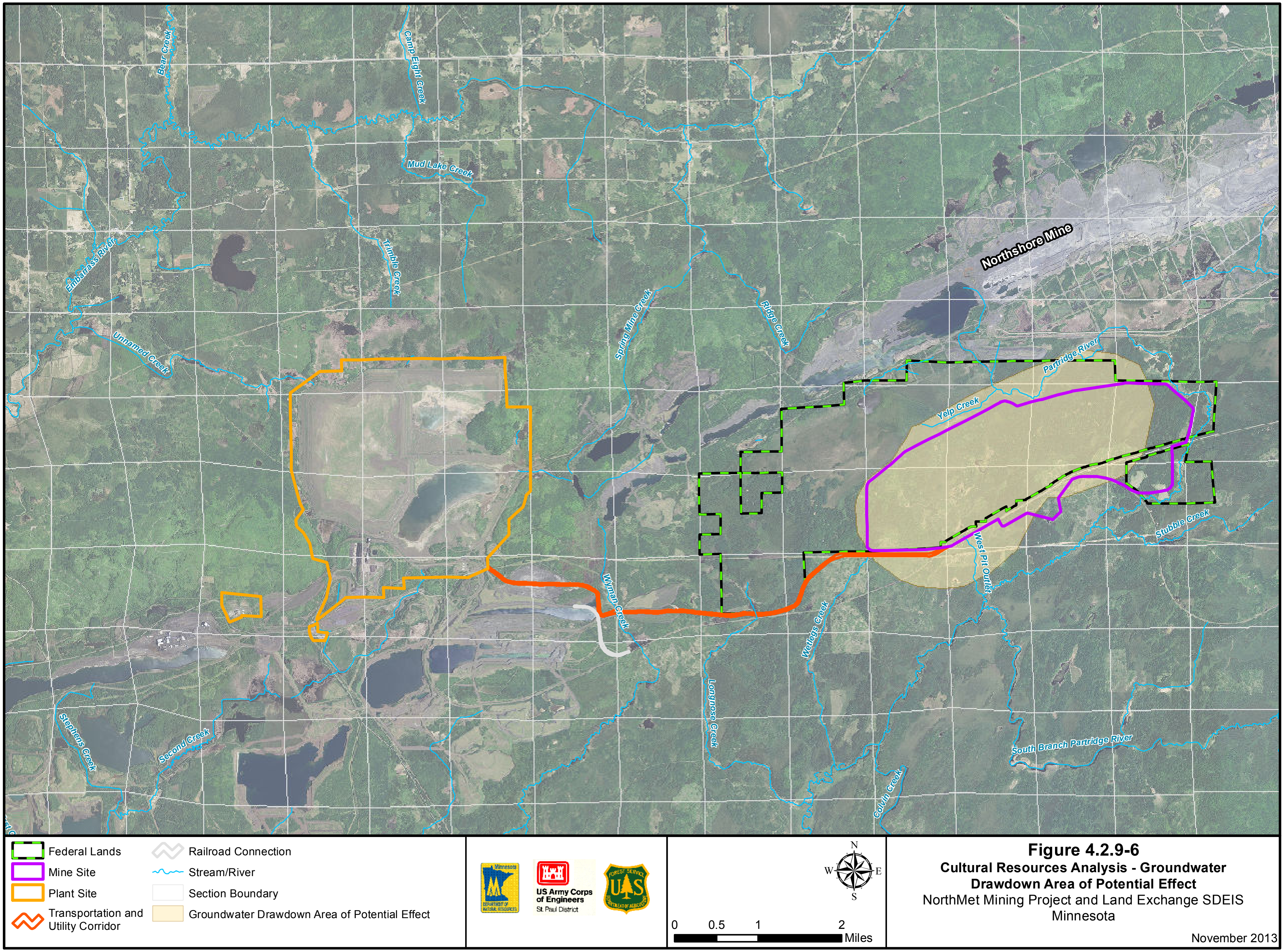

Figure 4.2.9-6

Cultural Resources Analysis - Groundwater Drawdown Area of Potential Effect

NorthMet Mining Project and Land Exchange SDEIS

Minnesota

November 2013

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The APE for visual effects was based on a cultural resource-specific analysis completed for the NorthMet Project Proposed Action by the USFS and USACE. At a distance of approximately 12 miles on a prominent landform (Skibo Scenic Overlook), the NorthMet Project Proposed Action stockpiles would be visible as a thin line on the horizon. The existing Plant Site buildings are visible from the same location. However, proposed construction at the Plant Site would not result in changes to the existing Plant Site profile visible in the distance. At intermediate distances between Skibo and the Mine Site, the elevations are lower and the Mine Site would not be visible. Therefore, the visual APE for the Mine Site is bounded by the crest of the Laurentian Divide (*Mesabe Widjiu*) and an area about 1 mile from the Mine Site on the eastern, western, and southern sides (see Section 5.2.11.2.2). The visual APE for the existing LTVSMC Tailings Basin at the Plant Site is not considered to be expansive, because the proposed Tailings Basin would be, for the most part, coincident with the existing basin and would not extend to an elevation higher than the existing LTVSMC Tailings Basin (see Figure 4.2.9-7).

To determine the combined noise effect of the NorthMet Project Proposed Action, the total noise generated from operations at both the Mine Site and Plant Site was added to the existing ambient daytime and nighttime baseline levels. Noise effects from rail transport were also assessed, but qualitatively. Blasting at the Mine Site would be a source of intermittent or non-continuous noise and vibration. Blasting noise is not included in the noise level estimates shown in the noise analysis because mine-blasting is typically an instantaneous event (not continuous or steady), and would occur only during daytime periods.

Operations at the Mine Site and Plant Site would occur 24 hours per day. The analysis showed total noise that would be experienced at any receptor location during the daytime (7 a.m. to 10 p.m.) and nighttime (10 p.m. to 7 a.m.) would be well below the Minnesota daytime and nighttime noise standards. In all cases, the NorthMet Project Proposed Action, when mining, hauling, and ore-crushing operations occur, would comply with the applicable Minnesota noise standards.

More specific information on noise-related effects is included in Section 5.2.8, for effects on humans, and Section 5.2.5, for effects on wildlife.

Identification of Historic Properties

The SHPO maintains the official inventory of historic properties in Minnesota, as specified in the NHPA and *Minnesota Statutes* 138.081. This inventory is physically housed in two separate sets of files: the History/Architecture files contain records of buildings, structures, and landscapes, and the Archaeological Site files contain records of archaeological sites. A review of SHPO and USFS files and all previous cultural resources studies was conducted for the area covered by the APEs.

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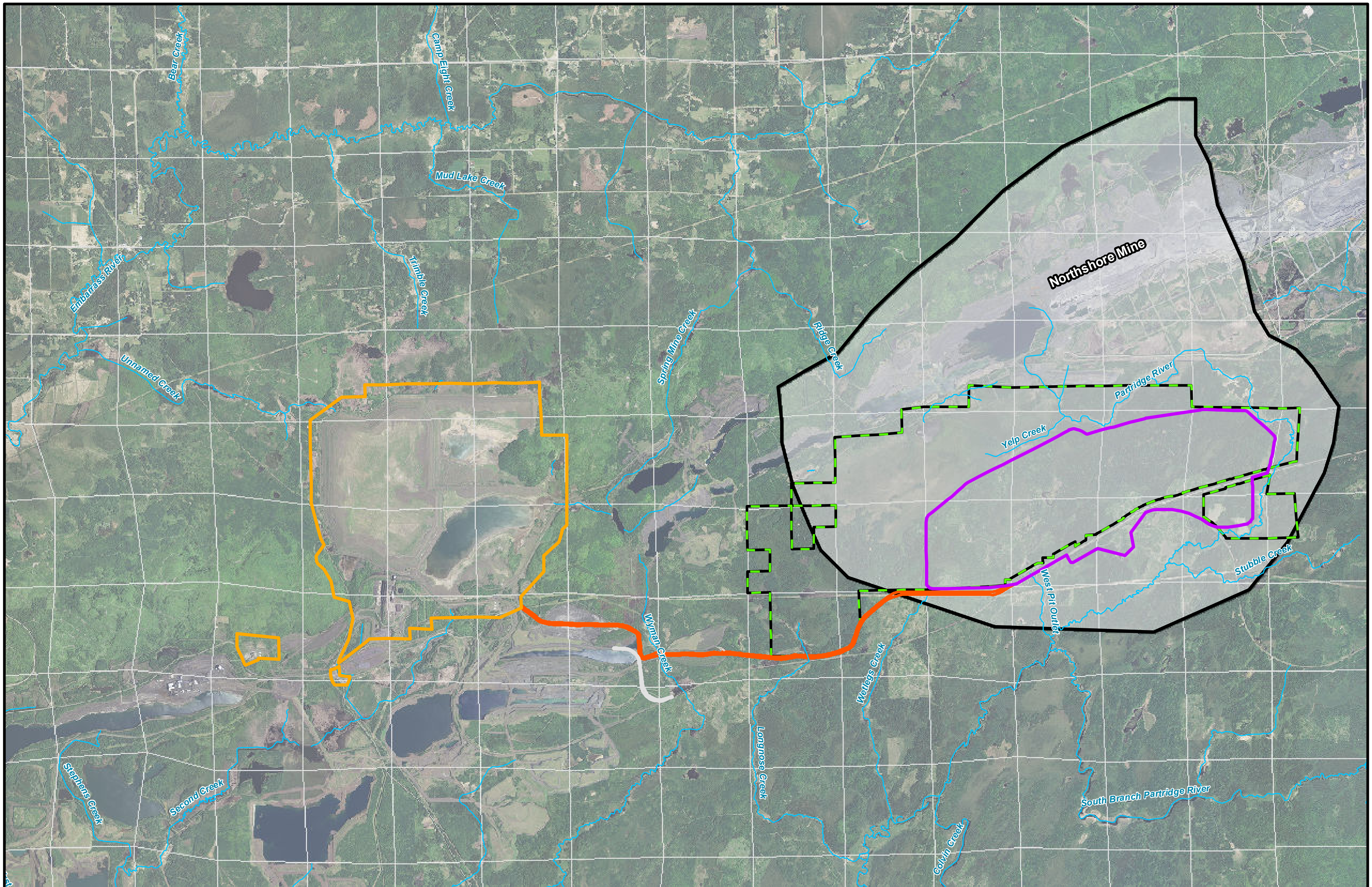

Federal Lands
Mine Site
Plant Site
Transportation and Utility Corridor
Railroad Connection
Stream/River
Section Boundary
Visual Area of Potential Effect

US Army Corps of Engineers St. Paul District

0 0.5 1 2 Miles

Figure 4.2.9-7
Cultural Resources Analysis - Visual Area of Potential Effect
NorthMet Mining Project and Land Exchange SDEIS
Minnesota

November 2013

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Cultural Context

This section provides a basis for understanding the identification and evaluation of historic properties as it relates to existing conditions. An emphasis is also placed on understanding Ojibwe history and traditions because of a greater emphasis on environmental effects and their potential to affect resources of importance to the Bands. This section provides sufficient context to understand the process of identification and evaluation of historic properties of religious and cultural significance to the Bands.

Paleoindian (Circa 13,300 to 9,000 Before Present)

The earliest evidence for human occupation in North America is referred to as the Paleoindian Period. The beginning of this period largely coincides with the transition from the Pleistocene to the Holocene about 11,700 years before present (BP), which marks the transition out of the last glaciation. The Paleoindian Period spans from about 13,300 to 9,500 BP and is generally associated with finely made fluted, lanceolate-shaped projectile points.

This was a period of rapid environmental change as the climate was warming. The ice probably began to retreat about 17,000 BP and, by 9,000 BP, had largely retreated to the Hudson Bay Lowland. Thinning of the ice allowed changes in atmospheric circulation patterns, further affecting climate change (Teller 1987:61).

Proglacial lakes formed from the meltwater of the ice sheets as its flow was blocked by vast amounts of glacially deposited sediment at the terminal positions of the ice. As the ice continued its retreat, the outlets to the glacial lakes down-cut, lowering lake levels and developing well-defined drainage ways, leading to rapid hydrologic change. Areas where stagnant blocks of ice were buried in glacial sediment developed spruce forests on them and persisted for thousands of years.

The people during this time lived in a subarctic environment that has no direct analogue in the world today. The animals of this environment included mammoths, giant bison, and other now-extinct species. In ice-free areas during this early period, there were variations of fluted, lanceolate-shaped projectile points, as found on archaeological sites. The first published discovery of these projectiles in association with mammoth and an extinct form of bison occurred at archaeological sites in New Mexico.

These early people are thought of as highly mobile big-game hunters who traveled in small bands. Tools were light, efficient, and remarkably similar across great distances (Mason 1981), which suggests that there was a rapid spread of people across the continent at that time.

Radiocarbon dates on mammoth bone collagen and wood associated with stone tools place people in the southeast Lake Michigan Basin by at least 12,500 BP. In Minnesota, the lack of excavated or recorded early Paleoindian sites makes it difficult to identify site types or assess their distribution across the landscape. The known sites appear to be oriented toward the current waterbodies, but that may reflect survey coverage as opposed to actual site distribution. The small number of sites suggests there was a small population in Minnesota or that a large number of sites were destroyed or were deeply buried as the landscape evolved (Mather and Lindbeck 2011).

The late Paleoindian Period is better represented in Minnesota and adjacent parts of Canada. Sites on paleo-shoreline features of proglacial lakes in the Great Lakes region are a well-documented aspect of early settlement patterns such as at the Lakehead Complex sites at Thunder Bay, Ontario dating to roughly 9,500 BP; sites on the Campbell beaches of Lake Agassiz in the Quetico Provincial Park and Boundary Waters Wilderness Area (Julig et al. 1990); and on a beach ridge of Glacial Lake Aitkin in Aitkin County (Allen 1993). Julig suggests that the beach ridges may have been used for travel routes around the large glacial lake basins (Julig 1988; Julig et al. 1990).

The Reservoir Lakes northwest of Duluth are well-known for extensive surface collections that include Late Paleoindian and Archaic Points (Harrison et al. 1995). Dates from the Bradbury Brook site in Mille Lacs County place the site occupation at about 10,000 to 9,000 BP (Malik and Bakken 1993:88).

The Bradbury Brook investigation and analysis of other late Paleoindian assemblages suggest a preference for the use of Knife Lake Siltstone, which is a preference that may extend to much of northeast Minnesota and is reflected in the collections from the Reservoir Lakes.

Archaic (Circa 9,000 to 2,500 Before Present)

By 9,000 BP, climatic conditions were probably similar to that of present day, as inferred from the pollen record (Wright 1974). Around 9,400 BP, Lake Superior was dropping rapidly from its Minong levels (Julig et al. 1990) and by 9,000 BP, Lake Agassiz was retreating northward.

At the beginning of this period, lakes covered substantially larger areas and open water would have occupied areas of present day peatland (Hohman Caine and Goltz 1995). Water levels in the larger pro-glacial lakes receded as streams developed and down cut their outlets. As post-glacial warming continued, hydrology and vegetation changed. About 7,000 years ago, much of Minnesota was dominated by prairie and lakes may have periodically dried up during summer droughts (Wright 1974; Watts and Winter 1966; Webb et al. 1983). With changes to the composition of plant communities and shifts in the ranges and varieties of animal species, human adaptations to the environment changed, as well. Moose and caribou were probably replaced by bison in many locations.

Less predictable resources during the mid-Holocene may have resulted in populations concentrating in areas around the largest lakes and streams (Mason 1981) and a shift from a foraging to a collector strategy, with greater use of local environments as task groups ranged from camps located near predictable resources (Hohman Caine and Goltz 1995; Dobbs 1989).

The Itasca Bison Kill Site is an Early Archaic site located at the headwaters of the Mississippi River. It is the only archaeological site in Minnesota where the remains of extinct bison (*Bison occidentalis)* were found in association with cultural material. The bison were killed on the shore of a now-extinct lake. Radiocarbon dates suggest the site dates to about 8,000 years ago. Pollen and macrofossils preserved at the site indicate that the surrounding countryside was an open, pine-dominated woodland giving way to expanding prairie (Shay 1971).

Early Archaic sites in the Canadian-Shield/boreal forest areas are somewhat rare when compared to areas south of the Great Lakes (Mason 1981). The lack of Archaic sites was striking in the results of an archaeological survey on Rainy Lake (Gibbon and Woolworth 1977). In general, the Shield Archaic assemblages lack the complexity found in other regions. Assemblages do include some woodworking tools such as trihedral adzes.

The Shield Archaic is a cultural tradition showing in place continuity over thousands of years with late Paleoindian antecedents as opposed to an intrusion of new people. It appears to be a gradual succession of individual small-scale adaptations to new conditions (Mason 1981; Dobbs 1989).

Population levels during the mid-Holocene may have been lower than those during the late Paleoindian period, because the closed, coniferous forests would have been relatively resource poor (Mason 1981). The lack of recorded sites may be the result of large portions of the archaeological record for this period being submerged as lake levels rose to modern levels, being deeply buried under alluvial sediment, or eroded as stream flows changed (Michlovic 1982; Bettis and Thompson 1981; Overstreet and Kolb 2003).

Woodland Tradition (Circa 2,500 Before Present to European Contact)

This stage in prehistory is characterized by the initial appearance of earthen mounds and ceramics, although it is not certain if mound-building and the adoption of ceramics are related and occur at the same time. The most important cultural trends during this time are increasing population growth, intensification of regional identity, increasingly efficient use of local raw materials and food resources, and the intrusion of ideas and technologies. Dobbs (1989) suggested that, in northern Minnesota, ceramic use seems like more of a “veneer” that overlays a basic Archaic hunting and gathering lifestyle.

Initial Woodland populations in northern Minnesota are represented by a net-impressed ceramic type known as Brainerd Ware, which spans a period of from about 3,000 BP to 1,600 BP. The distribution of Brainerd Ware is well-known in the Mississippi River headwaters, extending west onto the plains. Brainerd Ware is also represented on some sites in St. Louis County (Hamilton 2009; Hohman Caine and Goltz 1995). Mather and Lindbeck (2011) suggest that this development occurred roughly at the same time wild rice was migrating from the lakes of southern and central Minnesota into the lakes of northern Minnesota. Residue from Brainerd vessels has produced rice phytoliths and radiocarbon dates of 2,000 years ago (Justin and Thompson 1995) and 2,700 BP to 2,800 years ago.

Many of the Brainerd sites are found on beach ridges associated with higher lake levels of this period. The remains of elk, bison, deer, and possibly caribou from a site near Leech Lake suggest the people who made Brainerd Ware were highly adapted to the prairie-forest ecotone (Hohman Caine and Goltz 1995).

The first burial mounds in northern Minnesota are associated with the Laurel Culture (Arizigian 2008). While the cultural relationship between Brainerd and Laurel is poorly understood, radiocarbon dates suggest that Brainerd precedes Laurel. Laurel dates range from 2,000 to 1,000 years ago. At the Big Rice site north of Virginia, wild rice grains were recovered from three pit features containing only Laurel ceramics and produced radiocarbon dates of about 2,035 to 1,700 years ago (Valppu and Rapp 2000).

In stylistic terms, Laurel is comparable to other woodland manifestations to the south and east. Laurel distribution is extremely broad, extending from west-central Quebec to east-central Saskatchewan, including northern Minnesota, where it is common in the Superior National Forest (Hamilton 2009). The best-known concentrations of Laurel occur in the Rainy River, Rainy Lake, and Vermilion River drainages and the Mississippi headwaters (Arizigian 2008).

Extensive surveys in Voyageurs National Park and the Superior National Forest have identified numerous Laurel sites, with 94 percent of those sites in the MDNR Laurentian Mixed Forest province and concentrated in the Border Lakes subsection of the Northern Superior Uplands. Most sites are in lacustrine settings (lakeshore, islands, and peninsulas), less than 20 percent are in riverine settings, and only 3 percent are in uplands.

During the Terminal Woodland, there are increases in site size and density, suggesting a population increase. The period begins in northern Minnesota, with the Blackduck-Kathio-Clam River cultures comprising stylistically similar ceramics. Kathio ceramics are primarily from the central lakes area of Minnesota, and Clam River ceramics are found mostly on tributaries to the St. Croix River in western Wisconsin. Early Blackduck begins about 1,400 years ago in the Mississippi headwaters and on the Rainy River, ending about 900 to 1,000 years ago.

The stratigraphic relationship of Blackduck ceramics to Laurel and the later Sandy Lake Ware is fairly well-known. Laurel and Blackduck may have coexisted for several hundred years. There have been no well-stratified sites excavated with components transitional between Laurel and Blackduck (Shaaf 1978) and it is unclear whether Blackduck represents in situ evolution of Laurel (Thomas and Mather 1996) or the replacement of Laurel by a separate group of people (Stoltman 1973).

The most recent pre-contact archaeological culture in northern and central Minnesota is the Psinomani, dating from 900 to 360 years ago. It is associated with Sandy Lake and Ogechie ceramics. Sandy Lake ceramics are similar to other woodland ceramic types throughout North America, but Ogechie ceramics are most similar to Oneota ceramic types produced by the agricultural communities to the south. These groups were north of areas where corn agriculture was practiced successfully, particularly on major lakes and waterways of the Mississippi River headwaters: the Rainy River – Rainy Lake, and Boundary Waters systems and eastward to Lake Superior, with some sites in the prairie region to the west. The larger site size and greater population density is often attributed to the use of wild rice, but evidence also suggests use of the prairie forest ecotone and prairie, which includes seasonal bison hunts. The differences in the archaeological assemblages in the prairie region versus the central lakes area may represent the seasonal round, as opposed to different subsistence strategies.

Psinomani archaeological sites in the Mille Lacs area have been linked to the historic Mdewakanton Dakota through early historic records and artifact assemblages that include French trade goods.

In the Mille Lacs area, the end date for the Psinomani is based on the historic record for the displacement of Dakota people by the Ojibwe in 1750 AD. In the Rainy River area at the Long Sault Site, Sandy Lake pottery was found in association with historic trade goods, overlying a Blackduck component that dated to 1750 AD. At the Creech site on Leech Lake, there were levels with both Sandy Lake and Blackduck stratigraphically above levels containing only Blackduck ceramics (Johnson 1991) and at Mitchell Dam, Sandy Lake was described as associated with Blackduck (Cooper and Johnson 1964).

The practice of these Eastern Woodland lifeways was disrupted during the mid-17th century as European explorers and trade goods began to enter the region.

Ojibwe Context

The Ojibwe people were living in the upper Great Lakes region when European explorers first entered the area. Some archaeologists associate Blackduck ceramics with the Algonkian-speaking groups, including the Cree and Ojibwe (Johnson 1969; Steinbring 1980), while others have suggested association with Siouan-speaking Assiniboine. More recently, archaeologists believe that the makers of Blackduck ceramics were most likely Algonkian speakers, but the ethnic divisions of Cree and Ojibwe are historical constructions with little validity in prehistory (Greenberg and Morrison 1982).

The ancestral Ojibwe were part of a large clan-based group of people that referred to themselves as Anishinabe (original people). This Algonquian-speaking group was spread over a vast area of the subarctic region of southern Canada and the northern United States, a territory much larger than that of any other Native American tribe in North America (Tanner 1986).

Subsistence patterns depended, to some extent, on the location any one particular group inhabited and varied greatly across the territory occupied. The groups were not connected by a uniform subsistence base, but by a clan network. These clan groups were seasonally mobile, autonomous groups for centuries prior to the arrival of Europeans in North America. The earliest accounts talk of a number of distinct, but related groups, such as the Saulteur, the Outchibou, or Marameg (Tanner 1994). These people became known as “Ojibway” after the publication in 1885 of William Warren’s *History of the Ojibway People* (Warren 1984).

Their story starts prior to arrival of Europeans in North American, when the Anishinabe were living along the eastern seaboard. It was during that time, according to the Anishinabe sacred migration story, that a man beheld a vision from the Creator that foretold of the destruction of the Anishinabe and called on them to move west until they found the place “where food grows on the water:”

> While we were on the east coast, a man had a dream or a vision if you will. In this dream, he was told a number of things. The first was, he was to leave the area and take as many people as would go with him. The second was, if people did not leave many would perish. The third was, to travel towards the west and to follow the great megis shell when it rose out of the water, or sand, and to stop when it lowered back into the water, or sand, or if something reminded them of a turtle. The fourth was that their journey would end when they found the food that grows on water.
>
> He left with many following him, and went down the St. Lawrence River and waterways that led to the Great Lakes area. While in the central part of the Great Lakes area, two peoples split off from us. They are the Potawatomi and the Ottawa, who went into Canada, Michigan, and Wisconsin. The Anishinabe continued on to the edge of Lake Superior. Once we came inland, we never saw the megis shell again. This journey took over five hundred years and the prophecy that was told while we were on the east coast was kept alive orally from generation to generation by traditional storytelling. On our journey, we stopped seven times, sometimes for five days, sometimes for five years, it all depended on the megis shell. (Berens and Raske, Pers. Comm., August 14, 2012)

Pressures from European trade and from their Iroquois neighbors are often cited as motivation for this move (Risjord 2005). However, this explanation for westward migration is a Euro-

American perspective and contrary to oral history (Berens and Raske, Pers. Comm., August 14, 2012).

Anishinabe oral tradition relates a 500-year journey, beginning in about 900 AD on the east coast. Near the end of this journey, the fifth of the seven stopping places was at Sault Ste. Marie, where a group stayed because of the rich fisheries. From Sault Ste. Marie, the Ojibwe split into two groups. One traveled north around Lake Superior and the other south around the lake. They met at Spirit Island in the St. Louis River Estuary, the sixth stopping place, where they found wild rice.

From Spirit Island, some moved east along the southern shore of Lake Superior to find the seventh stopping place, which was at Madeline Island—the last point on the migration.

Perhaps because the last part of the migration occurred during the time of European explorations, early accounts of settlement locations and how they relate to the migration and first arrival in the western Great Lakes are difficult to interpret. Oral tradition places the Ojibwe in the Lake Superior region as early as 1400 AD (Benton-Banai 1988:102). Other sources place the Ojibwe on the north shores of Lake Superior and the Upper Peninsula of Michigan by 1500 AD (Clifton et al. 1986).

The first known encounter with Europeans was at Sault Ste. Marie in 1609, when Samuel Champlain, founder of New France, established relations, intending to set up trading partnerships. As the Ojibwe began to focus on trapping for furs to trade, the once-autonomous bands reorganized into village-centered sociopolitical entities. This was an important demographic consequence of French influence and endemic native wars. Villages were established along the southern shore of Lake Superior in Keweenaw Bay, La Point, and Sault Ste. Marie, and probably represented only a fraction of the population dispersed across the Western Great Lakes and interior waters (Zedeño et al. 2001).

As the fur trade gained momentum in the east, increased conflict resulted as the beaver supply was being exhausted. In the mid-1600s, the British-allied Iroquois pushed the Huron out of their land and into the Tionontati, Erie, and Ottawa regions, which also affected the Ojibwe presence at Sault Ste. Marie. Subsequently, throughout the early 1700s, many groups moved into areas previously vacated because of the Iroquois threat. The Fox began an aggressive campaign against the French in the Detroit area, who were thought to prevent the Fox from carrying on trade with the Dakota. The Fox and the Dakota were allied in their interests in Plains resources. The Ojibwe went to the aid of the French as a sign of their loyalty. The final battle between the Fox and the Ojibwe was fought at St. Croix Falls in 1755. The Ojibwe conflict with the Fox had affected Dakota-Ojibwe relations.

After the second Treaty of Paris in 1783 sealed the victory of the American Revolution, the new Americans felt that the land ceded to them in the treaty included the land where the Ojibwe and other Great Lakes tribes lived (Tanner 1986). Warfare between the Ojibwe and the Dakota made merchants extremely cautious of moving to land west of Michigan (Hickerson 1970). In order to end continuing land disputes between the Ojibwe and the Dakota, and secure a peaceful frontier for settlers, the United States encouraged the signing of the 1825 Treaty. The treaty defined boundaries of land owned by the Ojibwe (Kappler 1904).

As more settlers pushed into the Lake Superior region in search of timber and minerals, the United States government bought land from the Ojibwe through cession treaties. The Treaty of

1836 ceded land in Michigan's Upper and Lower Peninsulas and parts of the Great Lakes, and the Treaty of 1837 ceded land in north-central Wisconsin and east-central Minnesota. The Treaty of 1842 ceded land in northern Michigan and Wisconsin and the western part of Lake Superior; and the 1854 Treaty ceded land in northeastern Minnesota, and created reservations for many Ojibwe bands. These treaties reserved the rights of the Ojibwe to hunt, fish, and gather on lands they sold to the United States (Kappler 1904).

History of the Iron Range

Minnesota became the thirty-second state in 1858, which spurred an ever-increasing flow of European-American settlement and the establishment of towns, cities, and enterprises other than fur trade (Mason 1981). Wheat surpassed corn as the principal crop in 1860, with much of it being exported out of state. White pine and red pine were sought after by loggers, and were harvested in the Fort Snelling area as early as 1820. By 1870, there were 207 saw mills in Minnesota. In 1877, a law allowing sale of timber off state lands further opened the state for logging. The logging boom had tapered off by the early 1900s (Risjord 2005).

In 1865, the newly appointed Minnesota state geologist, Augustus Hanchett, with the help of his assistant, Thomas Clark, issued a report generally describing copper ore deposits in the Lake Superior area and iron ore deposits at Lake Vermilion (Hanchett and Clark 1865). The following year, Henry H. Eames replaced Hanchett as state geologist and issued a report confirming the presence of gold ore around Lake Vermilion, creating a short-lived Minnesota gold rush during which other Minnesota ores were ignored (Lamppa 2004). Discovery of iron ore in the Vermilion Range led the Pennsylvania industrialist Charlemagne Tower to buy large tracts of land on the Vermilion Range. In 1882, Tower organized the Minnesota Iron Company and, by 1884, shipped the first ore from the Soudan Mine by rail on the company's Duluth and Iron Range Railroad to Lake Superior (Risjord 2005).

The Merritt Brothers of Duluth laid groundwork for their Mountain Iron Mine through their explorations during the 1890s (Minnesota Historical Society 2008). Up to that point, only the far-eastern portion of the Mesabi Range had been mined for iron, and not on a large commercial scale, with mostly hand tools being employed (Walker 1979; Atkins 2007). They opened their second mine in 1891 near Biwabik. By 1892, they shipped their first carload of ore on their Duluth, Missabe, and North Railroad to dock in Superior, Wisconsin (Minnesota Historical Society 2008). A loan from John D. Rockefeller to the Merritts to expand the railroad ultimately led to the transfer of all of their mining and rail properties to Rockefeller. Shortly thereafter, all of the mining interests in Minnesota were owned by eastern interests, with J.P. Morgan consolidating the Rockefeller and Carnegie holdings in 1901 under U.S. Steel (Risjord 2005).

By 1890, when the Mesabi Iron Range deposits were discovered, nearly 300 iron mining companies had been incorporated in Minnesota. By 1900, the Mesabi Range was the most extensive iron ore mining area in the world, supplying increasing demand by steel mills throughout the Great Lakes states (Hall 1987). Early mining ventures in the Mesabi Iron Range focused on hematite, a soft granular rock rich in iron that could be mined with steam shovels and required limited processing. More than 95 percent of the iron deposits in the Mesabi Range consist of taconite, a hard iron-bearing rock that must be pulverized and processed for mineral extraction (Risjord 2005).

In the late 1920s, increased mechanization reduced the number of workers needed and increased productivity. However, due to the Great Depression, iron ore production in the Iron Ranges dropped dramatically by the early 1930s (Lamppa 2004). A cost-effective technology for taconite processing was developed by the late 1930s. Taconite mining was made even more economically feasible by two factors: 1) legislation passed in 1941, replacing property taxes within the Iron Range with taxes on actual ore mined, and 2) increased demand due to World War II. The Reserve Mining Company was formed in 1942 (Risjord 2005). In 1964, when interest in taconite pellet use in steel manufacture prompted interest in increasing taconite pellet production, an amendment was passed that guaranteed that the tax advantages of the 1941 taconite legislation would be maintained (Lamppa 2004).

In 1957, the Erie Mining Company opened its concentration plant at Hoyt Lakes. This plant was Minnesota's second large-scale taconite plant, and it remained in operation through 2001, with a change in ownership to LTVSMC in the 1980s, and then to Cleveland Cliffs in 2001 (Zellie 2007). While six new taconite plants were built on the Iron Range in the 1960s and '70s, inexpensive imports changed the industry and decreased demand by two-thirds (Risjord 2005).

Cultural Resources Investigations

Several cultural resources studies have been completed within or adjacent to the NorthMet Project and Land Exchange areas (see Figure 4.2.9-8). This section presents previous investigations that have been conducted prior to the development of the NorthMet Project Proposed Action, as well as investigations conducted specifically for the NorthMet Project Proposed Action.

Previous Investigations

In 1985, the USFS conducted a Phase I cultural resources survey as part of the Yelp Lake Timber Sale (USFS 1985). The survey consisted of a desktop review of historical aerial photographs and pedestrian reconnaissance survey of manmade features such as clearings, roadways, and trails, as well as landforms exhibiting the potential for containing archaeological sites. Overall, the area was considered to have low potential for containing prehistoric and historic archaeological sites, as well as architectural structures. During the Phase I cultural resources survey, one historic period resource (09-09-01-115) was identified. The resource was only described as being related to the historical railroad and logging context and does not fall within the current NorthMet Project or Land Exchange areas.

In 1990, the USFS conducted a Phase I cultural resources survey as part of the Stubble Creek Timber Sale (USFS 1990). The survey consisted of a desktop review of historical aerial photographs, helicopter flyover, and pedestrian reconnaissance survey of manmade features such as clearings, roadways, trails, and structures, as well as landforms exhibiting the potential for containing archaeological sites. Overall, the area was considered to have moderate potential for containing historic archaeological sites and architectural structures and a low potential for containing pre-contact archaeological sites, with the exception of areas adjacent to the Partridge River. During the Phase I cultural resources survey, no previously recorded cultural resources were noted within the NorthMet Project area; however, three new cultural resources were identified (09-09-01-362, 09-09-01-363, and 09-09-01-364). All three resources are associated with the historic period, though the report is unclear as to whether these resources are archaeological sites, standing architectural structures, or both. The North Partridge Camp

(09-09-01-362) and the Stubble Creek Mill (09-09-01-364) were not evaluated and the South Branch Bridge (09-09-01-363) was recommended not eligible. None of these resources fall within the current NorthMet Project or Land Exchange areas.

In 1997, the USFS conducted a Phase I cultural resources survey as part of the Laird/LTV II Project (USFS 1997). The survey consisted of a desktop review of historical aerial photographs, helicopter flyover, and pedestrian reconnaissance survey of manmade features such as clearings, roadways, and trails, as well as landforms exhibiting the potential for containing archaeological sites. During the Phase I cultural resources survey, no new cultural resources were identified; however, five previously identified cultural resources were noted. None of these five previously identified resources fall within the current NorthMet Project or Land Exchange areas.

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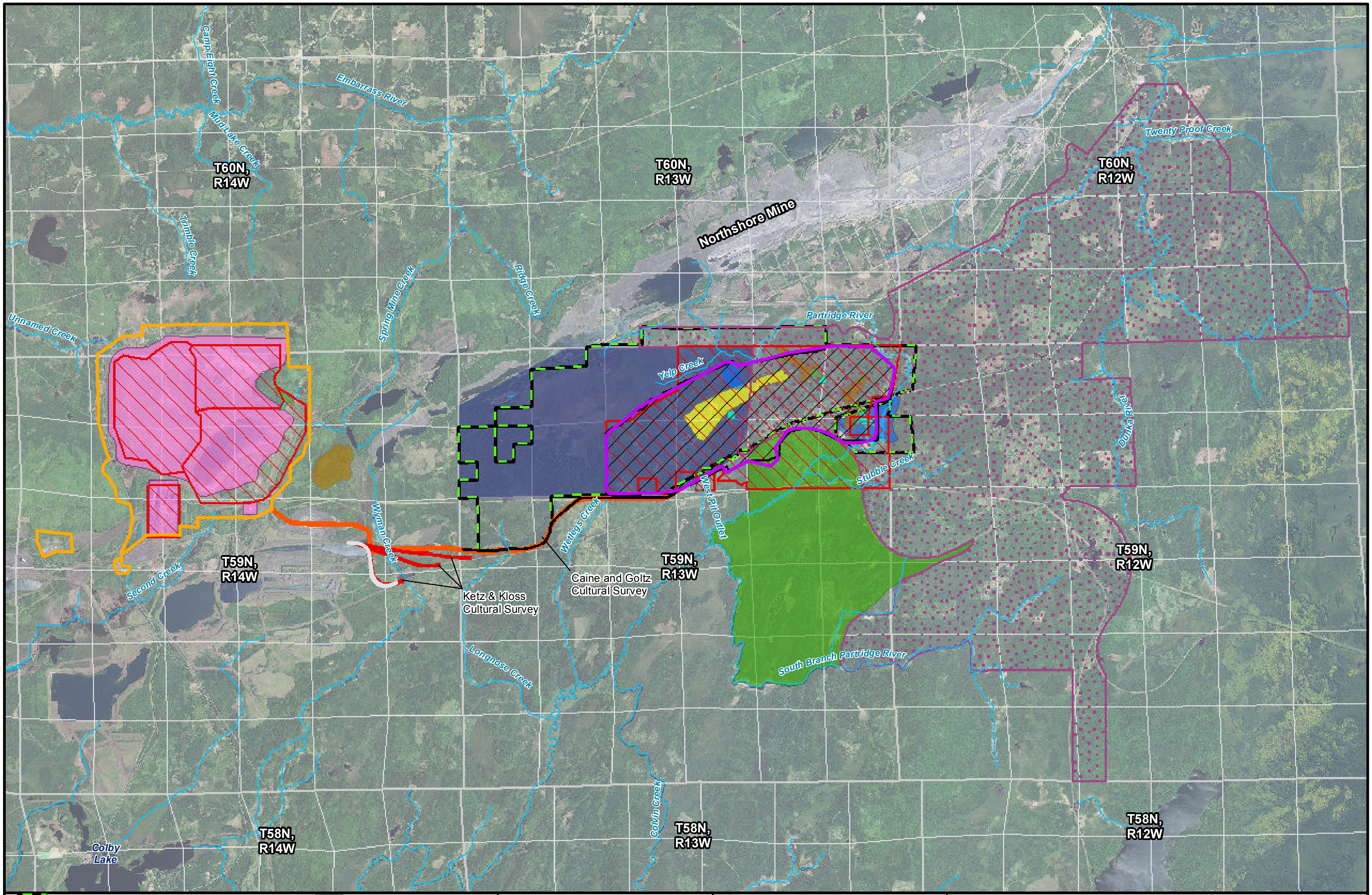

Federal Lands
Mine Site
Plant Site
Transportation and Utility Corridor
Railroad Connection
Stream/River
Section Boundary

Previous Cultural Survey

Caine and Goltz 2006; 2008
Ketz & Kloss 2004
USFS 1997
USACE 2010
USFS 2012
USFS 2011
USFS 1985
USFS 1990
Foth and Van Dyke 1999
Zellie 2007

N E S W

0 0.5 1 2 Miles

Figure 4.2.9-8
Cultural Resources Analysis - Previous Investigations
NorthMet Mining Project and Land Exchange SDEIS
Minnesota

November 2013

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Investigations Conducted for the NorthMet Project Proposed Action

In 1999, Foth and Van Dyke completed a Phase I archaeological survey within the proposed Mine Site where exploratory drilling was to take place (Foth and Van Dyke 1999). The survey area covered approximately 20 acres. The Phase I archaeological survey involved the excavation of 166 shovel tests placed at 15-meter intervals along the proposed drilling transects with exception to areas exhibiting standing water or exposed bedrock. No new or previously identified archaeological resources were identified within the survey area; however, the literature review portion of the investigation indicated that three historic logging camps (including the Knot Camp Site) and a mill were located to the south and east of the proposed Mine Site.

In 2004, The 106 Group Ltd (106 Group) conducted a cultural resources assessment for the NorthMet Project Proposed Action (Ketz and Kloss 2004). The assessment included the lease area (an area approximating the Mine Site), the former LTVSMC processing plant, the Tailings Basin, and three proposed railroad interconnection alternatives. The 106 Group found that no pre-contact archaeological sites had been previously identified within the 2004 study area. It was also concluded that the pre-contact archaeological potential for most of the study area is poorly understood, but likely of low potential. However, several upland areas located adjacent to the Partridge River and large wetland complexes were considered to have high potential for pre-contact archaeological resources. The 106 Group noted the presence of one previously reported (not field-verified) historic archeological site, the Knot Logging Camp (21SLmn), as well as the potential for two early historic Native American trails as noted on historical maps (Ketz and Kloss 2004; Trygg 1966). The 2004 study also identified several architectural history resources associated with the former LTVSMC processing plant. These resources include the former Erie Mining Company Taconite facility and associated mining features including an associated rail line. The 106 Group recommended that a Phase II architectural history evaluation be completed for the LTVSMC site (Ketz and Kloss 2004).

In 2005, Soils Consulting conducted a Phase I archaeological survey for the NorthMet Project Proposed Action (Hohman Caine and Goltz 2006). The investigation entailed the archaeological survey of select landscape features determined by Hohman Caine and Goltz to have the highest potential for pre-contact archaeological sites. Additionally, a survey was also carried out in areas noted on historical maps and/or in previously identified archaeological site files as containing historical features, such as Native American trails or logging camps. During the investigation, one new archaeological site (NorthMet Archaeological Site) was identified and one previously identified archaeological site (Knot Logging Camp [21SLmn]) was revisited. The NorthMet Archaeological Site was found to contain four lithic artifacts. This newly identified site was recommended as potentially eligible for listing on the NRHP under Criterion D for its potential to yield important information regarding the pre-contact use of the region’s landscape (Hohman Caine and Goltz 2006). The Knot Logging Camp was reported to have been affected by recent logging activities and was recommended as not eligible for listing on the NRHP due to its lack of integrity.

Additionally, a deeply worn trail was identified during the 2005 investigation (Hohman Caine and Goltz 2006). Soils Consulting suggested that the worn trail may represent a section of a historical Native American trail as noted on a map compiled by John W. Trygg from the original GLO surveys (Trygg 1966). There is the potential that this trail could represent a historical Native American trail connecting Lake Vermilion to Beaver Bay. Shovel testing was completed along the potential historical trail; however, no archaeological resources were identified (Hohman Caine and Goltz 2006).

In 2007, Soils Consulting conducted a Phase I archaeological survey for the NorthMet Project Proposed Action focusing on the Dunka Road Expansion and Substation areas, as well as a Phase II archaeological evaluation of the previously identified NorthMet Archaeological Site (Hohman Caine and Goltz 2008). The Phase I archaeological survey consisted of a pedestrian reconnaissance survey of areas considered to have potential for containing archaeological sites. No areas were designated as requiring subsurface testing. No archaeological resources were identified during the Phase I archaeological survey of the Dunka Road Expansion and Substation areas (Hohman Caine and Goltz 2008). The Phase II archaeological evaluation of the NorthMet Archaeological Site consisted of the placement of three shovel tests and four 1-meter by 1-meter excavation units and one ¼-meter by ¼-meter excavation unit. The Phase II investigation rendered three potential lithic artifacts consisting of one possible basalt core, one possible siltstone flake, and one fragment of quartz. No features or concentrations, such as fire-cracked rock or discolored soils, were noted and the site area was documented as having been previously disturbed by a 10-meter-wide road cut. Upon completion of the Phase II archaeological evaluation of the NorthMet Archaeological Site, Soils Consulting found that the site was unlikely to yield additional information important to the understanding of the past. Therefore, Soils Consulting recommended that the NorthMet Archaeological Site be considered not eligible for listing in the NRHP (Hohman Caine and Goltz 2008). The USACE and SHPO subsequently concurred with this recommendation.

In 2007, Landscape Research LLC (Landscape Research) conducted a Phase I architectural history survey and developed a historic context to evaluate the architectural resources at the former LTVSMC processing plant that could be affected by the NorthMet Project Proposed Action (Zellie 2007). Through consultation with the USACE and SHPO, it was determined that these were the appropriate steps for evaluating the architectural resources that could be affected. The Phase I architectural history survey identified 17 properties, two of which (the Erie Mining Company Concentration Building (SL-HLC-008) and segments of the Erie Mining Company Railroad mine and track (SL-HLC-015)) were recommended eligible for listing in the NRHP. The former LTVSMC processing plant as a whole, however, was not recommended as eligible for listing as an NRHP historic district due to the previous demolition of the pelletizing building. The pelletizing building was a critical component of taconite production and its demolition significantly altered the historic integrity of the plant complex. Landscape Research also recommended that the Erie Mining Company Concentration Building (SL-HLC-008), as well as other key plant buildings and structures, be appropriately recorded prior to their mandated (Rule 6132-1300 E 4 c) post-mining demolition. The SHPO concurred with these recommendations in 2009, but an MOA that includes these properties has yet to be finalized.

Efforts to Identify Properties of Religious and Cultural Significance

At a consultation meeting in July 2008 to discuss the results of the surveys conducted by Soils Consulting as referenced above, the Bands voiced general concerns about archaeological survey coverage and specific concerns with the Indian trails shown on the Trygg Maps.

The Bands and USACE worked together to develop a plan for the identification of properties of religious and cultural significance (Plan). In April 2010, the USACE consulted with the Bands and PolyMet concerning the implementation of the Plan. The Plan consisted of four components:

1. Interviews to be conducted by the Bands with Band elders to gather information concerning past use of the NorthMet Project area.
2. Baseline ethno-historical research pertaining to Ojibwe use of the APEs would be used in a cultural landscape assessment of the NorthMet Project area and surrounding vicinity. Background research to identify cultural and natural landscape features would include, at a minimum, the original GLO survey notes and maps developed by Trygg, along with other historic maps of the NorthMet Project area and surrounding vicinity, relevant historic documents and literature.
3. Classification of plant communities by the identification of canopy species using aerial infrared photography and the identification of understory, shrub, and herbaceous layers using existing plant lists of specific community types, based on the MDNR's ECS. This also included ground-truthing to determine accuracy for classification and gathering of additional information on AOCs to the Bands.
4. A field survey to locate and assess the cultural and natural features identified as a result of the background research, elder interviews, and plant classification.

The intent of the Plan was to use plant community classification to identify plant resource areas of interest to the Bands and facilitate identification of historic properties. The archival research was to provide historic documentation and context for the historic Native American trail system and possibly identify other places important to the Bands. The elder interviews then would be used to further identify and understand tribal use areas and places of importance. The field investigation component was to be informed by the results of those efforts.

The field review primarily focused on a reconnaissance-level investigation of the trail corridors as mapped by Trygg (1966) and specific trail locations recorded during the Land Office surveys. Reconnaissance of the trail corridors was conducted by the USACE and USFS with participation from the Bands. Barr participated in a portion of this fieldwork to gather information for completing the classification of plant communities. Barr also continued their effort to gather plant data aside from the trail reconnaissance.

During 2010 and 2011, PolyMet contracted the Bois Forte, Fond du Lac, and Grand Portage to conduct interviews with Band elders. The Fond du Lac and Grand Portage bands have not made the results of the interviews available for use, though the Bois Forte interviews have been considered during this identification process. The Bois Forte interviews did not provide any specific locations, but some general information was provided. Elders recalled that some Band members had utilized the general NorthMet Project area for hunting, fishing, and plant gathering of wild rice, maple-sugar, berries, and birch bark; however, they could not provide specific locations or uses within the NorthMet Project area.

Although the federal Co-lead Agencies recognize the importance of natural resources such as wild rice beds as both ecological communities and as important traditional cultural resources for the Ojibwe people. However, those resources must meet NRHP criteria to be considered historic properties and receive further consideration under Section 106. The federal Co-lead Agencies have considered effects on wild rice and other natural resources, as discussed in other resource-specific sections of the SDEIS and below in Sections 4.2.9.2.4 and 5.2.9.

The results of the elder interviews, archival research, and plant surveys are discussed in a report titled *NorthMet Project Cultural Landscape Study for PolyMet* (Zellie 2012). The report has been reviewed and coordinated with the USACE, USFS, and Bands. The USFS conducted a historic context study of the Beaver Bay to Lake Vermilion (BBLV) overland trail, which was provided as an appendix to the final report. Additional fieldwork completed by the USACE, USFS, and Bands may be added to the above-referenced report or provided as a standalone report, based on future consultation with the Bands. As a result of the field reconnaissance, archival research, and elder interviews, a number of properties of religious and cultural significance have been identified within the APE. These properties include the Spring Mine Lake Sugarbush, the *Mesabe Widjiu* (Laurentian Divide), the Overlook location, and the BBLV Trail.

4.2.9.2.4 Identified Cultural Resources

Cultural resources investigated within the NorthMet Project area—such as architectural history properties, archaeological sites, and properties of religious and cultural significance to the Bands—are discussed in this subsection. The investigations completed to date in the NorthMet Project area have identified cultural resources as summarized in Table 4.2.9-1.

Table 4.2.9-1 Cultural Resources Identified in the NorthMet Project Area

Resource ID	Resource Name	Resource Type	NRHP Determination by Co-lead Agencies	SHPO Concurrence with Co-lead Agencies' Findings
SL-HLC-002	Coarse Crusher	Architectural Property	Not Eligible	Concur
SL-HLC-003	Fine Crusher	Architectural Property	Not Eligible	Concur
SL-HLC-004	Conveyor and Drive House	Architectural Property	Not Eligible	Concur
SL-HLC-005	General Shops	Architectural Property	Not Eligible	Concur
SL-HLC-006	Reservoir	Architectural Property	Not Eligible	Concur
SL-HLC-007	Water Tower	Architectural Property	Not Eligible	Concur
SL-HLC-008	Erie Mining Company Concentrator Building	Architectural Property	Eligible	Concur
SL-HLC-009	Tailings Thickener Tanks	Architectural Property	Not Eligible	Concur
SL-HLC-010	Pelletizing Building (razed)	Architectural Property	Not Eligible	Concur
SL-HLC-011	Central Heating Plant	Architectural Property	Not Eligible	Concur
SL-HLC-012	Fuel Oil Tanks	Architectural Property	Not Eligible	Concur
SL-HLC-013	Pellet Stockpile and Stacker	Architectural Property	Not Eligible	Concur
SL-HLC-014	Mine Area No. 2 Shops	Architectural Property	Not Eligible	Concur
SL-HLC-015	Erie Mining Company Railroad Mine and Plant Track	Architectural Property	Eligible	Concur

Resource ID	Resource Name	Resource Type	NRHP Determination by Co-lead Agencies	SHPO Concurrence with Co-lead Agencies' Findings
SL-HLC-016	Tailings Basin	Architectural Property	Not Eligible	Concur
SL-HLC-017	Mine Area No. 1 Shops	Architectural Property	Not Eligible	Concur
SL-HLC-018	Erie Mining Company Concentration Plant Complex	Architectural Property	Not Eligible	Concur
SL-HLC-pending	Spring Mine Lake Sugarbush	Archaeological site	Eligible	Concur
SL-HLC-pending	*Mesabe Widjiu* (Laurentian Divide)	Archaeological Site	Eligible	Concur
SL-HLC-pending	Overlook	Archaeological Site	Not Eligible	Concur
SL-HLC-pending	BBLV Trail[1]	Archaeological Site	Eligible	Concur
21SL pending	NorthMet Archaeological Site	Archaeological site	Not Eligible	Concur
21SLmn	Knot Logging Camp	Archaeological site	Not Eligible	Concur

[1] USFS designation BBLV Trail Segment #1 (USFS #01-569).

The section is a summary of the cultural resources that have been identified by the federal Co-lead Agencies for the NorthMet Project Proposed Action.

The historic site SL-HLC-018 consists of the primary Erie Mining Company Concentration Plant buildings, such as the coarse and fine crushers and the concentrator; mine and plant track segments of the Erie Mining Company railroad; a Tailings Basin; pellet stockpile area; and mine areas. Treated as a mining complex or district, the property's integrity is diminished by the loss of the pelletizing plant, a central component. Its qualities of association, design, and related aspects of feeling and setting are lost without this key component (Zellie 2007). Although some components of the property may be determined eligible individually, the Erie Mining Company Concentration Plant Complex (SL-HLC-018), as a complex/district, was determined not eligible for inclusion in the NRHP.

Of the remaining buildings and structures comprising the plant complex, the Concentrator Building (SL-HLC-008) is a key property and reflects Erie Mining Company's decades of experimentation in production and engineering design (Zellie 2007). The Concentrator Building is recommended as being individually eligible for inclusion in the NRHP under Criterion A in the areas of Industry and Engineering, and also under Criterion C in the area of Engineering.

The Erie Mining Company railroad (SL-HLC-015) is a 74-mile railroad system created solely for the transportation of ore for shipment to Taconite Harbor. The railroad was in operation during the plant's period of significance (1954 to 1969) and directly linked pellet production with shipping facilities. Although the majority of the main track of railroad is outside of the NorthMet Project area and area of direct effects, the mine track, and plant track segments would be within the APE. The mine and plant track segments of the Erie Mining Company railroad are recommended as eligible for inclusion in the NRHP under Criterion A in the areas of Commerce, Industry, and Transportation.

Of the remaining buildings and structures inventoried within the plant complex, all others are determined individually not eligible for inclusion in the NRHP. These would include the coarse crusher (SL-HLC-002), fine crusher (SL-HLC-003), conveyor and drive house (SL-HLC-004), general shops (SL-HLC-005), reservoir (SL-HLC-006), water tower (SL-HLC-007), tailings thickener tanks (SL-HLC-009), pelletizing building (SL-HLC-010), central heating plant (SL-HLC-011), fuel oil tanks (SL-HLC-012), pellet stockpile and stacker (SL-HLC-013), Area 2 Shops (SL-HLC-014), Tailings Basin (SL-HLC-016), and Area 1 Shops (SL-HLC-017).

Although not located within the Plant Site, the Spring Mine Lake Sugarbush Site (SL-HLC-pending) is located within the APE to the west of the Mine Site. Field investigations as early as 1969 (Loftus 1977) had identified a “Late Historic Period Chippewa Sugar Maple Camp,” south of the intersection of the BBLV Trail and east of the New Indian Trail (Trygg 1966). This sloping, approximately 80-acre site appears to be a natural maple-basswood stand of cultural use and significance. The site was reported to have a structure in the interior of a maple grove that was constructed of pine logs secured with round iron nails. Stockpiled birchbark baskets and basswood wedges[sic] or paddles and “various other containers” were interspersed with metal pots and pans within the structure, (Loftus 1977:73). The report concluded that the site was culturally significant because it allowed “for a comparison of Late Historic Chippewa sugaring practices with those of the Early Historic Period.” Recent visits to the site by USACE staff and Band members identified it as a large multi-component site with evidence of maple sugaring activity from a range of time periods. Various types of historic artifacts and features demonstrated the continued use of the site into the middle part of the 20th century. The stand itself contains trees that may be up to 200 years old, according to the Erie Mining Company forester (Loftus 1977). During the 2010 survey, many large maple trees were observed that exhibited scaring from repeated tapping. The trunks on these trees were flattened at about 4 to 8 ft above the ground, with visible interior decay on many trees that was most likely the result of the long-term effect of repeated tapping for sap collection. Also, the site has more than 75 percent sugar maple, less than 5 percent basswood, and less than 1 percent yellow birch. This community type in its natural state would have about 35 percent sugar maple, 10 to 25 percent basswood, and some yellow birch (Zellie 2012). This difference may be the result of the relationship between the maple tree and the Ojibwe. The traditional practice of sugaring includes an emphasis on the use of basswood for paddles and troughs.

The Spring Mine Lake Sugarbush Site possesses good historic integrity, notably an integral relationship to traditional cultural practices or beliefs, and retains artifactual evidence of prior use as a sugarbush. Based on the site’s tie to recent oral histories by Ojibwe elders, its location near the BBLV and New Indian trails mapped by Trygg (1966:17), photographic evidence of use by Ojibwe families as early as 1941 (Latady and Isham 2011), and its potential role as part of a once-extensive system of sugarbush locations in St. Louis County, the Spring Mine Lake Sugarbush is determined eligible for inclusion in the NRHP under Criterion A. It functioned as a place for sharing and maintaining traditional Ojibwe knowledge of and spiritual connections to the world, which were fundamental to the cultural identity of the Bois Forte Band. Under Criterion D, the site is significant for its potential to answer important questions about possible 19th and 20th century Ojibwe maple sugaring practices.

Mesabe Widjiu, or the Laurentian Divide (SL-HLC-pending), is regarded as a sacred place to the Bands, possessing cultural significance for the Ojibwe. Often referred to by various names, such as the Giant’s Range or Mesabi Heights, the *Mesabe Widjiu* is a long linear landform running the length of the Mesabi Iron Range and into the area of Thunder Bay Ontario. This portion of the Mesabi Range and Laurentian Divide, parts of which intersect the Plant Site, occupies the crest of a line of low, rugged, Precambrian rock hills where the divide separates the watershed of streams that flow north to the Arctic Ocean from the watershed of streams that flow south through the Great Lakes to the Atlantic Ocean (Ojakangas and Matsch 1982:184). Based on the elder interviews, the *Mesabe Widjiu* is part of the Band's oral history and cosmology explaining the origin of the hills and the separation of waters along the divide. The *Mesabe Widjiu* is also the path that the Thunderbirds follow. The various granite-capped outcrops and ledges are used for traditional practices because of the *Widjiu*'s spiritual significance. Despite distant views of mining features to the east that include the skyline of the Erie Mining Company plant, the *Mesabe Widjiu* viewshed possesses good historic integrity, notably an integral relationship to traditional cultural practices or beliefs. *Mesabe Widjiu* is determined eligible for inclusion in the NRHP under Criterion A for its association with important Ojibwe spiritual and cultural practices.

In connection with *Mesabe Widjiu*, a granite bedrock outcrop (SL-HLC-pending) providing an east-facing Overlook is located at the site of the proposed Tailings Basin within the Plant Site. Recent visits to the Overlook by USACE staff and Band members identified the presence of oak trees and a number of potentially important natural features, including a spring. In addition, the Overlook is situated at the junction of two trails. Although this trail feature is identified on Trygg maps, the location is not corroborated by the GLO land survey notebooks from that township. Band elders have noted the cultural significance of both oak trees and east-facing overlooks in the Ojibwe tradition. An outcrop such as this might have been used by Ojibwe for spiritual reasons. Because there is no documented use of this location, the Overlook is determined not individually eligible for inclusion in the NRHP, but included as part of the *Mesabe Widjiu*.

Overland trail systems, such as the 75-mile-long BBLV Trail, were frequently referenced during late 19th century GLO surveys in the western Superior Basin (Trygg 1966). Despite mention in the historic record, the trails themselves, and the role they played as transportation systems prior to development of railroad transportation in the region, are underrepresented in the literature. The available literature would suggest, however, that overland trails played a prominent role within a regional transportation system that included interior waterways, short-haul portages, and overland portages leading from Lake Superior to points inland. While the vast majority of the transportation networks in the Western Superior Basin are recognized as routes that maximized waterborne transportation, the BBLV Trail represents one of the few overland trail corridors where lakes and rivers were not utilized. Within this context, it would appear that the route functioned as a winter transportation corridor, or perhaps an expedient summer route from the Lake Superior Watershed into Lake Vermilion. Support for the BBLV Trail's function as a winter route comes from several sources, both primary and anecdotal in nature. Christian Wieland, who conducted the GLO survey of T59N, R13W in the winter of 1872 noted crossing the "Trail from Beaver Bay to Lake Vermilion" at three locations while conducting the survey (GLO 1873).

Historic records also suggest that overland trails were utilized by both local Ojibwe and mineral prospectors from at least the mid-19th century through the early 20th century (Skillings 1972; Lancaster 2009). Historic overland trails are best viewed as a component of an interrelated transportation system where trails and water routes interconnect to form a large and intricate system of communication and transportation (Burns 1985:1-2). The southeastern head of the overland trail is situated at Beaver Bay, which had a significant Ojibwe population from at least 1854 to 1930 (Davis 1968; Skillings 1972; Lancaster 2009). Beaver Bay provided access from a mid-point on Lake Superior, located about halfway between Grand Portage and Fond du Lac, the two primary, historic ingress points to the interior portions of Northeastern Minnesota.

The significance of the BBLV Trail to the Ojibwe of Northeastern Minnesota is perhaps more nuanced than the significance ascribed by archaeologists, whose focus remains on attaching significance to physical manifestations of historic events. Consultation with the Bands elicited the importance of both how the trails connected past Ojibwe community in a physical sense and the ability for trails to also connect communities in a contemporary sense. Statements of significance were predicated on the fact that in the late 19th century, Ojibwe residence in the newly ceded territory was highly mobile, and families enrolled at locations at which they happened to be when the rolls were being populated. “In a sense, Ojibwe from scattered locations throughout the ceded territory may have enrolled at a location that was far away from their place of primary residence … at the time, social organization was very fluid, and marriages, disagreements, and the opportunities for wage labor caused folks to move around a lot.” There is a general agreement among tribal consultation partners that the trails, or in the case of some, the trail corridors themselves, function as “physical manifestations of the social fluidity that existed among northeastern Minnesota’s Ojibwe communities at that time.” Consulting partners stated that the trails are “like a lifeline that permeates all aspects of history. That the overland trails are something entirely different than functional trails that are present today, trails that some would refer to as coming and going trails, in that you use them for a purpose and then you return home. The Beaver Bay to Lake Vermilion Trail is viewed as something different … it is viewed as a trail that connects you to who you are, in that they are important signature of cultural identity and reconnection to past ways” (Berens and Raske, Pers. Comm., August 14, 2012).

Although barely discernible in some cases, a few well-defined segments of the BBLV Trail and two other unnamed trail segments represent the trail corridors that cross the Mine Site and Plant Site, as well as the NorthMet Project area (Zellie 2012). Although interrupted by Euro-American agriculture, logging, and mining, as well as road and townsite development, the trails remain an important cultural and spiritual connection for the Bands. Recent oral histories by Band elders substantiate this significance. These segments are potentially part of a once-extensive system of overland trails that were in use during hundreds of years of Ojibwe occupation. Therefore, the BBLV Trail is significant for the role it played in the broad patterns of Ojibwe land use and early mineral exploration. It is eligible for inclusion in the NRHP under Criteria for Evaluation A and D.

Preliminary effect determinations have been drafted by the federal Co-lead Agencies for review and comment by the Bands and SHPO. The federal Co-lead Agencies have determined that the above properties would eligible for inclusion in the NRHP. The agencies are working on final boundary determinations for those properties in consultation with the SHPO and the Bands.

The NorthMet Archaeological Site (21SL pending) is located at the Mine Site. The site was identified through subsurface testing and consisted of pre-contact lithic artifacts. Due to the sparse nature of the artifacts and lack of features, it was believed that the site was unlikely to yield any further information significant to the understanding of past cultural history, and therefore was determined to be not eligible under Criterion D. As a result, the site was determined to be not eligible for inclusion in the NRHP.

The Knot Logging Camp (21SLmn) is located outside the NorthMet Project area, although within the APE of the NorthMet Project Proposed Action. The historic site was originally identified by USFS staff through historic aerial photography analysis. Field investigations at the site identified pit features and historic debris typical of a logging camp, including stove parts, cans, and other metal materials. The site had been reported to be severely affected by recent and historic logging activities. No obvious remnants of previously identified berms were evident. Historic research failed to uncover anything regarding the individual camp itself other than its affiliation with a brief period in the logging industry in northeastern Minnesota. Thus, the site was determined to be not eligible under Criterion A. Due to the sparse nature of the artifacts and lack of significant features, it was believed that the site was unlikely to yield any further information significant to the understanding of past cultural history, and therefore was determined to be not eligible under Criterion D.

Summary of Results Coordination

The USACE has coordinated the results of the archaeological surveys discussed above with the SHPO (USACE 2007; USACE 2009; SHPO 2007) and, based on strategic sampling of the NorthMet Project area, the SHPO and USACE concurred that no further efforts were required to identify archaeological resources within the APE. However, the Bands had concerns about the survey coverage (see section above for additional detail).

Through consultation with the USACE and SHPO, it was determined that a Phase I architectural history survey, coupled with the development of a historic context, were appropriate steps for evaluating the architectural resources that may be affected by the NorthMet Project Proposed Action. The Phase I architectural history survey identified two properties that were recommended eligible for listing in the NRHP: the Erie Mining Company Concentration Building (SL-HLC-008) and segments of the Erie Mining Company Railroad mine and track (SL-HLC-015). The SHPO concurred with these recommendations in 2009, but an MOA that includes these properties has yet to be finalized.

The USACE and USFS have consulted with the Bands and the SHPO concerning the results of identification efforts for properties of religious and cultural significance to the Bands. Consultation focused on applying NRHP criteria to the properties identified, discussion of property boundaries for those meeting the criteria, as well as discussions to further understand the traditional religious and cultural significance of those properties. As a result, the Spring Lake Mine Sugarbush, the BBLV Trail; and *Mesabe Widjiu* were determined eligible The Overlook location was not considered by the Co-leads to be eligible in itself, but eligible as part of the *Mesabe Widjiu*. At various times during consultation for the NorthMet Project Proposed Action, the Bands have proposed a historic district that includes the above properties as well as others that have been reported outside of the APEs. The USACE and the USFS will consider additional information that becomes available concerning a possible historic district as they complete their review under section 106 of the NHPA.

To summarize, the federal Co-lead Agencies have followed the initiation and identification processes outlined in 36 CFR 800.3 and 36 CFR 800.4, respectively, and have involved consulting parties in the finding and determination process completed to date. Multiple historic property identification efforts have occurred over a 13-year period within the proposed NorthMet Project area. These identification efforts have included both standard field inventory and assessment and identification of properties of cultural and religious significance to consulting Bands.

4.2.9.3 Cultural Identity: Natural Resources as Cultural Resources

For most Native American tribes, subsistence is synonymous with culture and identity. Subsistence activities generally constitute a way of being and relating to the world, and thus comprise an essential component of Native American identity and culture. Because Native Americans consider subsistence activities such as obtaining, processing, and distributing natural resources as essential components of maintaining their cultural customs and traditions, one cannot be arbitrarily removed from the other. Therefore, Native Americans generally consider an effect on subsistence resources and/or the ability to hunt, fish, or gather these resources as an effect on associated and perhaps fundamental aspects of cultures and traditions.

The spiritual connection to subsistence resources, and the manner in which these resources are harvested, is an essential part of Ojibwe culture. Potential effects on subsistence resources could therefore impact the culture and tradition of the Ojibwe. For instance, subsistence practices in a particular area could be affected by a loss of hunting, fishing, or gathering opportunities, thereby affecting the traditional or cultural practice that takes place in that area. Effects on subsistence resources in areas where traditions are practiced may have an effect on the ability of individuals or families to pass those traditional practices, knowledge, and beliefs to future generations. The identity of Ojibwe as a people is dependent on the transmission of that knowledge and belief system to the next generation.

4.2.9.3.1 Federal Tribal Trust Responsibility

The federal government has a unique legal relationship with the federally recognized Native American tribes, which has been set forth in the U.S. Constitution, treaties, statutes, court decisions, and EOs. This legal relationship is often referred to as the “Federal Trust Doctrine” or “Federal Tribal Trust Responsibility,” which is a body of law defining the relationship of federal government with federally recognized Native American tribes.

Beginning in the mid-19th century, the government of the United States made treaties with the Ojibwe that ceded areas of land in northern Minnesota to the federal government. In return, specific reservations were created for the tribes’ use and other considerations specified. The treaties also preserved the right of the Ojibwe bands to hunt, fish, and gather off the reservations within these ceded territories. The federal trust responsibility requires that federal agencies consider their actions with respect to tribal rights, particularly reserve rights, where they exist.

In 1854, the Chippewa of Lake Superior entered into a treaty (1854 Treaty of La Pointe or 1854 Treaty; Kappler 1904) with the United States whereby the Chippewa ceded to the United States ownership of their lands in northeastern Minnesota. These lands are generally known as the 1854 Ceded Territory. Article 11 of the 1854 Treaty provides, *“...and such of them as reside in the territory hereby ceded, shall have the right to hunt and fish therein, until otherwise ordered by the President.”* The Chippewa of Lake Superior who reside in the 1854 Ceded Territory are the Fond du Lac, Grand Portage, and Bois Forte Bands. The NorthMet Project area is within the 1854 Ceded Territory, and thus federal agencies must consult on a government-to-government basis with interested signatories to the 1854 Treaty to understand how the proposed federal actions may impinge on or abrogate treaty rights.

Natural resources and the lands on which they are gathered are important to the Bands for a number of reasons, including cultural, spiritual, and/or historical meanings, and will be considered under federal agency tribal trust responsibilities as outlined above and also as cultural resources under NEPA.

4.2.9.3.2 Perspectives on the Environment

The SDEIS uses different criteria and methods to describe how the NorthMet Project Proposed Action would affect the environment. These systems are used to identify, describe, and map progressively smaller areas of land with increasingly uniform ecological features. The systems primarily use associations of biotic and environmental factors, including climate, geology, topography, soils, hydrology, and vegetation.

The integration of ecosystems models with greater emphasis on the relationship of people to the land has become popular with Tribal natural resource and landscape planning. The integration of Native American traditional values regarding the natural world as a whole landscape system encompasses both visible physical aspects of the land along with less apparent values such as cultural relationships and spirituality.

The wildlife and vegetation sections describe the natural environment by using the MDNR's ECS, which follows the NHFEU. The NorthMet Project area is within the Laurentian Mixed Forest province, covering northern Minnesota, Wisconsin, and Michigan, as well as southern Ontario and portions of New England. More specifically, the NorthMet Project area is located along the border of the Laurentian Uplands and Nashwauk Uplands subsections.

The Laurentian Uplands and Nashwauk Uplands subsections are characterized by till plains, moraines, peatlands, and flat outwash plains (MDNR 2011g; MDNR 2011i). The Continental Divide separates the Nashwauk Uplands subsection, with waters flowing north to Hudson Bay, west to the Mississippi River, or south to Lake Superior. Land cover within these subsections is described in Table 4.2.9-2 below.

Table 4.2.9-2 Laurentian Uplands and Nashwauk Uplands Subsections

Subsection/Land Cover	Total Acres	Percent of Total Area in Subsection
Nashwauk Uplands	810,028	
Aquatic Environments	283,510	35
Disturbed	40,501	5
Forest	437,415	54
Cropland/Grassland	48,602	6
Laurentian Uplands	567,280	
Aquatic Environments	113,456	20
Disturbed	5,673	1
Forest	448,151	79
Cropland/Grassland	0	0

Source: MDNR 2011g; MDNR 2011i.

Both subsections are dominated by forest habitat (e.g., upland and lowland deciduous and coniferous forests) and aquatic environments (e.g., open water, wetlands), with a smaller amount of disturbed and cropland/grassland. 1854 Treaty resources—including vegetation, wildlife, and fish— are discussed below within the context of these land cover types.

4.2.9.3.3 1854 Treaty Resources

Another perspective on natural resources of cultural importance can be viewed through the relationship of the federal government with the Bands. The Land Exchange Proposed Action represents an exchange of private and federal land, but it is also represents an exchange of access to natural resources expressed in treaties made between the United States and Bands of Ojibwe Indians in the 19th century. The 1854 Treaty was signed by Henry C. Gilbert and David B. Herriman for the United States and representatives of the Lake Superior Chippewa on September 30, 1854, and proclaimed on January 29, 1855. The 1854 Treaty ceded all of the Lake Superior Chippewa lands in the Arrowhead Region of Northeastern Minnesota to the United States, in exchange for reservations for the Lake Superior Chippewa in Wisconsin, Michigan, and Minnesota. The signatory tribes retain hunting, fishing, and gathering rights within this region.

The rights to capture or gather (or take) subsistence resources within the 1854 Ceded Territory are provided to the Bands on a usufruct basis. The concept of individuals not owning specific land, but using the resources on land controlled by larger cultural groups, represented this usufruct basis that was so important to the survival of the Ojibwe everywhere in Minnesota prior to arrival of Europeans. As a usufructuary created by the 1854 Treaty, the Bands are allowed to use resources from land owned by others. The NorthMet Project area and Land Exchange area fall within the territory ceded as part of the 1854 Treaty between the U.S. government and the Chippewa of Lake Superior. Rights for hunting and fishing under the 1854 Treaty are exercised on lands within this territory. It is therefore important to address what these resources are and what cultural importance they have to the Bands.

Interpretations of the 1854 Treaty resources range from an emphasis on hunting and fishing to efforts by the courts to determine Ojibwe land use prior to the treaties that lists virtually every resource in the 1854 Ceded Territory that was utilized by the Ojibwe (Lac Courte Oreilles III, 653 F. Supp. 1420, 1424). While this provided an extensive list of possible resources, the emphasis on certain natural resources such as wild rice, moose, white-tailed deer, maple sugar, certain fish and aquatic species, and certain well-known medicinal plants heightens their level of cultural importance. Table 4.2.9-3 shows other animal and plant species that have historically been, and/or could potentially be, harvested in the 1854 Ceded Territory.

Table 4.2.9-3 Species Potentially Harvested in 1854 Ceded Territory

Mammal/Reptile					
white-tailed	beaver	snowshoe hare	moose	otter	elk
deer	marten	cottontail rabbit	woodchuck	lynx	bison
black bear	mink	badger	squirrel	fox	turtles
muskrat	fisher	porcupine	raccoon	wolf	turtle eggs
Bird					
ducks	songbirds	turkeys	eagles	owls	partridges
geese	grouse (various)	hawks			
Fish					
whitefish	chubs	turbot	walleye	sturgeon	perch
herring	lake trout	in-shore suckers	pike	muskie	
Plant/Plant Materials					
adder's mouth	choke cherry	ground pine	mountain holly	shield fern	Virginia
agrimony	climbing bitter-	harebell	mountain maple	shin leaf	waterleaf
alternate-leaved	sweet	hare's tail	mullein	shining willow	white campion
dogwood	cocklebur	hawthorn	musquash root	slender ladies’	white lettuce
American dog	common	hazelnut	nannyberry	tresses	white oak
violet	burdock	heal-all	navy bean	slippery elm	white pine
arbor vitae	common	heart-leaved	northern	small bedstraw	white sage
(white cedar)	milkweed	umbrella-wort	clintonia	small cleaver	white spruce
arum-leaved	common	hemlock	Norway pine	small Solomon's	white sweet
arrow-head	plantain	highbush	Ojibwe potato	seal	clover
balsam fir	common thistle	blackberry	Ojibwe squash	smooth	wild balsam-
balsam poplar	corn	highbush	ox-eye daisy	gooseberry	apple
basswood	cow parsnip	cranberry	panicled	smooth	wild bergamot
beaked hazelnut	cow wheat	hog peanut	dogwood	juneberry	wild black
beech	crack willow	hop	paper birch	smooth rose	currant
black ash	cranberry	horseweed	pearly	smooth sumac	wild cherry
black oak	cranberry pole	hound's tongue	everlasting	snowberry	wild columbine
black snakeroot	bean	Indian cup plant	Philadelphia	speckled alder	wild geranium
black spruce	creamy	Indian turnip	fleabane	speckled elder	wild ginger
black-eyed	vetchling	jack pine	pin cherry	sphagnum moss	wild leek
Susan	cucumber	Joe-Pye weed	pitcher-plant	spotted touch-	wild mint
bloodroot	curled dock	Labrador tea	poison ivy	me-not	wild onion
blue cohosh	cursed crowfoot	large-flowered	prickly ash	spreading dog-	wild parsnip
blue flag	daisy fleabane	bellwort	prickly	bane	wild plum
blueberry	dandelion	large pie	gooseberry	squash	wild red currant
bluewood aster	downy	pumpkin	prince's pine	stag-horn sumac	wild rice
bog rosemary	arrowwood	large-toothed	purple meadow	starflower	wild sarsaparilla
bog willow	Dudley’s rush	aspen	rue	star-flowered	wild strawberry
box elder	entire-leaved	large toothwort	quaking aspen	Solomon’s	winterberry
brake	groundsel	large-leaved	rattlesnake grass	seal	wintergreen
bristly crowfoot	esser cat's foot	aster	red ash	steeple bush	wood betony
bunch berry	evening	large-leaved	red baneberry	sugar maple	wood horsetail
bur oak	primrose	aven	red elderberry	swamp	wood nettle
bush	false spikenard	leather leaf	red haw apple	persicaria	wool grass
honeysuckle	female fern	lichens	red maple	sweet cicely	woolly yarrow
butternut	field horsetail	lima bean	red oak	sweet fern	yarrow
Canada	flowering	low birch	red raspberry	sweet flag	yellow birch
anemone	spurge	Lyall’s nettle	rein orchis	sweet gale	yellow ladies’
Canada	fragrant	marsh	reindeer moss	sweet grass	slipper
hawkweed	goldenrod	bellflower	river-bank grape	sweet white	yellow lotus
		marsh cress	rough cinquefoil	water lily	

Canada mayflower	fragrant golden-rod	marsh five-finger	sand cherry	tall blue lettuce	yellow water lily
Canada moonseed	giant puffball	marsh marigold	scouring rush	tamarack	
Canada thistle	ginseng	marsh skullcap	sensitive fern	tansy	
Canada violet	golden corydalis	marsh vetchling	sessile-leaved bellwort	tansy-mustard	
Carey’s persicaria	golden ragwort	meadow-sweet	shell bark hickory	thimble-weed	
carrion flower	goldthread	moosewood		tower mustard	
catnip	goose grass			twisted stalk	
cat-tail	gourds			Virginia creeper	
	great bulrush			Virginia grape fern	
	great willow-herb				

Source: Appendix C.

The 1854 Treaty resources can be more accurately characterized by examining how they are being currently regulated by the Bands. Governance of hunting, fishing, trapping, management, and gathering of natural resources by the Fond du Lac Band of Lake Superior Chippewa within the 1854 Ceded Territory is demonstrated in the Fond du Lac Ceded Territory Conservation Code (Fond du Lac 1992). The purpose of the Code is to provide a system for tribal control and regulation of hunting, fishing, and gathering within the Ceded Territory, provide a means to promote public health and safety through the conservation and management of natural resources within the Ceded Territory, and to promote and protect the rights of the Fond du Lac retained under the 1854 Treaty.

The 1854 Treaty Authority is an Inter-tribal Natural Resources Management Organization that manages the off-reservation hunting, fishing, and gathering rights of the Grand Portage and Bois Forte Bands of Lake Superior Chippewa in the territory under legal agreement with the State of Minnesota. The 1854 Treaty Authority’s mission statement is to “provide an Inter-Tribal natural resource program to ensure that the rights secured to member Native American tribes by treaties of the United States to hunt, fish, and gather within the 1854 Ceded Territory shall be protected, preserved and enhanced for the benefit of present and future member Native American tribes in a manner consistent with the character of such rights, through provisions of services.” The 1854 Treaty Authority’s management of natural resources generally focuses on some of the most commonly hunted, fished, or gathered natural resources; therefore, an analysis of subsistence use by the Bands cannot be all-encompassing. The 1854 Treaty Authority and the natural resources which they manage and regularly report on are being used merely as a way to better quantify an analysis of potential natural resource use by the Bands within the NorthMet Project area.

Vegetation

The 1854 Treaty Authority developed a Code for Treaty Gathering (2007) to facilitate Treaty-related gathering of wild plants or forest products on lands and waters open to the public within the 1854 Ceded Territory (see Table 4.2.9-4). The gathering activities conducted under this code are for subsistence use only. Subsistence levels are identified for each resource, and any gathering beyond those levels is considered commercial harvesting. Band members may gather other plant species not listed in the table below, but may not gather threatened or endangered species. If the state, county, or federal government prohibits gathering in a forest campground, wildlife management area, SNA, State of Minnesota-designated old growth stand, state park, wayside, beach, water access, plantation, or other specially designated area such as the BWCAW, then gathering by Band members is also prohibited (1854 Treaty Authority 2007).

Plant species or resources discussed in this code were grouped according to their habitat or cover types, and presented along with the area (in acres) of each habitat type located in the NorthMet Project area (see Table 4.2.9-4 and Section 4.2.4). This provides an estimate of how much of each 1854 Treaty Authority-regulated resource or species could be present in the NorthMet Project area based on predominant cover types.

Table 4.2.9-4 Cover Types of Associated Species and Resources Regulated by the 1854 Treaty Authority in the NorthMet Project Area

Cover Types	**Associated Plant Species or Resource**	**Mine Site (Acres)[1]**	**Transportation and Utility Corridor (Acres)[1]**	**Plant Site (Acres)[1]**
Upland coniferous forest	Conifer boughs, princess pine, birch bark, firewood, other plants or forest products	1,195.5	2.6	99.8
Lowland coniferous forest	Conifer boughs, princess pine, firewood, other plants or forest products	781.2	0.2	41.9
Upland deciduous forest	Princess pine, ginseng, birch bark, firewood, other plants or forest products	648.0	2.7	646.7
Shrubland	Firewood, other plants or forest products	241.7	7.7	333.4
Disturbed	NA	128.0	94.4	2,755.5
Aquatic environments	Wild rice, other plants or forest products	12.7	2.7	636.7
Cropland/Grassland	NA	4.9	9.8	0.0
Upland conifer-deciduous mixed forest	Conifer boughs, princess pine, ginseng, birch bark, firewood, other plants or forest products	2.4	0.0	0.0
Lowland deciduous forest	Princess pine, birch bark, firewood, other plants or forest products	0.1	0.0	0.0
Total	**NA**	**3,014.5**	**120.2**	**4,514.0**

Source: 1854 Treaty Authority 2007.

[1] Acres from Section 4.2.4.

Specific plant surveys were also completed to assess "the degree to which the [NorthMet Project area] provides opportunities to gather a variety of plant species for use in traditional Ojibwe cultural practices" (Zellie 2012). More than 152 plant species were identified during these surveys; the five most common plant species were identified in at least half of the 43 sample plots, while another 21 plant species were identified in at least one-quarter of the plots. Balsam fir (*Abies balsamea*) was the most frequently encountered species within the sample plots, followed by black spruce (*Picea mariana*), bigleaf aster (*Eurybia macrophyllus*), bunchberry dogwood (*Cornus canadensis*), and Canada mayflower (*Maianthemum canadense*).

The 152 species identified were also grouped into seven distinct ECS community types (Zellie 2012). Three plant species were found in five of the seven ECS community types, including balsam fir, speckled alder (*Alnus incana*), and low-bush blueberry (*Vaccinium angustifolium*). Eleven species were found in four of the seven ECS community types, and 12 species were found in three of the seven ECS community types (see Table 4.2.9-5). These 26 species occur in a larger range of habitat types and are thus more likely to occur in the NorthMet Project area. Plant species found in multiple community types would generally be more broadly available to gatherers of plants, whereas plant species found in only one community type would require a trip to that specific community to gather it (Zellie 2012). Of the 26 species listed in Table

4.2.9-5, only one (blue-joint grass) does not have a traditional Ojibwe use according to *Plants Used by the Great Lakes Ojibwa* (Meeker et al. 1993).

Table 4.2.9-5 Plant Species Found in At Least Three ECS Vegetation Community Types

Number of ECS Community Types Found In	Common Name (Scientific Name)
Five	Balsam fir, speckled alder, low-bush blueberry
Four	Lady fern (*Athyrium filix-femina*), paper birch (*Betula papyrifera*), creeping snowberry (*Gaultheria hispidula*), tamarack (*Larix laricina*), Labrador tea (*Ledum groenlandicum*), black spruce, blue-joint grass (*Calamagrostis canadensis*), goldthread (*Coptis trifolia*), bunchberry dogwood, beaked hazelnut (*Corylus cornuta*), wild red raspberry (*Rubus idaeus*)
Three	Northern white cedar (*Thuja occidentalis*), twinflower (*Linnea borealis*), red maple (*Acer rubrum*), mountain maple (*Acer spicatum*), serviceberry (*Amelanchier sanguinea*), wild sarsaparilla (*Aralia nudicaulis*), blue-bead lily (*Clintonia borealis*), bigleaf aster, three-lobed bedstraw (*Galium trifidum*), Canada mayflower, quaking aspen (*Populus tremuloides*), rosy twisted-stalk (*Streptopus roseus*)

Source: Zellie 2012.

According to the *NorthMet Project Cultural Landscape Study* (Zellie 2012), the “Ojibwe organized their economy around wild rice and the seasonal cycle of fishing, sugaring, trapping, and hunting.” Reliance on wild rice varied with the availability and cycle of abundance, but because of its shelf life of up to 10 years, it was a staple food for native peoples and early explorers and fur traders. Wild rice is included in Table 4.2.9-4 as an 1854 Treaty Authority-regulated resource, as it is a culturally important plant species. The annual harvest of wild rice totals more than 2 million pounds, and involves thousands of tribal members, demonstrating its continuing role in Ojibwe spiritual practices, culture, livelihood, and identity (Zellie 2012). Wild rice is not known to occur within the Plant Site, Transportation and Utility Corridor, or the Mine Site. However, it was identified through surveys in isolated patches in the Upper Partridge River upstream of Colby Lake, in the Partridge River downstream of Colby Lake, in isolated patches on the Embarrass River above Embarrass Lake, and downstream of Embarrass Lake. See Sections 4.2.2 and 4.2.4 for further discussions of wild rice near the NorthMet Project area.

Similarly, the sugar maple (*Acer saccharum*) is a culturally important plant species, as it has traditionally been and is still tapped to make maple syrup and sugar. “The sugar, in granular form or syrup, provided seasoning for grains and breads, stews, teas, berries, and vegetables” (Zellie 2012). A stand of sugar maple was located southwest of Spring Mine Lake between the Mine Site and Plant Site. This site, called the “sugarbush” or “sugar camp” site, appears to be a natural maple-basswood stand that has been utilized during the past two centuries. Many of the sugar maple trees at this site display evidence that they have been tapped for maple syrup in the past, including misshapen boles from 4 to 8 ft off the ground. Small groups of sugar maple were also identified near the overlook area northeast of the Plant Site, but nowhere else, including the Mine Site.

In addition to sugar maple and wild rice, the Ojibwe also relied on spruce root, birch and cedar bark, sage, hazelnuts, and blueberries and other berries (Zellie 2012). Many of these species also had medicinal uses besides being used as food sources. This is consistent with the 1854 Treaty

Authority-regulated resources listed in Table 4.2.9-4, and many of these species were identified in multiple ECS community types during surveys (see Table 4.2.9-5).

Wildlife

The 1854 Treaty Authority developed a Ceded Territory Conservation Code (2012) to regulate hunting, fishing, trapping, and gathering of resources for subsistence use in the 1854 Ceded Territory. The wildlife species regulated by the 1854 Treaty Authority are listed in Table 4.2.9-6, and are categorized by the habitat type they typically utilize. Table 4.2.9-6 also lists the acreage of these habitats present at the Mine Site, Transportation and Utility Corridor, and Plant Site.

Table 4.2.9-6 Key Habitat, Cover Types, and Associated Species Regulated by the 1854 Treaty Authority in the NorthMet Project Area

Key Habitat Type, Cover Types, and Management Indicator Habitats	Associated Wildlife Species Regulated by the 1854 Treaty Authority	Plant Site (Acres)	Mine Site (Acres)	Transportation and Utility Corridor (Acres)
1. Mature Upland Forest, Continuous Upland/Lowland Forest: aspen forest/aspen-birch forest, jack pine forest, mixed pine-hardwood forest (MIHs 1-13)	Snowshoe hare, bobcat, fisher, pine marten, ruffed grouse, spruce grouse	788.4	2,627.2	5.5
2. Open Ground, Bare Soils: disturbed/developed (no MIH)		2,755.5	128.0	94.4
3. Grassland and Brushland, Early Successional Forest (no MIH)	American badger, sharp-tailed grouse	333.4	246.6	17.5
4. Aquatic Environments: Tailings Basin, Partridge River, Embarrass River, former LTVSMC mine pits, wetlands (MIH 14)	American mink, muskrat, beaver, river otter, sora, Virginia rail, Wilson's snipe, Canada goose, snow goose, redhead, northern pintail, canvasback, mallard, American black duck, red-breasted merganser, American coot, common gallinule	636.7	12.7	2.7

Key Habitat Type, Cover Types, and Management Indicator Habitats	Associated Wildlife Species Regulated by the 1854 Treaty Authority	Plant Site (Acres)	Mine Site (Acres)	Transportation and Utility Corridor (Acres)
5. Multiple Habitats (MIHs 1-14)	White-tailed deer[1] (1, 3), moose (1, 3, 4), black bear (1, 3), coyote (1, 3), red fox (1, 3), raccoon (1, 3, 4), gray fox (1, 3), eastern cottontail rabbit (1, 3), eastern fox squirrel (1, 3), eastern gray squirrel (1, 3), Virginia opossum (1, 3), Canada lynx (1-4), wild turkey (1, 3, 4), American crow (1-4), mourning dove (1, 3), American woodcock (1, 3), ring-necked pheasant (3, 4), Canada goose (3, 4), snow goose (3, 4), greater white-fronted goose (3, 4), brant (3, 4), wood duck (1, 4), greater scaup (3, 4), lesser scaup (1, 3, 4), hooded merganser (1, 4), common merganser (1, 4)			
Total[2]		4,514.0	3,014.5	120.1

Source: 1854 Treaty Authority 2013; 1854 Treaty Authority 2012.

[1] Numbers refer to the Key Habitat Types (1-5) where those species may occur or are known to occur.
[2] Total acres may be more or less than presented due to rounding.

Mature upland and lowland forest is the most common habitat type at the NorthMet Project area (primarily at the Mine Site). Section 4.2.4 provides a more detailed discussion of vegetation cover and habitat types. Species that may be present include snowshoe hare, bobcat, fisher, pine marten, ruffed grouse, and spruce grouse. These species represent a group that generally requires large forested blocks and/or minimal human intrusion.

Areas of open ground and bare soils are rare at the Mine Site but are abundant at the Plant Site due to former LTVSMC operations or deposition in the existing LTVSMC Tailings Basin. Both open ground and bare soils are considered non-natural habitats. No 1854 Treaty Authority-regulated species are specifically associated with this habitat type.

Brush/grassland and very early successional forest are uncommon at the Mine Site and Plant Site (ENSR 2005) and, where present, are typically small patches resulting from recent logging. The revegetation of the existing LTVSMC Tailings Basin is counted as grassland, though it is disturbed habitat and is unlikely to be heavily used by wildlife species. The species listed in Table 4.2.9-6 include the American badger and sharp-tailed grouse, which are generally associated with large patches of grassland and savanna habitats that are not present in the NorthMet Project area. The USFS has indicated that American woodcock has been observed at the Mine Site.

The Mine Site and adjacent federal lands contain a large expanse of wetland habitat consisting primarily of coniferous and open bogs. Species that utilize this habitat include semi-aquatic mammals, shorebirds, and waterfowl. Currently, there are no bodies of open water at the Mine Site. At the Plant Site, open water and aquatic communities are confined to the existing LTVSMC Tailings Basin. The Tailings Basin attracts Canada geese and other waterfowl, though the NorthMet Project area does not otherwise appear to provide good habitat for waterfowl or shorebirds.

Multiple habitats are not mapped as such, but are made up of combinations of other key habitat types. This category is used for 1854 Treaty Authority-regulated species that are known to use multiple habitats during a season, such as white-tailed deer, bear, moose, and multiple other species listed in Table 4.2.9-6.

Other wildlife species may be considered culturally important, including but not limited to the gray wolf and bald eagle, and are discussed in Section 4.2.5.

Aquatic Species

As mentioned above, the 1854 Treaty Authority manages the off-reservation fishing rights of the Grand Portage and Bois Forte Bands of Lake Superior Chippewa in the 1854 Ceded Territory. They have developed the *1854 Treaty Authority Fishing Seasons, 2013-2014* (2013) document to address fishing seasons and limits on waters open to the public within the 1854 Ceded Territory. Fish species with a season and limit are presented in Table 4.2.9-7 below, along with fish species that have been collected at sites in the vicinity of the NorthMet Project area. Five fish species that are regulated by the 1854 Treaty Authority (i.e., northern pike, white sucker, burbot, black bullhead, and yellow perch) occur near or on the NorthMet Project areas; the remaining species collected near the Mine Site, Transportation and Utility Corridor, or Plant Site include species more typical for first- and second-order streams (e.g., minnows, darters, etc.). Section 4.2.6 describes in more detail the species collected and the stream and shoreline habitat available.

Table 4.2.9-7 Fish Species Regulated by the 1854 Treaty Authority and Collected in the NorthMet Project Area

1854 Treaty Authority-Regulated Fish Species[1]
Northern pike, *white sucker*, *burbot*, *black bullhead*, *yellow perch*, walleye, sauger, muskellunge, largemouth/smallmouth bass, rock bass, black/white crappie, sunfish/bluegill, white/yellow bass, flathead/channel catfish, yellow/brown bullhead, lake whitefish, rainbow smelt, lake sturgeon, ruffe, white perch, round goby, lake trout, chinook/pink/coho salmon, brook/brown/rainbow trout, splake, carp, bigmouth buffalo, sheepshead/freshwater drum, bowfin, cisco, gar, goldeye
Species Collected in the Vicinity of the NorthMet Project Area[1, 2]
Northern pike, *white sucker*, *burbot*, *black bullhead*, *yellow perch*, longnose dace, common shiner, Johnny darter, brassy minnow, northern redbelly dace, brook stickleback, blacknose dace, pearl dace, tadpole madtom, central mudminnow, fathead minnow, mottled sculpin, golden shiner, finescale dace, creek chub

Source: 1854 Treaty Authority 2013; 1854 Treaty Authority 2012.

[1] Species in common between the 1854 Treaty Authority fishing season list and those collected in the NorthMet Project area are listed in italics.
[2] Species list from tables in Section 4.2.6.

The lake sturgeon is a culturally important fish species that has a season and limits enforced (1854 Treaty Authority 2013), and it is also listed as a USFS RFSS. However, lake sturgeon are not known to occur near the NorthMet Project area, and there is no likely habitat for them on the federal lands. Though lake sturgeon have been stocked into the St. Louis River above the Fond du Lac dam, upstream migration would be blocked by a dam downstream of the Embarrass River confluence with the St. Louis River. See Section 4.2.6 for a more thorough discussion of lake sturgeon and their management.

Access to the NorthMet Project Area for Subsistence Use

The Mine Site is entirely surrounded by private restricted property, roads, and railroads. There are access points to the NorthMet Project area, however, via a Forest Service road, the Partridge River, and various trails segments. The Plant Site and the Transportation and Utility Corridor are owned by either Cliffs Erie LLC or PolyMet, and are not open to the public. Entry points are gated and/or guarded, and crossing the corridor is prohibited. As such, current subsistence use in the NorthMet Project area is limited, but not restricted.

4.2.10 Socioeconomics

The Arrowhead region of northeastern Minnesota, which includes Cook, Lake, and St. Louis counties, contains the well-known Mesabi Iron Range. Precious metal mining in this region can be dated to the late 1800s, with St. Louis County in particular having a long mining heritage. Many local communities were established to support these iron mining operations. While mining is still a major component of the area's economy and culture, the same can also be said for the region's other natural resources. As with much of Minnesota, timber production has a long history in this area. Tourism, much of it centered on the BWCAW and the region's other outstanding public lands, is an important and growing economic sector and is deeply ingrained in the region's culture.

The study area for socioeconomics extends beyond the area of direct potential project effects to include all of Cook, Lake, and St. Louis counties (see Figure 4.2.10-1). This geography includes the proposed Mine Site, Transportation and Utility Corridor, and Plant Site as well as the non-federal tracts included in the Land Exchange Proposed Action.

Socioeconomic data are not available, and thus are not reported for the Mine Site, Transportation and Utility Corridor, and Plant Site on an individual basis. Socioeconomic data in this section are instead collected and analyzed at the county level and, where appropriate, for cities (Aurora, Babbitt, Biwabik, Duluth, Ely, Hibbing, Hoyt Lakes, Tower, and Virginia), as well as the unincorporated area known as Soudan (all of which are located in St. Louis County, and which are collectively referred to hereafter as "study area communities"). While other portions of northeastern Minnesota could experience some socioeconomic effects from the NorthMet Project Proposed Action, these cities were chosen for several reasons. Duluth, which is approximately 2 hours driving distance from the NorthMet Project area, is included because its population is a large share of St. Louis County's overall population. Other larger cities are those within approximately a 1 hour driving distance. These are the population centers most likely to provide labor and housing (temporary and permanent) and thus are the most likely to be impacted by the NorthMet Project Proposed Action.

Data and observations for the Fond du Lac (St. Louis and Carleton counties), Grand Portage (Cook County), and Bois Forte (St. Louis and Koochiching counties) reservations and off-reservation areas are also included where information was available. While portions of these reservations are outside of the study area, tribal members nonetheless exercise usufructuary rights to hunt, fish, and gather plants within the 1854 Ceded Territory.

4.2.10.1 Mine Site, Transportation and Utility Corridor, Plant Site

4.2.10.1.1 Demographics

This section describes the demographics of the three-county study area in terms of population, age, race, income, poverty, and educational statistics.

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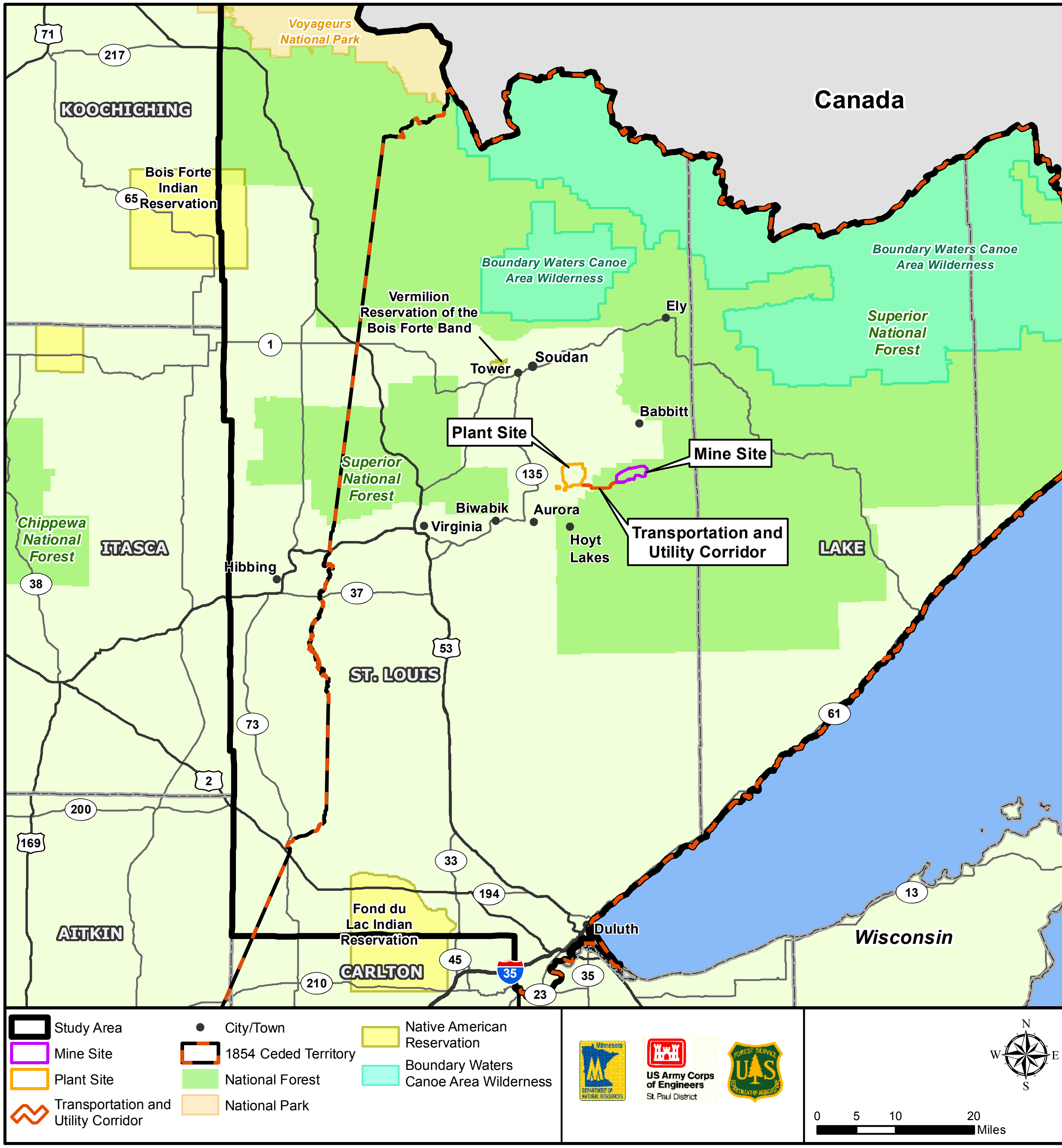

Figure 4.2.10-1
Socioeconomic Study Area
NorthMet Mining Project and Land Exchange SDEIS
Minnesota

November 2013

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Population, Age, and Race

Population and population trends for the study area from 1980 through 2010 are shown in Table 4.2.10-1. The population of St. Louis County is concentrated in and around the City of Duluth, approximately 65 miles south of the NorthMet Project area, with smaller, secondary centers in the Iron Range communities of Ely, Hibbing, and Virginia. Lake and Cook counties have few large population centers near the NorthMet Project area. The population of the study area and its individual communities has declined by nearly 10 percent since 1980 (from more than 239,000 in 1980 to 216,000 in 2010), while the population of the state as a whole has increased by more than 30 percent. In individual communities listed in Table 4.2.10-1, population has declined substantially compared to the study area as a whole. At least some of this population decline may be attributable to "the out-migration of previous residents after the decline in economic opportunity represented by the loss of so many iron industry jobs" (Powers 2007). The exceptions are the Fond du Lac, Grand Portage, and Bois Forte reservations, where populations have increased since 1990.

Table 4.2.10-1 Population of Study Area Communities 1980 to 2010

	Year				Change (1980–2010)[1]	
Geography	**1980**	**1990**	**2000**	**2010**	**Number**	**%**
Minnesota	4,075,970	4,375,099	4,919,479	5,303,925	1,227,955	30.10
Cook County	4,092	3,868	5,168	5,176	1,084	26.50
Lake County	13,043	10,415	11,058	10,866	-2,177	-16.70
St. Louis County	222,229	193,433	200,528	200,226	-22,003	-9.90
Study Area	**239,364**	**207,716**	**216,754**	**216,268**	**-23,096**	**-9.60**
Aurora	2,670	1,965	1,850	1,682	-988	-37.00
Babbitt	2,435	1,562	1,670	1,475	-960	-39.40
Biwabik	1,428	1,097	954	969	-459	-32.10
Bois Forte Reservation	na	358	657	874	516	144.10
Duluth	92,811	85,493	86,918	86,265	-6,546	-7.10
Ely	4820	3,968	3,724	3,460	-1,360	-28.20
Fond du Lac Reservation	na	3,229	3,728	4,240	1,011	31.30
Grand Portage Reservation	na	306	557	565	259	84.60
Hibbing	21193	18,046	17,071	16,361	-4,832	-22.80
Hoyt Lakes	3,186	2,348	2,082	2,017	-1,169	-36.70
Soudan	na	502	372	446	-56	-11.20
Tower	640	502	469	500	-140	-21.90
Virginia	11056	9,410	9,157	8,712	-2,344	-21.20

Source: U.S. Census Bureau 1980, 1990, 2000, and 2010b.

1 Population data for 1980 were not available for Soudan, Minnesota and the three Native American reservations. In these cases, the population change reflects the 1990–2010 time period.
na = Not available

As shown in Table 4.2.10-2, the median age of the population in study area counties and cities (typically age 40 to 45) is substantially higher than that of the state (age 35). Moreover, the median age of study area communities has grown at a more rapid pace than the state as a whole. Minnesota's median age grew by two full years between 2000 and 2010, while the median age of most study area communities—with the exception of Duluth, Hibbing, and Virginia—grew by 3 to 5 years. Again, with the exception of Duluth, study area communities tend to have (as a percentage of the total population) fewer children under 18, fewer adults (18 to 64), and more senior citizens (age 65 or older) than the state as a whole.

The study area is more than 93 percent Caucasian (see Table 4.2.10-3), compared to 85 percent for the state as a whole. However, Native Americans comprise 2 percent of the study area's population compared to 1 percent of the state's overall population.

Table 4.2.10-2 Age Characteristics of Study Area Residents, 2010

Geography	**Median Age, 2000**	**Median Age, 2010**	**Population Segments (% of total)**		
			0-17 yrs.	**18-64 yrs.**	**65+ yrs.**
State of Minnesota	35.4	37.4	24	63	13
Cook County	44.0	49.8	17	63	20
Lake County	42.9	48.3	19	59	22
St. Louis County	39.0	40.8	30	64	16
Study Area	**na**	**na**	**29**	**64**	**16**
Aurora	45.2	48.4	19	56	24
Babbitt	46.8	51.1	17	52	31
Biwabik	41.5	46.8	20	58	22
Bois Forte Reservation	31.6	34.1	33	55	13
Duluth	35.4	33.6	19	68	14
Ely	40.8	45.3	16	61	23
Fond du Lac Reservation	33.5	36.5	28	60	12
Grand Portage Reservation	36.5	39.2	23	67	10
Hibbing	41.0	42.5	22	61	18
Hoyt Lakes	45.6	49.3	20	55	25
Soudan	na	46.7	18	62	20
Tower	45.3	48.4	19	57	24
Virginia	43.2	44.9	19	59	22

Source: U.S. Census Bureau 2000 and 2010b.

Percent totals may be greater or less than 100% due to rounding.
na = Not available

Table 4.2.10-3 Racial Characteristics of Study Area Residents, 2010

Geography	Total Population	White (%)	African American (%)	Native American (%)	Asian (%)	Hawaiian/ Pac. Islander (%)	Other (%)	Multiple Races (%)	Hispanic[1] (%)
State of Minnesota	5,303,925	85	5	1	4	<1	2	2	5
Cook County	5,176	88	<1	8	<1	<1	<1	2	1
Lake County	10,866	98	<1	<1	<1	<1	<1	1	<1
St. Louis County	200,226	93	1	2	<1	<1	<1	2	1
Study Area	**216,268**	**93**	**1**	**2**	**<1**	**<1**	**<1**	**2**	**1**
Aurora	1,682	98	<1	<1	<1	0	0	1	<1
Babbitt	1,475	98	<1	<1	<1	0	<1	1	<1
Biwabik	969	98	<1	<1	<1	0	<1	<1	<1
Bois Forte Reservation	874	26	<1	70	<1	0	<1	3	3
Duluth	86,265	90	2	3	2	0	<1	3	2
Ely	3,460	96	1	<1	<1	0	<1	2	1
Fond du Lac Reservation	4,240	55	<1	39	<1	0	<1	6	2
Grand Portage Reservation	565	27	1.1	68	2	0	<1	2	<1
Hibbing	16,361	96	<1	<1	<1	0	<1	2	1
Hoyt Lakes	2,017	98	<1	<1	<1	0	0	1	<1
Soudan	446	96	1	<1	<1	0	0	<1	<1
Tower	500	95	<1	2	<1	0	<1	2	1
Virginia	8,712	92	2	3	<1	0	<1	3	2

Source: U.S. Census Bureau 2010b.

[1] Hispanic status is considered separately from racial identification.
Percent totals may be greater or less than 100% due to rounding.

Educational Attainment

Table 4.2.10-4 shows the educational attainment of residents in the study area. Educational attainment in the study area as a whole and in most study area communities (as measured by the percentage of residents age 25 and over who achieved degrees beyond a high school diploma) was lower in these communities than in St. Louis County as a whole and the state in 2010. Whereas 41 percent of state residents (age 25 and older) and 37 percent of St. Louis County residents had achieved Associate’s degrees or higher in 2010, approximately 15 to 30 percent of residents of study area communities (except for Duluth, Ely, and Soudan) had achieved similar degrees.

Table 4.2.10-4 Educational Characteristics of Study Area Residents, 2010

Geography	Total[1]	No High School Diploma (%)	High School Diploma and/or Some College (%)	Associate's Degree (%)	Bachelor's Degree (%)	Advanced Degree (%)
State of Minnesota	3,450,999	9	50	10	21	10
Cook County	4,091	7	52	8	20	13
Lake County	8,167	7	63	10	14	6
St. Louis County	133,796	8	56	11	18	8
Study Area	**146,054**	**8**	**56**	**11**	**17**	**8**
Aurora	1,146	11	64	13	9	3
Babbitt	1,047	14	68	12	5	2
Bois Forte Reservation	759	10	63	14	10	3
Biwabik	425	22	61	5	9	4
Duluth	51,753	8	51	9	21	11
Ely	2,333	8	53	14	20	6
Fond du Lac Reservation	2,472	14	61	13	10	3
Grand Portage Reservation	314	26	57	9	5	4
Hibbing	11,454	12	62	10	11	5
Hoyt Lakes	1,612	7	66	14	12	2
Soudan	348	6	49	28	12	4
Tower	315	5	67	13	9	5
Virginia	6,347	11	56	15	13	5

Source: U.S. Census Bureau 2010a.

[1] Data are for residents age 25 or older.
Percent totals may be greater or less than 100% due to rounding.

Income and Poverty

Table 4.2.10-5 shows income and poverty characteristics for the study area communities. The median income of individual study area communities is significantly lower than that of the state as a whole, with the exception of Soudan. It is also the case that the median income of individual communities is generally lower than that of St. Louis County. The median income in Babbitt and Hoyt Lakes—the communities closest to the NorthMet Project area—are two-thirds and four-fifths, respectively, of the state median income. In some study area communities, such as Ely and Tower, the median household income is slightly more than half of the state total. Poverty rates are also higher in the study area as a whole than in the state. In many individual communities, poverty rates are as high or higher than the state (with the exceptions of Hoyt Lakes, Soudan, and Tower).

Table 4.2.10-5 Income and Poverty Characteristics of Study Area Communities in 2010

Geography	Median Household Income ($)	Percentage of State Median Household Income	Population with Income Below Poverty Level[1, 2]	Percentage of Population Below Poverty Level[1,2]
State of Minnesota	57,243	na	542,133	11
Cook County	49,162	86	463	9
Lake County	46,765	82	1,252	12
St. Louis County	44,941	79	28,931	15
Study Area	**na**	**na**	**30,646**	**15**
Aurora	45,285	79	182	12
Babbitt	37,500	66	133	10
Biwabik	40,417	57	197	19
Bois Forte Reservation	32,656	71	100	15
Duluth	41,092	72	16,339	20
Ely	31,905	56	561	18
Fond du Lac Reservation	41,300	72	893	22
Grand Portage Reservation	33,056	58	82	17
Hibbing	36,585	64	2,737	17
Hoyt Lakes	45,338	79	89	5
Soudan	65,000	114	27	7
Tower	31,607	55	21	5
Virginia	32,664	57	1,759	21

Source: U.S. Census Bureau 2010a.

1 Percentage based on the "Population for whom poverty status is determined" which is less than the total population.
2 The United States Census Bureau defines poverty status using a set of monetary standards (consistent with *Office of Management and Budget Statistical Policy Directive 14*) that vary by family size and composition (e.g., marital status and number of children). Poverty thresholds are updated annually to reflect economic conditions. Poverty thresholds in 2009 (the year for which the data in this table are presented) can be found at:
http://www.census.gov/hhes/www/poverty/data/threshld/thresh09.html
Percent totals may be greater or less than 100% due to rounding.
na = Not available

4.2.10.1.2 Employment

This section evaluates two different measures of employment. At-place employment describes jobs that exist in a given location, regardless of where job-holders live. It is a measure of the economic activity in a community. However, workers in northeastern Minnesota are often accustomed to driving long distances to jobs, particularly in the mining industry (Powers 2007). Thus, information about at-place employment is supplemented with information about jobs held by residents. This second measure describes the extent to which a community's residents are employed.

At-place Employment

Tables 4.2.10-6 and 4.2.10-7 show at-place employment trends for the study area by major industry classification. Data from 1980 and 1990 are reported by SIC (see Table 4.2.10-6), while 2009 data reflect industries as defined by the North American Industrial Classification System

(NAICS) (see Table 4.2.10-7), which replaced the Standard Industrial Classification (SIC) system in 1997.

Table 4.2.10-6 At-place Historical Employment by Major SIC Industry in 1980 and 1990

Major Industry	**Minnesota**		**Cook County**		**Lake County**		**St. Louis County**	
Year	1980	1990	1980	1990	1980	1990	1980	1990
Agricultural services	3,950	6,812	na	na	A[1]	B	93	152
Metal mining	16,182	7,437	0	A	F	E	12,208	5,317
Construction	82,673	76,200	75	101	E	B	4,305	2,577
Manufacturing	392,742	394,202	122	C	366	621	8,595	6,162
Transportation, communications, utilities	84,967	106,166	22	A	113	122	3,360	3,713
Wholesale trade	114,717	133,464	A	A	74	B	4,247	2,907
Retail trade	322,153	395,801	265	459	590	633	16,457	16,602
Finance, insurance, real estate	101,314	133,678	34	82	102	C	3,211	2,805
Services	367,202	573,009	358	F	455	595	16,716	22,598
Public administration	8,780	5,387	A	A	18	A	366	184
Total	1,494,680	1832,156	895	1,401	2,985	2,555	69,558	63,017

Source: UVGSDC 2008.

[1] Letter codes indicate suppression flags in the original data set—cases where exact data were withheld by the United States Census Bureau in order to protect company-confidential data. As a result, study area data cannot be calculated. Flags indicate approximate employment, as follows: A: 0-19 employees; B: 20-99 employees; C: 100-249 employees; E: 250-499 employees; F: 500-999 employees.

na = Not available

Table 4.2.10-7 At-place Employment by Major NAICS Industry in 2009

	Minnesota		Cook County		Lake County		St. Louis County	
Major NAICS Industry	**Number**	**% of Total**	**Number**	**% of Total**	**Number**	**% of Total**	**Number**	**% of Total**
Forestry, fishing, hunting	2,462	<1	A[1]	na	A	na	172	<1
Mining, quarrying, oil/gas	4,703	<1	B	na	C	na	3,151	4
Utilities	13,711	<1	120	6	B	na	921	1
Construction	99,101	4	B	na	96	3	3,261	4
Manufacturing	307,822	13	9	<1	F	na	4,378	5
Wholesale trade	131,638	5	283	14	B	na	2,279	3
Retail trade	291,328	12	A	na	332	11	12,583	15
Transportation, warehousing	75,384	3	59	3	A	na	1,934	2
Information	64,096	3	36	2	C	na	2,187	3
Finance and insurance	148,621	6	B	na	179	6	3,655	5
Real estate	36,296	2	B	na	84	3	1,017	1
Professional, sci., tech. svcs.	139,270	6	26	1	B	na	3,269	4
Management	118,124	5	42	2	41	1	937	1
Admin., support, waste mgt.	123,915	5	C	na	B	na	3,212	4
Educational services	66,458	3	304	15	E	na	2,360	3
Health care, social assistance	421,935	18	641	33	54	2	21,789	27
Arts, entertainment, recreation	39,550	2	46	2	607	21	1,221	2
Accommodation, food svcs.	213,136	9	A	na	174	6	9,308	11
Other svcs.	119,334	5	-	0	-	0	3,995	5
Industries not classified	290	<1	-	0	-	0	5	<1
Total	2,417,174	100.0	1,975	100.0	2,955	100.0	81,634	100.0

Source: U.S. Census Bureau 2009.

Percent totals may be greater or less than 100% due to rounding.

[1] Letter codes indicate suppression flags in the original data set—cases where exact data were withheld by the United States Census Bureau in order to protect company-confidential data. As a result, study area data cannot be calculated. Flags indicate approximate employment, as follows: A: 0-19 employees; B: 20-99 employees; C: 100-249 employees; E: 250-499 employees; F: 500-999 employees.

na = Not available

In 2009, the top employment sectors in the study area were health care and social assistance, retail trade, manufacturing, educational services (which does not include public schools or other public education functions), and accommodation and food services. SIC and NAICS data are available for counties, whole zip codes, and Metropolitan Statistical Areas, but not for the specific geographic areas considered in this chapter (i.e., most of the study area communities occupy only a portion of a zip code; thus, the data for the whole zip code are not appropriate). Therefore, only county-level data are used. The U.S. Census Bureau withholds some data for smaller geographies (such as cities); therefore, study area totals cannot be calculated.

Mining employment has declined consistently in all three study area counties, from more than 12,000 in 1980 to approximately 3,000 in 2009 in St. Louis County. Mining-related employment is volatile and fluctuates from year to year due to the market price of commodities being extracted. Since mining employment can vary greatly from one year to the next, the decline observed from 1980 and 2009 does not represent a steady reduction in mining-related employment. At the same time, service-related employment in the study area (which includes the NAICS categories for professional services, management, health care, education, arts/entertainment, and accommodation/food) has increased substantially since 1980, mirroring broader state and national trends.

Industry Concentrations

Certain industries, particularly mining and utilities, are more concentrated in the study area, particularly St. Louis County, than in the state as a whole. Sector concentration can be measured by the location quotient (LQ), which is the ratio between the local economy and the economy of a reference unit, such as the state. For this analysis, the LQ was calculated using each study area county as a local economy and the state as the reference unit. Given the number of industry totals that were suppressed by the U.S. Census Bureau in Tables 4.2.10-6 and 4.2.10-7, a combined study area LQ could not be calculated. A LQ of 1.00 indicates that a given industry is exactly as strong, in terms of employment, in the local economy as it is in the reference economy. A LQ below 1.00 indicates a relatively weak local industry, while a LQ above 1.00 indicates a relatively strong local industry.

As illustrated by Table 4.2.10-8, the LQ for the mining industry in St. Louis County is nearly 20, meaning that mining employment in the county is approximately 20 times as concentrated as in the state as a whole. As noted above, LQs for the study area as a whole could not be calculated because of data confidentiality. However, this concentration has been declining in recent years. In 1980 (see Table 4.2.10-6), St. Louis County accounted for approximately 75 percent of the state's mining employment. In 2009 (see Table 4.2.10-7), that share had fallen to approximately 66 percent of state mining employment. Mining employment in other study area counties was minimal.

The high LQ for the utilities industry is likely tied to power plants and utility infrastructure that support the region's mining activity. Other relatively high LQ values vary by county, but generally include educational services, health care and social assistance, and arts/entertainment. Forestry, fishing, and hunting have high LQ values in St. Louis County, while Real Estate has a high LQ value in Lake County. Industries with particularly low LQ values include manufacturing and management. These findings support stakeholder observations about the strength of the region's tourism economy (real estate in Lake County, arts, entertainment, accommodation, and food).

Regional Tourism

Tourism is rooted in the Arrowhead region's unique recreation opportunities such as the BWCAW, and is more broadly dependent on recreational opportunities such as hunting, fishing, boating, sightseeing, and wilderness experiences provided by the region's high-quality natural environment.

Mining and tourism have coexisted in the study area for decades. As shown in Table 4.2.10-7, industries associated with tourism (arts, entertainment, recreation, accommodation, and food) account for nearly 13 percent of all employment in St. Louis County (data could not be summed for the entire study area). The "attractive landscape and climatic features [of the region have] attracted recreationists, retirees, and other new residents" (Powers 2007). In particular, retirement income (from individuals who move to the Arrowhead region for its recreational and scenic resources) has been an important source of economic vitality for the region's communities (Powers 2007). These non-mining economic gains have occurred in the presence of active mining activity (including the Northshore Mine adjacent to the NorthMet Project area) and the remnant landscape of past mining activity.

Retirees

The demographic data in Section 4.2.10.1.1, as well as some of the industry clusters identified above, support the views, expressed by some stakeholders, that the study area is an increasingly attractive location for retirees. The median ages in nearly all study area communities increased between 2000 and 2010, and are, in most cases, higher than the state median (see Table 4.2.10-2). The relative strength of the Health Care and Social Assistance industry category is also consistent with an older population in need of such services.

The employment status data in Table 4.2.10-9 may also support this conclusion about retirees: statewide, 71 percent of residents over the age of 16 participate in the workforce (i.e., they hold or are actively looking for a job). By comparison, only 62 percent of the over-16 population in the study area is in the workforce. While some of this difference is likely attributable to long-term unemployment (which often leads workers to drop out of the workforce entirely), this gap may also suggest the presence of retired individuals, who are, by definition, no longer in the workforce.

Research also shows links between the presence of recreation and natural amenities and increased retirement throughout the United States (see McGranahan 1999). The economic data cited above, combined with the amenities present in and near the study area—such as BWCAW, Superior National Forest, and the other resources described throughout this SDEIS—are consistent with the findings of this type of research.

Table 4.2.10-8 Location Quotients for Major NAICS Industries in the Study Area, 2009

Industry	Cook County	Lake County	St. Louis County
Forestry, fishing, hunting	na	na	2.07
Mining, quarrying, oil/gas	na	na	19.84
Utilities	10.71	na	1.99
Construction	na	0.79	0.97
Manufacturing	0.04	na	0.42
Wholesale trade	2.63	na	0.51
Retail trade	na	0.93	1.28
Transportation, warehousing	0.96	na	0.76
Information	0.69	na	1.01
Finance and insurance	na	0.99	0.73
Real estate	na	1.89	0.83
Professional, scientific, technical services	0.23	na	0.70
Management	0.44	0.28	0.23
Admin., support, waste mgt.	na	na	0.77
Educational services	5.60	na	1.05
Health care, social assistance	1.86	0.10	1.53
Arts, entertainment., rec.	1.42	12.55	0.91
Accommodation, food services	na	0.67	1.29
Other services	NA	NA	0.99
Industries not classified	NA	NA	0.51

Source: U.S. Census Bureau 2009.

Note: LQs compare county employment to statewide employment. LQs for the entire study area cannot be calculated.
na = Not available

Jobs Held by Residents

Employment data for residents of study area communities is shown in Table 4.2.10-9. Unemployment rates in Lake and Cook counties were generally consistent with or lower than statewide unemployment. However, unemployment in St. Louis County and particularly in individual St. Louis County communities was generally much higher than in the state as a whole. These data are estimates based on information collected by the U.S. Census Bureau from 2005 to 2009, and thus may not fully capture the depth of the unemployment effects that the study area has experienced as a result of the national recession during and following that time period.

Occupation (e.g., general type of work) and industry classifications of jobs held by study area residents are shown in Tables 4.2.10-10 and 4.2.10-11. These data show that management, science, business, arts, sales, education, health, manufacturing, and retail make up a large percentage of the jobs held by study area residents. The sectors of agriculture, forestry, fishing and hunting, and mining (including metal mining such as the NorthMet Project Proposed Action) account for a higher share of locally held jobs than the statewide average. This is especially true for communities closer to the mine (e.g., Aurora, Babbitt, Biwabik, and Hoyt Lakes).

Occupational categories are provided for each community per the U.S. Census Bureau’s SIC definitions. The occupation categories also show the prevalence of management and service job functions as opposed to more traditional production and manufacturing activities typically associated within mining.

Table 4.2.10-9 Employment Status of Study Area Communities, 2009

Geography	Total Population ≥16 Years	In Civilian Labor Force[1]	Employed	Unemployed	Unemployment Rate (%)
State of Minnesota	4,111,966	2,916,931	2,730,721	186,210	6
Cook County	4,455	2,875	2,741	134	5
Lake County	9,143	5,596	5,395	201	4
St. Louis County	164,849	102,619	94,402	8,217	8
Study Area	**178,447**	**111,090**	**102,538**	**8,552**	**7.7**
Aurora	1,264	681	641	40	6
Babbitt	1,167	579	544	35	6
Biwabik	508	318	240	78	25
Bois Forte Reservation	850	481	445	36	8
Duluth	71,606	46,415	42,629	3,786	8
Ely	3,064	1,751	1,617	134	8
Fond du Lac Reservation	3,089	1,935	1,662	273	14
Grand Portage Reservation	331	227	218	9	4
Hibbing	13,222	7,166	6,531	635	9
Hoyt Lakes	1,740	996	834	162	16
Soudan	397	273	256	17	6
Tower	353	201	178	23	11
Virginia	7,157	3,814	3,413	401	11

Source: U.S. Census Bureau 2010a.

[1] Excludes armed forces personnel, and individuals who reported that they were not seeking employment.
Percent totals may be greater or less than 100% due to rounding.

Table 4.2.10-10 Employment in Study Area Communities by Occupation

Geography	Civilian Employed Pop. ≥16 Years	Occupation (% of total employed population)				
		Management, Science, Business, Arts	Services	Sales/ Office	Natural Resources	Production/ Transportation
State of Minnesota	2,730,721	38	16	25	9	13
Cook County	2,741	33	18	27	13	9
Lake County	5,395	27	22	22	14	15
St. Louis County	94,402	34	21	24	11	10
Study Area	**102,538**	**34**	**21**	**24**	**11**	**10**
Aurora	641	25	21	17	21	16
Babbitt	544	21	19	27	14	18
Biwabik	445	22	30	17	16	15
Bois Forte Reservation	240	22	26	29	14	10
Duluth	42,629	37	23	24	7	9
Ely	1,617	25	31	29	10	5
Fond du Lac Reservation	1,662	24	25	23	11	17
Grand Portage Reservation	218	21	38	24	15	2
Hibbing	6,531	27	23	28	13	10
Hoyt Lakes	834	20	21	20	18	21
Soudan	256	22	28	20	14	17
Tower	178	26	29	17	19	8
Virginia	3,413	31	22	25	16	6

Source: U.S. Census Bureau 2010a.

Percent totals may be greater or less than 100% due to rounding.

Table 4.2.10-11 Employment in Study Area Communities by Industry

		Industry (% of total employed population)												
Geography	**Civilian Employed Population ≥16 Years**	Forestry, Fishing, Hunting, and Mining	Construction	Manufacturing	Wholesale	Retail	Transportation and Utilities	Information	Finance, Insurance, Real Estate	Professional, Scientific, Management, Administration	Education, Health	Arts, Entertainment, Recreation, Accommodation, Food	Other Services, except Public Administration	Public Administration
Minnesota	2,730,721	2	6	14	3	12	5	2	7	9	24	8	4	3
Cook County	2,741	2	10	7	1	14	2	1	9	10	13	20	4	9
Lake County	5,395	8	7	9	1	10	5	2	6	6	27	13	4	3
St. Louis County	94,402	4	7	7	2	12	6	2	5	6	31	11	4	5
Study Area	**102,538**	**4**	**7**	**7**	**2**	**12**	**5**	**2**	**5**	**6**	**30**	**11**	**4**	**5**
Aurora	641	15	14	8	2	8	9	1	5	4	25	8	0	1
Babbitt	544	17	5	7	2	11	4	1	6	6	19	12	6	5
Biwabik	445	15	5	4	2	16	4	1	3	3	35	10	2	1
Bois Forte Reservation	240	5	8	5	1	4	6	0	1	3	16	35	2	14
Duluth	42,629	1	5	6	2	12	5	2	5	7	35	12	4	4
Ely	1,617	6	5	3	1	12	1	1	5	13	20	19	8	6
Fond du Lac Reservation	1,662	1	7	12	4	11	3	1	4	4	21	16	3	12
Grand Portage Reservation	218	0	5	2	1	19	2	0	14	6	15	25	2	9
Hibbing	6,531	7	6	9	2	13	7	1	4	6	27	9	6	4
Hoyt Lakes	834	13	8	12	0	14	9	0	6	8	21	5	3	3
Soudan	256	7	8	12	2	4	5	0	8	1	23	26	0	5
Tower	178	1	2	8	2	8	0	0	7	1	19	33	12	7
Virginia	3,413	6	8	7	1	12	5	2	7	7	28	8	4	5

Source: U.S. Census Bureau 2010a.

Percent totals may be greater or less than 100% due to rounding.

Income

Table 4.2.10-12 shows the average income earned by employees in each major NAICS industry. Mining and utilities pay very high average wages statewide and in St. Louis County. However, wages paid to health care and social services workers account for more than one-quarter of the total wages paid by private companies in St. Louis County and for more than 16 percent of statewide wages.

4.2.10.1.3 Public Finance

Sales and use tax revenues from study area counties by all industries and the mining industry are summarized in Table 4.2.10-13. This table illustrates the relative sales and use tax contribution from the mining industry in the state.

The mining and processing of base and precious metals in the state are not currently subject to production tax. However, mining is subject to the following taxes (MDR 2011):

- Net proceeds tax: tax proceeds are distributed to the state general fund if mined resources do not fall within the taconite assistance area. Taxes paid on mined resources within the taconite assistance area (which includes the NorthMet Project area) are distributed as follows: 5 percent to the city or town where mined, 10 percent to the Municipal Aid Account, 10 percent to the school district, 20 percent to the Regular School Fund, 20 percent to Taconite Property Tax Relief, 5 percent to IRRRB, 5 percent to the Douglas J. Johnson Economic Protection Trust Fund, and 5 percent to the Taconite Environmental Protection Fund.
- Occupation tax: 2.45 percent of the taxable amount (typically the mine value), as determined by the Minnesota Department of Revenue. Revenue generated through the occupation tax is credited to the general fund, with 10 percent designated for the University of Minnesota, 40 percent designated for public elementary and secondary schools, and 50 percent remaining in the state’s general fund.
- Sales and use tax: 6.875 percent of all purchases that do not qualify for an exemption.
- Withholding tax on royalty payments: 6.25 percent of royalty payment.

Ad valorem tax is established and collected by the counties, local communities, and school districts according to Minnesota state law.

4.2.10.1.4 Housing

Table 4.2.10-14 illustrates the housing characteristics of the study area. Much of the overall vacancy rate reflects the large number of seasonal (vacation) homes in the region, particularly in Cook and Lake counties where nearly two-thirds of vacant housing units are for seasonal use. Excluding seasonal units, vacancy rates in the study area are somewhat higher than in the state as a whole, although vacancy rates in individual communities vary significantly. There are approximately 5,400 hotel rooms and 1,175 occupied berths and 225 vacant berths in mobile home parks in the study area (Northland Connection 2012). Hotels and mobile homes are often used by mine construction employees, especially those with short-term assignments. The study area has a slightly lower share of owner-occupied housing units than in the state. Household sizes are smaller in the study area than in the state as a whole. These data are consistent with trends (see Section 4.2.10.1.2) suggesting that the study area is becoming increasingly attractive to retirees, who tend to have higher home ownership rates and smaller household sizes than other segments of the population.

Table 4.2.10-12 Payroll ($1,000s) by Major NAICS Industry, 2009

	Minnesota		Cook County		Lake County		St. Louis County	
Industry	**Payroll**	**Avg. per Employee**	**Payroll**	**Avg. per Employee**	**Payroll**	**Avg. per Employee**	**Payroll**	**Avg. per Employee**
Forestry, fishing, hunting	$79,116	$32,135	D	na	$172	na	$4,723	$27,459
Mining, quarrying, oil/gas	$322,301	$68,531	D	na	D	na	$196,993	$62,518
Utilities	$1,085,613	$79,178	$5,043	$42,025	D	na	$73,916	$80,256
Construction	$5,558,534	$56,090	D	na	$2,959	$30,823	$179,640	$55,087
Manufacturing	$14,782,085	$48,022	$483	$53,667	$23,083	na	$187,373	$42,799
Wholesale trade	$8,320,168	$63,205	$6,647	$23,488	D	na	$96,299	$42,255
Retail trade	$6,773,100	$23,249	D	na	$7,672	$23,108	$265,991	$21,139
Transportation, warehousing	$2,938,953	$38,986	$2,589	$43,881	D	na	$73,216	$37,857
Information	$3,920,852	$61,172	$1,518	$42,167	$2,540	na	$82,475	$37,711
Finance and insurance	$10,454,638	$70,344	$804	na	$5,819	$32,508	$146,947	$40,204
Real estate	$1,335,591	$36,797	$796	na	$1,339	$15,940	$25,263	$24,841
Professional, sci., tech. svcs.	$8,121,631	$58,316	$611	$23,500	$1,172	na	$148,666	$45,478
Management	$9,246,827	$78,281	$989	$23,548	$972	$23,707	$59,195	$63,175
Admin., support, waste mgt.	$4,215,273	$34,017	D	na	D	na	$65,069	$20,258
Educational services	$1,661,448	$25,000	$6,027	$19,826	$11,497	na	$50,130	$21,242
Health care, social assistance	$16,303,572	$38,640	$11,675	$18,214	$1,447	$26,796	$822,689	$37,757
Arts, entertainment, rec.	$1,087,163	$27,488	$655	$14,239	$9,972	$16,428	$18,759	$15,364
Accommodation, food svcs.	$3,068,339	$14,396	D	na	$2,722	$15,644	$125,175	$13,448
Other svcs.	$2,898,411	$24,288	$-	na	$-	na	$79,563	$19,916
Industries not classified	$5,619	$19,376	$-	na	$-	na	$169	$33,800
Total	$102,179,234	$42,272	$52,668	$26,667	$86,786	$29,369	$2,702,251	$33,102

Source: U.S. Census Bureau 2009.

Letter codes indicate suppression flags in the original data set—cases where exact data were withheld by the United States Census Bureau in order to protect company-confidential data. Flags indicate approximate employment, as follows:
A: 0-19 employees; B: 20-99 employees; C: 100-249 employees; E: 250-499 employees; F: 500-999 employees.
na = Not available

Table 4.2.10-13 Select Sales and Use Tax Statistics ($1,000s)

	Total Tax (Sales and Use)					
	Cook County		Lake County		St. Louis County	
Year	**All Industries**	**Metal Mining**	**All Industries**	**Metal Mining**	**All Industries**	**Metal Mining[2]**
1995	$3,345	NR[1]	$4,318	NR	$91,008	NR
2000	$4,192	0	$5,390	0	$114,011	$4,150
2009	$5,897	0	$8,515	0	$158,227	$7,210

Source: MDR 2010.

[1] NR: Not reported
[2] 2009 data reported as "Mining – All Other".

Table 4.2.10-14 Study Area Housing Unit Characteristics, 2010

Geography	Total HU	Occupied HU (%)	Owner-Occupied HU (%)	Renter-Occupied HU (%)	Vacancy Rate (%)	Vacancy Rate, Non-seasonal (%)	Average Household Size (persons)
Minnesota	2,347,201	89	65	24	11	6	2.48
Cook	5,839	43	32	11	57	5	2.05
Lake	7,681	63	51	12	37	6	2.21
St. Louis	103,058	82	59	24	18	6	2.25
Study Area	**116,578**	**79**	**57**	**22**	**21**	**6**	**2.24**
Aurora	887	88	68	20	12	9	2.09
Babbitt	818	86	74	13	14	9	2.07
Biwabik	543	86	63	24	14	10	2.03
Duluth	38,208	93	57	37	7	6	2.23
Ely	2,022	83	54	29	17	13	1.93
Hibbing	8,200	90	64	26	10	8	2.17
Hoyt Lakes	1,016	87	77	10	13	9	2.27
Soudan	244	84	75	9	16	8	2.18
Tower	331	80	54	26	20	10	1.89
Virginia	4,738	90	51	38	11	10	1.95
Bois Forte Reservation	451	65	46	20	35	5	2.97
Fond du Lac Reservation	1,729	89	66	23	11	3	2.72
Grand Portage Reservation	313	82	41	41	18	4	2.20

Source: U.S. Census Bureau 2010a.

Percent totals may be greater or less than 100% due to rounding.
HU = Housing unit(s).

4.2.10.1.5 Public Services and Facilities

Water and Sewer

Table 4.2.10-15 summarizes the condition of public water and sewer facilities throughout the study area. All of the cities evaluated have public water and wastewater systems, with varying degrees of available capacity. Residents and businesses in unincorporated areas typically rely on individual wells and septic systems. Potable water for municipal systems comes from either groundwater or surface water (notably, Duluth obtains its drinking water from Lake Superior). Most of the public water and sewer infrastructure supporting the study area communities was constructed to accommodate larger populations than currently reside in the area (e.g., the 1980 and 1990 populations listed in Table 4.2.10-1).

Table 4.2.10-15 Water and Wastewater Capacity

	Water			Wastewater		
Geography	**Capacity (MGD)[1]**	**Average Demand (MGD)**	**System Issues/Upgrades**	**Capacity (MGD)**	**Average Demand (MGD)**	**System Issues/Upgrades**
Aurora	0.864	0.222	Study underway with Biwabik to identify new water source. Considering building a new facility for both.	0.900	0.200	$7 million upgrade in the last four years.
Babbitt	0.600	0.200	None	0.500	0.200	Consulting firm hired to look into upgrading or rebuilding a new wastewater plant.
Biwabik	0.430	0.128	Study underway with Aurora to identify new water source. Considering building a new facility for both.	0.220	0.160	None
Duluth	40	19	Water tower to go online mid-May 2012 adding 900,000 gallons to the 68 million storage capacity.	100	16	The city is upgrading or replacing two wastewater lift stations each year at an annual cost of $600,000 per year.
Ely	1	0.350	$350,000 rehab work every year.	1.5	0.400	$350,000 rehab work every year.
Hibbing	3.2	2.3	None	4.5	2	Wastewater inflow & infiltration concerns throughout the city; certain neighborhoods have wastewater backups during large rain events.
Hoyt Lakes	1.5	0.307	Minor upgrades to the water plant.	0.650	0.270	Began preliminary engineering for rebuilding wastewater facility.
Soudan/ Tower[2]	0.300	0.0900	Needs new water tower.	0.176	0.13	None
Virginia[3]	5	1.7	None	4.3	2	Starting project to expand wastewater plant and reduce mercury; projected completion 1st quarter 2013.

Source: Northland Connection 2012.

1 MGD = million gallons per day.
2 Soudan and Tower share resources
3 Data reflect current wastewater system. Once wastewater upgrade is complete, capacity will increase to 9.9 mg/d and average demand will go up to 3.1 mg/d.

Emergency Services

Table 4.2.10-16 illustrates the available public safety resources. Each county in the study area has its own sheriff's department, which provides law enforcement and other services for unincorporated areas. Municipalities provide their own police protection, except for Aurora, which contracts with the St. Louis County Sherriff's Office (SLCPD 2012) and Biwabik, which receives law enforcement from Gilbert (Northland Connection 2012). The St. Louis County Sheriff's Office also maintains countywide 911 service, coordinating police, fire, and emergency medical response. Similarly, each community maintains its own fire department, typically a volunteer department. The City of Babbitt fire department provides emergency response to the Northshore Mine, and has up-to-date equipment.

A variety of public and private ambulances provide emergency medical service for the study area. Ambulance service is integrated into some municipal fire departments (such as Babbitt, Duluth, Hibbing, and Virginia). Other municipalities either contract with nearby cities or with private ambulance services.

Table 4.2.10-16 Public Safety

Geography	Police Officers	Firefighters	EMS Ambulance Personnel
Aurora	5	22	7
Babbitt	4	35	25
Biwabik	7(2)	21	21
Duluth	152	125	48
Ely	8	32	27
Hibbing	30	23	19
Hoyt Lakes	6	21	23
Soudan/Tower[1]	1	15	19
Virginia	18	21[3]	21[3]

Source: Northland Connection 2012.

1 Soudan and Tower share resources.
2 Biwabik receives law enforcement from Gilbert.
3 Firefighters are full-trained EMS and operate ambulance services from fire hall.

Medical Services

The study area communities are served by both medical clinics and hospital facilities. The closest medical facility to the NorthMet Project area is Essentia Health Northern Pines in Aurora. This 16-bed facility has Level IV trauma status, indicating that staff are able to stabilize patients for transport to more advanced trauma centers (Essentia 2012). Other nearby Level IV trauma centers are in Ely and Virginia, while the nearest advanced care (Level II) hospitals are Essentia Health St. Mary's Medical Center and St. Luke's Hospital, both in Duluth (MDH 2011).

Education

Table 4.2.10-17 shows the capacity and enrollment of public schools. As with other public services and facilities, each municipality maintains its own public school system, supplemented with county-run independent school systems. Most public schools in the region are designed to accommodate larger populations. Some jurisdictions, such as the Duluth school district, are choosing to close or repurpose school buildings.

Table 4.2.10-17 Capacity and Enrollment of Public Schools

Geography	Capacity	Enrollment	Facilities to be Upgraded, Replaced, Combined, or Closed
Aurora[1]	1,500	886	The district plans to replace boilers and resurface parking lots at their facilities.
Babbitt	1,200	348	None
Biwabik[1]	1,500	886	The district plans to replace boilers and resurface parking lots at their facilities.
Duluth	9,800	8,308	School district is downsizing and modernizing its facilities, resulting in one less high school, one less middle school, two less elementary schools, and one less K-8 facility.
Ely	1,775	542	None
Hibbing	2,680	2,319	None
Hoyt Lakes[1]	1500	886	The district plans to replace boilers and resurface parking lots at their facilities.
Tower/Soudan[2]	175	94	None
Virginia	1,623	1,623	Considering setting up portable classrooms for fall 2012; community is in the process of securing funding and support to either add or build new facilities.

Source: Northland Connection 2012.

1 These communities are part of the Mesabi School district.
2 Soudan and Tower share resources.

The region is also served by a number of community and technical colleges (MNSCU 2012):

- **Mesabi Range Community and Technical College (Virginia and Eveleth)**: Offers 50 diploma, certification, or degree (A.A.) programs, with notable specialties in wind energy technology, and human services.
- **Vermilion Community College (Ely):** Offers 30 programs, many focused on environmental programs and outdoor careers, such as water quality science, outdoor therapeutic recreation, sports management, park ranger training.
- **Hibbing Community College:** Offers a mix of more than 40 programs ranging from traditional liberal arts to career-oriented programs.
- **Fond du Lac Tribal and Community College (Cloquet):** Offers nearly 40 programs, ranging from liberal arts and nursing to specialty programs in American Indian studies, geospatial technologies, environmental science, and clean energy technology.
- **Lake Superior College (Duluth):** Offers nearly 100 programs, with heavy emphasis on nursing and other medical specialties, along with a full range of liberal arts and professional training.

The study area is also home to two 4-year institutes of higher learning. These include the University of Minnesota Duluth, with nearly 12,000 enrolled undergraduate, graduate, and other students (University of Minnesota Duluth 2011); and the College of St. Scholastica in Duluth, with more than 4,000 enrolled students (CSS 2012).

4.2.10.1.6 Subsistence

There is no nationwide federal definition of subsistence, nor has the State of Minnesota developed a formal definition. Title VIII of the Alaska National Interest Lands Conservation Act (P.L. 96-487) defines subsistence for rural Alaska residents (regardless of whether they are Native American) as:

> the customary and traditional uses…of wild renewable resources for direct, personal, or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of non-edible byproducts of fish and wildlife resources taken for personal or family consumption; for barter, or sharing for personal or family consumption; and for customary trade.

This Alaskan definition is consistent with subsistence activities within the study area as well. For many study area residents, particularly members of Bois Forte, Fond du Lac, and Grand Portage, as well as other Native American bands, subsistence hunting, fishing, trapping, and gathering activities are a significant activity. Individuals participate in subsistence activities for numerous reasons, including food supply, personal income, and the continuance of cultural customs and traditions.

As part of the 1854 Treaty, Native American bands retain the right "to hunt, fish, trap, and gather for subsistence on public lands and waters open to the public (publicly owned and accessible to the public without charge) within the [1854 Ceded Territory]" (MDNR 2010). The 1854 Treaty and subsequent court interpretations also include limited rights to commercial harvest.

A 2002 study of subsistence activities amongst the Bois Forte and Grand Portage Bands (Vogt 2004) demonstrates the wide variety of species and items collected as part of subsistence activities in the study area, including the following:

- fish: more than 25 species, with the most commonly harvested being walleye, northern pike, lake trout, and crappie;
- birds and mammals: more than 10 species, with the most commonly harvested being deer, grouse, moose, and duck; and
- plants: more than 12 species/items, with the most commonly harvested being wild rice, various berries, and maple sap/syrup.

Among the survey respondents, subsistence activity (including hunting, fishing, and plant gathering) accounted for approximately one meal per week. Subsistence activity typically occurs either on Native American reservations or within other parts of the 1854 Ceded Territory. Fishing and hunting occur throughout the year, although harvesting fish for consumption is more prevalent during warmer months, while harvesting land animals is more prevalent during colder months (Vogt 2004). Grand Portage's subsistence fish consumption averages 144 grams/day, five times higher than the MPCA assumed fish consumption rate of 30 grams/day. Fond du Lac's subsistence fish consumption is on average 60 grams/day, two times higher than the MPCA assumed fish consumption rate (ERM 2012). The effects of mercury bioaccumulation on subsistence activity are discussed in Section 5.2.10.2.6.

In addition to the survey results described above, Table 4.2.9-3 in Section 4.2.9 shows other animal and plant species that have historically been and/or could potentially be harvested in the 1854 Ceded Territory.

The 1854 Treaty Authority manages big game (moose, deer, and bear) hunting, as well as furbearer trapping (pine marten, fisher, otter, and bobcat) on behalf of the Bois Forte and Grand Portage bands, in accordance with a 1988 negotiated agreement with Minnesota. Under this agreement, big game harvests are limited. Harvests for all species (including big game and trapping) have generally declined since 1994 (Edwards 2012).

The Mine Site and Transportation and Utility Corridor fall partially within the state-defined moose harvest area, although no moose were harvested by the bands within approximately 20 miles of this location from 1994-2011. The majority of deer hunting and a portion of furbearer trapping occurred in St. Louis County during this time period (Edwards 2012).

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4.2.11 Recreation and Visual Resources

This section describes the recreational facilities and activities that typically take place in the NorthMet Project area, as well as the surrounding Arrowhead region. Because recreation in this region is strongly tied to the aesthetic condition of the landscape, this section also describes the visual setting of the NorthMet Project area and surrounding land.

4.2.11.1 Mine Site

4.2.11.1.1 Recreational Facilities and Activities

Surface rights to the Mine Site and adjoining federal lands are held by the USFS, and the Mine Site is part of the Superior National Forest. Management of the physical, biological, and social resources of the Superior National Forest are set forth in the Forest Plan. Intended to ensure that ecosystems are capable of a sustainable flow of beneficial goods and services, the plan includes guidelines and standards for almost 20 activities within the Superior National Forest including recreation and scenic, or visual, resources.

Recreation opportunities in the Superior National Forest are managed within the framework of the Recreation Opportunity Spectrum (ROS). Using criteria that consider distance to roads, motorized lakes and trails (i.e., lakes and trails where motorized transportation is permitted), this system defines five classes that summarize recreation setting, opportunity, and experience. At one extreme, areas designated “primitive” have little evidence of people and are difficult to access. At the other extreme, “rural” areas are more accessible and provide developed facilities as well as opportunities to interact with other recreationists.

Most of the Mine Site is within the Semi-Primitive Motorized ROS with a small portion being Roaded Natural. This designation indicates areas where motor vehicles may be permitted and interactions between visitors are intended to be infrequent, but where human activity such as timber harvesting may be visible.

While this designation permits recreational activity, the Mine Site is entirely surrounded by private, restricted property, roads, and railroads. In particular, the Northshore Mine borders the Mine Site to the north, the restricted-access Plant Site borders the Mine Site to the west, and the Transportation and Utility Corridor isolates the Mine Site from adjacent portions of the Superior National Forest to the south. Some portions of the Mine Site are contiguous with Superior National Forest and state-owned public land, notably the eastern boundary of the Mine Site. However, these public lands are also encircled by restricted property, roads, and railroads. As a result, there is no public access to, and no practical opportunity to engage in recreational activity at, the Mine Site.

The region surrounding the Mine Site and adjoining federal lands is a popular and highly valued destination for recreation. Recreational activities that typically occur within 25 miles of the federal lands include (but are not limited to):

- Boating and camping in the BWCAW (approximately 20 miles north of the federal lands) and other local, state, and federal lands.
- Hunting, fishing (particularly in the Embarrass and Partridge Rivers), and hiking.

- Year-round recreation, including downhill skiing at the Giants Ridge Golf & Ski Resort (approximately 15 miles east of the Mine Site), cross-country skiing, snowmobiling, mountain biking, hiking, and golf.
- Biking, hiking, and roller-blading on the Mesabi Trail, which spans 70 miles across the Iron Range.

These activities typically do not occur in the immediate vicinity of the Mine Site, Plant Site, and Transportation and Utility Corridor. For example, the nearest designated USFS campgrounds are Cadotte Lake, 16 miles southeast, and Birch Lake, 12 miles north. There are two back-country camping facilities on Stone Lake and Big Lake, approximately 8 miles southeast of the Mine Site. The nearest designated boat launch (Colby Lake) is within 5 miles, and the nearest designated USFS trails (including the St. Louis River and Bird Lake Trails) are south and east of Hoyt Lakes, more than 8 miles south of the Plant Site. The USDA Visitor Use report for the Superior National Forest indicates that in 2011 there were 1.1 million national forest visits, with roughly 76 percent of those visits being for recreational purposes. A national forest visit is defined as “the entry of one person upon a national forest to participate in recreation activities for an unspecified period of time” (USFS 2012). It is important to note that visitation to any single part of the Superior National Forest cannot be determined.

4.2.11.1.2 Visual Resources

The NorthMet Project area lies within, and adjacent to, the Superior National Forest in northeastern Minnesota. The Superior National Forest provides over 3 million acres of rich and varied resources (USFS 2007c). The visual character of the NorthMet Project area varies from upland forests and wetlands to developed industrial areas. There are several active, closed, and reclaimed mines near the NorthMet Project area, and evidence of past and ongoing mining (such as reclaimed or abandoned waste rock piles) is present in many parts of the area surrounding the Mine Site.

The Mine Site and the adjoining federal lands are located along the south flank of the Mesabi Iron Range, immediately south of the Giants Range formation (see Figure 1-1). The Iron Range supports numerous active mining operations, including the Northshore taconite mine located north of the Mine Site. The Mine Site is relatively flat, with elevations between 1,570 ft and 1,600 ft amsl. The Giants Range formation is the dominant landscape feature in the area. It rises steeply to an average elevation of approximately 1,700 ft amsl (with some elevations above 1,800 ft amsl) along the ridgeline (approximately 1 to 2 miles from the Mine Site), and declines approximately 150 to 200 ft on its northern flank. The One Hundred Mile Swamp, Partridge River, and the Northshore Mine are to the north between the Mine Site and the Giants Range.

The Mine Site is surrounded by wetlands (including the One Hundred Mile Swamp) and mixed deciduous and coniferous upland forests to the east, south, and west. The average canopy height in the upland forest is 30 to 60 ft with occasional white pine and white spruce in excess of 70 ft. In the wetland areas, the coniferous canopy is approximately 30 to 40 ft while the deciduous growth is less than 20 ft tall. The Partridge River makes a horseshoe bend around the north, east, and south sides of the Mine Site.

The nearest potential visual receptors to the Mine Site—places where the public may be able to see the Mine Site on a regular basis, such as homes or public roads with open views—are illustrated on Figure 4.2.11-1. The ability to view the Mine Site is highly dependent on the topography and foliage present at a viewer's specific location, but views of the Mine Site may be present at:

- clusters of rural homes, approximately 7 miles to the south near the unincorporated village of Skibo;
- the City of Hoyt Lakes, approximately 9 miles to the southwest;
- along Lake County Road 2 within the incorporated limits of the City of Babbitt, approximately 12 miles to the east; and
- the Skibo Vista Scenic Overlook, along Lake County Highway 15, approximately 12 miles south (see Figure 4.2.11-2).

The Mine Site may also be visible from Forest Road 112, which passes less than 2 miles from the Mine Site; however, traffic on this road is likely to be low, given the absence of population centers or significant recreational sites along the road.

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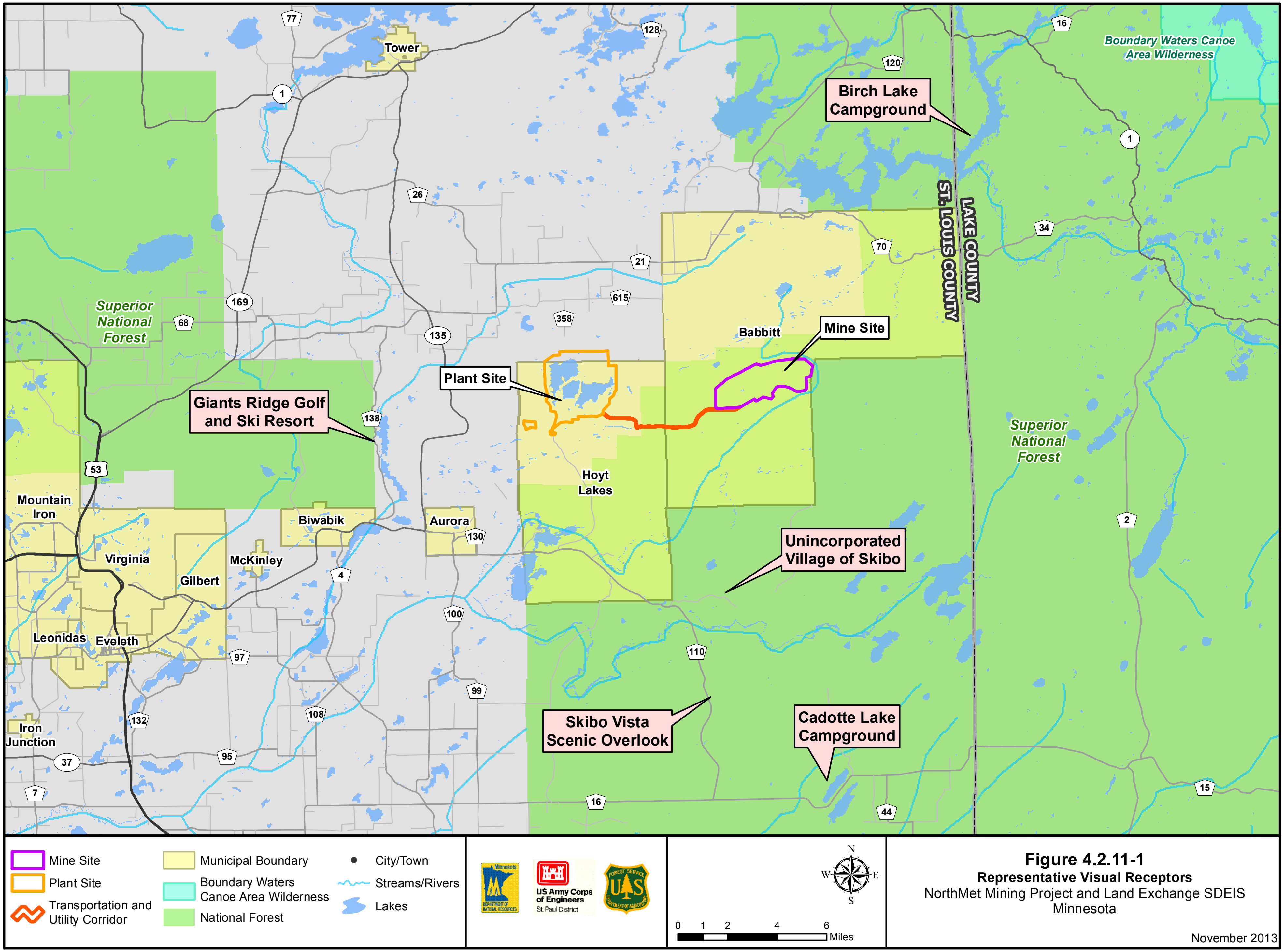

Figure 4.2.11-1
Representative Visual Receptors
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Figure 4.2.11-2 Mine Site and Plant Site, as Viewed from Skibo Vista Scenic Overlook

The USFS uses the Scenery Management System to identify desired visual conditions, as expressed by the Scenic Integrity Objectives (SIOs). The SIO designations for Superior National Forest are defined in the Forest Plan. For purposes of this SDEIS, the following SIO definitions have been used to evaluate the visual resources of the non-federal lands (based on USFS 1995):

- Low SIO: The landscape appears moderately altered, and non-natural landscape features may begin to dominate.
- Moderate SIO: The landscape appears slightly altered. Non-natural features or activities may be apparent, but do not dominate.
- High SIO: The landscape appears unaltered, essentially in a “natural” state, with minimal evidence of non-natural features or activities.

The Mine Site and adjoining federal lands are designated by the USFS as areas of Low SIO. Within this designation, the landscape appears altered, and non-natural landscape features may begin to dominate. There are no major recreational trails within the Superior National Forest adjacent to the Mine Site that would expose recreational users to views of the mine on a regular basis.

Native American tribal members exercise rights to hunt, fish, and gather on Superior National Forest lands, including lands near the Mine Site. The frequency with which tribal members exercise these rights in portions of Superior National Forest with views of the Mine Site is not known; however, as described in Sections 4.2.9 and 5.2.9, there are several cultural resources and locations adjacent to or potentially within sight of the Mine Site (as well as the Plant Site and Transportation and Utility Corridor), such as the Spring Lake Mine Sugarbush, Trygg Trail Corridor, and *Mesabe Widjiu*. Note that these sites are not depicted in the figures in this section due to sensitivity regarding cultural resources and locations.

4.2.11.2 Transportation and Utility Corridor

4.2.11.2.1 Recreational Facilities and Activities

The Transportation and Utility Corridor is within an area designated as Roaded Natural. This designation indicates areas that are mostly natural in appearance (with some modification), and where evidence of other users and interactions between users are somewhat frequent. The Transportation and Utility Corridor is owned or leased by PolyMet, and is not open to the public. Entry points are gated and/or guarded, and crossing the corridor is prohibited. No recreational activity is permitted along the corridor.

4.2.11.2.2 Visual Resources

The Transportation and Utility Corridor follows Dunka Road between the Mine Site and the Plant Site and includes existing road and rail lines. Viewpoints for the corridor are the same as those for the Mine Site and Plant Site. The portions of Superior National Forest near the Transportation and Utility Corridor are within the Low SIO designation. As described in Section 4.2.11.1, users of culturally important locations may have views of the Transportation and Utility Corridor.

4.2.11.3 Plant Site

4.2.11.3.1 Recreational Facilities and Activities

The Plant Site is located at the former LTVSMC processing plant. It is owned by PolyMet, and it is not open to the public. Entry roads are gated and/or guarded. No recreational activity is permitted at this site.

4.2.11.3.2 Visual Resources

Topography at the Plant Site rises from approximately 1,550 ft amsl near the railroad at the south end of the plant to approximately 1,780 ft amsl at the north end adjacent to the Tailings Basin (on the northern flank of the Giants Range). The inactive LTVSMC industrial processing buildings—including crushing, grinding, concentrating, and maintenance and pellet storage/rail loading facilities—dominate the visual landscape at the Plant Site, and have done so since their construction in the 1950s. The nearest potential visual receptors are residences approximately 3.5 miles north of the Plant Site on County Road 358 and County Road 615. These rural residences are outside the incorporated limits of the cities of Babbitt and Hoyt Lakes. The City of Hoyt Lakes is the next closest visual receptor and is approximately 5 miles south of the Plant Site. The Tailings Basin and some buildings at the Plant Site would likely be visible from the ski slopes at the Giants Ridge Golf and Ski Resort, approximately 8 miles west-southwest of the Plant Site.

The existing LTVSMC Tailings Basin is located to the north of the buildings with legacy mine pits and waste rock stockpile sites to the south and east and a railroad to the west. Second Creek and its headwater wetlands also border the site immediately to the south. The Tailings Basin is surrounded by wetlands and low, forested (mixed coniferous and deciduous) uplands to the north, east, and west. The closest residences to the Tailings Basin are along Beckman Road and Salo Road, approximately 1.5 and 2.5 miles north of the Tailings Basin, respectively. Some of the culturally important locations described above and in Section 4.2.9 are closer: the Sugarbush is approximately 0.5 miles from the Plant Site, the *Mesabe Widjiu* intersects the Plant Site and is less than 2 miles from the Mine Site, and portions of the Trygg Trail Corridor cross both the Mine Site and Plant Site. As described above for the Mine Site, users of these culturally important locations may have views of the Plant Site.

Figure 4.2.11-1 shows the Plant Site in relation to the Mine Site, from the Skibo Vista Scenic Overlook, approximately 13 miles south of the Plant Site.

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4.2.12 Wilderness and Other Special Designation Areas

For this analysis, the term "wilderness" is defined by the Wilderness Act of 1964 (Public Law 88-577) (16 USC §§ 1131-1136) of 1964. In its planning, management, and monitoring, the USFS identifies four characteristics of wilderness, as defined in the Wilderness Act:

- Untrammeled: The Wilderness Act states that wilderness "[is] an area where the earth and its community of life are untrammeled by man," and "generally appears to have been affected primarily by the forces of nature." This quality monitors human activities that directly control or manipulate the components or processes of ecological systems inside wilderness.
- Undeveloped: The Wilderness Act states that wilderness is "an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation," "where man himself is a visitor who does not remain" and "with the imprint of man's work substantially unnoticeable." This quality monitors the presence of structures, construction, habitations, and other evidence of modern human presence or occupation.
- Natural: The Wilderness Act states that wilderness is "protected and managed so as to preserve its natural conditions." This quality monitors both intended and unintended effects on ecological systems inside a wilderness. The natural quality of wilderness character may potentially be affected by actions located outside the wilderness through effects on water quality and air quality.
- Solitude or a Primitive and Unconfined Type of Recreation: The Wilderness Act states that wilderness has "outstanding opportunities for solitude or a primitive and unconfined type of recreation." This quality monitors conditions that affect the opportunity for people to experience solitude or primitive, unconfined recreation in a wilderness setting. An indicator of this quality is remoteness from occupied and modified areas outside the wilderness, such as noise or visual effects.

Other federal special designation areas are identified by Presidential Designation, Congressional Designation, or Administrative Designation and define lands that are considered to have remarkable ecological, paleontological, historic, scenic, recreational, geologic, or fish and wildlife value. They include wilderness areas, wilderness study areas, RNAs and cRNAs, national scenic or historic trails, wild or scenic rivers, UBAs, national natural landmarks, national historic landmarks, and national monuments, among others. These special designation areas are managed by federal land management agencies such as the BLM, USFS, Park Service, and USFWS. The state similarly designates areas for special management due to their wilderness value.

None of the elements of the NorthMet Project Proposed Action are located within or adjacent to any wilderness areas. Similarly there are no special designation areas within or adjacent to the Mine Site, Plant Site, or Transportation and Utility Corridor. While recreation facilities such as parks are listed in this section, recreational use of those facilities is described in Section 4.2.11.

4.2.12.1 Federally Managed Areas

This section discusses federally managed wilderness and special designation areas that are close enough to the NorthMet Project area that they may be affected by activities related to the NorthMet Project Proposed Action.

4.2.12.1.1 Wilderness Areas

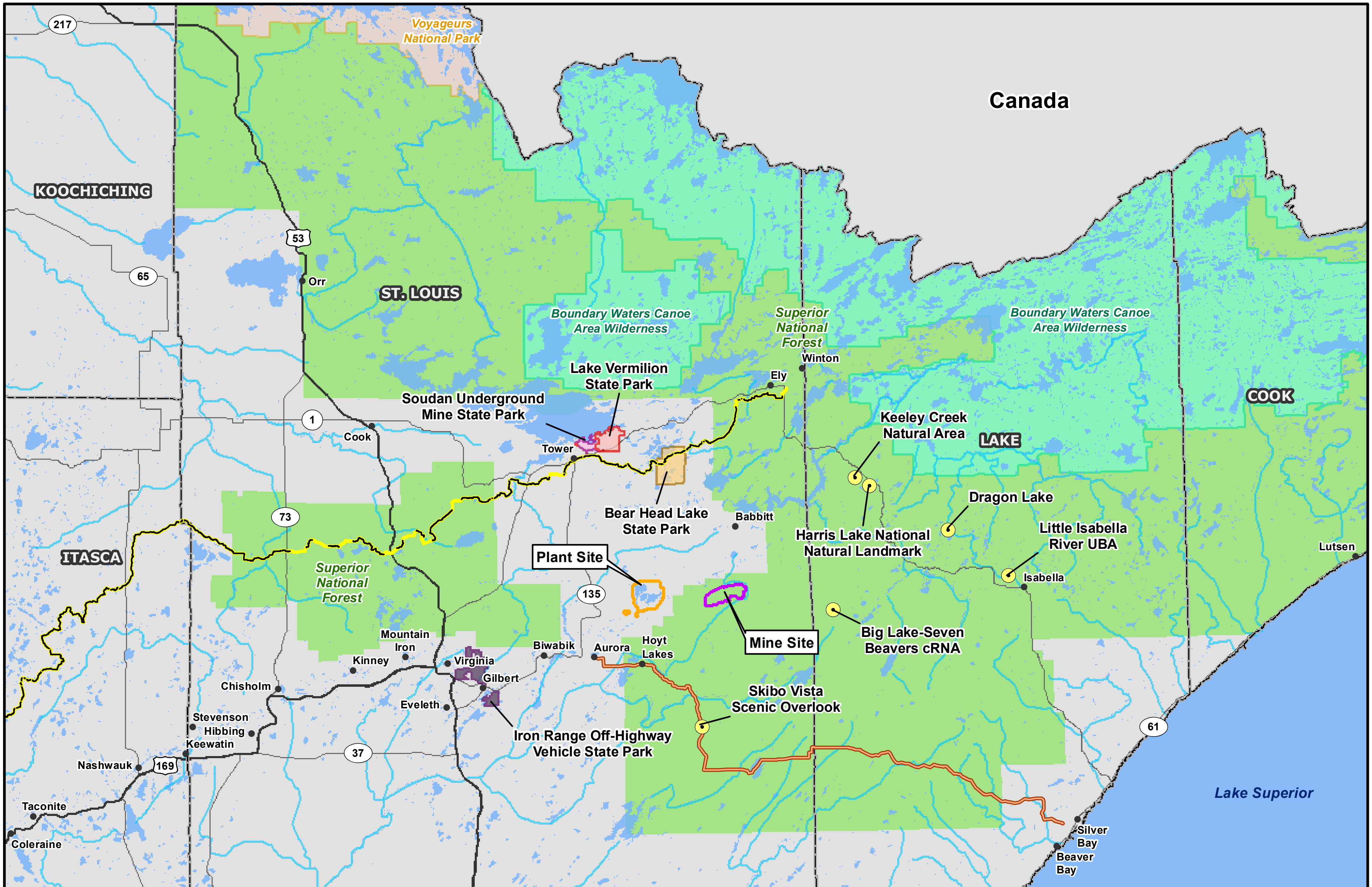
The NorthMet Project area is approximately 20 miles south of the BWCAW (see Figure 4.2.12-1). Portions of the BWCAW were formally designated a wilderness area in 1964 under Public Law 88-577. This wilderness area was further expanded and given its current name in 1978 under Public Law 95-495, and now encompasses more than 1 million acres along the United States' international boundary with Canada. The BWCAW is managed by the USFS as part of the larger Superior National Forest. It attracts more than 250,000 visitors annually and is used year-round for camping, hiking, fishing, canoeing, and hunting. Motorized vehicle use is limited. Activity and access are controlled by use permits managed by the USFS (USFS 2004c).

The BWCAW contains several hundred miles of streams and approximately 1,175 lakes that vary in size from 10 to 10,000 acres. Together, there are about 190,000 acres of open water or 20 percent of the surface area of the BWCAW that provides opportunities for long-distance travel by watercraft. The BWCAW is the only large lakeland wilderness in the National Wilderness Preservation System (USHR 1978).

The wilderness has approximately 80 entry points that provide access to 1,200 miles of designated canoe routes, 18 hiking trails, and nearly 2,200 campsites. There are numerous cultural resources in the BWCAW including camp sites, villages, wild ricing sites, cemetery areas, pictographs, and sites of spiritual and traditional importance. The wilderness also contains evidence of a number of historic European and early Native American activities.

The same 1978 law that created the BWCAW also designated the BWCAW as a Mining Protection Area. This designation prohibits exploration, lease, and exploitation of minerals in the wilderness, and the prohibition of mineral exploration or exploitation on property owned by the United States if that activity could materially change the wilderness characteristics of the BWCAW (USHR 1978).

Voyageurs National Park is adjacent to the BWCAW and is located approximately 50 miles northwest of the NorthMet Project area (see Figure 4.2.12-1). The National Park Service manages nearly 127,500 acres of park lands designated for wilderness study. The BWCAW and Voyageurs National Park are contiguous with Canada's Quetico Provincial Wilderness Park. Together, these three areas represent 2.39 million acres of managed wilderness area.



Mine Site
Plant Site
Special Designation Area
Taconite State Trail
Boundary Waters Canoe Area Wilderness
Superior National Forest Scenic Byway
Lake Vermilion State Park
Iron Range Off-Highway Vehicle State Park
Bear Head Lake State Park
Soudan Underground Mine State Park
National Park
National Forest
City/Town
Streams/Rivers
Lakes

US Army Corps of Engineers St. Paul District

0 2.5 5 10 15 Miles

Figure 4.2.12-1
Wilderness and Special Designation Areas
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4.2.12.1.2 Established and Candidate Research Natural Areas

The Forest Service designates and manages RNAs and cRNAs for the purpose of preserving and maintaining areas for ecological research, observation, genetic conservation, monitoring, and educational activities (USFS 2004b). The RNAs may serve as baseline or reference areas for comparison to other similar ecosystems that are subject to a wider range of management activities. They also provide opportunities for low-impact activities designed to educate people about ecological processes. No recreation facilities are provided. Dispersed recreation use occurs but is generally discouraged. The cRNAs are managed in similar fashion to the RNAs, with the exception that semi-primitive, non-motorized recreation is permitted.

Three RNAs are within 25 miles of the NorthMet Project area: the Big Lake – Seven Beavers cRNA, the Keeley Creek RNA, and the Dragon Lake cRNA.

The Big Lake – Seven Beavers Area includes an excellent representation of a variety of characteristic upland and lowland plant communities, dominated by wetland communities including lowland black spruce, lowland cedar, shrub swamp, and bog, connected to Sand Lake Peatland SNA (managed by the MDNR). The 5,599 acres of the cRNA are located approximately 12 miles east of the NorthMet Project area (USFS 2011h) (see Figure 4.2.12-1). This cRNA (and adjacent Sand Lake Peatland SNA) is located within the Headwaters Site, which is an area of ecological significance. Due to high biodiversity, low disturbance, and the size and complexity of the peatlands present on the site, it is considered a blueprint for natural resource management in the Laurentian Uplands subsection.

Keeley Creek Natural Area, located within the Superior National Forest in Stony River Township, approximately 25 miles northeast of the NorthMet Project area (see Figure 4.2.12-1), comprises 640 acres designated as an RNA within a larger 1,180-acre area designated as a national natural landmark. The Keeley Creek area contains a large tract of undisturbed mixed pine and black spruce forest with rare mature jack pine stands and significant upland bogs (USFS 2011h).

Dragon Lake is located approximately 25 miles northeast of the NorthMet Project area (see Figure 4.2.12-1). The cRNA comprises 2,075 acres of old growth red pine, upland and lowland black spruce, wetland bog, and wetland shrub swamp communities, as well as former Isabella pinery (USFS 2011h).

4.2.12.1.3 Unique Biological Areas

UBAs are designated by the USFS for their outstanding biological and other special values and managed within the USFS land and natural resource management plans. The common thread to these areas is that they exhibit plant communities, associations, and/or individual species of particular interest. UBAs are primarily managed for interpretive purposes. None are suitable for timber management. The Dry Mesic Jack Pine/Black Spruce and Lowland Conifer Landscape Ecosystems dominate this area in the Superior National Forest. UBAs are protected from actual or potential damage due to public use. Dispersed recreation use may occur, but is generally discouraged, and may be limited to bird watching, orienteering, fishing, hunting, berry picking, plant identification, and wildlife viewing (USFS 2004b).

UBAs within the 25-mile vicinity of the NorthMet Project area include the Little Isabella River UBA (approximately 25 miles east of the NorthMet Project area) and the Harris Lake National Natural Landmark (approximately 20 miles northeast of the NorthMet Project area) (USFS

2004b) (see Figure 4.2.12-1). National Natural Landmark sites are designated by the Secretary of the Interior as sites that contain outstanding biological and geological resources, based on their outstanding condition, illustrative value, rarity, diversity, and value to science and education.

4.2.12.1.4 National Historic Landmark

National Historic Landmarks are nationally significant places designated by the Secretary of the Interior as possessing exceptional value or quality in illustrating or interpreting US heritage. The Soudan Iron Mine has been designated as a National Historic Landmark. It is known as the state's oldest and deepest iron mine and now hosts the Soudan Underground Laboratory. It resides within the Soudan Underground Mine State Park, located approximately 18 miles northwest of the NorthMet Project area, near Tower, on the southern shore of Lake Vermilion (see Figure 4.2.12-1). The park comprises approximately 1,300 acres and receives more than 33,000 visitors annually (MDNR 2011o).

4.2.12.1.5 National Recreation Trail

National Recreation Trails are designated by the Secretary of Interior or the Secretary of Agriculture to recognize exemplary trails of local and regional significance. The Taconite State Trail is designated as a National Recreation Trail and managed by the MDNR. Running from Grand Rapids to the Arrowhead State Trail, the Taconite State Trail is 165 miles long. A segment of the trail is 15 to 17 miles north of the NorthMet Project area, running from the City of Ely westward to Tower (see Figure 4.2.12-1). Spur trails run south from this segment into the City of Babbitt, and then east and west. The trail provides year-round opportunities for hiking, biking, snowmobiling, in-line skating, and other recreational uses (MDNR 2011p).

4.2.12.2 State Managed Areas

Like the federal government, the State of Minnesota also designates and manages for wilderness value a number of areas.

4.2.12.2.1 Boundary Waters Canoe Area Wilderness

In 2003, Minnesota designated 18,000 acres of state-owned lands within the BWCAW as state wilderness. These are state forest lands that are described as an inholding within the federally designated wilderness. The definition of wilderness used by the state is similar to that set forth in the federal Wilderness Act. Legislation passed in 1975 established the state's wilderness program. *Minnesota Statues* 2006, Chapter 86A.05, subdivision 6 contains management guidelines for wilderness areas. However, the state lands now designated as state wilderness are using the management directions of the larger BWCAW and there is no state wilderness management plan for the area (Propst and Dawson 2008)

4.2.12.2.2 Scenic Byway

Minnesota Scenic Byways are roads that feature many of Minnesota's finest cultural, historic, natural, recreational, archaeological, and cultural locations and landscapes. The Superior National Forest Scenic Byway (Forest Highway 11) is a 54-mile long scenic roadway that runs from Aurora to Silver Bay, with the closest segment approximately 9 miles southeast of the NorthMet Project area along County Route 110 (see Figure 4.2.12-1). It is designated as a scenic byway by the State of Minnesota. The majority of the Byway runs through the Superior National

Forest, offering access to hiking trails, historic sites, and the Superior National Forest itself. A key feature of the Byway is the opportunity it provides travelers to views of 250-year-old stands of white pine (US Department of Transportation [US DOT] 2011). Skibo Vista Scenic Overlook is one of the other key features along the Superior National Forest Scenic Byway. See Section 4.2.11 for further information about visual resources at the Skibo Vista Scenic Overlook.

4.2.12.2.3 State Parks

Soudan Underground Mine State Park is located 18 miles northwest (see Figure 4.2.12-1) of the NorthMet Project area and is home to Minnesota's oldest iron ore mine. The park covers 1,322 acres and has 5 miles of hiking trails. The park is located on a ridge on the south shore of Lake Vermilion and offers a combination of recreational opportunities, including picnicking, hiking, snowmobiling, and tours of a former iron ore mine. There are stands of white and Norway pine—mixed with some balsam, aspen, and birch—that cover the upland areas. The lowlands are dominated by white cedar interspersed with balsam, tamarack, black spruce, ash, and muskeg (MDNR 2011o).

Lake Vermilion State Park is 16 miles northwest of the NorthMet Project area (see Figure 4.2.12-1), on the eastern shores of Lake Vermilion adjacent to Soudan Underground Mine State Park. Lake Vermilion is just south of the Superior National Forest and BWCAW. The park is Minnesota's newest state park, open since 2010 for recreation opportunities such as hiking, snowshoeing, snowmobiling, and geocaching. It is the first major state park built in Minnesota in more than 30 years. Construction is underway for boat docks, fishing platforms, picnic shelters, roads, parking areas, and a paved bike route that will connect to the Mesabi Trail (MDNR 2012f).

Bear Head Lake State Park, which covers 5,685 acres, is located 11 miles north of the NorthMet Project area, just south of the BWCAW (see Figure 4.2.12-1). The woods are made up of red and white pine, spruce, paper birch, and fir on the highlands and tamarack, black spruce, and white cedar on the lowlands. Small, clear trout lakes similar to those found in the BWCAW provide recreational opportunities such as fishing, swimming, and boating. The park also offers 17 miles of hiking trails, campgrounds, cross-country skiing, snowmobiling, and snowshoeing (MDNR 2012a).

Iron Range Off-Highway Vehicle State Park is located 17 miles southwest of the NorthMet Project area in Gilbert, Minnesota (see Figure 4.2.12-1). The park offers 36 miles of off-highway vehicle trails over 4,064 acres (MDNR 2012b).

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4.2.13 Hazardous Materials

A hazardous material, as defined by the Institute of Hazardous Materials Management (2012), is any biological, chemical, or physical item or agent which has the potential to cause harm to humans, animals, or the environment. Categories of hazardous materials include, but are not limited to, explosives, flammables, oxidizers, poisons, irritants, and corrosives. At the federal level, management, handling, and transportation of these materials are regulated by laws and regulations administered by the USEPA, Occupational Safety and Health Administration (OSHA), and DOT, each with its own specific definition of hazardous material. The State of Minnesota also has regulations related to hazardous materials.

In addition, wastes generated from process operations can be classified as hazardous. Minnesota Statutes define a hazardous waste as any refuse, sludge, or other waste material or combinations of refuse, sludge, or other waste materials in solid, semi-solid, liquid, or contained gaseous form, which, because of quantity, concentration, or chemical, physical, or infectious characteristics, may cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness. A waste can also be determined to be hazardous if it poses a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed, or otherwise managed. Hazardous waste does not include source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954, as amended (*Minnesota Statute* 116.06 Subdivision 11). As with hazardous materials, hazardous wastes are subject to state and federal management, transportation, and disposal regulations. Issues relating to the presence of hazardous materials or waste may include the accidental release of these materials during transportation, storage, handling, and/or use and any resulting potential effects on the environment.

There are no current mining or other operations or activities at either the Mine Site or Plant Site that involve the use of hazardous materials. As discussed in Section 4.2.1, there are AOCs associated with contamination by hazardous materials from the former LTVSMC mining operations.

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4.2.14 Geotechnical Stability

This section describes the current geotechnical conditions for the proposed sites of the material disposal facilities proposed as part of the NorthMet Project Proposed Action: the waste rock stockpiles, the Tailings Basin, and the Hydrometallurgical Residue Facility.

The waste rock stockpiles would be constructed on undisturbed highland and lowland areas at the Mine Site consisting of varying layers (thickness and material types) of glacial till and some surficial peat in lowland areas. The Hydrometallurgical Residue Facility would be constructed on top of the existing LTVSMC Emergency Basin and would extend onto existing undisturbed ground. The Tailings Basin constructed as part of the NorthMet Project Proposed Action would be located on top of a portion of the existing LTVSMC Tailings Basin and would extend onto existing undisturbed ground. Geotechnical conditions are relatively similar along the length of existing LTVSMC Tailings Basin dams, with varying layers of coarse, fine, and slime tailings. The characteristics and design of the proposed waste management features are discussed in Chapter 3.0, while the rationale of the design—including consideration for design criteria, safety factors, and modeling of geotechnical stability of the existing and proposed features—is discussed in Chapter 5.0. Further information on the geology and hydrogeology is provided in Section 4.2.2.

4.2.14.1 Waste Rock Stockpiles

4.2.14.1.1 Location and Descriptive Overview

The waste rock stockpiles would be located at the Mine Site, an undeveloped site currently affected only by logging and exploration drilling activities.

The locations of the proposed stockpiles are shown in Figure 4.2.14-1. The acreages for the stockpiles would be as follows:

- The permanent Category 1 Stockpile would occupy 557 acres to the north of the West Pit;
- The temporary Category 2/3 Stockpile would occupy 181 acres to the south east of the East Pit;
- The temporary Category 4 Stockpile would occupy 57 acres above the Central Pit (it would be removed and placed into the East Pit prior to mining at the Central Pit); and
- The temporary Ore Surge Pile would occupy 32 acres to the south of the East Pit and west of the Category 2/3 Stockpile.

In addition to the stockpiles listed above, the temporary Overburden Storage and Laydown Area would occupy 31 acres to the southeast of the West Pit.

There are no existing mining facilities or constructed geotechnical features that are at risk of geotechnical instability at the proposed stockpile locations.

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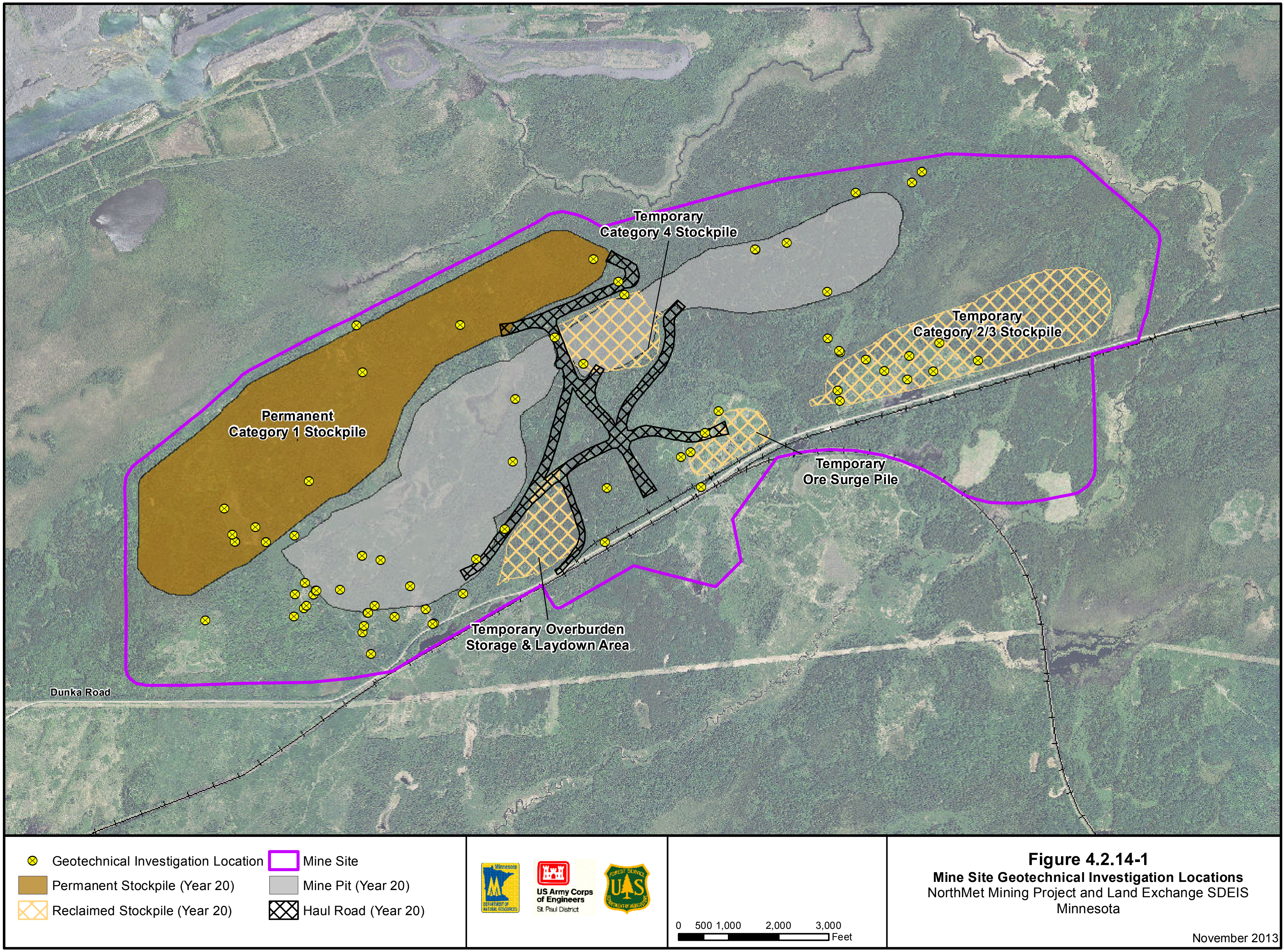

Figure 4.2.14-1
Mine Site Geotechnical Investigation Locations
NorthMet Mining Project and Land Exchange SDEIS
Minnesota

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4.2.14.1.2 Investigations

The existing site conditions at the stockpile footprints have been evaluated and reported by Golder Associates, Inc. for PolyMet (PolyMet 2012p). As shown in Figure 4.2.14-1, geotechnical information for the Mine Site was gathered from a number of borings and test trenches. The site exploration drilling database, drilling logs, and geophysics (electrical resistivity) data were used to develop an estimated depth to bedrock isopach map. Laboratory tests were also conducted to obtain index properties of the samples recovered from the test trenches and boreholes, to confirm field classifications, and for use in developing correlations with engineering properties of the soils encountered.

4.2.14.1.3 Surficial Soils and Geology

Site Conditions for Category 1 Stockpile

Borings and mapping indicate that bedrock depths at the proposed Category 1 Stockpile range from 4 ft in the central part of the northern extent up to 40 ft at the southwestern edge. Soils in the highland areas are glacial tills in origin and the consistency typically varies from coarser material to clays. Existing data indicate that lowland areas contain horizons of glacial, alluvial, and lacustrine deposits overlain by peat and relatively finer-grained soils.

Site Conditions for Category 2/3 Stockpile

Borings and mapping indicate that bedrock depths at the proposed Category 2/3 Stockpile range from 3.5 to 33 ft below the surface. Soils in the highland areas typically consist of sands and gravel with varying amount of silt. Lowland areas typically contain surficial peat and fine grained soils, underlain by glacial and alluvial deposits.

Site Conditions for Category 4 Stockpile

Borings and mapping indicate that bedrock depths at the proposed Category 4 Stockpile range from 8.0 to 26 ft. The Category 4 Stockpile would be located on highland soils, which typically consist of sands and gravels. Because the soil samples were collected only in the highland areas at the northeastern and the southwestern end of the stockpile, they may differ from foundation soils at other locations within the Category 4 Stockpile footprint, especially in wetland areas.

Site Conditions for Ore Surge Pile

Borings and mapping indicate that bedrock depths at the proposed Ore Surge Pile range from 6.5 to 12 ft. Soil samples were collected only from the highland areas of the stockpile, which may differ from foundation soils at other locations within the Ore Surge Pile stockpile footprint, especially from soils within the lowland areas located on the eastern side of the stockpile.

Site Conditions for Overburden Storage and Laydown Area

The conditions for the Overburden Storage and Laydown Area include wetland areas interspersed with areas of glacial till (typically silty sand) overlying bedrock of varying depth.

4.2.14.1.4 Geotechnical Summary

The majority of the soils collected were non-plastic. Measured in situ moisture contents for non-peat material ranged from 1.0 to 26.9 percent. The permeability of the tested undisturbed native soils ranged from 3.1×10^{-7} to 9.4×10^{-7} cm/sec. The permeability of the tested compacted native soils ranged from 1.1×10^{-7} to 2.0×10^{-7} cm/sec, indicating that the native soils are favorable for use as a compacted soil liner. Typically, the native glacial tills have sufficiently high fines content, and are considered good candidates for materials being used with the geomembrane cover construction as proposed for the reclamation of the Category 1 Stockpile.

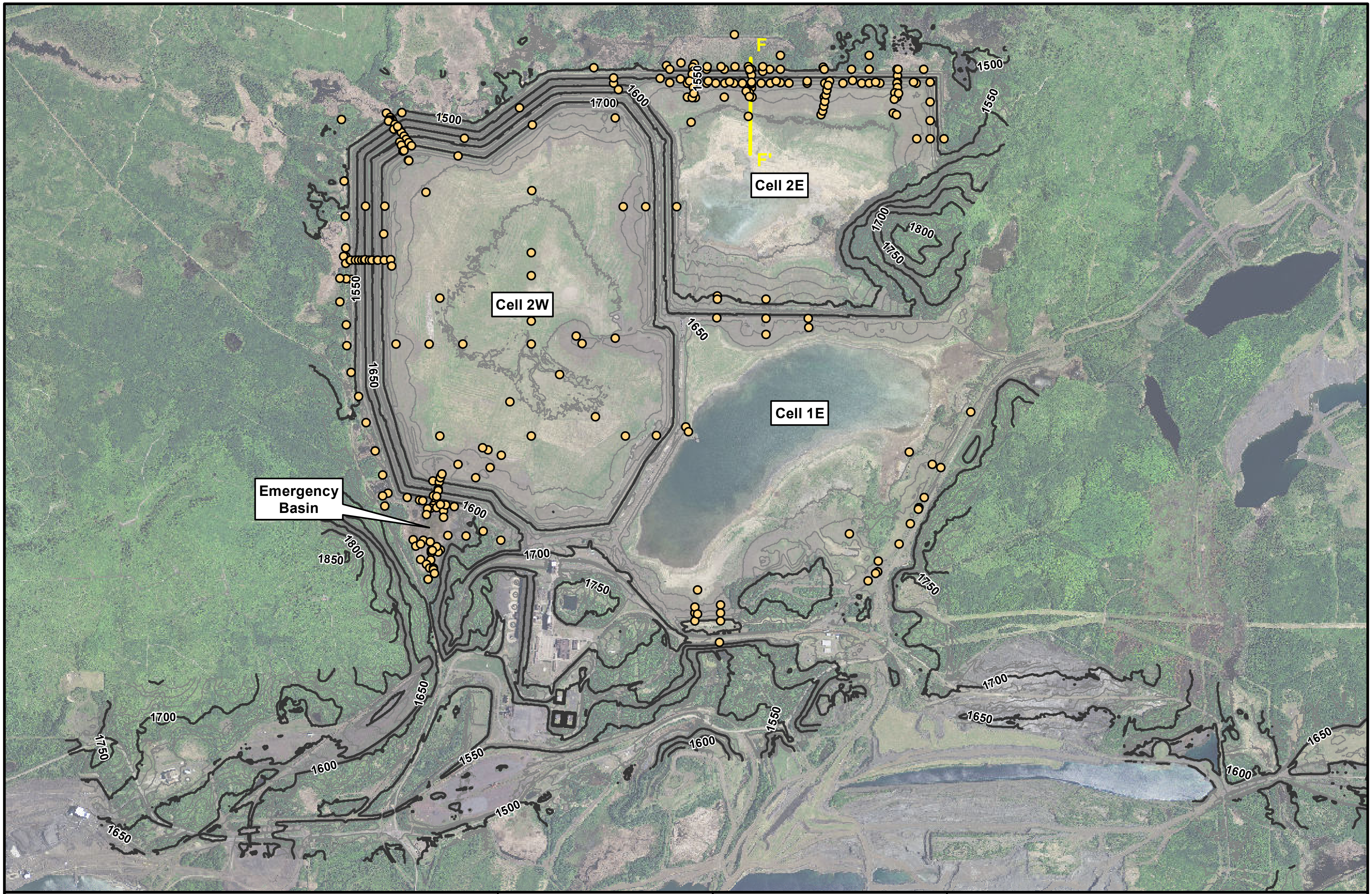
One-dimensional consolidation test (American Society for Testing and Materials [ASTM] D2435) and a consolidated-undrained (CU) triaxial shear test (ASTM D4767) was undertaken for one sample taken from the Category 1 Stockpile footprint area. The in situ effective stress strength parameters yielded an effective cohesion of zero with an effective friction angle of 34.6 degrees. The consolidation testing indicated a coefficient of consolidation of 5.3×10^{-1} to 9.6x10-1 ft^2/day and a coefficient of compression of 0.05 to 0.13 under the loading range of 1 to 16 kips per square feet (ksf). Additional geotechnical investigations are required to gain a better understanding of the liner interface frictional values (for the liners that would be used at the proposed facility), as well as the strength parameters for the foundation and stockpile materials prior to construction of the stockpiles. PolyMet has committed to undertake further investigations as necessary.

4.2.14.2 Tailings Basin

4.2.14.2.1 Location and Descriptive Overview

The Tailings Basin constructed as part of the NorthMet Project Proposed Action would be located on top of the existing LTVSMC Tailings Basin. The existing LTVSMC Tailings Basin is contained by constructed dams with a small portion on the east and south side of the basin abutting natural higher ground, and, as shown in Figure 4.2.14-2, is configured as a combination of three adjacent cells identified as Cell 1E, Cell 2E, and Cell 2W. With an average dam height of 95 ft, Cell 2E is the lowest of the three cells and covers approximately 620 acres in surface area. Cell 1E covers approximately 980 acres and has an average height of 125 ft. Cell 2W is the largest and highest of the three cells, covering approximately 1,450 acres in surface area, with an average dam height of 200 ft.

Flotation tailings would be deposited on top of the existing LTVSMC Tailings Basin, beginning in Cell 2E and then progressing into the combined Cell 2E and 1E when they achieve equal elevation, to a proposed final height of 200 ft. Cell 2W is not proposed for use for tailings deposition. Refer to Chapters 3.0 and 5.2.14 for more information on the proposed design of the Tailings Basin.



Geotechnical Investigation Locations
Cross Section
Contour - 50 Ft
Contour - 5 Ft

0 1,000 2,000 4,000 Feet

Figure 4.2.14-2
Existing LTVSMC Tailings Basin Layout
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4.2.14.2.2 Development of the Existing LTVSMC Tailings Basin

The existing LTVSMC Tailings Basin was constructed in stages beginning in the 1950s. Constructed perimeter dams were established using a rock, sand, and gravel starter dam over natural surface material (glacial till and fibrous peat in areas). The facility was unlined such that tailings from taconite processing were discharged directly on native material. The basin was filled to near the crest of the original starter dam and then berms were progressively developed on top of the starter dams and deposited tailings using the discharged coarse tailings (upstream construction method).

Upstream tailings basin construction methods generally involve spigotting of tailings in a slurry from the cell perimeter (or dam) into the interior of the cell using a portable spigotting system. Coarse tailings tend to settle out of the slurry near the spigot point near the perimeter of the dam, while the fine tailings and slimes tend to be carried further into the cell by the slurry. Very fine materials such as slimes tend to settle in the interior pond. The base of new lifts were developed inward in the upstream direction, hence the term upstream construction method.

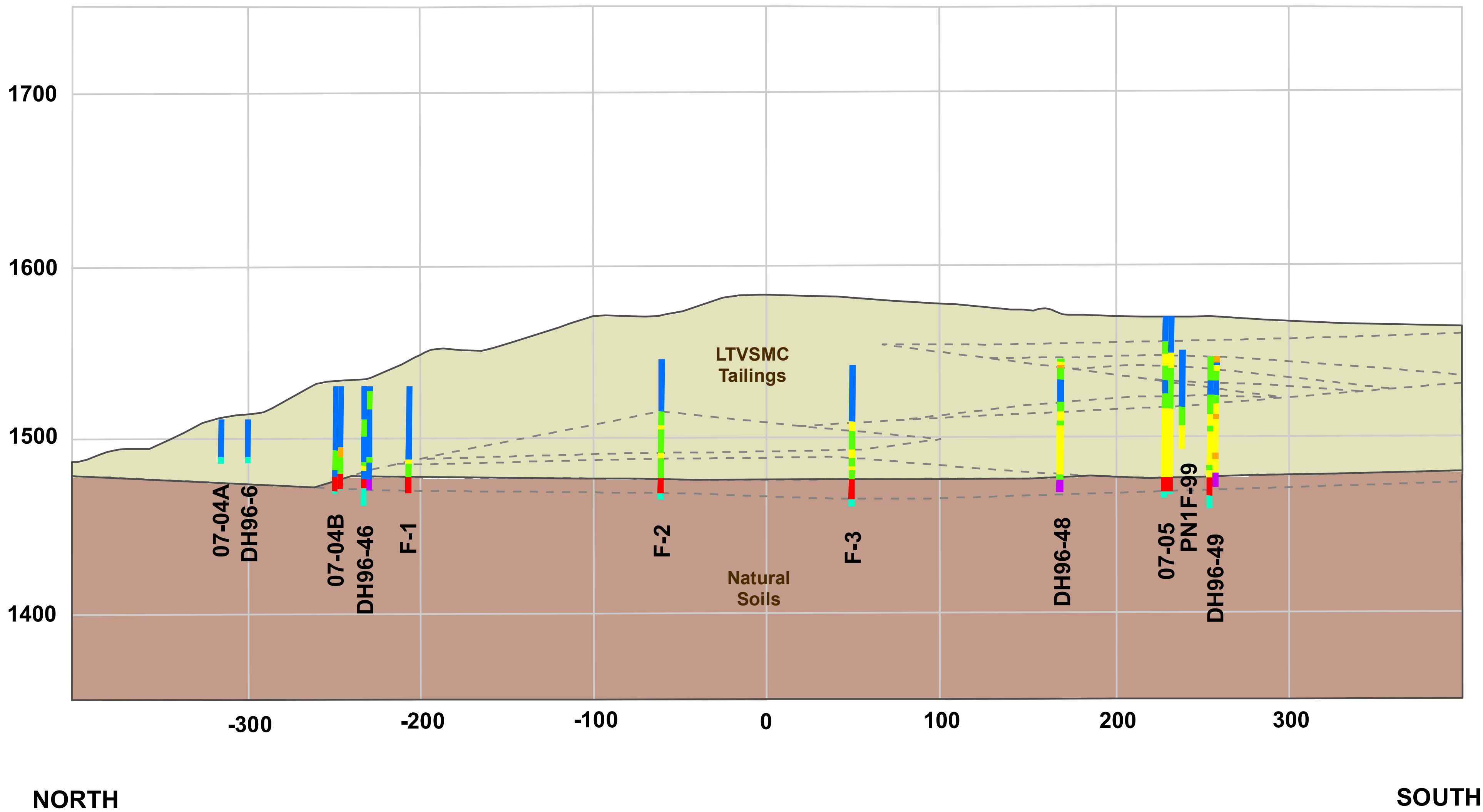
During the spigotting process, some fine tailings and slimes are normally trapped within the coarse tailings near the spigot point. In periods of very high water levels in the tailings pond, or during periods of operational difficulties or operator error, additional fines and slimes may be deposited close to the perimeter dams. Typically, the material near the spigot points, forms the foundation of future lifts of the shell, and is preferably a well-drained, coarse material that will provide a stronger base while reducing the height of the phreatic head within the shell. The inclusion of relatively large zones of finer-grained tailings within this outer shell reduces the drainage ability of the shell, increasing the phreatic surface, and reduces the localized shear strength due to the generally weaker behavior of the finer-grained tailings. There were instances in the operation of the existing LTVSMC Tailings Basin where significant amounts of fines and slimes settled out near the perimeter. These fines and slimes were then covered with coarse tailings as the basin continued to be developed. Figure 4.2.14-3 shows complex and varying layers of materials identified in drilling along Cross Section F of the existing LTVSMC Tailings Basin. It should be noted that this figure provides an idealized section considering information that may not be located exactly along the section line. As such, some information was translated horizontally onto this section to provide a more detailed description of the material variability, and some materials may appear out of context (i.e., the left-most boreholes show layers of peat found within the tailings; however, these layers of peat are projected from boreholes that have a native ground surface at a relatively higher elevation than is shown in this figure). Additional investigation and modeling show similar inclusions throughout the basin. This is discussed further in the Surficial Geology section below.

In 1993, approximately 260,000 long tons of higher-sulfur waste rock from the Dunka Mine was mixed with approximately 29,000 tons of limestone and buried under spigotted LTVSMC tailings in the southern part of Cell 2W. Additionally, in Cell 2W, rapid construction in later years of development resulted in oversteepened dams on all sides of Cell 2W. Some seepage has occurred from the dam in this and other areas along the dam embankments. Other points along the dam embankments have been subject to erosion of the perimeter dam due to the leaking and failure of LTVSMC discharge pipes, and from the natural geomorphological processes such as melting snow, precipitation runoff, soil creep, wind erosion and others. No large-scale failures were reported due to these events and eroded surfaces were filled with available material as needed.

In 1995 and 1996, approximately 1,500 cubic yards of spoil material dredged from Taconite Harbor in Lake Superior was placed in the south-eastern portion of Cell 1E.

Fly ash, dredging spoil, and coal pile cleanup material have also previously been disposed of in a solid waste storage site upgradient to the east of Cell 1E. The MPCA will determine whether the Coal Ash Landfill could be inundated or would need to be relocated. If relocation is required, the landfill relocation would need to be accomplished prior to year 7 of Tailings Basin operation.

The existing LTVSMC Tailings Basin operations were shut down in January 2001 and have been inactive since then except for closure and reclamation activities consistent with an MDNR-approved Closure Plan. Reclamation also includes the use of some parts of Cell 2W as a land farm where contaminated soil is mixed with organics for remediation. These activities are expected to be completed by 2016.



Coarse Tailings
Sensitive Fines
Fine Tailings
Slimes
Clay
Peat
Till

*Colors represent results of boring samples

US Army Corps of Engineers
St. Paul District

Figure 4.2.14-3
Tailings Basin - Cross Section F (Existing Conditions)
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Minnesota

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4.2.14.2.3 Investigations

The site conditions at the existing LTVSMC Tailings Basin have been evaluated throughout its existence and most recently reported by PolyMet (PolyMet 2012n). As shown in Figure 4.2.14-2, information has been gathered over several geotechnical investigation efforts at various locations around the existing LTVSMC Tailings Basin since its development. Collected site data includes:

- cone penetrometer testing (CPT) involving soundings at six points in Cell 1E, 14 points in Cell 2E, and 10 points in Cell 2W;
- dissipation testing at nearly all CPT locations during the sounding;
- seismic shear wave velocity testing conducted at each of the CPT locations during the sounding;
- dilatometer testing in borings approximately 10 ft adjacent to each CPT location;
- standard penetration test borings at a total of 27 locations near the CPT locations;
- vane shear testing at various depths performed at nine locations in Cells 1E and 2E; and
- solid flight auger borings near the western, northern, and eastern crests of the dams around Cell 2W.

Laboratory testing of bulk and undisturbed materials was also undertaken to verify the data collected during in situ testing, as well as to further asses the characteristics of the material for its hydraulic and strength parameters.

Other studies performed to investigate the hydrogeology of the site are discussed in Section 4.2.2.

4.2.14.2.4 Surficial Geology

Tailings

The former LTVSMC Tailings Dam generally consists of a shell of LTVSMC coarse tailings, with intermingled fingers of LTVSMC fine tailings and slimes. The interior of the cells consists primarily of layers of LTVSMC fine tailings and slimes, while coarse tailings are generally found near the perimeter of the basin. These vary in thicknesses and extent throughout the basin due to changing of tailings deposition points and durations. The depth of the tailings to the underlying native material varies between each of the cells.

Sampling to date has identified that the stratigraphy is very complex. Figure 4.2.14-3 shows a cross section of the existing LTVSMC Perimeter Dam at cross section F, illustrating the complexity and variability in tailings layering within each borehole, and between boreholes. This variability between boreholes also contributes to the uncertainty of layering, and the extent of fines and slimes at various depths near the cell perimeter dams.

The LTVSMC coarse tailings are generally classified as poorly graded fine- to medium-grained sand. The LTVSMC slimes particle sizes have been classified to range from silty sand to lean clay.

Natural Soils and Geology

Native, surficial deposits in the area of the existing LTVSMC Tailings Basin generally consist of native till material that ranges from clay to gravel. In places, the till is overlain by up to 10 ft of organic peat.

4.2.14.2.5 Geotechnical Summary

The selected drained and undrained strength and permeability inputs for the various materials used in modeling (Section 5.2.14.2) are summarized in Table 4.2.14-1.

Analyses determined that the LTVSMC coarse tailings are anticipated to behave in a dilative manner (i.e., expand in volume) as they are sheared, and are therefore less conducive to pore water pressure generation during shearing. The fine tailings and slimes are anticipated to behave in a contractive manner (i.e., reduce in volume) as they are sheared and are therefore prone to pore water pressure generation during shearing, resulting in a loss of strength. Organic peat has also been characterized as being prone to strength loss during shearing.

The existing northern dam in Cell 2E has been identified as a potential area of weakness as it is underlain by a layer of fibrous peat up to approximately 10 ft thick that extends north beyond the toe of the dam into a nearby wetland and due to the presence of some contractive fine tailings and slimes. A deposit of glacial till lies beneath the peat. The crest of the dam in this area is approximately 90 ft above the surrounding ground surface and consists mostly of coarse tailings with also some weaker layers of fines and slimes that occur close to the foot (heal/downstream face) of the dam.

Table 4.2.14-1 Summary of Seepage and Stability Parameters for the Material at the Existing LTVSMC Tailings Basin

Material	Saturated Permeability		Saturated Unit Weight	ESSA		USSA		
				Cohesion, c'	Friction, ϕ	Cohesion, Su	Friction, ϕ_{cu}	USSR, Su/σ'_{vo}
	cm/sec	ft/sec	pcf	psf	deg	psf	degree	
LTVSMC Coarse Tailings	2.44E-03	8.00E-05	135	0	38.5	0	38.5	-
LTVSMC Fine Tailings	2.00E-05	6.56E-07	130	0	33.0	-	-	0.25
LTVSMC Slimes	9.60E-07	3.15E-08	120	0	33.0	-	-	0.22
LTVSMC Bulk Tailings	8.02E-05	2.63E-06	130	0	38.5	0	38.5	-
LTVSMC FT/slimes	3.05E-06	1.00E-07	125	0	33.0	-	-	0.24
Glacial Till	5.03E-03	1.65E-04	135	0	36.5	0	36.5	-
Compressed Peat*	3.60E-06	1.18E-07	85	Shear/normal function		-	-	0.23
Virgin Peat	1.00E-03	3.30E-05	70					
Rock Starter Dam	1.52	5.00E-02	140	0	40.0	0	40.0	-

* Permeability of the compressed peat (below the dam) was altered for anisotropy, applying a ratio of ky/kx = 0.067.
ESSA = Effective Stress Stability Analysis
ft/sec = Feet per second
pcf = Pound(s) per cubic foot
psf = Pound(s) per square foot
USSA = Undrained Strength Stability Analysis
USSR = Undrained Sheer Strength Ratio

Further information on the parameters used for the design and modeling of the existing LTVSMC and proposed Tailings Basins is provided in Chapter 5.0.

4.2.14.3 Hydrometallurgical Residue Facility

4.2.14.3.1 Location and Descriptive Overview

As shown in Figure 4.2.14-2, the Hydrometallurgical Residue Facility is located in a natural low point in the topography adjacent to Cell 2W of the existing LTVSMC Tailings Basin and over the existing LTVSMC Emergency Basin. The southern tip of the existing LTVSMC Emergency Basin begins near the central portion of the Hydrometallurgical Residue Facility, widening and deepening into a former ravine that trended to the north. Drainage of the existing LTVSMC Emergency Basin occurs to the northwest between Cell 2W and a railroad grade located along the western perimeter of the area.

The southern dam of Cell 2W is approximately 160 ft in height from the surface of the existing LTVSMC Emergency Basin. It has an overall slope angle of 4 horizontal to 1 vertical (4:1) including mid-slope benches.

4.2.14.3.2 Development of the Existing LTVSMC Emergency Basin

The original purpose of the existing LTVSMC Emergency Basin was to contain taconite tailings discharge (slimes, and fine and coarse tailings) from the main tailings thickeners in the event of a power failure or similar occurrence which necessitated draining the tailings delivery system. Accidental overflows, spillage, and floor drainage from the former LTVSMC Concentrator Building also reached the existing LTVSMC Emergency Basin. These materials were deposited by gravity through an underground emergency tunnel terminating at the southeast side of the existing LTVSMC Emergency Basin. Overflow from sumps in the former LTVSMC booster pump house number 1 was also directed into the existing LTVSMC Emergency Basin.

Prior to the construction of the existing LTVSMC Tailings Basin Cell 2W, the existing LTVSMC Emergency Basin extended roughly 3,000 ft north from its current confinement. The southern starter dam for the existing LTVSMC Tailings Basin Cell 2W (the same dam as the proposed Hydrometallurgical Residue Facility north dam) was constructed over the unconsolidated emergency tailings in 1970 and 1971. An upstream construction method was used to construct the dam whereby the height of the dam was advanced incrementally by constructing a new lift upstream (into the basin) and above the crest of the existing dam. The north dam consists predominantly of LTVSMC coarse tailings with occasional inclusions of LTVSMC fine tailings and LTVSMC slimes. LTVSMC tailings were deposited over the existing emergency tailings in Cell 2W following this time.

4.2.14.3.3 Investigations

The existing site conditions at the Hydrometallurgical Residue Facility have been evaluated throughout its existence and most recently reported on by PolyMet (PolyMet 2012a).

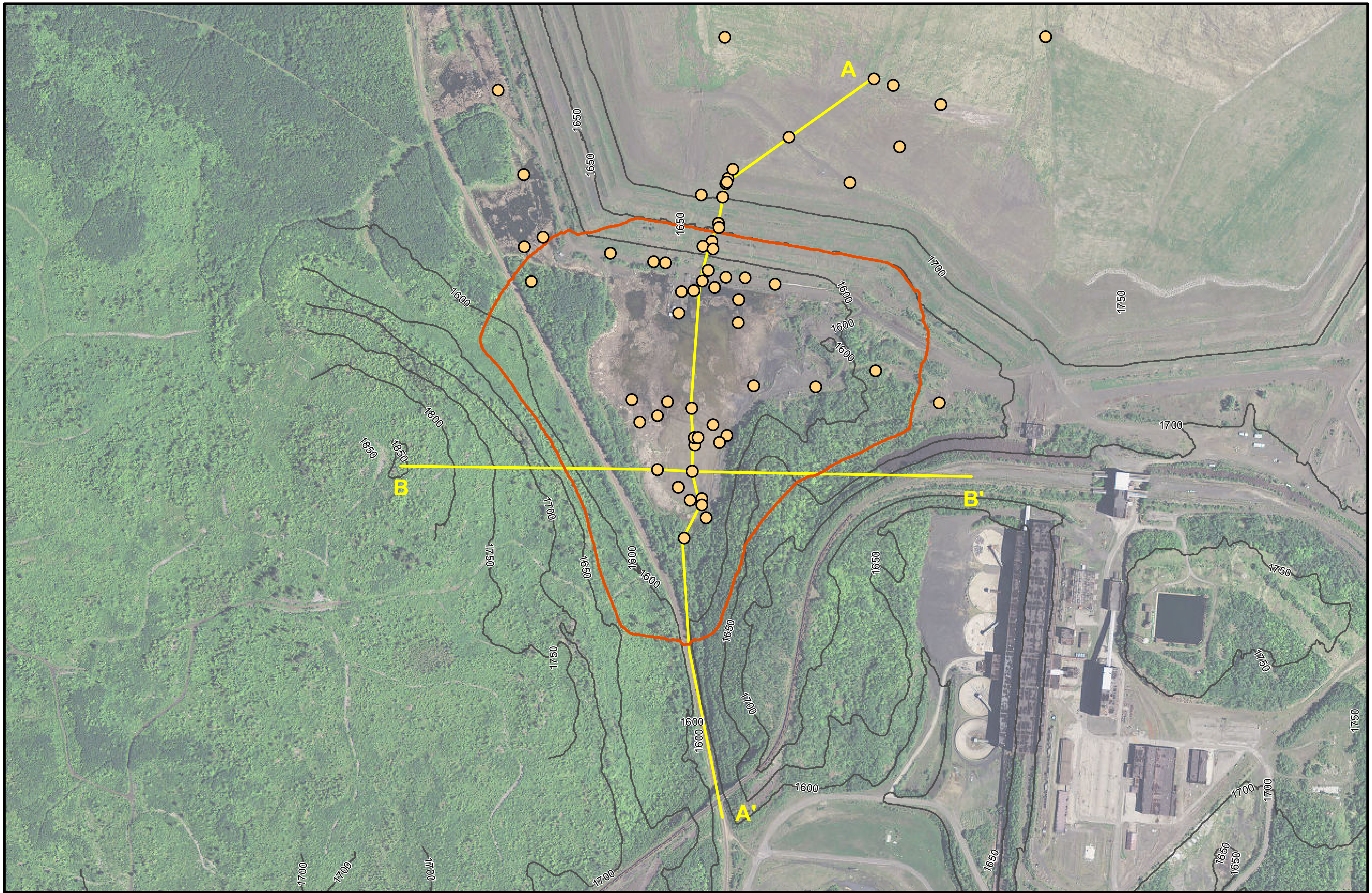
The geotechnical assessment of the proposed site for the Hydrometallurgical Residue Facility utilized existing regional geological surveys and maps as well as historical and recent site surveys undertaken at the existing LTVSMC Tailings Basin as shown in Figure 4.2.14-4.

A minor amount of hydraulic conductivity testing has been performed on the bedrock underlying the site.

4.2.14.3.4 Surficial Geology

Emergency Tailings

Existing materials in the existing LTVSMC Emergency Basin consist of a mixture of coarse tailings, fines, and slimes. Deposited materials have experienced relatively minor amounts of consolidation since cessation of LTVSMC operations in early 2001. This layering is shown in Cross Section A in Figure 4.2.14-5. There are approximately 50 ft of tailings in the thickest part of the Emergency Basin.



Hydrometallurgical Residue Facility

Geotechnical Investigation Locations

Cross Section

US Army Corps of Engineers
St. Paul District

0 250 500 1,000
Feet

Figure 4.2.14-4

Hydrometallurgical Residue Facility - Geotechnical Investigation Locations

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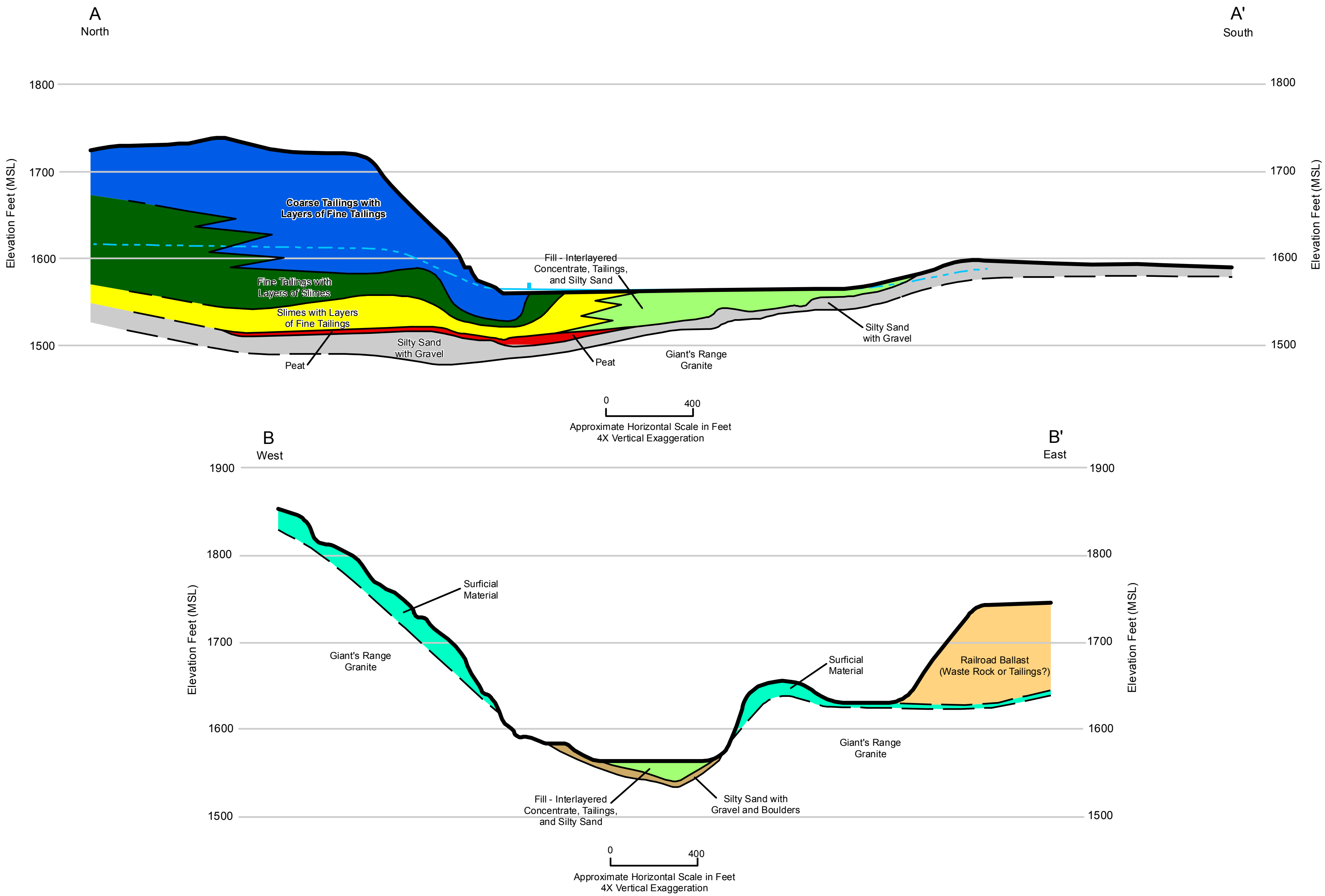

- Coarse Tailings with Layers of Fine Tailings
- Fill - Interlayered Concentrate, Tailings, and Silty Sand
- Slimes with Layers of Fine Tailings
- Fine Tailings with Layers of Slimes
- Railroad Ballast
- Peat
- Silty Sand with Gravel
- Silty Sand with Gravel and Boulders
- Surficial Material

Figure 4.2.14-5
Hydrometallurgical Residue Facility - Cross Sections A and B (Existing Conditions)
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Minnesota

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Natural Soils and Geology

In the area of the Hydrometallurgical Residue Facility, bedrock is generally within 25 ft of the existing ground surface, except where surface materials have been built up either to support the former LTVSMC facilities or where tailings or mill overflow materials have been deposited in the existing LTVSMC Emergency Basin (see Figure 4.2.14-5). To facilitate the expedited consolidation of the in-place LTVSMC tailings, wick drains would be installed within the Emergency Basin. This would reduce drainage path lengths and increase the drainage ability in the LTVSMC tailings and underlying compressed peat.

Native surficial deposits, which have been sampled and logged at boring locations in and around the existing LTVSMC Emergency Basin, have been limited to silty sands with interbedded coarser grained alluvial deposits and peat. A thin layer of peat below the fill in the existing LTVSMC Emergency Basin thickens beneath the toe of the existing LTVSMC Tailings Basin.

4.2.14.3.5 Geotechnical Summary

The values of hydraulic conductivity inputs, stress-deformation properties, and the material properties used in modeling and the slope stability analyses discussed in Section 5.2.14 are summarized in Table 4.2.14-2 and Table 4.2.14-3.

There are no other significant structures existing at the proposed Hydrometallurgical Residue Facility site that appear to be at risk of geotechnical instability as a result of its construction.

Further information on the parameters used for the design and modeling of the Hydrometallurgical Residue Facility is provided in Section 5.2.14.

Table 4.2.14-2 Summary of Modeling Permeabilities for the Material Relevant to the Hydrometallurgical Residue Facility

	Modeling Permeability	
Material	**cm/sec**	**ft/sec**
LTVSMC Coarse Tailings	2.44E-03	8.00E-05
LTVSMC Fine Tailings	2.00E-05	6.56E-07
LTVSMC Slimes	9.60E-07	3.15E-08
LTVSMC Bulk Tailings	8.02E-05	2.63E-06
Glacial Till	5.03E-03	1.65E-04
Sand	1.00E-02	3.28E-04
Residue (used for rate of drainage computation – quantity vs. time)	3.40E-05	1.12E-06
Residue (used for computation of time for drainage to occur)	5.50E-06	1.80E-07
Compressed Peat	3.60E-06	1.18E-07
Bedrock	8.56E-08	2.81E-09
LTVSMC Slimes – with wick drains	2.34E-08	7.69E-08
Compressed Peat – with wick drains	8.75E-09	2.87E-08

Table 4.2.14-3 Summary of Shear Strength Parameters for the Material Relevant to the Hydrometallurgical Residue Facility

Material	Model	Unit Weight (pcf)	Elasticity modulus, (psf)	ϕ (deg)	Poisson's ratio, μ	Normal Consol. line slope, λ	Consol. Line slope, Swelling line slope, κ	Initial Void Ratio, e_o
Glacial Till	Linear Elastic	135	5.00E+05	-	0.30	-	-	-
LTVSMC Coarse Tailings	Linear Elastic	135	8.40+05	-	0.30	-	-	-
LTVSMC Fine Tailings	Soft Clay (Modified Cam Clay)	130	-	33	0.30	0.05	0.01	1.07
LTVSMC Slimes	Soft Clay (Modified Cam Clay)	120	-	34	0.30	0.07	0.01	1.14
LTVSMC Slimes – with wick drains	Soft Clay (Modified Cam Clay)	120	-	34	0.30	0.07	0.01	1.14
Residue	Linear Elastic	115	-	30	0.30	0.18	00.03	1.92
Giant's Range Granite	Linear Elastic	165	1.69E+09	-	0.18	-	-	-
Sand	Linear Elastic	120	6.00E+05	-	0.30	-	-	-
LTVSMC Bulk Tailings	Linear Elastic	130	1.00E+06	-	0.30	-	-	-
Bedrock – blasted	Linear Elastic	135	1.00E+06	-	0.30	-	-	-
Compressed Peat	Soft Clay (Modified Cam Clay)	85	-	30	0.30	0.70	0.09	3.84
Compressed Peat – with wick drains	Soft Clay (Modified Cam Clay)	85	-	30	0.30	0.70	0.09	3.84

pcf = Pound(s) per cubic foot
psf = Pound(s) per square foot

4.3 LAND EXCHANGE

4.3.1 Land Use

The federal and non-federal lands were reviewed against parameters similar to the Mine Site and Plant Site, including existing land use plans, zoning designations, public access routes, mineral ownership and economic potential, and title.

Additionally, each tract of the Land Exchange Proposed Action was evaluated for the presence of known existing hazardous material effects and contaminated sites and for the potential for hazardous materials to be currently affecting the lands. Research to evaluate potential hazardous materials or hazardous material sites on these land areas consisted of review of three types of data sources, depending on the size and geographic spread of the land area. The data sources used include:

- an ASTM/AAI Phase I ESA;
- an Environmental Regulatory Database search, which was conducted by Environmental Data Resources, Inc. (EDR), and consists of a report of federal, state, local, or tribal agency databases; and
- the MPCA website database titled, "What's In My Neighborhood?"

A Phase I ESA provides a comprehensive review of environmental regulatory databases and includes a physical site visit, interviews with property or adjacent property owners and local officials, and review of historical data such as aerial photographs, topographic maps, fire insurance maps, land title records, or property tax files. Conclusions are drawn based upon the findings to identify recognized environmental conditions based on the comprehensive review and the opinion of the environmental professional.

The Environmental Regulatory Database search defines and summarizes the ASTM databases reviewed in the EDR report and notes whether any sites (including the target property) were identified within a specified search radius. The database sites identified in the EDR report were evaluated with respect to the target land area to determine which sites indicate hazardous material effects.

The MPCA website database identifies potentially contaminated sites through a searchable inventory of properties, as well as sites that have already been cleaned up and those currently being investigated or cleaned up. The website also contains a searchable inventory of businesses that have applied for and received different types of environmental permits and registrations from the MPCA.

4.3.1.1 Federal Lands

4.3.1.1.1 Land Exchange Proposed Action

The boundaries of the federal lands include the Mine Site and extend further north and west and exclude the privately owned land bordering Dunka Road to the south of the Mine Site. Section 4.2.1.2 provides a discussion of the existing land use on the federal lands.

The Land Exchange Proposed Action includes 6,495.4 acres of federal lands with a perimeter of approximately 23 linear miles. By comparison, Superior National Forest comprises 4,600,831.8 acres, of which 2,171,603.9 acres, with a perimeter of 10,054.8 linear miles (including the federal lands), are managed by the USFS. The majority of the federal lands are within the General Forest – Longer Rotation Management Area, while the remainder is within the General Forest Management Area (see Figure 4.3.1-1). These management areas are defined in Section 4.2.1.2. Table 4.3.1-1 summarizes the acreage of the federal lands, by management area, for the Land Exchange Proposed Action.

There is no known existing contamination by hazardous materials in the federal lands.

Table 4.3.1-1 Management Area Designations for the Federal Lands under the Land Exchange Proposed Action

Management Area Designation	Total Acreage
General Forest – Longer Rotation	6,140.1
General Forest	355.3

4.3.1.1.2 Land Exchange Alternative B

Under the Land Exchange Alternative B, 4,752.6 acres of federal lands would be exchanged for the 4,926.3-acre Tract 1. Table 4.3.1-2 summarizes the acreage of the federal lands, by management area, for the Land Exchange Alternative B. Section 4.3.1.2.1 describes Tract 1.

Table 4.3.1-2 Management Area Designations for the Federal Lands under Land Exchange Alternative B

Management Area Designation	Total Acreage
General Forest – Longer Rotation	4,397.3
General Forest	355.3

4.3.1.2 Non-federal Lands

The non-federal lands comprise five tracts—each consisting of one or more individual parcels—totaling 7,075.0 acres. The land use conditions of each tract are described below. Tracts 1 and 2 of the Land Exchange Proposed Action include areas with potential conservation value (i.e., cRNA Management Area and Riparian Emphasis Management Area). Some of the parcels within Tract 2, Tract 3, and Tract 4 have limited accessibility by either road or foot trail, although there are segments that show evidence of timber harvesting (see Figures 5.3.1-1 and 5.3.1-2).

4.3.1.2.1 Tract 1 – Hay Lake Lands

Tract 1 is located in central St. Louis County, approximately 3 miles north-northwest of the City of Biwabik. The tract consists of one parcel covering approximately 4,926.3 acres, with a perimeter of approximately 15 linear miles.

Land Use Regulation

Land use in Tract 1 is governed by the St. Louis County zoning ordinance. It is divided among the following zoning districts (St. Louis County 2011):

- **Forest Agricultural Management (FAM-1)**: This district recognizes and promotes the development of forestry and agricultural industry and encourages recreational activity. It is typically applied to areas with very low density land development. This district is located in the northeast corner and occupies approximately 5 percent of the Tract 1 lands.
- **Forest Agricultural Management (FAM-2)**: This district recognizes and promotes the development of forestry and agricultural industry and encourages recreational activity. It is typically applied to areas with very low density land development. Whereas FAM-1 has a minimum parcel size of at least 35 acres, FAM-2 has a minimum parcel size of 17 acres. This district is located throughout the parcel and occupies approximately 57 percent of the Tract 1 lands.
- **Sensitive Areas (SENS-3)**: In addition to the forestry/agriculture focus embodied in the FAM-2 district, the SENS-3 district also recognizes significant areas that are unsuitable for intensive development due to the potential for environmental hazards or other features to negatively affect environmental conditions. This classification surrounds most of Hay Lake and Little Rice Lake, as well as a large portion of the river and riparian areas. This district is located throughout the parcel and occupies approximately 33 percent of the Tract 1 lands.
- **Residential (RES-3)**: This district recognizes and promotes residential development with limited non-residential uses. This district is located northeast and southwest of Hay Lake and occupies approximately 5 percent of the Tract 1 lands.

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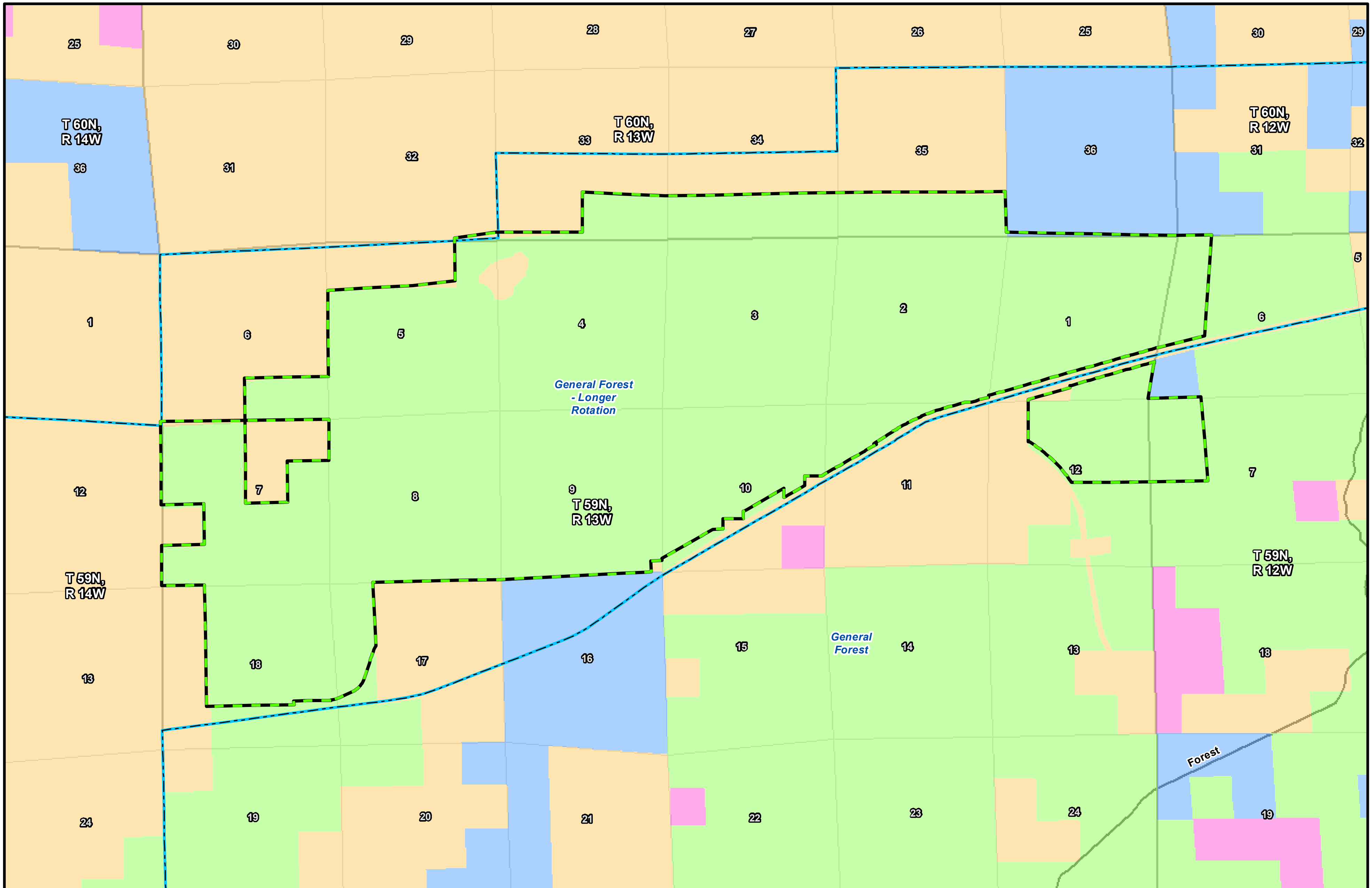

Federal Lands
Management Area
Road
Section Boundary
Section Label
National Forest Ownership
County Ownership
State of Minnesota Ownership
Other Ownership

US Army Corps of Engineers St. Paul District

0 0.25 0.5 1 Miles

Figure 4.3.1-1
Ownership of Federal Lands
NorthMet Mining Project and Land Exchange SDEIS
Minnesota

November 2013

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Adjacent to Tract 1 on the west and north are Superior National Forest lands that fall within the General Forest Management Area. Two cRNA management areas adjoin the tract: Pike Mountain on the southwest corner and Loka Lake on the northeast corner (USFS 2011b). The cRNAs are designated by the USFS for the purpose of preserving and maintaining areas for ecological research, observation, genetic conservation, monitoring, and educational activities. No recreation facilities are provided in these management areas and while dispersed recreation occurs, it is generally discouraged. The Pike Mountain cRNA is characterized by a hardwoods forest plant community. The Loka Lake cRNA is characterized by high-quality lowland black spruce and tamarack swamp (USFS 2011h).

Adjacent to Tract 1 on the south and east are privately owned lands within St. Louis County's Multiple Use Non-Shoreland 4 (MUNS-4) zoning district. This designation allows for a diverse array of developments suitable to rural areas outside of shoreland areas. These may include residential, light industry, commercial, livestock, sanitary landfill, airport, and utility facilities, among others (St. Louis County 2011).

As part of the Land Exchange Proposed Action, the non-federal lands were the subject of Phase I ESAs. Potential areas of legacy contamination were discovered on Tract 1. These areas were investigated and remediated through removal and disposal of potentially contaminated soil and materials. Any remnant contamination (limited to two instances where less than 5 gallons of used oil were spilled) is expected to degrade in situ (NTS 2011).

Existing Land Use

Tract 1 includes Hay Lake, identified as a wild rice water by the MDNR, Little Rice Lake, and an unnamed lake (see Figure 4.3.1-2). Approximately 8 miles of the upper Pike River flow through Tract 1. There is an electrical transmission line across Sections 19, 20, and 21, and a portion of Section 16 (USFS 2011b). CR 715 forms part of the eastern boundary of the tract.

A small boat landing and primitive parking area provide access to the Pike River adjacent to CR 715. Several trails also emanate from CR 715, some with bridges crossing the upper Pike River; all of these trails are gated or bermed. There is evidence that a sand/gravel pit near CR 715 has been used as a dumping site in the recent past, but has been fully remediated and cleared of trash and debris (NTS 2011). The gravel pit area is gated, but there is evidence that it has been used as a shooting range. There are also numerous deer stands on the parcel (ERM 2011b).

Property Rights, Title, and Mineral Resources

PolyMet currently owns surface rights to Tract 1. The tract is subject to a mortgage in favor of Iron Range Resources, which would be satisfied at closing of the Land Exchange Proposed Action (USFS 2011c). Title to this parcel has been reviewed and approved by the USDA, Office of General Counsel so long as certain recommended affirmative title insurance is provided (USFS 2011c).

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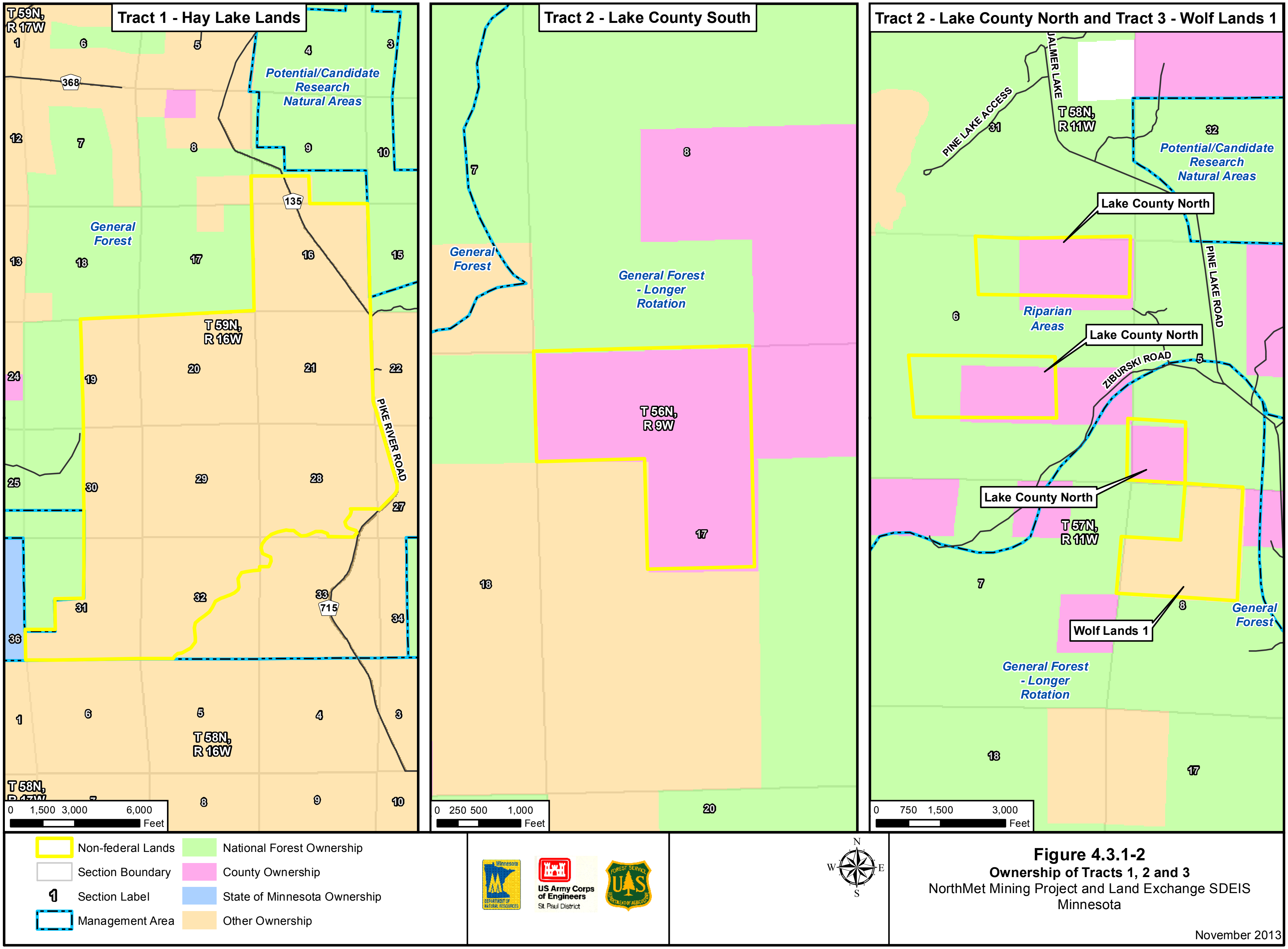

Figure 4.3.1-2
Ownership of Tracts 1, 2 and 3
NorthMet Mining Project and Land Exchange SDEIS
Minnesota

November 2013

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Tract 1 was assessed for mineral resource potential as part of the Feasibility Analysis completed in 2009 (USFS 2009c). The geology of the area is mostly granitic rocks with the southwestern-most part underlain by metamorphosed basalts, gabbros, and sedimentary rocks. The mineral potential for the tract was determined to be limited, as granitic rocks are not known to host mineral deposits. The MDNR core library index showed no drilling on or near the area. Additional investigation in 2011 indicates potential for aggregate production from the northeastern corner of the tract along the Pike River. Tract 1 appears to have a low potential for exploration or development of bedrock or surficial deposits (Barr 2011c).

Legacy Pollution

The legacy pollution data review described in Section 4.3.1 found that hazardous materials may be present on Tract 1, specifically along Pike River Drive on the northeast side of the tract, and between Hay Lake and CR 715, west of the Pike River. The Phase I ESA for Tract 1 described several areas where releases of hazardous materials may exist due to unauthorized dumping. The EDR report and MPCA database also identified three unauthorized or unpermitted dump sites on Tract 1. The southernmost dump, west of the Pike River, is named Unauthorized Dump-Biwabik. The two remaining dump sites, Unauthorized Dump-2 and Unnamed Dump-Biwabik/2, are north of the first dump site and adjacent to CR 715. These types of dumps are typically old farm, homestead, or municipal disposal sites that accepted household waste. There are no records of inspection or enforcement actions at these sites as documented on the MPCA database (NTS 2010a; EDR 2009a; MPCA 2012d); however, a subsequent Phase II investigation found no evidence of spills or contamination, and found that legacy pollution had been resolved at the site (NTS 2011).

4.3.1.2.2 Tract 2 ‑ Lake County Lands

Tract 2 comprises four parcels in Lake County, southeast of Seven Beaver Lake, totaling 381.9 acres with a perimeter of approximately 7 linear miles. No hazardous material issues were identified at Tract 2 (EDR 2011a; EDR 2011b; MPCA 2012d).

Land Use Regulation

All Lake County parcels fall within Lake County’s Forest-Recreation zoning district (Nelson, Pers. Comm., October 10, 2011). The Forest-Recreation district provides for remote residential development distant from public services. It is intended to prevent the destruction of natural or man-made resources, maintain large tracts for forest recreation purposes, provide for the continuation of forest management and production programs, and foster recreational uses and other compatible activities.

The Lake County North parcels are surrounded by land within two Superior National Forest Management Areas (see Figure 4.3.1-2): the General Forest – Longer Rotation Management Area (see Section 4.2.1.2) and the Riparian Emphasis Area Management Area. Lands in the Riparian Emphasis Area are located along rivers and lakes that receive moderate to low levels of recreation use. This designation promotes the restoration, protection, and enhancement of areas sensitive to degradation. Lands surrounding Seven Beaver Lake and adjacent to Tract 2 are the headwaters area of the St. Louis River, and are designated as a Riparian Emphasis Area Management Area.

The Lake County South parcel is largely bordered by lands in the General Forest – Longer Rotation Management Area. Adjacent parcels to the southwest are privately owned land; parcels to the northeast are county land in the Forest-Recreation zoning district.

Existing Land Use

A trail provides access to the Lake County South parcels, but access to the trail is relatively difficult (ERM 2011b). There is evidence of clearcut timber activity on the Lake County North parcels.

There is limited access to the Lake County South parcel due to wetlands and private land restrictions, and little evidence of active use (ERM 2011b).

Property Rights, Title, and Mineral Resources

Tract 2 parcels are tax forfeit lands that are being purchased in the name of Lake-Forest Enterprise, Inc. on a land contract from Lake County. An assignment on file with Andresen and Butterworth, PA assigns all right, title, and interest in these lands to PolyMet (USFS 2011c).

A review of mineral resources on Tract 2 indicates a low potential for exploration or development of bedrock or surficial deposits (Barr 2011c). A title commitment review found that one 40-acre parcel has one-half mineral interest outstanding and that all other minerals will be reserved by the State of Minnesota and subject to the Secretary's Rules and Regulations. Within the Lake County South parcel, one 40-acre parcel is subject to mineral reservation that includes the right to sink, cave, disturb, or remove surface material. Another parcel has one-half outstanding mineral interest with the right to remove but "doing no injury to the surface or else paying for damages." The third and final 40-acre parcel and the remaining one-half mineral interest would be reserved by the State of Minnesota and would be subject to the Secretary's Rules and Regulations (USFS 2011c).

4.3.1.2.3 Tract 3 – Wolf Lands

The Wolf Lands consist of four separate parcels in Lake County totaling 1,575.8 acres with a perimeter of approximately 14 linear miles. No hazardous material issues were identified at Tract 3 (EDR 2011b; EDR 2011c; EDR 2011d; EDR 2011e; MPCA 2012d).

Land Use Regulation

All Tract 3 parcels are within Lake County's Forest-Recreation zoning district, defined in Section 4.3.1.2.3 (Nelson, Pers. Comm., October 10, 2011).

Wolf Lands 1, the southernmost parcel, is largely bordered by Superior National Forest land in the General Forest-Longer Rotation Management Area. Adjacent parcels to the southwest and northeast corners owned by Lake County are also within the Forest-Recreation district (see Figure 4.3.1-2).

Wolf Lands 2 is bordered on the north and south by Superior National Forest land in the General Forest Management Area. Adjacent parcels to the east are privately owned, in Lake County's Forest-Recreation district. Adjacent parcels to the west and southeast are state-owned land (see Figure 4.3.1-3).

Wolf Lands 3 is adjacent to Superior National Forest land in the General Forest Management Area. Small privately-owned parcels to the west and east are within Lake County's Forest-Recreation district (see Figure 4.3.1-3). A timber harvest agreement currently encumbers parts of this parcel (USFS 2011c).

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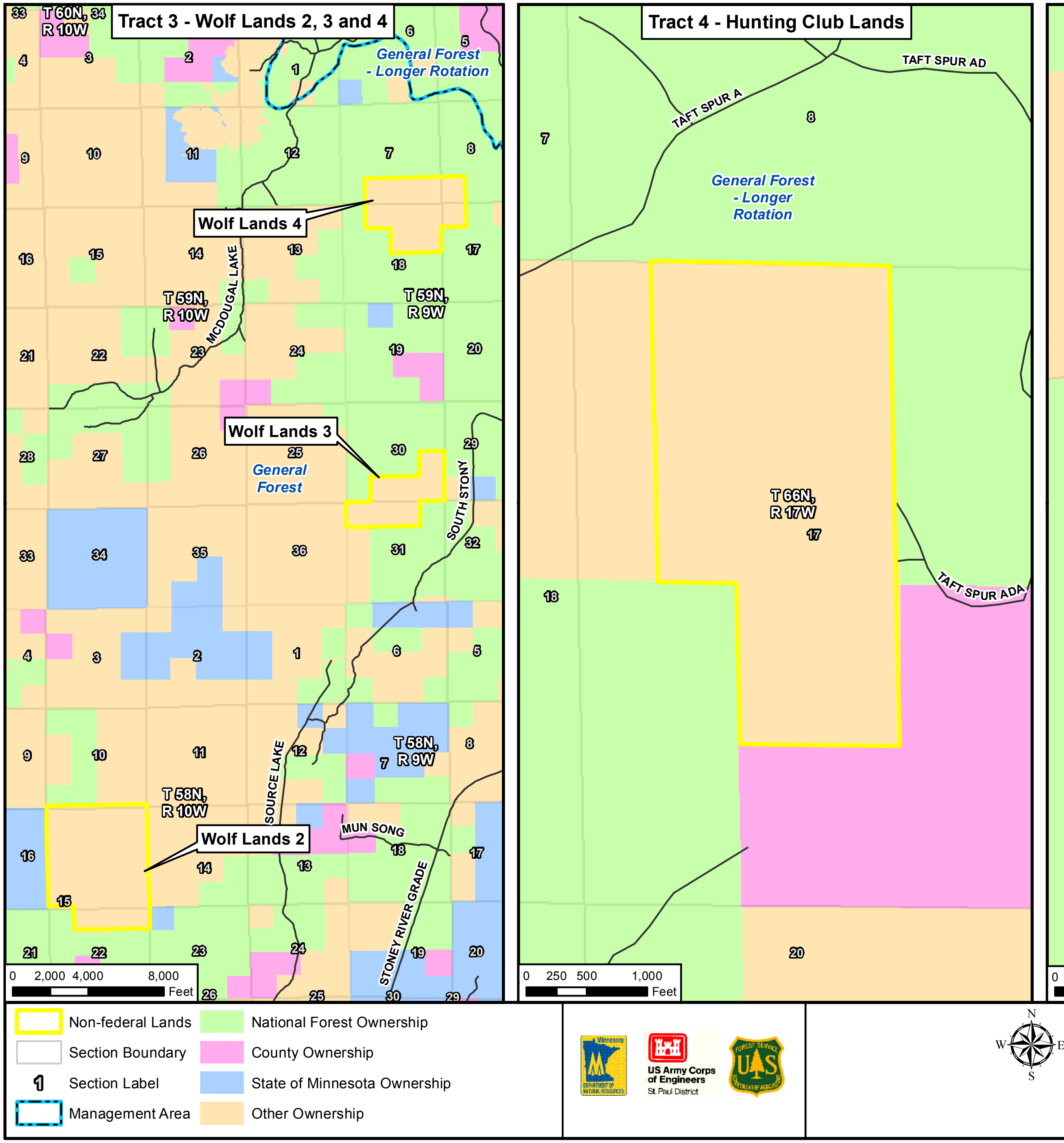

Figure 4.3.1-3
Ownership of Tracts 3, 4 and 5
NorthMet Mining Project and Land Exchange SDEIS
Minnesota

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Wolf Lands 4 is surrounded by Superior National Forest land in the General Forest Management Area (see Figure 4.3.1-3).

Existing Land Use

Access to Wolf Lands 1 and 2 is limited, due to the distance from roads and the presence of wetlands surrounding Wolf Lands 2. There is no evidence of any active land use on either of these parcels (ERM 2011b).

Wolf Lands 3 is accessible from a trail off of Forest Road 393. There is evidence of ongoing timber harvesting on this parcel (ERM 2011b).

Wolf Lands 4 is accessible via overland hiking from Forest Road 106, but there is no evidence of active land use (ERM 2011b).

Property Rights, Title, and Mineral Resources

Tract 3 is being purchased in the name of Lake-Forest Enterprise, Inc., through options from Wolf Lands, Inc. An assignment on file with Andersen and Butterworth, PA assigns all right, title, and interest in these lands to PolyMet (USFS 2011c).

There appears to be low potential for exploration or development of bedrock or surficial deposits on the Wolf Lands parcels. There is a moderate potential for aggregate development within Wolf Lands 2, but the parcel’s wetland areas and limited access may restrict this opportunity (Barr 2011c).

Within Wolf Lands 1 there is an undivided three-quarter mineral interest reserved by Anton T. Anderson; all remaining mineral interests are held by Kimberly Clark with the right to cave, disturb, damage, or remove the surface while accepting liability for surface damage. The title commitment review indicated that this represents a poor condition of title but may be immaterial because the mineral development potential is low. In addition, there is no timber reservation or agreement in place (USFS 2011c).

Within Wolf Lands 2, 3, and 4, mineral interests are reserved by Duluth & Iron Range Railroad Co. along with the right to sink, cave, disturb, and remove the surface. The title commitment review indicated that this represents a poor condition of title that may be immaterial because the mineral development potential is low.

Within Wolf Lands 3, Stora Ernso North America Corporation has reserved timber rights pursuant to a timber agreement in its deed to Wolflands Corporation. The timber reservation expires December 31, 2013. The timber reservation applies to Sections 8 and 17, T59N, R9W (two 40-acre parcels) (USFS 2011c). There are no timber reservations or agreements in place for Wolf Lands 1, 2, or 4.

4.3.1.2.4 Tract 4 – Hunting Club Lands

Tract 4 is a single parcel southwest of Crane Lake in St. Louis County. It is composed of 160.0 acres, with a perimeter of approximately 2 linear miles. No hazardous material issues were identified at Tract 4 (EDR 2011f; MPCA 2012d).

Land Use Regulation

Tract 4 is within St. Louis County's Forest Agricultural Management (FAM-1) zoning district. This district is intended to promote the forestry and agricultural industries, as well as recreational uses (St. Louis County 2011). Adjacent parcels on the west and southeast are also in this county zoning district. Adjacent parcels to the southwest, north, and east are Superior National Forest lands in the General Forest– Longer Rotation Management Area (see Figure 4.3.1-3).

Existing Land Use

Tract 4 is accessible by trail from a gravel road northwest of the property. The tract partially includes portions of two small unnamed lakes. There is no evidence of active land use.

Property Rights, Title, and Mineral Resources

There is low potential for exploration or development of bedrock or surficial deposits within Tract 4 (Barr 2011c). The only title exception is the property's enrollment in the Sustainable Forest Incentive Act Covenant dated September 3, 2002. This status normally includes an 8-year commitment for enrollment (USFS 2011c). Definitive information about mineral ownership and expiration of the Sustainable Forest Incentive Act covenant (dated 2002) for this tract will be provided in the Final EIS.

4.3.1.2.5 Tract 5 – McFarland Lake Lands

Tract 5 is a single parcel approximately 3 miles from the US-Canada border in Cook County. It covers approximately 30.8 acres, with a perimeter of approximately 1 linear mile. No hazardous material issues were identified at Tract 5 (NTS 2010b; EDR 2009b; MPCA 2012d).

Land Use Regulation

Tract 5 is in an unincorporated area in Cook County's Forest/Agriculture Residential (FAR 2) zoning district. This designation is characterized by a mix of forestry, agriculture, residential, and recreational uses (Cook County 2011). Adjacent privately owned parcels to the north and southeast are also within this county zoning designation. The tract is bordered on the west and south by lands within the General Forest – Longer Rotation Management Area (see Figure 4.3.1-3).

Existing Land Use

Tract 5 was formerly owned and used by Wheaton College. A bunkhouse, fire ring, outhouse, and cistern are present, although these structures would be removed prior to the completion of the Land Exchange Proposed Action. The tract's eastern boundary is formed by McFarland Lake, an entry point to the BWCAW. Access to the property is by water from a landing off CR 16, or by a walking trail from the end of CR 16 (ERM 2011b).

Property Rights, Title, and Mineral Resources

PolyMet is the owner of surface rights for this tract. The tract is subject to a mortgage in favor of Iron Range Resources, which would be satisfied at closing of the Land Exchange Proposed Action (USFS 2011c).

The tract was assessed for mineral potential and encumbrances as part of the Feasibility Analysis completed in 2009. The geology underlying the tract is gabbroic and sedimentary rocks. Studies of the mineral potential in this area are rare because of the proximity to the BWCAW, but this type of formation has not shown mineral potential elsewhere in the county. The MDNR core library index shows no drilling in or near the area. There are no nearby gravel operations that would indicate any potential for surficial materials (USFS 2009c).

There appears to be low potential for exploration or development of bedrock or surficial deposits within Tract 5 (Barr 2011c). Mineral rights to Tract 5 are outstanding, but deeds do not appear to waive the right to subjacent support (USFS 2011c) (i.e., mineral exploration and extraction may not compromise the “lay of the land” by weakening underground support of the surface).

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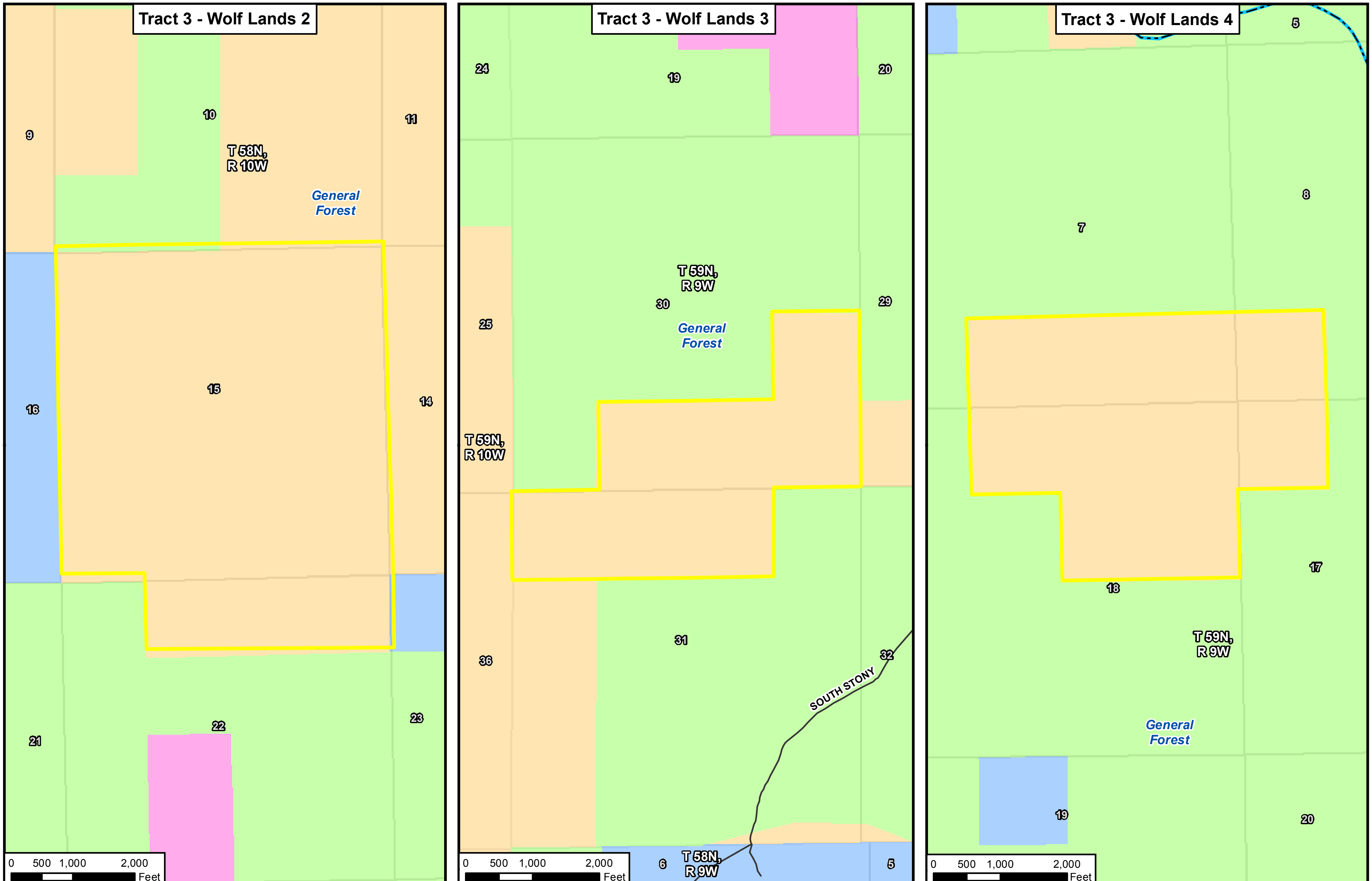

Non-federal Lands
Section Boundary
1 Section Label
Management Area
National Forest Ownership
County Ownership
State of Minnesota Ownership
Other Ownership

N
W E
S

Figure 4.3.1-4
Ownership of Tract 3
NorthMet Mining Project and Land Exchange SDEIS
Minnesota

November 2013

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4.3.2 Water Resources

The federal lands are similar to the Mine Site area previously discussed, but excludes the privately-owned land bordering Dunka Road to the south of the Mine Site. Section 4.2.2 presents a discussion of the existing conditions on the federal lands. The water resources of the federal lands are briefly described in Section 4.3.2.1. Water resources of the non-federal lands are described in Section 4.3.2.2.

4.3.2.1 Federal Lands

4.3.2.1.1 Land Exchange Proposed Action

The Land Exchange Proposed Action consists of exchanging 6,495.4 acres of federal lands (see Figure 3.3-1) for 7,075.0 acres of non-federal lands. Most of the Mine Site is composed of federal lands, with a small portion located south of Dunka Road in non-federal lands. The Land Exchange Proposed Action also includes federal lands located north and west of the Mine Site.

Groundwater

Groundwater resources in and near the Mine Site are discussed in detail in Section 4.2.2.2.1. In general, the glacial aquifer within the Land Exchange Proposed Action federal lands is typically very thin (less than 30 ft) with limited yield; there are no large-scale regional aquifers (MPCA 1995). The Duluth Complex, which immediately underlies the glacial material, is the least fractured of the bedrock units in the area, and therefore has the poorest aquifer characteristics.

Surface Water

Surface water resources in and near the Mine Site are discussed in detail in Section 4.2.2.2.2. Surface water resources within the Land Exchange Proposed Action federal lands include Mud Lake (PW-148P), and 3.8 miles of the Partridge River and 0.7 miles of Yelp Creek (see Table 4.3.2-1), also a MDNR-designated public water resource. There are no known wild rice beds within these public waters.

Table 4.3.2-1 Summary of Surface Water and Wild Rice Beds for Federal Lands

	Federal Lands	
	Land Exchange Proposed Action	**Land Exchange Alternative B**
Public Water Lakes, ac. (mi. shore)	30.5 (0.9)	Approximately 8.9 (0.2)
Public Water Streams, mi. stream	4.5	4.5
Wild Rice Beds, ac.	--	--

Source: PW data from MDNR 2012j; Wild Rice data from MDNR 2008c.

4.3.2.1.2 Land Exchange Alternative B

Land Exchange Alternative B: Smaller Federal Parcel lands are somewhat smaller than the Land Exchange Proposed Action, totaling 4,752.6 acres, which excludes the far western portion of the Land Exchange Proposed Action federal land area (see Figure 3.3-1). The Land Exchange Alternative B consists of exchanging 4,752.6 acres of federal lands for 4,926.3 acres of non-federal lands.

Groundwater

Groundwater resources of the Land Exchange Alternative B: Smaller Federal Parcel lands are essentially the same as those of the Land Exchange Proposed Action.

Surface Water

Surface water resources of the Land Exchange Alternative B: Smaller Federal Parcel lands are essentially the same as those of the Land Exchange Proposed Action, with the exception that the northwest boundary of the Land Exchange Alternative B bisects Mud Lake, including only about 30 percent of its shoreline.

4.3.2.2 Non-federal Lands

Water resources considered in this evaluation of the five non-federal land tracts proposed for exchange include the following:

- quality and flow of groundwater;
- quality and flow of surface water; and
- quantity of wild rice beds.

4.3.2.2.1 Regional Groundwater Resources

Regional Groundwater Water Quality

There are no known, site-specific groundwater quality data for any of the non-federal Land Exchange Proposed Action lands. However, there were two studies that collected surficial groundwater quality data throughout the region that may be used to generally characterize potential groundwater quality at the exchange sites. The MPCA studied groundwater quality throughout the state, and published several documents that describe the general condition of the groundwater resource in northeast Minnesota. They note that glacial aquifers in this part of the state are commonly thin and limited in their extent and yield; there are no large-scale regional aquifers (MPCA 1995). The Regional Copper-Nickel Study (Seigel and Ericson 1980) generally focused on the area around the Duluth Complex, so data from that study may not be as broadly applicable.

In addition, between 1992 and 1996, the MPCA's Ground Water Monitoring and Assessment Program sampled 21 wells completed in surficial sand and gravel aquifers and 64 completed in buried, confined sand and gravel aquifers within MPCA Region 1, which encompasses seven counties in northeastern Minnesota including St. Louis County (MPCA 1999). The MPCA study concluded that groundwater quality across the region is generally good. Concentrations of major cations and anions were lower in surficial and buried drift aquifers compared to similar aquifers statewide, while concentrations of trace metals were higher. They noted that since geology controls groundwater quality in the region, trace inorganic constituents commonly found in the bedrock, such as beryllium, manganese, boron, arsenic, and selenium may have naturally elevated concentrations locally. Of the 85 surficial and buried aquifer samples that were collected, MPCA recorded five exceedances of the state drinking water criteria for beryllium, four for manganese, and one for boron. There were no exceedances noted for arsenic or selenium.

Although these data may not be directly applicable to any one of the Land Exchange Proposed Action lands, they can be used to draw general conclusions about the probable range of water quality. Table 4.2.2-6 summarizes Mine Site groundwater quality data and compares it with the MPCA (i.e., Northeast MN Baseline) and copper-nickel (i.e., Cu-Ni Baseline) study data for surficial aquifers. The range of values across the region for the five constituents of concern noted by the MPCA was generally comparable to the ranges monitored at the Mine Site, with the exception of manganese, which was higher for some of the regional samples.

Probable Groundwater Source Areas for the Exchange Lands

As suggested by the MPCA study for the northeast region, all of the exchange tracts, with the possible exception of the Tract 1, appear to be characterized by thin glacial aquifers with limited yield. Source areas of surficial groundwater also appear to be limited, usually within a mile or two of each tract.

The general applicability of the regional, surficial data to the exchange lands is somewhat dependent on the potential for local anthropogenic (man-made) contamination of groundwater. A cursory evaluation of the surficial groundwater source area for each parcel is made in the groundwater discussion for each of the tracts below.

4.3.2.2.2 Surface Water Resources

The five tracts drain either south to the Lake Superior Watershed or north to the Hudson Bay Watershed. Except for timber harvest, they are all generally undisturbed with native forest cover. Little, if any, hydrologic or water quality data has been collected for any of the tracts. The surface water resources of each tract are described below. Table 4.3.2-2 summarizes the surface water and wild rice beds of each tract.

Table 4.3.2-2 Summary of Surface Water and Wild Rice Beds for all Land Exchange Proposed Action Tracts

	Non-federal Lands					**Non-federal Totals**
	Tract 1 – Hay Lake Lands	**Tract 2 – Lake County Lands**	**Tract 3- Wolf Lands**	**Tract 4 – Hunting Club Lands**	**Tract 5 – McFarland Lake Lands**	
Public Water Lakes, ac. (mi. shore)	125.7 (2.8)	--	--	--	0 (0.2)	**125.7 (3.0)**
Public Water Streams, mi. stream	8.1	--	1.0	--	--	**9.1**
Wild Rice Beds, acres.	125.7	--	--	--	--	**125.7**

Source: PW data from MDNR 2012j; Wild Rice data from MDNR 2008c.

4.3.2.2.3 Tract 1 – Hay Lake Lands

Groundwater

This tract would appear to be the most susceptible of all the tracts to anthropogenic influences since it is located only a few miles away from the Mesabi Iron Range and several local communities. However, a natural topographic and bedrock divide separates most of the Mesabi Iron Range mining activities from the tract, meaning that surficial groundwater flow to the tract is isolated from most mining and community influences. One mining feature within the same watershed (Pike River) is ArcelorMittal Steel's Tailings Basin, located about 0.5 miles to the west. The general topography of the area suggests that groundwater flow from the Tailings Basin is to the northeast, away from the Hay Lake lands. Limited surface water quality data from Hay Lake and Rice Lake indicate that sulfate concentrations vary between less than 1.0 and 2.3 mg/L (Barr 2009b), indicating no influence from the Tailings Basin.

Three piles of household waste and soil with minor oil impacts were removed from the Hay Lake tract by PolyMet. Confirmation soil sampling and analyses indicated all impacted soils were removed, and found no evidence that contamination had migrated to groundwater (NTS 2011).

Surface Water

Hay Lake lands drain to the Pike River, which flows into Lake Vermilion near Tower, Minnesota (see Figure 4.3.2-1). The lands contain two MDNR-designated public water lakes—Hay Lake (PW 69-579P) and Rice Lake (PW 69-578W). Hay Lake is 96.2 acres with 1.9 miles of shoreline; Rice Lake is 29.5 acres with about 1 mile of shoreline. This tract also contains about 8 miles of the Pike River, an MDNR-designated public water stream. Hay Lake, Rice Lake, and the Pike River, all of which contain wild rice beds, lie within the Hay Lake lands. These are the only waterbodies within the proposed non-federal land exchange tracts known to contain wild rice beds. These waterbodies were included in three recent annual wild rice surveys (Barr 2009b, 2010c and 2011a); survey results were similar for all three years with no apparent trends in density or distribution. Hay Lake was found to have small, low density wild rice beds (density factor 1 of 5) across the entire lake. Rice Lake was found to have many beds across the entire lake with density factor ratings of 3 to 5. Pike River was also found to have beds with density factor ratings of 3 to 5 across the entire river near Hay Lake, with near-bank beds further upstream.

ArcelorMittal Steel's Tailings Basin is located about 2 miles northwest of Hay Lake (see Figure 4.3.2-1). Seepage from the basin flows north into Wouri Creek, which is also a tributary to Pike River. Three water quality samples taken from Hay Lake during the summer of 2009 all had a sulfate concentration of 1.1 mg/L (Barr 2011a), suggesting that seepage from the ArcelorMittal Steel Tailings Basin is not reaching the lake. Water clarity was estimated at 6 to 12 ft based on 1999-2001 satellite imagery. No water quality data exists for Rice Lake or that portion of Pike River flowing through the land. There are no other known water quality data for this tract.

4.3.2.2.4 Tract 2 – Lake County Lands

Groundwater

The Lake County lands are located near the headwaters of small, tributary streams with local source areas for groundwater. There are no known land-use activities within the source areas that suggest the potential for detrimental effects to groundwater quality.

Surface Water

This tract contains four parcels, three are located in close proximity to each other with a fourth parcel located about 14 miles to the southeast (see Figure 4.3.2-2 and Figure 4.3.2-3). There are no DNR-designated public waters within Tract 2. The three clustered parcels flow to the southwest through a series of small streams that are tributaries to the Cloquet River. The Cloquet River drains into the St. Louis River, which ultimately drains into Lake Superior. The Lake County South parcel flows to a tributary of the Beaver River (MDNR-designated public water stream), which ultimately drains into Lake Superior. There are no known water quality data for this tract.

4.3.2.2.5 Tract 3 – Wolf Lands

Groundwater

The Wolf Lands are located near the headwaters of small, tributary streams with local source areas for groundwater. There are no known land-use activities within the source areas that suggest the potential for detrimental effects to groundwater quality.

Surface Water

This tract consists of four parcels (see Figure 4.3.2-3, Figure 4.3.2-4, Figure 4.3.2-5, and Figure 4.3.2-6). Wolf Lands 1 is located immediately adjacent to the Lake County lands, contains no protected waters, and discharges to the same Cloquet River tributary as the Lake County lands.

Wolf Lands 2 is located adjacent to two creeks that are tributaries to Greenwood Lake; Mary Ann Creek is located to the west and an unnamed creek is located to the southeast. Greenwood Lake flows northerly to the Stony River. There are no public waters within this parcel.

Coyote Creek flows within the northern portion of Wolf Lands 3 and bifurcates Wolf Lands 4. Coyote Creek is a tributary and a MDNR-designated public water stream to McDougal Lake, which eventually flows into Stony River. Wolf Lands 3 contains 0.1 mile and Wolf Lands 4 contains 0.9 mile of Coyote Creek. There is no known water quality data for this tract.

4.3.2.2.6 Tract 4 – Hunting Club Lands

Groundwater

The Hunting Club lands are located near the headwaters of small, tributary streams with local source areas for groundwater. There are no known land-use activities within the source areas that suggest the potential for detrimental effects to groundwater quality.

Surface Water

This entire tract drains into an unnamed tributary of the Vermilion River, which flows north to Crane Lake (see Figure 4.3.2-7). There are no DNR-designated public waters within this land. There is no known water quality data for this tract.

4.3.2.2.7 Tract 5 – McFarland Lake Lands

Groundwater

The McFarland Lake lands may have the most limited groundwater resource of all the tracts due to very shallow glacial material over bedrock. Source areas for groundwater flow to the tract appear to be limited to the tract itself and a small, undeveloped drainage 0.5 mile northwest of the tract. There are no known land-use activities within the source area that could potentially affect groundwater quality.

Surface Water

This tract is tributary to McFarland Lake (MDNR PW 027P), which drains into the border lakes of the BWCAW (see Figure 4.3.2-8). It contains about 990 ft of McFarland Lake shoreline. There is no known water quality data for this tract or for McFarland Lake, other than 13 secchi disk (water clarity) readings taken from 1989 through 2008. The average secchi disk reading was 16.1 ft, which is near the high end of the typical range for water clarity in this region of Minnesota. This secchi disk reading indicates that McFarland Lake is about mid-way between oligotrophic and mesotrophic, which suggests that the lake has relatively low nutrient enrichment.

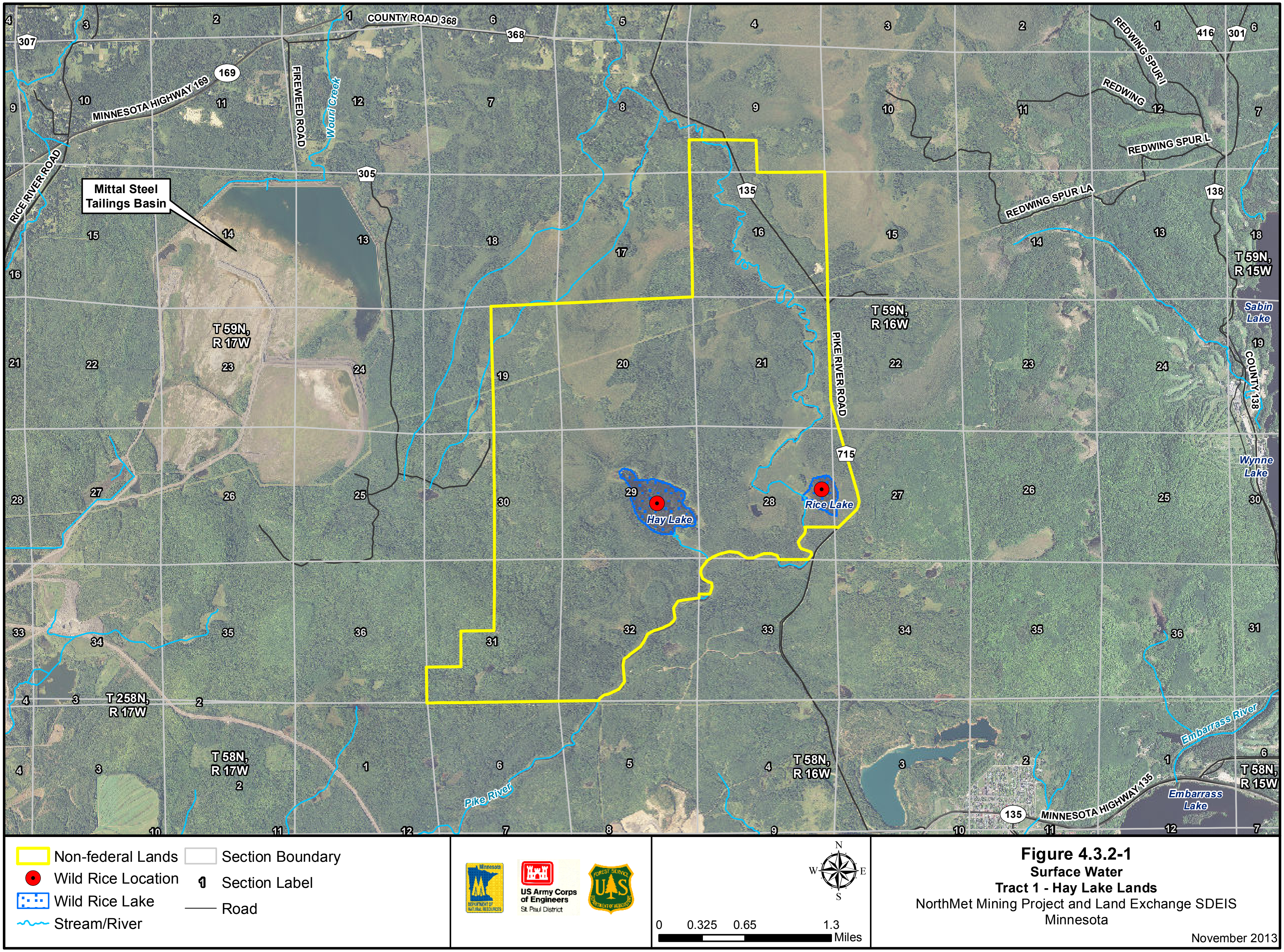

Figure 4.3.2-1
Surface Water
Tract 1 - Hay Lake Lands
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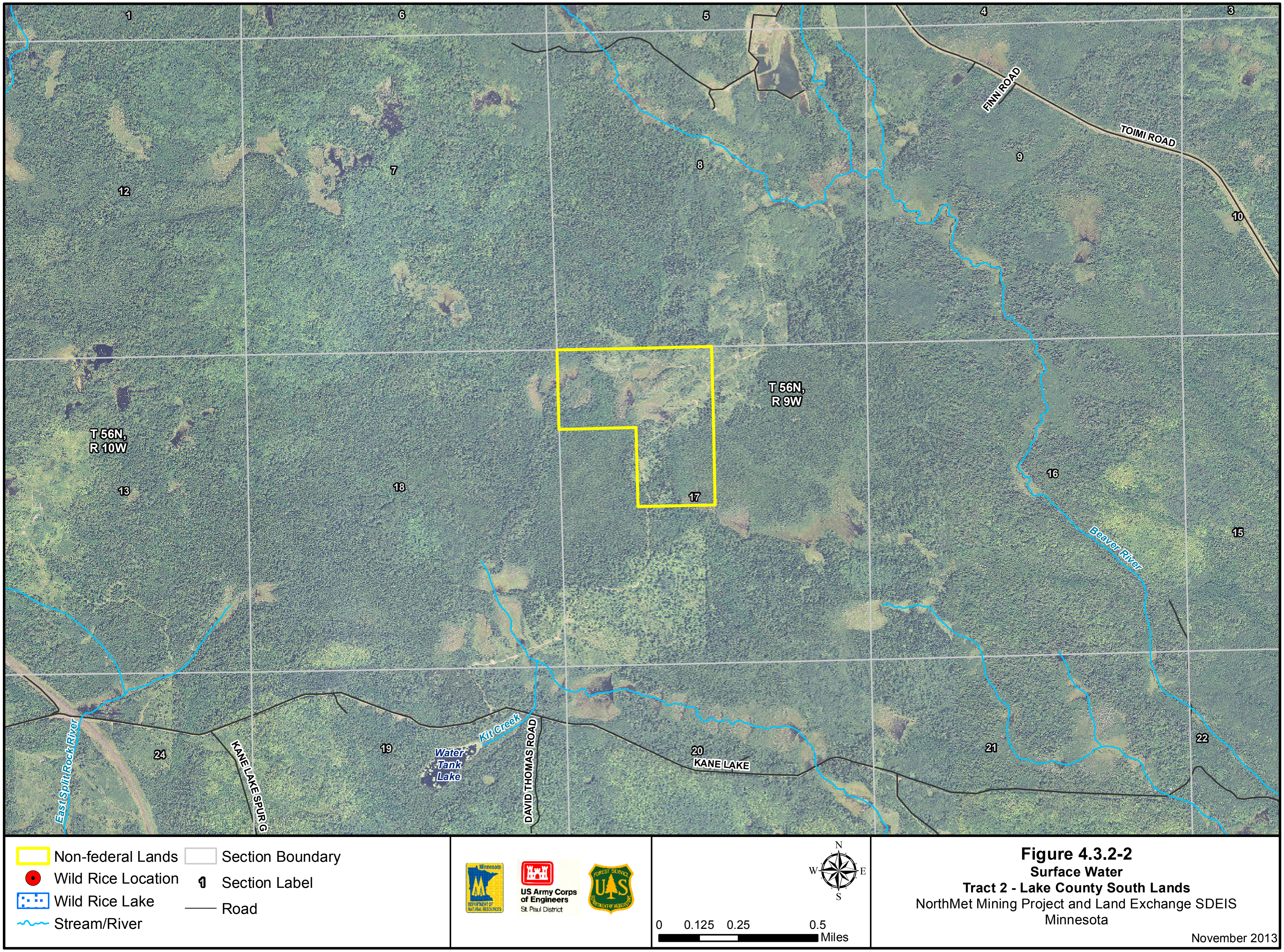

Non-federal Lands
Wild Rice Location
Wild Rice Lake
Stream/River
Section Boundary
1 Section Label
Road

US Army Corps of Engineers
St. Paul District

Figure 4.3.2-2
Surface Water
Tract 2 - Lake County South Lands
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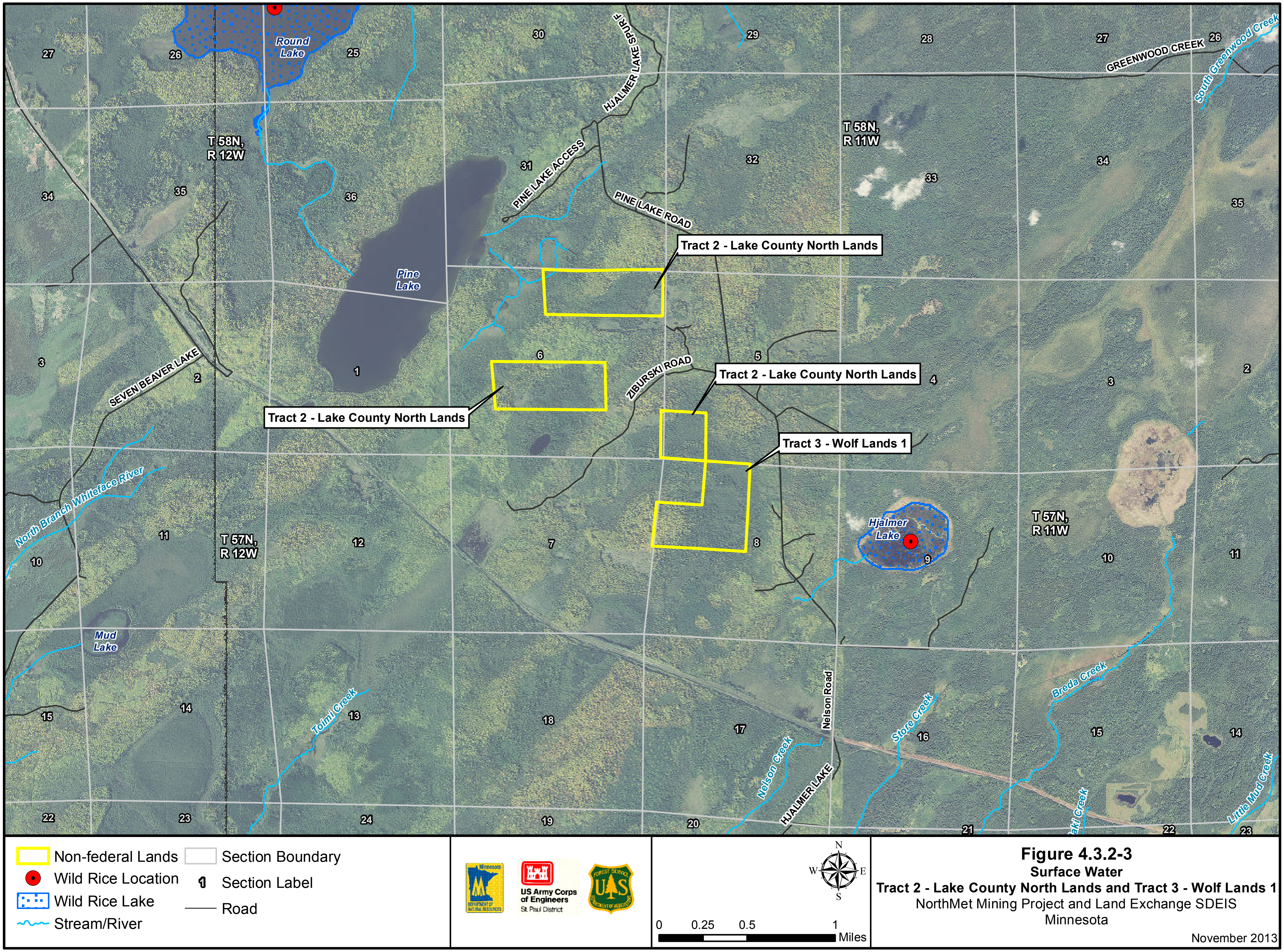

Figure 4.3.2-3
Surface Water
Tract 2 - Lake County North Lands and Tract 3 - Wolf Lands 1
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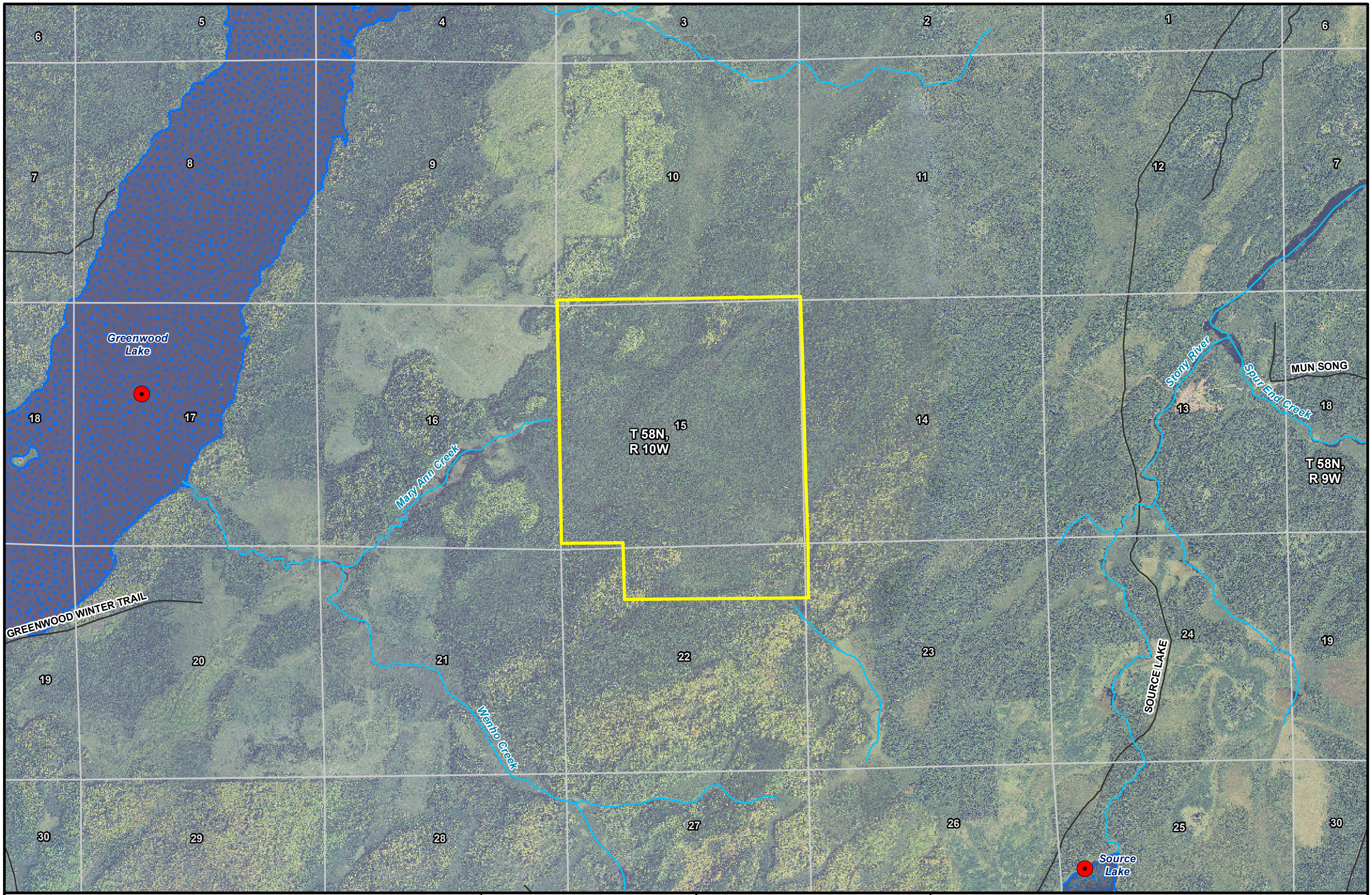

Non-federal Lands
Wild Rice Location
Wild Rice Lake
Stream/River
Section Boundary
Section Label
Road

0 0.175 0.35 0.7 Miles

Figure 4.3.2-4
Surface Water
Tract 3 - Wolf Lands 2
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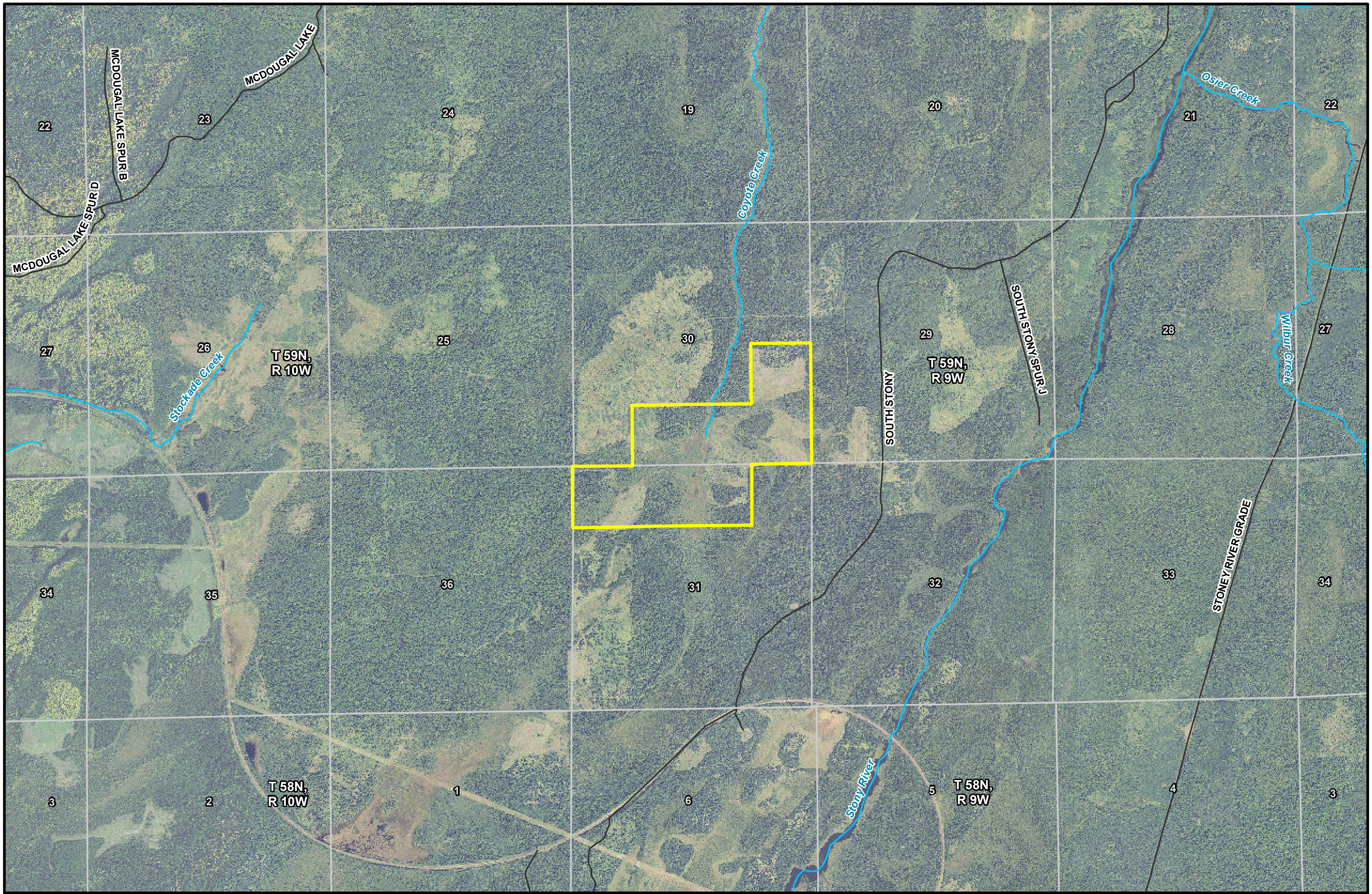

Non-federal Lands
Wild Rice Location
Wild Rice Lake
Stream/River
Section Boundary
Section Label
Road

N
W E
S

0 0.175 0.35 0.7 Miles

Figure 4.3.2-5
Surface Water
Tract 3 - Wolf Lands 3
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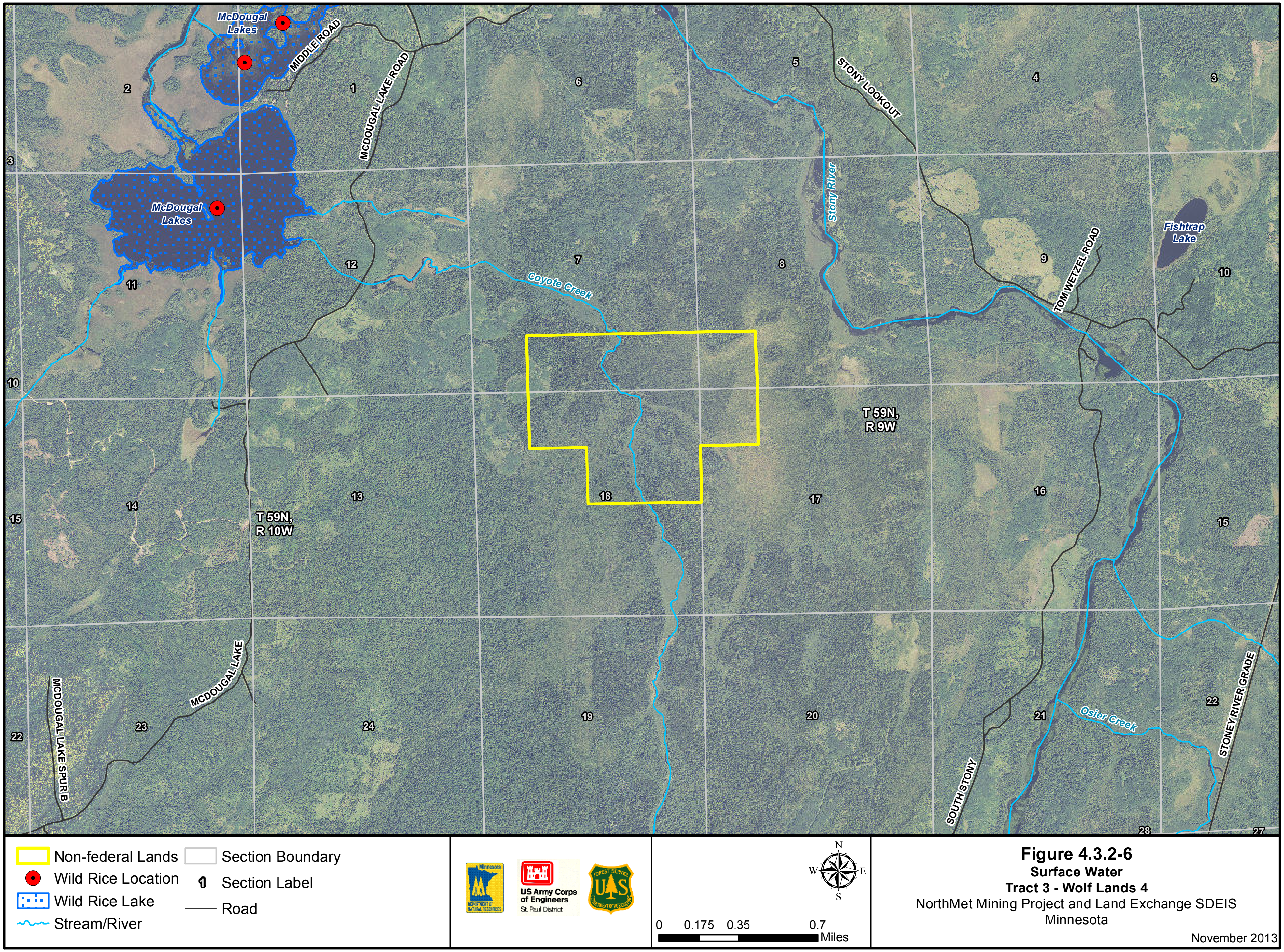

Figure 4.3.2-6
Surface Water
Tract 3 - Wolf Lands 4
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Non-federal Lands
Wild Rice Location
Wild Rice Lake
Stream/River
Section Boundary
Section Label
Road

US Army Corps of Engineers
St. Paul District

0 0.25 0.5 1 Miles

Figure 4.3.2-7
Surface Water
Tract 4 - Hunting Club Lands
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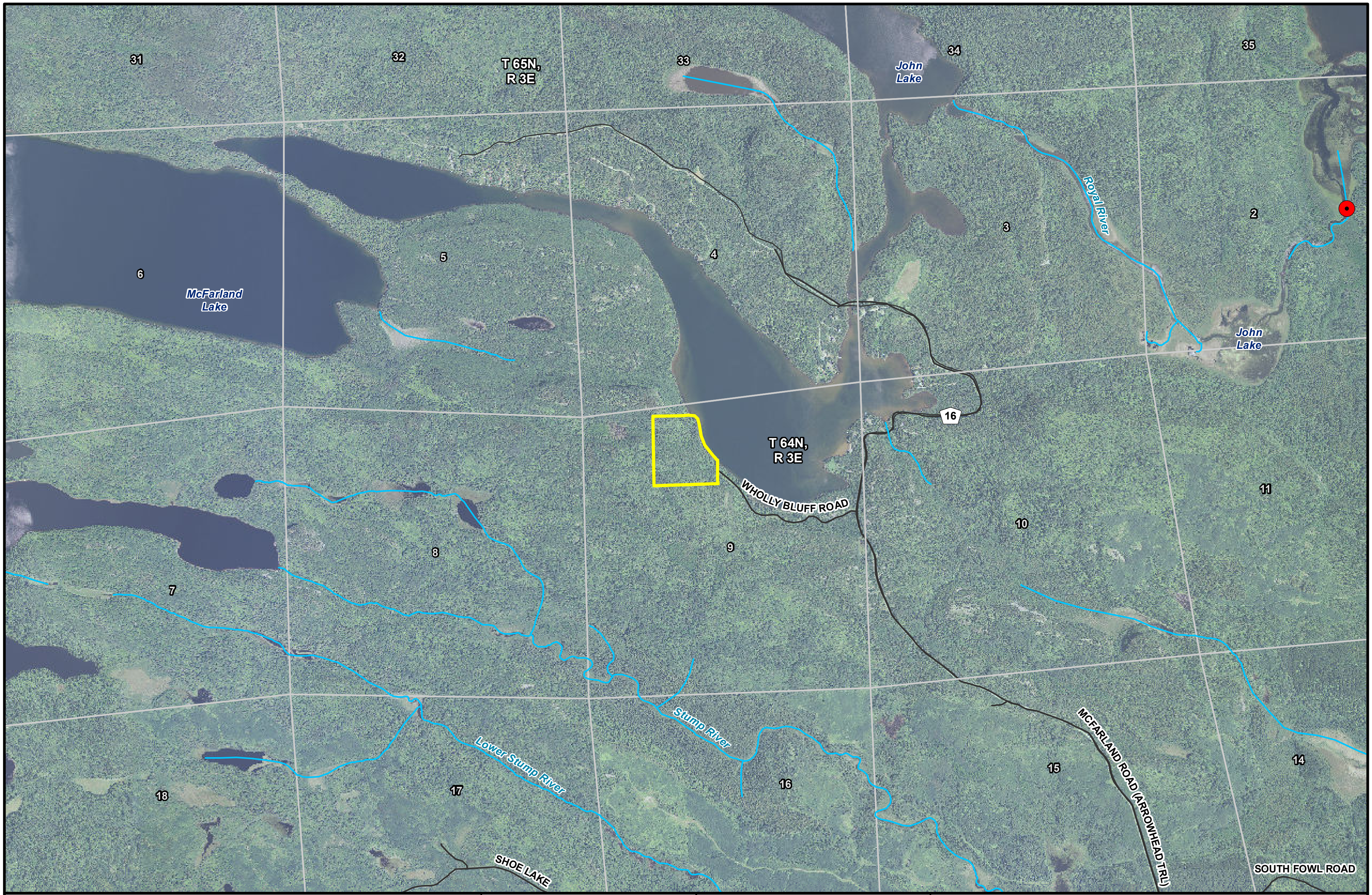

Non-federal Lands
Wild Rice Location
Wild Rice Lake
Stream/River
Section Boundary
Section Label
Road

US Army Corps of Engineers
St. Paul District

N
W E
S

0 0.15 0.3 0.6 Miles

Figure 4.3.2-8
Surface Water
Tract 5 - McFarland Lake Lands
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4.3.3 Wetlands

4.3.3.1 Federal Lands

The federal lands, both the Land Exchange Proposed Action and Land Exchange Alternative B boundaries, are located in the Partridge River drainage, about 3 miles south of Iron Lake and the Laurentian Divide (see Figure 4.3.3-1). As previously stated, the Partridge River is located in the East St. Louis River Watershed, which discharges into Lake Superior. Much of the federal lands consist of wetlands and the Land Exchange Proposed Action boundary includes a portion of the One Hundred Mile Swamp. The One Hundred Mile Swamp (see Figure 4.3.3-1) is a large wetland of approximately 3,028 acres that was aerially surveyed by the MDNR as part of a larger study; however, no delineated boundary exists for the One Hundred Mile Swamp. The following sections provide baseline information on the Land Exchange Proposed Action and Land Exchange Alternative B boundaries.

4.3.3.1.1 Land Exchange Proposed Action

Wetland Delineation and Classification

Wetland characterization, mapping, and surveys for the federal lands were conducted between 2004 and 2010. The wetland delineation and classification is the same as described in Section 4.2.3.1.1. The federal lands within the Land Exchange Proposed Action encompass 6,495.4 acres (see Figure 4.3.3-1).

A wetland delineation of the federal lands surrounding the Mine Site was subsequently conducted in August 2004, June 2005, and July 2006. Between 2007 and 2010, additional wetlands within the federal lands adjacent to the Mine Site were identified from aerial photographic interpretation and field studies. In August 2008, additional upland and wetland habitat surveys were conducted on the areas outside the Mine Site on the adjoining federal lands. Initially, potential wetland locations were determined by reviewing CIR aerial photographs, USGS topographic maps, and wetland maps previously prepared. Aerial photographs and field maps were then used in the field to verify cover types. Upon completion of field studies, cover types were mapped as habitat polygons. Polygons were digitized using GIS and overlaid onto habitat maps created from aerial photographs. These maps and the associated GIS database were used to determine the approximate acreage of each wetland type.

During the field surveys, data was collected related to the overall functions and values of the wetlands within the federal lands associated with the Mine Site (see Section 4.2.3.1.3) and of representative wetlands within the federal lands adjacent to the Mine Site. Wetland functions and values were rated using the guidelines in the MnRAM, Versions 3.0-3.2.

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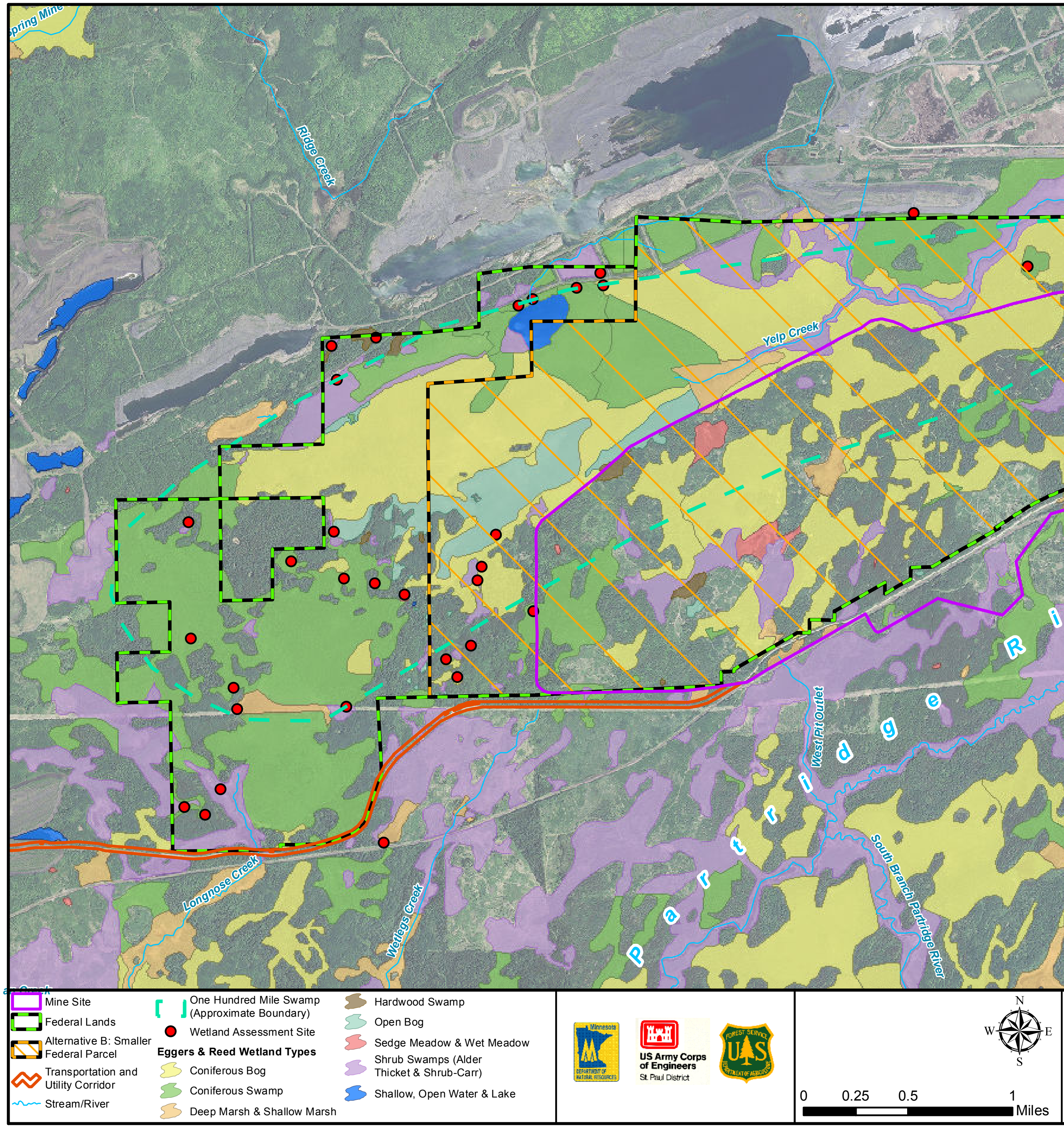

Figure 4.3.3-1

Wetland Community Types Federal Lands and Alternative B: Smaller Federal Parcel

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Hydrology, Wetland Vegetation, and Community Types

The hydrology, wetland vegetation, and community types of the federal lands within the Land Exchange Proposed Action include those elements within the Mine Site boundary (see Section 4.2.3.1.2), as well as the adjoining federal lands to the northwest. The hydrology, wetland vegetation, and community types are discussed below.

Bogs in the federal lands consist of leatherleaf and bog Labrador-tea, with scattered speckled alder, swamp birch, tamarack, and, in some areas, cattail and sedges. Sphagnum moss was observed to cover 80 to 90 percent of the bogs. Other species encountered during the field work include: black spruce, tamarack, blueberry, small fruited bog cranberry, willows, purple pitcher plant, marsh cinquefoil, cottongrass, round sundew, starflower, bunchberry, and Solomon's seal (AECOM 2011a).

Shrub swamp communities on the adjoining federal lands surrounding the Mine Site were observed to consist of a dense cover of speckled alder. These wetlands typically include sapling balsam fir, jack pine, black spruce, willow, and the occasional American mountain-ash. Dominant low shrubs include bog Labrador-tea, leatherleaf, lowbush blueberry, prickly rose, raspberry, and red-osier dogwood. Mountain maple saplings were also present during the field work in a few wetlands. Herbaceous layer species include club and sphagnum mosses, woolly sedge, bluejoint, horsetail, wood fern, bunchberry, bluebead lily, starflower, and creeping snowberry (AECOM 2011a).

The forested swamp communities (coniferous swamps and hardwood swamps) for the federal lands surrounding the Mine Site are also dominated by black spruce and northern white cedar, with scattered tamarack. Deciduous and mixed forest wetlands are uncommon; aspen is the dominant deciduous species found in these forests. Much of One Hundred Mile Swamp consists of mature (80-plus years) black spruce and northern white cedar. Bog Labrador-tea, leatherleaf, and blueberry are prevalent, as is spruce regeneration. In some areas with dense stands of spruce, few shrubs were seen during field surveys, but sphagnum and club mosses often covered nearly 100 percent of the ground. More open stands may have an understory comprised of shrubs and scattered sapling white cedar, tamarack, and black spruce, along with speckled alder and willow. Common species include bluebead lily, Solomon's seal, horsetail, starflower, and creeping snowberry. Some areas also have cottongrass and bog laurel. An area in the southern portion of One Hundred Mile Swamp has a large number of purple pitcher plants. Forest and shrub cover typically range from 40 to 70 percent, while moss and other understory vegetation cover from 60 to 90 percent of the ground (AECOM 2011a).

There were several ponds/inland fresh meadow (emergent) wetlands identified on the federal lands surrounding the Mine Site that were created by logging activities, road construction, or beaver dams, or were natural depressions or associated with the Partridge River. These wetlands were often dominated by bluejoint, sedges, and cattails. Water depths were several feet in deeper areas. Spruce and other trees associated with the wetland were often killed when flooded as a result of the rising water level. Willows, tamarack, and speckled alder were often found along the border of these wetlands, but comprised less than 20 percent of the cover. Wild iris is common in some inland fresh meadow wetlands, as was horsetail, burreed, spikerush, and woolly sedge (AECOM 2011a).

The wetland assessment identified 200 wetlands covering 4,164.4 acres (64 percent) within the 6,495.4 acre federal lands boundary (see Figure 4.3.3-1). Table 4.3.3-1 below summarizes the wetland areas within the federal lands represented by each Eggers and Reed (1997) wetland community type. A large portion of the wetlands within the federal lands are located in the floodplains of Yelp Creek and the Partridge River or one of their associated tributaries. The most common wetland types within the federal lands are coniferous bogs (approximately 47 percent), coniferous swamps (31 percent), and shrub swamps (approximately 13 percent), which includes alder thickets and shrub-carrs.

Other wetland community types present within the federal lands include open bog, shallow marsh, hardwood swamp, open water, and sedge/wet meadows. Section 4.2.3.1.2 provides a discussion on the hydrology, wetland vegetation, and community types of the federal lands

Table 4.3.3-1 Wetland Acreage by Wetland Community Type for the Federal Lands within the Land Exchange Proposed Action and within the Land Exchange Alternative B

	Land Exchange Proposed Action		**Land Exchange Alternative B**	
Eggers and Reed Class[1]	**Acres**	**%**	**Acres**	**%**
Coniferous bog	1,961.4	47	1,677.0	59
Coniferous swamp	1,287.8	31	476.1	17
Deep marsh	0.0	0	0.0	0
Hardwood swamp	21.1	<1	13.7	<1
Open bog	209.5	5	175.0	6
Open water (includes shallow, open water, and lakes)	30.8	1	8.6	<1
Sedge/wet meadow	35.7	1	34.9	1
Shallow marsh	97.0	2	80.9	3
Shrub swamp (includes alder thicket and shrub-carr)	521.1	13	394.7	14
Total	4,164.4	100	2,860.9	100

1 Eggers and Reed 1997.

Wetland Functional Assessment

The Land Exchange Proposed Action federal lands include the Mine Site area as well as the adjoining federal lands to the northwest. The wetland function and values assessment for the Mine Site is described in 4.2.3.1.3 and wetlands function and values for the federal lands surrounding the Mine Site are provided below.

During the surveys conducted for the federal lands surrounding the Mine Site, the primary wetland functions rated by MnRAM 3.2 were evaluated based on a review of the following: 1) wetland soil, hydrology, and vegetation; 2) outlet characteristics; 3) watershed and adjacent upland land uses and conditions; 4) erosion and sedimentation; and 5) human disturbances (AECOM 2011a). The Eggers and Reed (1997) classification system was used to classify wetland communities for the wetland function and value evaluation. Landscape factors were typically evaluated on a larger scale. Sixty-three questions given in MnRAM 3.2 were addressed for the August 2008 field surveys, and all factors were evaluated for each wetland surveyed. Based on this assessment methodology, wetlands were rated high, medium, or low.

The wetland functions that were typically most applicable to the federal lands include the following:

- maintenance of characteristic hydrologic regime;
- maintenance of wetland water quality;
- vegetative diversity/integrity;
- maintenance of characteristic wildlife habitat structure;
- downstream water quality;
- groundwater interaction; and
- aesthetics/recreation/education/cultural.

During 2008, 40 wetlands, or portions of wetlands, were evaluated for their functions and values at representative wetland locations within the federal lands outside the Mine Site boundary (see Figure 4.2.3-2 and Table 4.3.3-2); nearly all wetlands were rated with a high value (approximately 93 percent) for wetland functions based on minimal or no current disturbance. Only a small subset (approximately 7 percent) of the wetlands was disturbed wetlands (AECOM 2011d). Vegetation diversity/integrity was high for 93 percent of the wetlands because they have been minimally altered by recent anthropogenic factors and had a relatively constant supply of water. Wetland vegetation around the Mine Site needed no active management and provided quality habitat for fish and wildlife. The overall rating was based on the highest rated community for vegetation diversity and integrity, rather than the average or weighted value for community vegetation diversity and integrity. MnRAM 3.2 guidance states that this is the appropriate measure for assessing wetland quality for regulatory purposes (AECOM 2011a).

Wildlife habitat was rated high for most wetlands on the basis of natural wildlife corridors and upland communities relatively untouched by recent human disturbances or effects. Wildlife habitat was rated lower in areas where there were few plant communities (AECOM 2011d).

Fish habitat was rated as not applicable for most wetlands, primarily because they did not have enough standing water throughout the year to support fish. Other characteristics associated with the rating include isolated wetlands that are not permanently flooded, or forested wetlands where the water table was below the surface for all or part of the year (AECOM 2011d).

Amphibian habitat was rated high for most wetlands, primarily because they stayed inundated long enough in most years to allow amphibians to successfully reproduce. Amphibian habitat was rated not applicable for some wetlands if conditions needed to support amphibian reproduction did not occur at the site. Forested wetlands with little or no standing water during the mating season would likely not support amphibians (AECOM 2011d).

Aesthetic, recreational, educational, and cultural values were rated medium. All wetlands were aesthetically pleasing and could be used for recreation, education, and cultural purposes. However, road access to the federal lands surrounding the Mine Site is only available via a private mining road and is not easily accessible to the general public (AECOM 2011d). Access to the federal lands is discussed in Section 4.3.1.

Table 4.3.3-2 Wetland Functions and Values Assessment for the Federal Lands Surrounding the Mine Site, 2008

Wetland Functions and Value Rating	Functional Value Ratings (%)								
	Vegetation Diversity/ Integrity	Hydrology	Flood Attenuation	Downstream Water Quality	Wetland Water Quality	Wildlife Habitat	Fish Habitat	Amphibian Habitat	Aesthetics/ Education/ Cultural
High	93	98	2	95	93	93	38	55	0
Moderate	7	2	98	5	7	7	2	7	100
Low	0	0	0	0	0	0	0	5	0
Not Available or Applicable	0	0	0	0	0	60	60	33	0
Total	100	100	100	100	100	160	100	100	100

Source: AECOM 2011a.

Floodplains

Floodplains are lowland areas adjacent to lakes, wetlands, and rivers that are prone to being inundated by water during a flood. Floodplains carry and store water and help to attenuate water flows. Floodplains also provide important habitat for fish and wildlife; filter sediments, nutrients, and pollutants from the water; and are important for public uses, such as fishing and hunting.

Floodplain acreage for the Land Exchange Proposed Action federal lands was evaluated as part of the wetland assessments, and was based on the locations of streams and adjacent topography and vegetation. Floodplain importance was determined by measuring the number of acres of floodplain per acre of parcel as an index to the relative importance of floodplains on the parcels.

Floodplain habitat associated with the Partridge River and Yelp Creek includes much of the One Hundred Mile Swamp (see Figure 4.3.3-2). The federal lands were found to have 1,889.4 acres (29 percent) of floodplain (500-year floodplain) and these floodplains are not FEMA regulatory floodplains (see Figure 4.3.3-2). The number of acres of floodplain per acre of parcel for the federal lands is 0.3.

Frontage of Waterways

Lakes, streams, and rivers/creeks and their associated riparian habitat provide important habitat for fish and wildlife and provide for additional recreational and social functions and values for humans. Lake, stream, and river/creek frontage and associated habitat are not typically evaluated during a wetland assessment, and were not considered during the wetland assessment field studies conducted for the NorthMet Project Proposed Action. However, the linear distance of lake and river/stream frontage for the federal lands was determined using GIS, and the length of frontage per acre of parcel was calculated as an index of the relative importance of frontage on the parcels.

Mud Lake, the dominant lake feature on the federal lands, is located within the One Hundred Mile Swamp and is 30.5 acres in size. Mud Lake was determined to have a frontage of approximately 4,550 ft. The length of lake frontage per acre of federal lands is 0.7 ft.

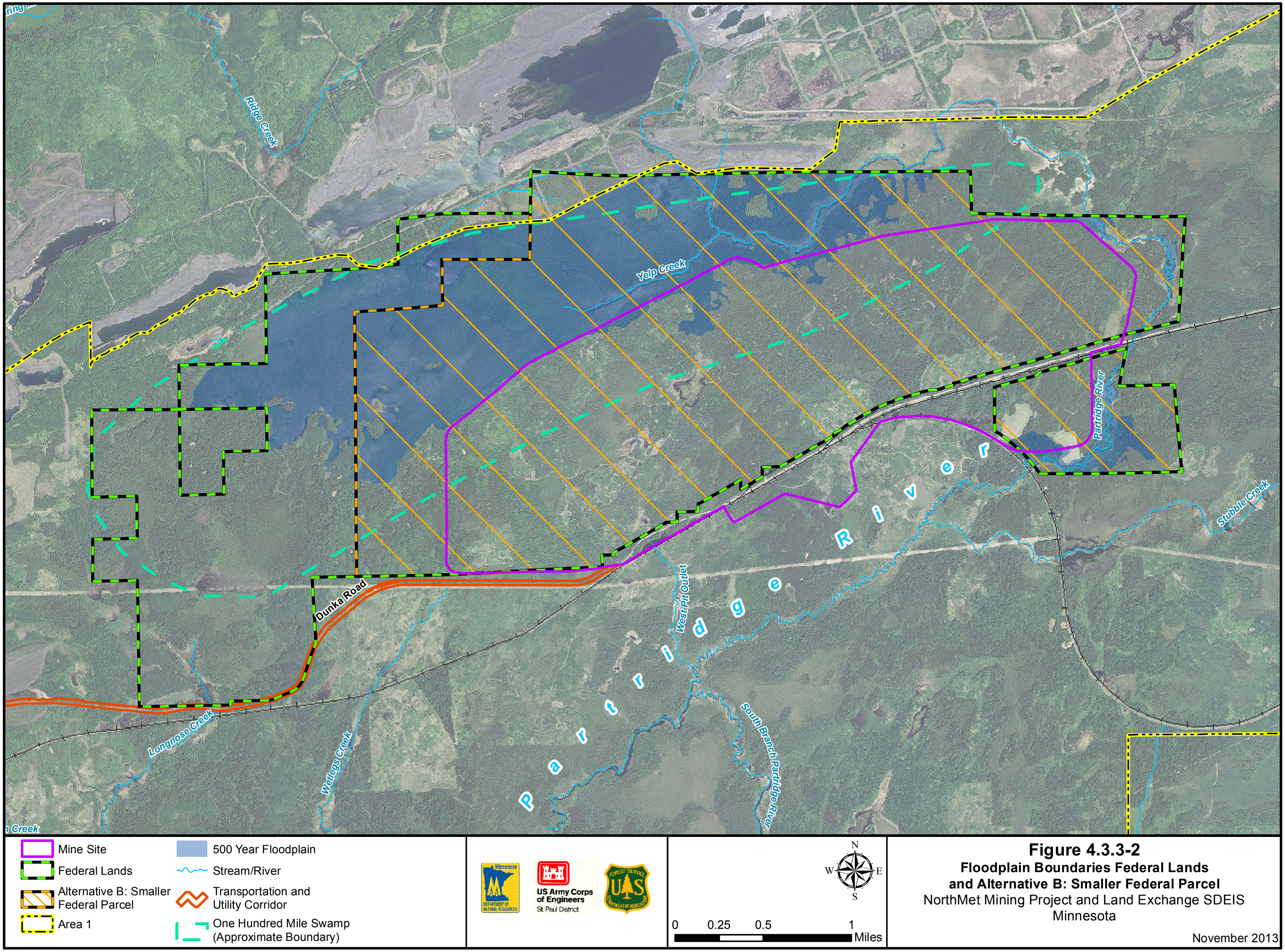

Figure 4.3.3-2

Floodplain Boundaries Federal Lands and Alternative B: Smaller Federal Parcel

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Yelp Creek flows out of the One Hundred Mile Swamp, while Yelp Creek and the Partridge River flow through portions of the federal lands. Collectively, the creek and river are 5.3 miles in length. Since both sides of the river provide riparian habitat, the length of the river on the federal lands was doubled to determine the importance of river frontage. It was determined that there were 55,968.0 linear ft of creek/river frontage on the federal lands. The length of creek/river frontage per acre of federal lands is 8.6 ft.

4.3.3.1.2 Land Exchange Alternative B

Wetland Delineation and Classification

Land Exchange Alternative B is a reduced area of the Land Exchange Proposed Action federal lands boundary, and the wetland delineation and classification is the same as described in Section 4.3.3.1.1. The Land Exchange Alternative B is 4,752.6 acres (see Figure 4.3.3-1).

Hydrology, Wetland Vegetation, and Community Types

The hydrology, wetland vegetation, and community types of the smaller federal parcel are a subset of the Land Exchange Proposed Action federal lands, and the hydrology, wetland vegetation, and community types are the same as described above in Section 4.3.3.1.1. The wetland assessment identified 143 wetlands covering 2,860.9 acres (60 percent) within the 4,752.6 acre smaller federal parcel boundary (see Figure 4.3.3-1). Table 4.3.3-1, above, summarizes the wetland areas within the Land Exchange Alternative B parcel represented by each Eggers and Reed (1997) wetland community type. A large portion of the wetlands within the Alternative B: Smaller Federal Parcel is located in the floodplains of Yelp Creek and the Partridge River or one of their associated tributaries. The most common wetland types within the Land Exchange Alternative B include coniferous bogs (approximately 59 percent), coniferous swamps (17 percent), and shrub swamps (approximately 14 percent), which includes alder thickets and shrub-carrs.

Other wetland community types present within the Land Exchange Alternative B include open bog, hardwood swamps, shallow marsh, and sedge/wet meadows. The sedge/wet meadows may receive some portion of its hydrology from groundwater. The shallow marsh community generally results from artificial impoundment by beaver dams, roads, and railroads and is primarily dependent on surface waters for hydrology.

Wetland Functional Assessment

Land Exchange Alternative B is a subset of the Land Exchange Proposed Action federal lands, and the wetland function and values assessment is the same as described in Section 4.3.3.1.1.

Floodplains

Floodplain habitat associated with the Partridge River and Yelp Creek includes much of the One Hundred Mile Swamp. The federal lands were found to have 1,412.9 acres (30 percent) of floodplain (500-year floodplain) and these floodplains are not FEMA regulatory floodplains (see Figure 4.3.3-2). The number of acres of floodplain per acre of parcel for the Land Exchange Alternative B is 0.3.

Frontage of Waterways

A portion of Mud Lake, 8.9 acres, is located within the Land Exchange Alternative B. The portion of Mud Lake was determined to have a frontage of approximately 1,200 ft. The length of lake frontage per acre of the Land Exchange Alternative B is 0.3 ft.

As with the Land Exchange Proposed Action, Yelp Creek flows out of the One Hundred Mile Swamp, while Yelp Creek and the Partridge River flow through portions of the Land Exchange Alternative B. Collectively, the creek and river are 5.3 miles in length in the Land Exchange Alternative B, corresponding to 55,968.0 linear ft of creek/river frontage (counting both sides of the water feature). The length of creek/river frontage per acre of the Land Exchange Alternative B is 11.8 ft.

4.3.3.2 Non-federal Lands

4.3.3.2.1 Non-federal Lands

The Land Exchange Proposed Action must comply with two EOs that are related to wetlands and floodplains. EO 11990 was signed by President Jimmy Carter on May 24, 1977 “in order to avoid to the extent possible the long and short term adverse impacts associated with the destruction or modifications of wetlands….” This order applies to land exchanges such that, as much as practicable, the exchange does not result in the loss of wetland resources. EO 11988 was signed by President Jimmy Carter on May 24, 1977 “in order to avoid to the extent possible the long and short term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative…” This order applies to land exchanges such that, as much as practicable, the exchange does not result in an increase in the flood damage potential.

The USFS policy is that the following three conditions satisfy the requirements of EOs 11990 and 11988 (FSH 5409.13 § 33.43c):

1. The value of the wetlands or floodplains for properties received and conveyed is equal (balancing test) and the land exchange is in the public interest.
2. Reservations or restrictions are retained on the unbalanced portion of the wetlands and floodplains on the federal lands when the land exchange is in the public interest but does not meet the balancing test.
3. The federal property is removed from the exchange proposal when the conditions described in the preceding paragraphs 1 or 2 cannot be met.

The USFS is also required, by both EOs 11990 and 11988, to reference in a conveyance those uses that are restricted under identified federal, state, or local wetland and floodplain regulations. In Minnesota, the CWA (USACE/EPA/MPCA), Protected Waters Permit Program (MDNR), and the WCA; Board of Water and Soil Resources regulate certain activities in wetlands. Floodplain management ordinances are administered at the local (county) level.

In addition to the evaluating wetlands in accordance with these EOs (acres for acres of wetland and no increase in flood hazards), analysis for the Land Exchange Proposed Action will include information on wetland community types as well as the ecological floodplain. Furthermore, the Land Exchange Proposed Action will evaluate the net change of shoreline frontage along rivers, streams, and lakes. Although such analysis is not required by EO 11990, it is consistent with the

USFS's strategic goal to sustain and enhance outdoor recreation opportunities and with the management direction to protect water resources.

Wetland Delineation and Classification

Wetland boundaries and community types for the non-federal lands were identified from aerial photographic interpretation and field studies; no federal or state delineation protocols were used, as it was primarily a habitat assessment (AECOM 2011b; AECOM 2011c). Infrared and true color aerial photographs and topographic maps of the parcels were reviewed to identify areas that could have wetlands based on vegetative characteristics and topography. In addition, wetlands identified by the NWI were overlaid onto aerial photographs to assist in wetland identification. Field studies were conducted subsequent to the initial desktop study in June 2009 for the Hay Lake Lands and McFarland Lands (AECOM 2011b) and in November 2010 for the Hunting Club Lands, Lake County Lands, and Wolf Lands (AECOM 2011c); this was done to better delineate wetland boundaries on the parcels using the same methods as used for the federal lands surrounding the Mine Site. Mapping information from the field work was then used to modify the NWI wetland types and boundaries.

Wetland surveys were conducted along transects located on primary roads (parcel access and logging) and secondary access routes (skid trails, stream corridors, wetlands, other natural corridors) in order to maximize the amount of area covered during the survey period. Additional surveys were conducted off of the primary and secondary access routes in an effort to better determine wetland boundaries and types (AECOM 2011b; 2011c).

The boundaries of wetlands were determined based on aerial photograph interpretation and NWI mapping, with some refining of wetland boundaries during field studies. Wetland boundaries were determined in the field based on hydrologic and vegetative characteristics and were more accurate where survey routes crossed or were near wetland boundaries. Approximate wetland boundaries and wetland types based on habitat mapping are shown on Figures 4.3.3-3 and 4.3.3-4. Surveys covered nearly all portions of the parcels, although not all wetlands were field surveyed (AECOM 2011b; AECOM 2011c).

During the field surveys in June 2009 and November 2010, data were collected using the guidelines in MnRAM 3.2 (Minnesota Board of Water and Soil Resources 2008) related to the functions and values of representative wetlands within the tracts (AECOM 2011b; AECOM 2011c). The primary wetland functions were evaluated based on a review of the 1) wetland soil, hydrology, and vegetation; 2) outlet characteristics; 3) watershed and adjacent upland land uses and conditions; 4) erosion and sedimentation; and 5) human disturbances. The Eggers and Reed (1997) classification system was used to classify wetland communities for the wetland function and value evaluation. Landscape factors were typically evaluated on a larger scale. For instance, soil and vegetation conditions within the watershed were usually similar for large groups of wetlands. The anthropogenic factors were also typically similar across broad areas. Based on the responses to questions addressed by MnRAM 3.2 and the assessment of special features, a function value of high, medium, or low was given for each primary function (AECOM 2011b; AECOM 2011c). See below for more information on MnRAM scoring for the non-federal lands.

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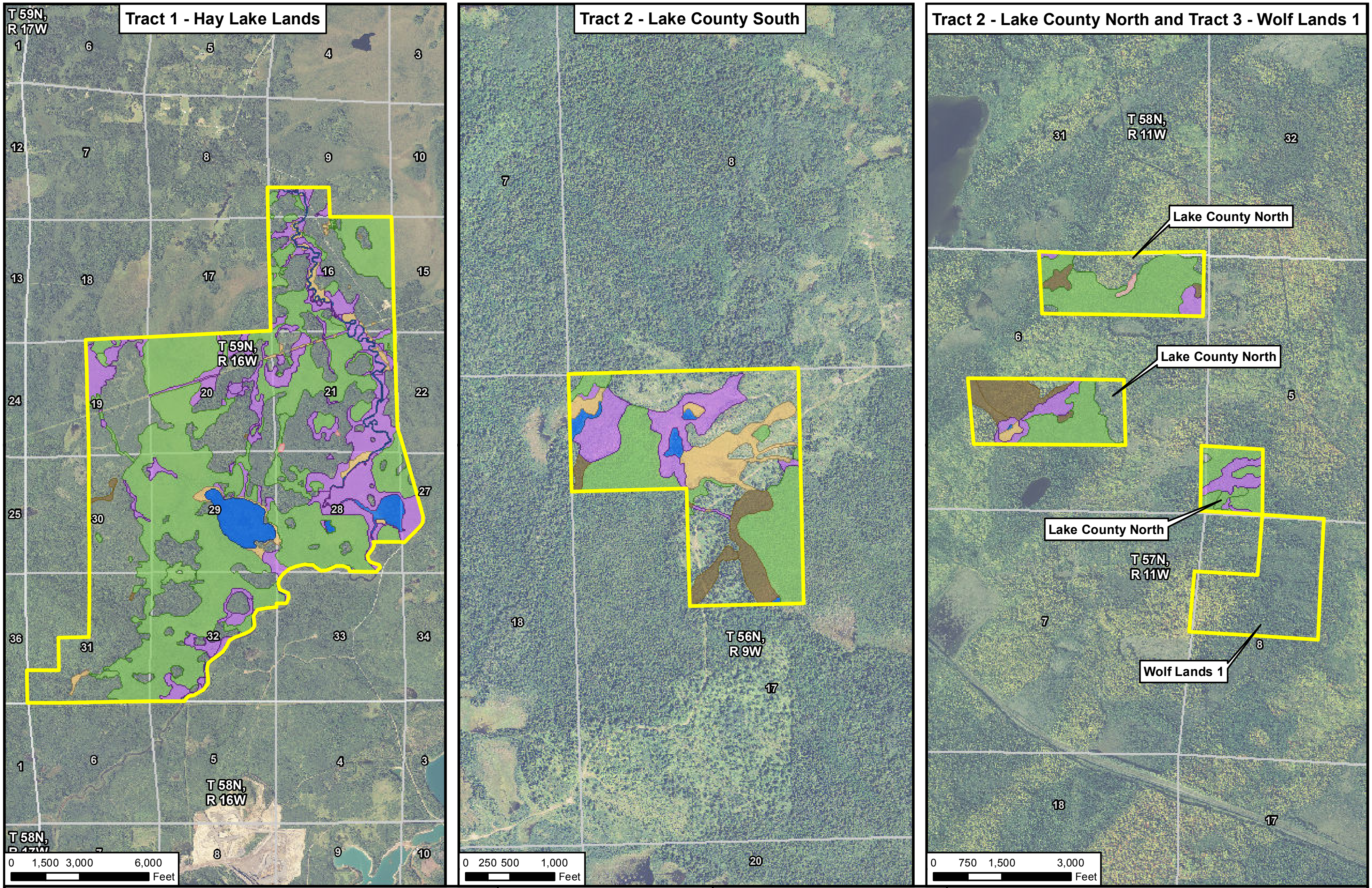

Non-federal Lands

Section Boundary

1 Section Label

Eggers & Reed Wetland Types

Shrub Swamps (Alder Thicket & Shrub-Carr)

Coniferous Swamp

Hardwood Swamp

Open Bog

Shallow, Open Water & Lake

Shallow Marsh & Deep Marsh

US Army Corps of Engineers St. Paul District

Figure 4.3.3-3

Wetland Community Types

Tract 1, Tract 2 and Tract 3

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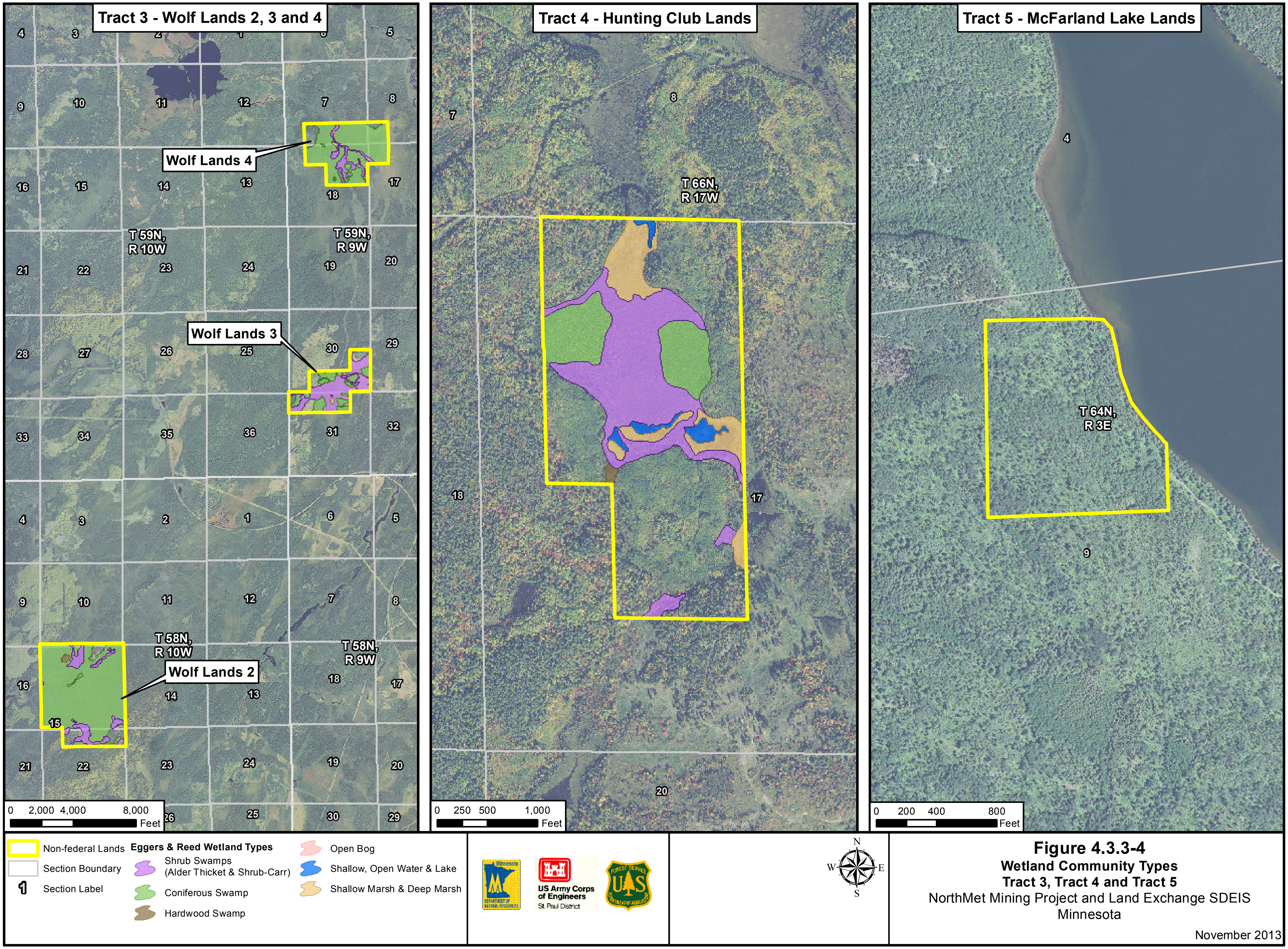

Figure 4.3.3-4
Wetland Community Types
Tract 3, Tract 4 and Tract 5
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Hydrology, Wetland Vegetation, and Community Types

Habitat and wetland community types within the five tracts were found to be consistent with habitats in much of the Mesabi Iron Range and northeastern Minnesota, including coniferous, deciduous, and mixed coniferous and deciduous forests, and a variety of wetland habitats. Generally, the parcels consisted of a mosaic of slightly elevated upland areas surrounded by wetland areas.

The surveys identified that the majority of the tracts' total area consists of wetlands (66 percent; 4,669.9 acres). Individual tracts with a higher percentage of upland areas include the Hunting Club parcel (60 percent upland), Hay Lake (41 percent upland), and McFarland Lake (100 percent upland) (see Table 4.3.3-3). The most common wetland types within the five non-federal tracts are coniferous swamps (approximately 69 percent) and shrub swamps (approximately 23 percent), which includes both alder thickets and shrub-carr wetlands. Wetland types based on Eggers and Reed (1997) classification system for the non-federal lands are presented in Table 4.3.3-4 below (AECOM 2011b; AECOM 2011c).

Table 4.3.3-3 Total Wetland and Upland Acreage for the Non-federal Lands

Tract	Wetland Acres [1]	Upland Acres [1]	Total Acres [1]	% of Wetlands	% of Upland
Tract 1 – Hay Lake	2,930.8	1,995.6	4,926.4	59	41
Tract 2 – Lake County					
Lake County North	209.3	55.9	265.2	79	21
Lake County South	73.6	43.4	117.0	63	37
Tract 3 – Wolf Lands					
Wolf Lands 1	90.4	35.4	125.8	72	28
Wolf Lands 2	706.2	61.5	767.7	92	8
Wolf Lands 3	233.2	44.3	277.5	84	16
Wolf Lands 4	362.8	41.9	404.7	90	10
Tract 4 - Hunting Club	63.6	96.5	160.1	40	60
Tract 5 – McFarland Lake	0.0	30.8	30.8	0	100
Total	4,669.9	2,405.3	7,075.2	66	34

1 Total acres may be more or less than presented due to rounding.

Table 4.3.3-4 Total Wetland Acreage by Wetland Type for the Non-federal Lands

Eggers and Reed Class[1]	Total Non-federal Lands Acres	Total Non-federal Lands %
Coniferous swamp[2]	3,242.4	69
Hardwood swamp[3]	58.0	1
Open bog	7.1	<1
Open water (includes shallow, open water, and lakes)	182.5	4
Shallow marsh[4]	117.5	3
Shrub swamp (includes alder thicket and shrub-carr)	1,062.4	23
Total	4,669.9	100

1 Eggers and Reed 1997.
2 Field data for coniferous bogs and coniferous swamps was combined.
3 Coniferous tree species may be present within some hardwood swamps.
4 Shallow marsh areas may contain deep marshes.

Wetlands Functional Assessment

Wetland functions and values for the non-federal lands were determined during the June 2009 and November 2010 field surveys. Wetland functions and values were evaluated at 64 sites within the five non-federal tracts (AECOM 2011b; AECOM 2011c; AECOM 2011d). The wetlands on the five non-federal lands share characteristics similar to those found on the federal lands. All wetlands on the non-federal lands were rated high for most wetland functions and values.

During the field surveys, data were collected related to the functions and values of representative wetland locations. A few survey locations were for individual wetlands, while for larger wetland complexes several locations were surveyed. An attempt was made to survey a variety of wetland types across the entire parcel (AECOM 2011b; AECOM 2011c). Survey locations for the wetland functions and values assessment are shown on Figures 4.3.3-3 through 4.3.3-4.

Table 4.3.3-5 summarizes the functional value ratings for the 64 wetlands that were evaluated for primary wetland functions rated by MnRAM 3.2. Wetlands were rated high for nearly all wetland functional values. Vegetation diversity/integrity was rated high for all wetlands. The overall rating for vegetation diversity/integrity was based on the highest rated community for vegetation diversity and integrity, rather than the average or weighted value for community vegetation diversity and integrity. MnRAM 3.2 guidance states that this is the appropriate measure for assessing wetland quality for regulatory purposes.

According to MnRAM scores (AECOM 2011b; AECOM 2011c), the following ratings were determined:

- Wetland hydrology and water quality were rated high for all wetlands, and high for all wetlands except three for downstream water quality. Most wetlands on Tracts 1 and 5 provide moderate to high flood attenuation value and most wetlands on Tracts 2, 3, and 4 provide moderate flood attenuation value, with two wetlands rated high for this function.
- Wildlife habitat was rated high for all but one wetland, as natural wildlife corridors and upland communities are relatively untouched by recent human disturbances or effects. There are no barriers to wildlife movement. Wildlife habitat was rated moderate in an area where there are few plant communities and large amounts of water.
- Fish habitat was rated high for wetlands that provide fish habitat. Fish habitat was rated as not applicable for some wetlands where the wetland does not have enough standing water throughout the year to support fish. Some other characteristics that might limit wetland value for fish would include isolated wetlands that are not permanently flooded, or forested wetlands where the water table is below the surface for all or part of the year.
- Amphibian habitat was rated high for most wetlands. This indicated that the wetland stays inundated long enough in most years to allow amphibians to successfully reproduce. Amphibian habitat was rated medium for some wetlands if ideal conditions needed to support amphibian reproduction do not occur at the parcels. Forested wetlands with little or no standing water or not enough woody vegetation during the mating season would likely not support amphibians. Wetlands with predatory fish may also not support amphibians. Other wetlands were rated not applicable for amphibian habitat, indicating that the parcel is not inundated long enough in most years to support successful breeding.

- Aesthetic, recreational, educational, and cultural values were rated medium for all but one wetland. All wetlands are aesthetically pleasing, and could be used for recreation, education, and cultural purposes. However, access by the general public access is limited to overland by foot or on snowmobile/all-terrain vehicle from Pike River Road or from USFS roads. A few wetlands have human influences on the viewshed due to close proximity to Pike River Road; however, due to their remote locations, most of the wetlands have little human influence on the viewshed.

Table 4.3.3-5 Wetland Functional Value Assessment for the Non-federal Lands

Wetland Functions and Value Rating	Functional Value Ratings (%)								
	Vegetation Diversity/ Integrity	Hydrology	Flood Attenuation	Downstream Water Quality	Wetland Water Quality	Wildlife Habitat	Fish Habitat	Amphibian Habitat	Aesthetics/ Education/ Cultural
High	100	100	8	97	100	98	55	69	2
Moderate	0	0	92	3	0	2	0	9	98
Low	0	0	0	0	0	0	0	6	0
Not Available or Applicable	0	0	0	0	0	0	45	16	0
Total	100	100	100	100	100	100	100	100	100

Source: AECOM 2011b; AECOM 2011c.

4.3.3.2.2 Tract 1 – Hay Lake Lands

Hydrology, Wetland Vegetation, and Community Types

Tract 1 is moderately hilly and consists primarily of second- or third-growth deciduous and coniferous forest uplands and emergent, shrub swamp, and forested wetlands. This parcel is adjacent to the Superior National Forest (AECOM 2011b). The wetland assessment identified 2,930.8 acres of wetlands within Tract 1 (approximately 59 percent of the land area) (see Figure 4.3.3-3 and Table 4.3.3-6). The most common wetland types within Tract 1 are coniferous swamps (approximately 67 percent) and shrub swamps (approximately 24 percent), which includes both alder thickets and shrub-carr wetlands.

Table 4.3.3-6 Total Wetland Acreage by Wetland Type for Tract 1

	Total Hay Lake	
Eggers and Reed Class[1]	**Acres**	**%**
Coniferous swamp[2]	1,953.9	67
Hardwood swamp[3]	8.0	<1
Open bog	86.2	3
Open water (includes shallow, open water, and lakes)	176.6	6
Shallow marsh[4]	0.0	0
Shrub swamp (includes alder thicket and shrub-carr)	706.1	24
Total	2,930.8	100

1 Eggers and Reed 1997.
2 Field data for coniferous bogs and coniferous swamps was combined.
3 Coniferous tree species may be present within some hardwood swamps.
4 Shallow marsh areas may contain deep marshes.

Wetlands on Tract 1 consist primarily of early successional coniferous swamps, shrub wetlands, and open water wetlands. Hay Lake, Rice Lake, an unnamed lake, and the Pike River are the dominant water features. Large bogs dominate much of the east-central portion of Tract 1. Several wetlands were created or enlarged due to impoundment of streams by beaver dams. Raised water levels resulted in stands of dead and dying spruce along portions of the Pike River (AECOM 2011b).

Bogs within Tract 1 are dominated by leatherleaf and bog Labrador-tea, with scattered young speckled alder, bog birch, tamarack, and in some areas, narrow-leaved cattail and sedges. Sphagnum and club moss often cover 80 to 90 percent of the bog. Scattered (less than 5 percent) black spruce (some dead) and immature tamarack are found in the tree layer. Lowbush blueberry, small-fruited bog cranberry, bog rosemary, and small willows are also common. Other species encountered include cottongrass, wild iris, wild raspberry, bunchberry, and northern bog orchid (AECOM 2011b).

Emergent wetlands are primarily limited to disturbed areas on Tract 1, floodplains associated with the Pike River, wetlands associated with abandoned logging roads, transmission line ROWs, and beaver ponds. These emergent wetlands are often dominated by Canada bluejoint grass, various sedge species, and narrow-leaved cattail (70 to 80 percent cover) and generally are characterized by water depths of one foot or greater. Spruce, tamarack, and northern white cedar associated with these wetlands are often killed when flooded due to the rising water level behind beaver dams. Willows, tamarack, red-osier dogwood, and speckled alder are often found along the border of these wetlands, but comprised less than 30 percent of the total cover. Wild iris is encountered in some wetlands, as is horsetail, bur reed, spikerush, water arum, broad-leaved arrowhead, and woolly sedge (AECOM 2011b).

Shrub swamp wetlands usually consist of a dense (60 to 90 percent) cover of speckled alder, meadowsweet, and bog birch, with alder often 6 ft or taller in height. Some of the wetlands have scattered black spruce, tamarack, and willow saplings, but tree cover does not exceed 25 percent. Dominant low shrubs are bog Labrador-tea, leatherleaf, lowbush blueberry, prickly rose, wild raspberry, and red-osier dogwood. Mountain maple saplings are also present in a few wetlands. Herbaceous layer species include club and sphagnum mosses, woolly sedge, Canada bluejoint grass, horsetail, bunchberry, and clintonia (AECOM 2011b).

Forested wetlands (coniferous and hardwood swamps) are dominated by black spruce and tamarack, with some scattered northern white cedar, red pine, and black ash also present. Coniferous wetland forests are the most common habitat type on the parcel; deciduous and mixed forest wetlands are uncommon. In some areas with dense stands of spruce, few shrubs are seen, but sphagnum and club mosses often cover nearly 100 percent of the ground. Some open stands have an understory comprised of shrubs and scattered sapling northern white cedar, tamarack, and black spruce, along with speckled alder and willow. Mountain maple is also encountered among tree species on Tract 1, primarily in deciduous and mixed forests. Common species encountered in the shrub layer include specked alder, leatherleaf, bog Labrador-tea, lowbush blueberry, and bog birch. Species found near the ground include clintonia, bracken fern, horsetail, bunchberry, wild raspberry, cottongrass, wild sarsaparilla, wild strawberry, and false lily-of-the-valley. Forest and shrub cover typically range from 30 to 60 percent, while moss and other understory vegetation cover ranges from 50 to 90 percent (AECOM 2011b).

Wetland Functional Assessment

Table 4.3.3-7 summarizes the 30 wetland functional value ratings that were obtained for Tract 1 for the primary wetland functions rated by MnRAM 3.2. Tract 1 wetlands were rated high for nearly all wetland functional values with the exception of flood attenuation and aesthetic, recreational, educational, and cultural values.

Table 4.3.3-7 Wetland Functional Value Assessment for Tract 1

	Functional Value Ratings (%)								
Wetland Functions and Value Rating	**Vegetation Diversity/ Integrity**	**Hydrology**	**Flood Attenuation**	**Downstream Water Quality**	**Wetland Water Quality**	**Wildlife Habitat**	**Fish Habitat**	**Amphibian Habitat**	**Aesthetics/ Education/ Cultural**
High	100	100	13	93	100	97	53	87	0
Moderate	0	0	87	7	0	3	0	3	100
Low	0	0	0	0	0	0	0	10	0
Not Available or Applicable	0	0	0	0	0	0	47	0	0
Total	100	100	100	100	100	100	100	100	100

Source: AECOM 2011b.

Floodplains

Floodplain identification for the non-federal lands was done using U.S. Department of Housing and Urban Development Flood Hazard Boundary Maps for Cook County, Lake County, and St. Louis County.

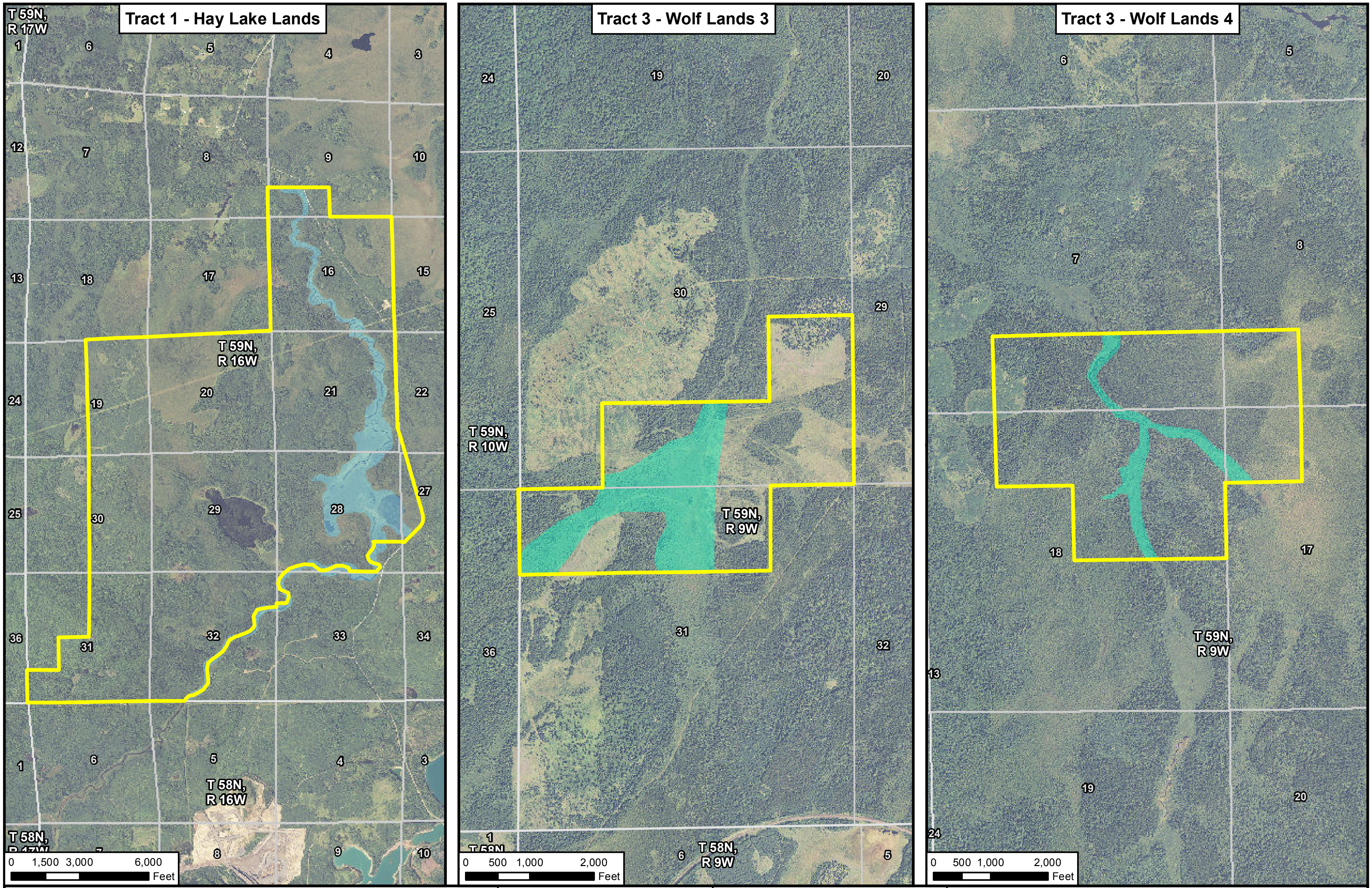
Floodplains were determined to be associated with Tract 1, and the floodplain habitat is associated with the Pike River (see Figure 4.3.3-5). Tract 1 was found to have 376.2 acres of floodplains that are not FEMA regulatory floodplains. The number of acres of floodplain per acre of parcel for Tract 1 is 0.08.

Frontage of Waterways

Within Tract 1, Hay Lake, 96.2 acres, has a frontage of 9,894.4 ft. Rice Lake, 29.5 acres, has a frontage of 4,829.6 ft. An unnamed lake between Hay Lake and Rice Lake is 3.9 acres in area and has a frontage of approximately 1,700 ft.

The Pike River flows from the southern boundary to the northern boundary of Tract 1 and is 8.1 miles in length. Riparian habitat is found on both sides of the river for 5.7 miles, and on only one side for 2.4 miles where the river formed the boundary of the parcel. The linear distance of river frontage for Tract 1 is approximately 72,864 linear ft (AECOM 2011d).

The length of lake and river frontage per acre on Tract 1 was calculated to be 3.5 ft per acre and 15.3 ft per acre, respectively.



Non-federal Lands

100 Year Floodplain

Section Boundary

Approximate Floodplain

1 Section Label

Figure 4.3.3-5

Floodplain Boundaries

Tract 1 and Tract 3

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4.3.3.2.3 Tract 2 – Lake County Lands

Hydrology, Wetland Vegetation, and Community Types

Tract 2 consists of 381.9 acres located in Lake County and is comprised of two parcels. Tract 2 identified 282.9 acres of wetlands (74 percent of Tract 2) (see Figure 4.3.3-3 and Table 4.3.3-8). The most common wetland types within Tract 2 are coniferous swamps (approximately 59 percent); shrub swamps (approximately 18 percent), which includes both alder thickets and shrub-carr wetlands; and hardwood swamps, which includes some coniferous swamps (approximately 16 percent). The two parcels (Lake County North and Lake County South) are nearly level and consist predominantly of second- and third-growth mixed deciduous and coniferous forest uplands and bog, emergent, shrub, and forested wetlands. Much of the Lake County South parcel has been recently logged (AECOM 2011c; AECOM 2011d).

Lake County North

The Lake County North parcel consists of 265.0 acres, of which 209.3 acres are identified as wetlands (approximately 79 percent) (see Figure 4.3.3-3 and Table 4.3.3-8). The most common wetland types within the Lake County North parcel are coniferous swamps (approximately 65 percent); shrub swamps (approximately 17 percent), which includes alder thickets and shrub-carr wetlands; and hardwood swamps, which includes some coniferous swamps (approximately 17 percent).

Table 4.3.3-8 Total Wetland Acreage by Wetland Type for Tract 2

	Lake County North		Lake County South		Total Lake County	
Eggers and Reed Class[1]	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**
Coniferous swamp[2]	135.0	65	32.4	44	167.4	59
Hardwood swamp[3]	34.7	17	9.9	13	44.6	16
Open bog	1.8	1	0.0	0	1.8	1
Open water (includes shallow, open water, and lakes)	0.2	<1	2.5	3	2.7	1
Shallow marsh[4]	2.5	1	12.3	17	14.8	5
Shrub swamp (includes alder thicket and shrub-carr)	35.1	17	16.5	22	51.6	18
Total	209.3	100	73.6	100	282.9	100

1 Eggers and Reed 1997.
2 Field data for coniferous bogs and coniferous swamps was combined.
3 Coniferous tree species may be present within some hardwood swamps.
4 Shallow marsh areas may contain deep marshes.

The Lake County North parcel has moderate topography, with the terrain generally sloping toward the southwest toward Pine Lake. This parcel consists of two smaller subparcels to the north and a single, small subparcel to the south that is adjacent to the Wolf Lands 1 parcel (see Figure 4.3.3-3). The subparcels are comprised of mostly wetland habitat, except for an area of upland habitat in the northern portion of the northern subparcel and in portions of the southern subparcel. Portions of the subparcels have recently been logged. Wetland habitat consists mostly of immature coniferous forest, with lesser amounts of mature mixed forest and shrubland (AECOM 2011c).

The Lake County North parcel encompasses several wetland types, including forested wetlands comprised of coniferous swamps and hardwood swamps, shrub swamps, and open bog/palustrine emergent wetlands, open water, and shallow marshes (collectively, emergent wetlands). Forested wetlands are comprised primarily of sapling northern white cedar and black spruce with lesser amounts of tamarack, although several drainages also contain black ash. Northern white cedar is predominant in the more southerly portions of the northern two subparcels, while black spruce is more common in the northern and northwestern portion of these two subparcels. Shrub wetland habitat is associated with several drainages, a beaver pond, a bog area, and recently logged areas, while emergent wetland habitat is found near the beaver pond and in recently logged areas. Shrub wetlands within the Lake County North parcel are dominated by speckled alder. Vegetation in the emergent wetlands consists of various sedge species and Canada bluejoint grass, with scattered black spruce, northern white cedar, tamarack, and speckled alder (AECOM 2011c).

Canopy cover in forested wetlands ranges from 50 to 80 percent and most canopy trees are 6 to 10 inches dbh. The midstory consists of balsam fir and black spruce (approximately 40 percent cover), while speckled alder, leatherleaf, and bog Labrador-tea are found in the shrub layer (40 percent cover) and club moss and sphagnum moss cover most of the ground (AECOM 2011c).

In general, the southern subparcel consists of forested wetland stands of immature black spruce and northern white cedar with northern white cedar to 20 inches dbh and black spruce to 14 inches dbh. Canopy cover is 50 percent, while the midstory cover is 60 percent and comprised of sapling balsam fir. The nearly continuous ground cover is dominated by sphagnum moss and club moss. Another immature forested wetland in the northern subparcel includes black ash trees to 16 inches dbh (AECOM 2011c).

Shrub and emergent wetland habitats are also found on the subparcels. Shrub wetland habitat is associated with several drainages, a beaver pond, a bog area, and recently logged areas, while emergent wetland habitat is found near the beaver pond and in recently logged areas. Shrub wetlands are dominated by speckled alder (to 80 percent cover). Two wetlands are classified as shrub wetlands because speckled alder covered 70 percent of the area, but the wetlands also have open bog characteristics since bog Labrador-tea also covers 70 to 80 percent of the wetlands, and sphagnum moss covers most of the ground. Scattered sapling black spruce, northern white cedar, and red-osier dogwood are also found in these wetlands. Vegetation in the emergent wetlands consists of various sedge species and Canada bluejoint (40 percent cover), with scattered black spruce, northern white cedar, tamarack, and speckled alder (AECOM 2011c).

Lake County South

The Lake County South parcel consists of 116.9 acres, of which 73.6 acres are identified as wetlands (approximately 63 percent) (see Figure 4.3.3-3 and Table 4.3.3-8). The most common wetland types within the Lake County South parcel are coniferous swamps (approximately 44 percent); shrub swamps (approximately 22 percent), which includes both alder thickets and shrub-carr wetlands; shallow marshes (approximately 17 percent); and hardwood swamps (approximately 13 percent).

Lake County South is relatively flat in the northwestern section, rises in elevation to the northeast, and then falls in elevation to the southeast. Water flows from west to east. At the time of the survey, a series of beaver dams and ponds dominated the landscape, as did areas that had been recently logged. Although shrubland dominates upland habitats, several habitat types comprise wetland habitats within this parcel (AECOM 2011c).

Forested wetlands dominate the western and southeastern portions of the parcel and are comprised of black spruce and northern white cedar. However, tamarack is found in some forest stands and black ash is an important component of several drainages. The overstory cover is about 50 to 70 percent, while the midstory coverage of balsam fir and black spruce is about 20 percent. Speckled alder, leatherleaf, bog Labrador-tea, and red-osier dogwood are common shrubs (to 80 percent cover), while sphagnum moss covers most of the ground. Forests in the northwestern section contain a dense mix of northern white cedar and black spruce with scattered black ash in the canopy (50 percent cover), and black spruce, northern white cedar, balsam fir, and speckled alder in the midstory and shrub layer (80 percent cover). Five beaver ponds were found on the parcel creating wetlands, which are comprised of open water with scattered dead spruce. These open-water wetlands are surrounded by emergent wetlands dominated by various sedge species, narrow-leaved cattail, woolgrass, and Canada bluejoint grass, or by dense stands of speckled alder in more shallow areas (AECOM 2011c).

Wetland Functional Assessment

Table 4.3.3-9 summarizes the 13 wetland functional value ratings (8 Lake County North and 5 Lake County South) that were obtained for Tract 2 for the primary wetland functions rated by MnRAM 3.2. Tract 2 wetlands were rated high for nearly all wetland functional values with the exception of flood attenuation and aesthetic, recreational, educational, and cultural values.

Table 4.3.3-9 Wetland Functional Value Assessment for Tract 2

	Functional Value Ratings (%)								
Wetland Functions and Value Rating	**Vegetation Diversity/ Integrity**	**Hydrology**	**Flood Attenuation**	**Downstream Water Quality**	**Wetland Water Quality**	**Wildlife Habitat**	**Fish Habitat**	**Amphibian Habitat**	**Aesthetics/ Education/ Cultural**
Lake County North									
High	100	100	0	100	100	100	63	63	0
Moderate	0	0	100	0	0	0	0	0	100
Low	0	0	0	0	0	0	0	0	0
Not Available or Applicable	0	0	0	0	0	0	37	37	0
Total	100	100	100	100	100	100	100	100	100
Lake County South									
High	100	100	0	100	100	100	60	60	20
Moderate	0	0	100	0	0	0	0	0	80
Low	0	0	0	0	0	0	0	0	0
Not Available or Applicable	0	0	0	0	0	0	40	40	0
Total	100	100	100	100	100	100	100	100	100

Source: AECOM 2011c.

Floodplains

Floodplains were not associated with Tract 2.

Frontage of Waterways

Tract 2 does not include any streams, rivers, creeks, or lakes.

4.3.3.2.4 Tract 3 – Wolf Lands

Hydrology, Wetland Vegetation, and Community Types

Tract 3 consists of a total of 1,575.8 acres located in Lake County and is comprised of four individual parcels. A total of 1,392.6 acres (88 percent) of wetlands were identified within Tract 3 (see Figures 4.3.3-3 and 4.3.3-4, and Table 4.3.3-10). The most common wetland types within the Wolf Lands are coniferous swamps (approximately 79 percent) and shrub swamps (approximately 20 percent), which includes alder thickets and shrub-carr wetlands. The four parcels are nearly level and consist predominantly of second- and third-growth mixed deciduous and coniferous forested uplands and bog, emergent, shrub, and forested wetlands. Much of the area of the parcels comprising the Wolf Lands has been recently logged (AECOM 2011c; AECOM 2011d).

Table 4.3.3-10 Total Wetland Acreage by Wetland Type for Tract 3

Eggers and Reed Class[1]	Wolf Lands 1		Wolf Lands 2		Wolf Lands 3		Wolf Lands 4		Total Wolf Lands	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Coniferous swamp[2]	75.4	84	627.4	89	82.6	35	320.3	88	1,105.7	79
Hardwood swamp[3]	0.0	0	5.0	1	0.0	0	0.0	0	5.0	<1
Open bog	3.0	3	0.0	0	0.0	0	0.2	<1	3.2	<1
Open water (includes shallow, open water, and lakes)	0.0	0	0.4	<1	0.0	0	0.0	0	0.4	<1
Shallow marsh[4]	0.0	0	0.4	<1	5.2	2	0.0	0	5.6	<1
Shrub swamp (includes alder thicket and shrub-carr)	12.0	13	73.0	10	145.4	63	42.3	12	272.7	20
Total	90.4	100	706.2	100	233.2	100	362.8	100	1,392.6	100

1 Eggers and Reed 1997.
2 Field data for coniferous bogs and coniferous swamps was combined.
3 Coniferous tree species may be present within some hardwood swamps.
4 Shallow marsh areas may contain deep marshes.

Wolf Lands 1

The Wolf Lands 1 parcel consists of 122.8 acres, of which 90.4 acres are mapped as wetlands (approximately 72 percent) (see Figure 4.3.3-3 and Table 4.3.3-10). The most common wetland types within this parcel are coniferous swamps (approximately 84 percent) and shrub swamps (approximately 13 percent), which includes alder thickets and shrub-carr wetlands.

Most of the upland habitat consists of mature mixed forest, while most wetland habitats consist of coniferous forest. The parcel is relatively flat but slopes gently downward toward the southwest. The Wolf Lands 1 parcel is adjacent to Lake County North (AECOM 2011c). The eastern half of the parcel is wetland, while upland comprises most of the western portion of the parcel. Pine Lake is about 0.5 mile northwest of the parcel (AECOM 2011c).

Immature forested wetland communities on the parcel are comprised primarily of black spruce, with scattered northern white cedar and tamarack. More mature forested wetlands have characteristics of more open bogs, as tree cover is sparse at about 30 percent, while 80 percent of the area is covered by bog Labrador-tea and leatherleaf, and sphagnum moss covers most of the ground. In more immature forests, tree cover ranges from 60 to 80 percent, with a canopy dominated by 6 to 10 inches dbh black spruce, with tamarack and northern white cedar also present. The midstory consists of balsam fir and black spruce (about 40 percent cover), while speckled alder, leatherleaf, bog Labrador-tea, and red-osier dogwood dominate the shrub layer (40 percent cover) and club moss and sphagnum moss cover most of the ground (AECOM 2011c).

Wolf Lands 2

The Wolf Lands 2 parcel consists of 767.9 acres, of which 706.2 acres are mapped as wetlands (approximately 92 percent) (see Figure 4.3.3-4 and Table 4.3.3-10). The most common wetland types within Wolf Lands 2 are coniferous swamps (approximately 89 percent) and shrub swamps (approximately 10 percent), which includes both alder thickets and shrub-carr wetlands.

The Wolf Lands 2 parcel, which slopes toward the southwest, can generally be characterized by gently undulating terrain. Overland water flows to the southwest and to Mary Ann Creek, Wenho Creek, and Greenwood Lake. The Wolf Lands 2 parcel consists primarily of forested wetlands comprised of black spruce and northern white cedar, with a black ash component in a few drainages; shrubland comprised of speckled alder is also common on the parcel. Most upland habitat consists of mixed forest. Several drainages are dominated by speckled alder, while emergent wetland habitat is associated with beaver ponds. Black spruce is the dominant tree in wetlands in the northern and eastern portions of the parcel, while northern white cedar is more prevalent in other portions of the parcel (AECOM 2011c).

Forested wetlands are of three types: black spruce dominant, a mix of black spruce and northern white cedar, or northern white cedar dominant. Canopy trees range from four to eight inches dbh, with total canopy cover from 70 to 80 percent. The midstory consists of sapling black spruce, northern white cedar, and balsam fir. Midstory cover is patchy, ranging from 10 to 40 percent. Bog Labrador-tea comprises 10 to 30 percent of the low shrub cover, while sphagnum moss often covers more than 80 percent of the ground. In areas with a dense canopy, the midstory and ground cover are poorly developed (AECOM 2011c).

Several drainages are dominated by shrub swamp vegetation. These parcels generally have a sparse overstory, with approximately 20 percent aerial cover of black spruce, northern white cedar, and tamarack. Speckled alder and sapling trees usually cover 60 percent or more of the midstory, while low shrub cover consists of bog Labrador-tea (40 to 60 percent cover) (AECOM 2011c).

Beaver dams and ponds were found in the southeastern portion of the parcel during the field survey. Typically, open water is adjacent to the dams, with emergent wetland surrounding the open water and shrub wetlands upstream of the dams (AECOM 2011c).

Wolf Lands 3

The Wolf Lands 3 parcel consists of 277.4 acres, of which about 233.2 acres are mapped as wetlands (approximately 84 percent) (see Figure 4.3.3-4 and Table 4.3.3-10). The most common wetland types within the Wolf Lands 3 parcel are shrub swamps (approximately 63 percent), which includes alder thickets and shrub-carr wetlands, and second most common are coniferous swamps (approximately 35 percent).

The Wolf Lands 3 parcel is relatively flat. Coyote Creek begins its flow north within the parcel. Uplands consist of mostly shrubland and deciduous forest, while wetlands are dominated by shrub wetland and coniferous forested wetland habitats (AECOM 2011c). About half of the parcel had been recently logged. Logged wetlands are dominated by grasses, forbs, and low-growing shrubs, including red-osier dogwood and speckled alder. In the unlogged areas, forested wetlands are comprised primarily of black spruce. In the northern portion of the parcel, black spruce is co-dominant with tamarack; in the rest of the parcel, tamarack is present in the canopy but in much lower quantity (AECOM 2011c).

In shrub swamp wetlands, speckled alder covers from 20 to 80 percent of the area. In some areas, bog Labrador-tea covers 80 to 90 percent of the ground, especially in areas with a dense cover of speckled alder. In areas with a lower density of speckled alder, grasses, forbs, and ferns are the dominant vegetation, but due to snow cover at the time of survey, it was not possible to determine percent ground cover or species composition. Scattered sapling black spruce and paper birch are also seen on logged wetlands. Woody debris from the recent logging operations is abundant in logged areas (AECOM 2011c).

In the unlogged areas, wetland forests are comprised of black spruce. In the northern part of the parcel, the black spruce is co-dominant with tamarack; in the rest of the parcel, tamarack is present in the canopy but in much lower amounts. Total canopy cover ranges from 60 to 80 percent, with canopy trees ranging from 4 to 10 inches dbh. The midstory consists of balsam fir and black spruce (20 to 30 percent cover), while the shrub layer is dominated by bog Labrador-tea (80 percent), over a ground layer of nearly continuous (80 percent cover or more) sphagnum moss with scattered grasses and forbs (AECOM 2011c).

Coyote Creek is bordered by an emergent sedge meadow wetland complex comprised of sedges, narrow-leaved cattail, and Canada bluejoint (collectively about 90 percent cover). There is also scattered sapling tamarack and northern white cedar, as well as scattered patches of speckled alder and bog Labrador-tea. The emergent wetland is bordered by dense (80 percent cover) speckled alder. Water depth in the emergent and shrub wetlands is approximately 18 to 24 inches (AECOM 2011c).

Logging roads on the parcel have become emergent wetland habitat dominated by narrow-leaved cattail, woolgrass, Canada bluejoint, scattered sedges, and speckled alder. Herbaceous vegetation covers about 70 to 80 percent of the wetland area, while alder shrubs cover approximately 10 percent of the wetlands (AECOM 2011c).

Wolf Lands 4

The Wolf Lands 4 parcel consists of 404.7 acres of which 362.8 acres are mapped as wetlands (approximately 90 percent) (see Figure 4.3.3-4 and Table 4.3.3-10). The most common wetland types within the Wolf Lands 4 parcel are coniferous swamps (approximately 88 percent) and shrub swamps (approximately 12 percent).

Coyote Creek bisects the parcel, while the Stony River is about 2,000 ft northwest of the parcel. Timber harvests recently occurred along the western border of the parcel. Upland habitats consist primarily of mature deciduous forest, while forested and shrub wetland community types dominate wetland habitats (AECOM 2011c).

Wetland types include coniferous forest, shrub wetlands, and emergent. Black spruce forests are the most prevalent community type in the northern half of the parcel, while northern white cedar is more prevalent in the southern half of the parcel. Emergent wetland communities that include various species of sedge, Canada bluejoint grass, and shrub wetlands comprised primarily of speckled alder are found in floodplains that border Coyote Creek. Shrub wetlands also occur in two drainages to Coyote Creek in the southeastern portion of the parcel and in a drainage to the Stony River in the northeastern portion of the parcel (AECOM 2011c).

Coniferous wetlands composed of black spruce and black spruce/northern white cedar are dominated by trees ranging from four to eight inches dbh, with a patchy canopy cover of about 50 percent. Scattered tamaracks are also found in these wetlands. The low shrub layer is nearly continuous (80 to 90 percent cover), and is comprised of leatherleaf, bog Labrador-tea, and other vegetation. Sphagnum and club mosses cover most of the ground. Other forests have a more developed midstory, with 60 percent cover by black spruce, northern white cedar, tamarack, and speckled alder, and a similarly dense shrub layer, with 60 to 70 percent cover by leatherleaf and bog Labrador-tea (AECOM 2011c).

Shrub wetlands are dominated by speckled alder (60 to 80 percent cover), with scattered black spruce, tamarack, and northern white cedar in the overstory. Leatherleaf and bog Labrador-tea cover about 40 to 50 percent of the shrub layer (AECOM 2011c).

Wetland Functional Assessment

Table 4.3.3-11 summarizes the 18 wetland functional value ratings (three for Wolf Lands 1, six for Wolf Lands 2, six for Wolf Lands 3, and three for Wolf Lands 4) that were obtained for Tract 3 for the primary wetland functions rated by MnRAM 3.2. Tract 3 wetlands were rated high for nearly all wetland functional values with the exception of flood attenuation on Wolf Lands 2, 3, and 4; amphibian habitat on Wolf Lands 3; and aesthetic, recreational, educational, and cultural values for all four sub-parcels.

Table 4.3.3-11 Wetland Functional Value Assessment for Tract 3

Wetland Functions and Value Rating	Functional Value Ratings (%)								
	Vegetation Diversity/ Integrity	**Hydrology**	**Flood Attenuation**	**Downstream Water Quality**	**Wetland Water Quality**	**Wildlife Habitat**	**Fish Habitat**	**Amphibian Habitat**	**Aesthetics/ Education/ Cultural**
Wolf Lands 1									
High	100	100	100	100	100	100	67	67	0
Moderate	0	0	0	0	0	0	0	0	100
Low	0	0	0	0	0	0	0	0	0
Not Available or Applicable	0	0	0	0	0	0	33	33	0
Total	100	100	100	100	100	100	100	100	100
Wolf Lands 2									
High	100	100	20	100	100	100	33	33	0
Moderate	0	0	80	0	0	0	0	0	100
Low	0	0	0	0	0	0	0	0	0
Not Available or Applicable	0	0	0	0	0	0	67	67	0
Total	100	100	100	100	100	100	100	100	100
Wolf Lands 3									
High	100	100	0	100	100	100	50	33	0
Moderate	0	0	100	0	0	0	0	33	100
Low	0	0	0	0	0	0	0	17	0
Not Available or Applicable	0	0	0	0	0	0	50	17	0
Total	100	100	100	100	100	100	100	100	100
Wolf Lands 4									
High	100	100	0	100	100	100	33	100	0
Moderate	0	0	100	0	0	0	0	0	100
Low	0	0	0	0	0	0	0	0	0
Not Available or Applicable	0	0	0	0	0	0	67	0	0
Total	100	100	100	100	100	100	100	100	100

Source: AECOM 2011c.

Floodplains

Floodplains are found on two of the Tract 3 parcels associated with the Coyote Creek (see Figure 4.3.3-5). Wolf Lands 3 was found to have 32.8 acres of floodplains and Wolf Lands 4 was found to have 79.4 acres and none are FEMA regulatory floodplains. The number of acres of floodplain per acre of parcel is 0.1 and 0.2, respectively (AECOM 2011d).

Frontage of Waterways

Coyote Creek begins in Wolf Lands 3, flows north into Wolf Lands 4, and continues north of Wolf Lands 4. The creek is 0.1 mile in length in Wolf Lands 3, and 0.9 miles in length in Wolf Lands 4. Riparian habitat is found on both sides of the river. The linear distance of river frontage for Wolf Lands 3 and Wolf Lands 4 is 1,056.0 and 9,504 linear ft, respectively. The length of river frontage per acre on Wolf Lands 3 and Wolf Lands 4 was calculated to be 3.8 and 23.5 ft, respectively.

4.3.3.2.5 Tract 4 – Hunting Club Lands

Hydrology, Wetland Vegetation, and Community Types

Tract 4 consists of 160.2 acres, of which 63.6 acres are mapped as wetland (approximately 40 percent) (see Figure 4.3.3-4 and Table 4.3.3-12). The most common wetland types within Tract 4 are shrub swamps (approximately 50 percent), which includes alder thickets and shrub-carr wetlands; coniferous swamps (approximately 24 percent); and shallow marshes (approximately 20 percent). The parcel is nearly level and consists predominantly of second- and third-growth deciduous and mixed deciduous and coniferous forested uplands and emergent, shrub, and forested wetlands (AECOM 2011c).

Table 4.3.3-12 Total Wetland Acreage by Wetland Type for Tract 4

	Total Hunting Club	
Eggers and Reed Class[1]	**Acres**	**%**
Coniferous swamp[2]	15.4	24
Hardwood swamp[3]	0.4	1
Open bog	0.0	0
Open water (includes shallow, open water, and lakes)	2.8	5
Shallow marsh[4]	13.0	20
Shrub swamp (includes alder thicket and shrub-carr)	32.0	50
Total	63.6	100

1 Eggers and Reed 1997.
2 Field data for coniferous bogs and coniferous swamps was combined.
3 Coniferous tree species may be present within some hardwood swamps.
4 Shallow marsh areas may contain deep marshes.

A wetland complex bisects the parcel and drains to the north and then northeast. From this low area, the land slopes upward to the east and west. Several beaver dams were found during field surveys along the creek on or near the parcel. The parcel consists primarily of wetland shrublands, with lesser amounts of emergent and shrub wetlands and upland deciduous forests (AECOM 2011c).

Beaver ponds and dams are the dominant wetland features on the parcel. Open water habitat is typical near the dams. Emergent vegetation, consisting of Canada bluejoint grass, narrow-leaved cattail, and various sedge species, are found in water from 12 to 24 inches deep, while speckled alder shrub wetlands are located near ponds at water depths from 6 to 18 inches. A large black spruce forest is located in the middle of the parcel. Overstory cover is about 60 percent, with most of the cover resulting from black spruce, with scattered tamarack occasionally present. The midstory consists of speckled alder (50 percent cover), while leatherleaf and bog Labrador-tea (80 percent cover) and sphagnum moss (about 80 percent cover) are found below the speckled alder (AECOM 2011c).

Wetland Functional Assessment

Table 4.3.3-13 summarizes the three wetland functional value ratings that were obtained for Tract 4 for the primary wetland functions rated by MnRAM 3.2. Tract 4 wetlands were rated high for nearly all wetland functional values with the exception of flood attenuation, amphibian habitat, and aesthetic, recreational, educational, and cultural values.

Table 4.3.3-13 Wetland Functional Value Assessment for Tract 4

Wetland Functions and Value Rating	Functional Value Ratings (%)								
	Vegetation Diversity/ Integrity	Hydrology	Flood Attenuation	Downstream Water Quality	Wetland Water Quality	Wildlife Habitat	Fish Habitat	Amphibian Habitat	Aesthetics/ Education/ Cultural
High	100	100	0	100	100	100	100	33	0
Moderate	0	0	100	0	0	0	0	33	100
Low	0	0	0	0	0	0	0	0	0
Not Available or Applicable	0	0	0	0	0	0	0	33	0
Total	100	100	100	100	100	100	100	99	100

Source: AECOM 2011c.

Floodplains

Floodplains were not associated with Tract 4.

Frontage of Waterways

Tract 4 does not include any streams, rivers, creeks, or lakes.

4.3.3.2.6 Tract 5 – McFarland Lake Lands

Hydrology, Wetland Vegetation, and Community Types

Tract 5 is a single parcel of 30.8 acres. The entire parcel is mapped as upland. The parcel is approximately 3 miles west of the U.S.-Canada border. This parcel is mostly on a hill slope and consists of second- and third-growth deciduous and coniferous forested uplands. There are no wetlands located on Tract 5. This parcel is surrounded by the Superior National Forest. McFarland Lake borders Tract 5 and provides lake habitat (AECOM 2011b).

Wetland Functional Assessment

No wetlands are associated with Tract 5; therefore, there are no functional assessment values.

Floodplains

Floodplains were not associated with Tract 5.

Frontage of Waterways

Tract 5 borders McFarland Lake. The parcel has a lake frontage of approximately 990 ft along McFarland Lake. The length of lake frontage per acre on Tract 5 was calculated to be 32.1 ft.

4.3.4 Vegetation

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013. The FEIS will consider any new listings, or changes in the previous listings, associated with the updated list. A Biological Evaluation (containing further information about RFSS species) has been prepared and is posted on the USFS website (http://www.fs.usda.gov/goto/superior/northmet).

4.3.4.1 Federal Lands

The federal lands include a large tract of mostly forested land, up to 6,495.4 acres in size. The tract is located in the west-central part of the Superior National Forest (PolyMet 2013c).

4.3.4.1.1 Land Exchange Proposed Action

Cover Types

Cover types consist of several categories of classification, including MDNR GAP land cover types, specific plant community survey results, MBS Sites of Biodiversity Significance, SNAs, USFS Management Areas, USFS ELTs, USFS MIH types, and USFS landscape ecosystems.

Habitat Types

The federal land cover types are similar to the Mine Site described in Section 4.2.4.2.1 (see Figure 4.2.4-1). Specific acreages for MDNR GAP land cover types on the federal lands are presented in Table 4.3.4-1 below. In the past, portions of the federal lands have been logged to varying degrees, depending on the management area allocation. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-1 Federal Lands Cover Types

Cover Types	Total Acres	Percent of Area
Lowland coniferous forest[1]	2,978.6	46
Upland coniferous forest[2]	1,618.9	25
Upland deciduous forest[3]	1,091.8	17
Shrubland	645.6	10
Disturbed	63.8	1
Aquatic environments	60.1	1
Upland conifer-deciduous mixed forest[4]	20.9	<1
Lowland deciduous forest[5]	9.5	<1
Cropland/grassland	6.2	<1
Total	**6,495.4**	**100**

Source: MDNR 2006b.

1 Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
2 Includes pine and spruce/fir forest cover types.
3 Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
4 Includes all mixed coniferous-deciduous forest cover types.
5 Includes black ash forest cover types.

Plant Community Surveys

Wetlands are dominated by immature black spruce and northern white cedar, with scattered tamarack (*Larix laricina*) and aspen (AECOM 2011d). There are several areas of open water, including Mud Lake, the Partridge River, Yelp Creek, and scattered small ponds. Bogs are dominated by leatherleaf (*Chamaedaphne calyculata*) and bog-Labrador tea (*Ledum groenlandicum*). Uplands are dominated by immature mixed pine-hardwood forests, including jack pine, black spruce, trembling aspen (*Populus tremuloides*), paper/white birch (*Betula papyrifera*), and balsam fir. Grassland/shrubland habitat is uncommon and is primarily associated with the transmission line ROW in the western portion and recent logging in the southeastern portion of the federal lands. Disturbed areas are associated with roads and landings, waste rock storage areas immediately north of the federal lands, and a rail route along the southern portion of the federal lands.

The majority of forest stand trees on the federal lands are characterized as immature, or 12 inches dbh or less, which corresponds to trees from 10 to 60 years in age (AECOM 2011d). For both coniferous and deciduous trees, the largest ones are approximately 18 to 20 inches dbh, but a 24-inch dbh red pine was found on the federal lands. Much of the One Hundred Mile Swamp north and west of the Mine Site consists of mature (80-plus years in age) black spruce and northern white cedar.

Of the wetlands that are located on the federal lands, the majority are determined to have high overall quality due to minimal or no current disturbance (AECOM 2011a). Of the wetlands that are located on the Mine Site, the majority (92 percent) is rated as having a high overall wetland quality and 8 percent are of moderate overall wetland quality. Wetlands on the federal lands are rated high for nearly all wetland functions, based on the MnRAM 3.2 criteria (AECOM 2011d). Vegetation diversity and integrity are rated moderate to high for all wetlands because recent human contact and alteration are minimal and the wetlands have a relatively constant supply of water. See Section 4.3.3 for a more detailed discussion on wetlands.

Minnesota Biological Survey

The majority (6,142.7 acres) of the federal lands consist of MBS Sites of High Biodiversity Significance, including the One Hundred Mile Swamp site (53 percent of federal lands) and the Upper Partridge River site (41 percent of federal lands). The Upper Dunka Peatlands site (less than 1 percent of federal lands) is a Site of Moderate Biodiversity Significance and is also located on the federal lands (MDNR 2008a). These sites are located in the Laurentian Uplands subsection.

Three vegetation communities, white pine-red pine forest (FDn43a; less than 1 percent of federal lands), black spruce-Jack pine woodlands (FDn32c; 17 percent of federal lands), and rich black spruce swamps (FPn62a; 5 percent of federal lands) have been characterized by the MBS as “imperiled,” “imperiled/vulnerable,” and “vulnerable” native plant communities, respectively (MDNR 2008b). Black ash-conifer swamps (WFn64a), black spruce bogs (APn80a), graminoid bogs (APn90b1), poor tamarack-black spruce swamps (APn81b), and white cedar swamps (FPn63a) are ranked as “apparently secure” in Minnesota based on abundance, distribution, trends, and threats. Aspen-birch forests: balsam fir subtype (FDn43b1), alder swamps (FPn73a), poor black spruce swamps (APn81a), rich tamarack-alder swamps (FPn82a), willow-dogwood shrub swamps (WMn82a), and low shrub poor fens (APn91a) are all considered “widespread and secure.”

Scientific and Natural Areas

Similar to the Mine Site, there are no lands designated or nominated for designation as SNAs on the federal lands (MDNR 2006c; Wilson, MDNR, Pers. Comm., February 14, 2012).

Culturally Important Plants

Natural resources culturally important to the Bands are discussed in Section 4.2.9.

Management Areas

The USFS manages its forests by assigning various management area allocations. The federal lands are currently managed under the General Forest – Longer Rotation Management Area (95 percent) and the General Forest Management Area (5 percent) (see Table 4.3.4-2) (USFS 2011j). Section 4.3.1 describes the management areas in detail.

Table 4.3.4-2 Management Areas for the Federal Lands

	Federal Lands	
Category	**Acres**	**Percent**
General Forest	355.3	5
General Forest – Longer Rotation	6,140.1	95
Potential/Candidate Research Natural Areas	0.0	0
Riparian Areas	0.0	0

Source: USFS 2011j.

Ecological Land Types

USFS ELT data for the federal lands are not fully developed, but provide data for over half of the parcel. The federal lands contain five different categories of ELTs, including Lowland Loamy Moist (ELT 1), Lowland Loamy Wet (ELT 2), Lowland Organic Acid to Neutral (ELT 6), Upland Deep Loamy Dry Coarse (ELT 13), and Upland Shallow Loamy Dry (ELT 16). Almost all of the federal lands are included within the Big-Bird Lake Moraine LTA, with the small remaining portion included in the Mesabi Range LTA.

Management Indicator Habitats

As mentioned previously, the USFS also tracks MIH types. The most abundant MIH type on the federal lands is lowland black spruce-tamarack forest (MIH 9; 3,060.2 acres), but upland forest (MIH 1; 1,330.0 acres) and upland conifer forest (MIH 5; 1,252.4 acres) is also present (see Table 4.3.4-3) (USFS 2010b). Aquatic habitats (MIH 14) are not tracked on the federal lands, though several open water features occur on the federal lands (see Figure 4.2.4-3). Though not considered MIH types, the federal lands contain 492.3 acres of lowland shrub habitat and 185.5 acres of lowland emergent wetlands, as well. The remaining acres present on the federal lands have no corresponding MIH classification.

The USFS Forest Stand data also contain information about forest stand ages. The majority of the federal lands consist of mature (3,854.2 acres) forest stands, with smaller amounts of immature (1,539.2 acres) stands and young (271.1 acres) stands (USFS 2011i). Additionally, the USFS tracks large (greater than 300 acres) contiguous patches of mature upland forest (MIH 13) on the Superior National Forest. There are currently no patches of mature upland forest over 300 acres on the federal lands (USFS 2012c). However, since smaller patches will grow over time into larger contiguous patches, the USFS predicts that in 2020, there would be two patches (707.8 acres and 322.1 acres) over 300 acres on the federal lands (USFS 2012d).

Table 4.3.4-3 MIH Types and Age Classes (Acres) for the Federal and Non-federal Lands

MIH Type	Total of Federal Lands[1]	Total of Non-federal Lands[2]	Tract 1 - Hay Lake	Tract 2 - Lake County North	Tract 2 - Lake County South	Tract 3 - Wolf 1	Tract 3 - Wolf 2	Tract 3 - Wolf 3	Tract 3 - Wolf 4	Tract 4 - Hunting Club	Tract 5 - McFarland Lake
MIH 1	1,330.0	2,694.5	2,366.0	49.1	2.1	43.8	56.8	40.9	20.4	89.3	26.1
MIH 5	1,252.4	79.9	54.2	1.1	0.0	0.0	7.9	0.0	0.0	12.7	4.0
MIH 9	3,060.2	3,308.5	1,817.6	193.7	46.2	72.2	626.6	186.2	348.9	17.1	0.0
MIH 14	0.0	226.7	206.2	0.5	3.3	0.0	0.5	0.9	4.3	10.3	0.7
Lowland Shrub	492.3	332.2	113.3	20.6	6.4	9.7	76.0	48.6	31.0	26.6	0.0
Lowland Emergent	185.5	385.7	365.0	0.0	15.6	0.0	0.0	0.9	0.0	4.2	0.0
Upland Grass	0.0	43.3	0.0	0.0	43.3	0.0	0.0	0.0	0.0	0.0	0.0
Age Class											
Young	271.1	778.2	533.8	24.4	43.3	2.2	7.6	130.4	9.5	27.0	0.0
Immature	1,539.2	3,539.7	3,259.8	74.6	0.8	76.1	68.7	21.8	5.4	32.5	0.0
Mature	3,854.2	1,824.6	460.2	144.9	47.6	37.8	615.1	74.9	354.3	59.7	30.1

Source: USFS 2010b; USFS 2011i.

[1] Determined based on: AECOM 2011c; AECOM 2011b; USFS 2010b; USFS 2011i.

Landscape Ecosystems

In order for the USFS to sustainably and ecologically manage National Forest System lands, it must consider areas based on historical and current ecosystem functions. The USFS tracks and manages the Superior National Forest and other National Forest System lands on several levels, but to maintain a broader ecosystem view it uses a landscape ecosystem basis. A landscape ecosystem is an area that shares similar habitat composition, structure, and functions and occurs naturally on the landscape (USFS 2004a). The federal lands are located within three landscape ecosystem types, including Jack Pine-Black Spruce, Lowland Conifer, and Mesic Red and White Pine (see Table 4.3.4-4).

The Jack Pine-Black Spruce landscape ecosystem occupies 3,000.1 acres of the federal lands (represents less than 0.01 percent of Jack Pine-Black Spruce landscape ecosystem). It is dominated by both jack pine and black spruce, but aspen and paper birch are also occasionally present (USFS 2004a). Typically, jack pine dominates areas after fire disturbances and black spruce dominates areas after wind disturbances.

The Lowland Conifer landscape ecosystem occupies 3,460.3 acres of the federal lands (represents 0.01 percent of Lowland Conifer landscape ecosystem). It is dominated by one or all three species of black spruce, tamarack, and northern white cedar (USFS 2004a). Typically, black spruce occupies acidic organic soils, northern white cedar occupies neutral sites, and tamarack occupies areas between both types. Fire disturbances are more frequent than wind disturbances.

The Mesic Red and White Pine landscape ecosystem occupies less than 1 acre of the federal lands (represents less than 0.01 percent of Mesic Red and White Pine landscape ecosystem). It is dominated by mixed stands of red pine, white pine, aspen, paper birch, northern white cedar, white spruce, and balsam fir (USFS 2004a). Severe fire disturbances typically result in aspen/birch stands with red and white pine also present. Succession generally reduces the aspen/birch component, which leaves pines as the dominant species. White spruce and balsam fir typically regenerate in the understory.

Table 4.3.4-4 Landscape Ecosystem Types (Acres) on Federal and Non-federal Lands[1,2]

Landscape Ecosystem Type	Total of Federal Lands	Total of Non-Federal Lands	Tract 1 - Hay Lake	Tract 2 - Lake County North	Tract 2 - Lake County South	Tract 3 - Wolf 1	Tract 3 - Wolf 2	Tract 3 - Wolf 3	Tract 3 - Wolf 4	Tract 4 - Hunting Club	Tract 5 - McFarland Lake
Dry-Mesic Red and White Pine	0.0	682.9	589.2	0.0	0.0	0.0	0.0	0.0	0.0	93.7	0.0
Mesic Red and White Pine	0.1	558.8	528.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.8
Jack Pine-Black Spruce	3,000.1	983.5	983.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lowland Conifer	3,460.3	4,455.0	2,835.3	227.6	80.2	84.3	653.2	217.7	356.7	0.0	0.0
Mesic Birch-Aspen-Spruce-Fir	0.0	302.1	0.9	37.4	0.0	41.5	114.7	59.7	47.9	0.0	0.0
Lowland Hardwood	0.0	66.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66.5	0.0
Sugar Maple	0.0	36.7	0.0	0.0	36.7	0.0	0.0	0.0	0.0	0.0	0.0

Source: USFS 2011g.

[1] Total acres may be more or less than presented elsewhere due to rounding or GIS layers used.
[2] Data may not have complete coverage of parcels.

Invasive Non-native Plants

The federal lands have the same invasive non-native species as the Mine Site since they occupy the same area. Section 4.2.4.2.2 provides a list of invasive non-native species likely located on the federal lands.

Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

No federally listed threatened and endangered plant species are known to occur on the federal lands. The federal lands contain the same state-listed ETSC plant species as the Mine Site, with the exception of *Botrychium campestre*, which is located south of the federal lands on the Mine Site; an additional species, *Pyrola minor*, is found north of the Mine Site on the federal lands. Section 4.2.4.2.3 provides a list and discussion of the ETSC species on the federal lands.

Eleven state-listed ETSC plant species are known to occur on the federal lands. Based on a review of the MDNR NHIS and field investigations (AECOM 2009b; Barr 2007j; Johnson-Groh 2004; Pomroy and Barnes 2004; Walton 2004), two state endangered species, two state threatened species, and seven state species of special concern have been identified on the federal lands (see Table 4.3.4-5 and Figure 4.2.4-2). Some colonies of species listed for the Mine Site may be located outside of the federal lands but within the Mine Site. As a result, numbers of individuals may be smaller than the Mine Site. Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013. The FEIS will consider any new listings, or changes in the previous listings, associated with the updated list.

Table 4.3.4-5 Endangered, Threatened, and Special Concern Plant Species Identified on the Federal Lands [5]

Common Name	Scientific Name	State Status[1]	No. of Populations[2]	No. of Individuals[2,3]	Habitat and Location
Pale moonwort[4]	*Botrychium pallidum*	E	1	2	Full to shady exposure, edge of alder thicket, along Dunka Road.
Ternate, or St. Lawrence, grapefern[4]	*Botrychium rugulosum* (*ternatum*)	T	1	4	Early successional habitats, fields, open woods, forests, and along Dunka Road.
Least grapefern[4]	*Botrychium simplex*	SC	3	905	Full to shady exposure, edge of alder thicket, forest roads, along Dunka Road.
Floating marsh marigold[4]	*Caltha natans*	E	1	29	Shallow water in ditches and streams, alder swamps, shallow marshes, beaver ponds, and Partridge River mudflat.
Neat spikerush[4]	*Eleocharis nitida*	T	1	~486 ft^2	Full exposure, moist ditches along Dunka Road, wet area between railroad grades, and railroad ditch.
Bog rush[4]	*Juncus stygius* var. *americanus*	SC	1	Unknown	Open-patterned peatlands, rich and poor fens, northern spruce bog within the One Hundred Mile swamp.
Club-spur orchid	*Platanthera clavellata*	SC	1	Unknown	Black spruce and/or tamarack swamps, northern spruce bog within the One Hundred Mile swamp.

Common Name	Scientific Name	State Status[1]	No. of Populations[2]	No. of Individuals[2,3]	Habitat and Location
Small shinleaf[4]	*Pyrola minor*	SC	1	10	Rich black spruce swamps, cedar swamps, on Sphagnum hummocks in forested peatlands within the One Hundred Mile swamp.
Lapland buttercup	*Ranunculus lapponicus*	SC	1	~919 ft^2	On and adjacent to Sphagnum hummocks in black spruce stands, up to 60 percent shaded with alder also dominant.
Clustered bur-reed	*Sparganium glomeratum*	SC	1	28	Shallow pools and channels up to 1.5 ft deep in Sphagnum at edge of black spruce swamps, beaver ponds, wet ditches, shallow marshes.
Torrey's manna-grass	*Torreyochloa pallida*	SC	1	~25 ft^2	In muddy soil along shore and in water within shallow channels, beaver ponds, shallow marshes, along Partridge River.

Sources: AECOM 2009b; Barr 2007j; Johnson-Groh 2004; MDNR 2005; MDNR 2011m; MDNR 2013a; Pomroy and Barnes 2004; Walton 2004.

1 E - Endangered, T - Threatened, SC - Species of Concern.
2 Note that the number of populations may differ from those given in the NHIS data because of populations found during other surveys; additional populations may be present in more marginal, secondary habitat that was not surveyed or in wetter areas.
3 Where the number of individuals could not be determined without damaging the population, then patch size was used as a representative abundance measure.
4 These species are also RFSS as tracked by the USFS.
5 Data included here were provided by the Division of Ecological Resources, MDNR, and were current as of March 13, 2013. These data are not based on an exhaustive inventory of the state. The lack of data for any geographic area shall not be construed to mean that no significant features are present.

Species Life Histories

The species life histories are provided in Section 4.2.4.2.3 for all species except the additional one listed below.

Small shinleaf (*Pyrola minor*) is listed as a species of special concern in Minnesota and as an RFSS in the Superior National Forest. The species was first reported in Lake County in 1914 near the North Kawishiwi River. It has since only been documented in Cook, St. Louis, Lake (Bell Museum of Natural History 2011), and Carlton counties (NatureServe 2011). *P. minor* is a circumpolar species occurring across Canada and the western United States in boreal and alpine habitats (MDNR 2011m). It usually occurs in conifer swamps, including black spruce and northern white cedar swamps, and black spruce-balsam fir woodlands. Small shinleaf can also be found along moist ecotones between wetlands and uplands or between streams and slopes. It is a perennial evergreen forb species that is rhizomatous and flowers in mid-July. It may be semi-tolerant to disturbance, since healthy populations exist along well-traveled portage routes and at sites that have experienced timber harvesting around 20 years prior (MDNR 2011m). Threats to *P. minor* include climate change, since it is a circumpolar species, and competition from non-native species.

Regional Foresters Sensitive Species

Seven state-listed ETSC plant species that occur on the federal lands (*Botrychium pallidum*, *Botrychium rugulosum*, *Botrychium simplex*, *Caltha natans*, *Eleocharis nitida*, *Juncus stygius*, and *Pyrola minor*) are also RFSS plants. A species description for *Pyrola minor* is provided above, and for the other six ETSC species in Section 4.2.4.2.3. The other RFSS plants that are likely located on the federal lands using MIH types and suitable habitat as indicators are discussed in Section 4.2.4.2.3.

4.3.4.1.2 Land Exchange Alternative B

Cover Types

A smaller portion of the federal lands (up to 4,752.6 acres) would be exchanged into private ownership under this alternative.

Habitat Types

The Alternative B: Smaller Federal Parcel contains similar MDNR GAP land cover types as the federal lands, but smaller acreages of them, with lowland coniferous forest making up the majority of the parcel and cropland/grassland occupying the least amount (see Table 4.3.4-6). The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-6 Alternative B: Smaller Federal Parcel Cover Types

Cover Types	Total Acres	Percent of Area
Lowland coniferous forest[1]	2,064.8	43
Upland coniferous forest[3]	1,366.1	29
Upland deciduous forest[4]	804.7	17
Shrubland	436.9	9
Disturbed	29.1	1
Aquatic environments	26.3	1
Upland conifer-deciduous mixed forest[5]	17.8	<1
Lowland deciduous forest[2]	4.7	<1
Cropland/grassland	2.2	<1
Total	**4,752.6**	**100**

Source: MDNR 2006b.

[1] Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
[2] Includes black ash forest cover types.
[3] Includes pine and spruce/fir forest cover types.
[4] Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
[5] Includes all mixed coniferous-deciduous forest cover types.

Minnesota Biological Survey

Lands as part of the Alternative B: Smaller Federal Parcel would be mostly classified as MBS Sites of High Biodiversity Significance, including the Upper Partridge River (56 percent of Alternative B: Smaller Federal Parcel lands) and the One Hundred Mile Swamp (40 percent of Alternative B: Smaller Federal Parcel lands) (MDNR 2008a). Less than 1 percent of Alternative

B: Smaller Federal Parcel would contain the Upper Dunka Peatlands MBS Site of Moderate Biodiversity Significance. These sites are located in the Laurentian Uplands subsection.

The Alternative B: Smaller Federal Parcel would also contain "imperiled," "imperiled/vulnerable," and "vulnerable" native plant communities, including white pine-red pine forests (FDn43a; less than 1 percent), rich black spruce swamp (FPn62a; 6 percent), and black spruce-Jack pine woodlands (FDn32c; 23 percent), respectively (MDNR 2008b). Black ash-conifer swamps (WFn64a), black spruce bogs (APn80a), graminoid bogs (APn90b1), poor tamarack-black spruce swamps (APn81b), and white cedar swamps (FPn63a) are ranked as "apparently secure" and are located in the Alternative B: Smaller Federal Parcel lands. Aspen-birch forests: balsam fir subtype (FDn43b1), alder swamps (FPn73a), poor black spruce swamps (APn81a), rich tamarack-alder swamps (FPn82a), willow-dogwood shrub swamps (WMn82a), and low shrub poor fens (APn91a) are all considered "widespread and secure" and are also on the Alternative B: Smaller Federal Parcel.

Scientific and Natural Areas

There are no SNAs located on or near the Alternative B: Smaller Federal Parcel lands.

Culturally Important Plants

Similar to the federal lands, natural resources culturally important to the Bands are discussed in Section 4.2.9.

Management Areas

The Alternative B: Smaller Federal Parcel lands are currently managed under the General Forest – Longer Rotation Management Area (93 percent) and the General Forest Management Area (7 percent; see Table 4.3.4-7) (USFS 2011j). Section 4.3.1 describes the management areas in detail.

Table 4.3.4-7 Management Areas for the Land Exchange Alternative B Lands

Category	Land Exchange Alternative B Lands Acres	Land Exchange Alternative B Lands Percent
General Forest	355.3	7
General Forest – Longer Rotation	4,397.3	93
Potential/Candidate Research Natural Areas	0.0	0
Riparian Areas	0.0	0

Source: USFS 2011j.

Ecological Land Types

The Alternative B: Smaller Federal Parcel lands contain the same five categories of ELTs as the federal lands. Section 4.3.4.1.1 provides a discussion of these ELT types.

Management Indicator Habitats

The Alternative B: Smaller Federal Parcel consists mostly of lowland black spruce-tamarack forest (MIH 9; 2,078.7 acres), with lesser amounts of upland conifer forest (MIH 5; 1,138.8 acres) and upland forest (MIH 1; 954.2 acres) (see Table 4.3.4-8 and Figure 4.2.4-3) (USFS

2010b). Aquatic habitats (MIH 14) are not tracked on the Alternative B: Smaller Federal Parcel lands, though several open water features are present. Though not considered an MIH type, the smaller federal parcel contains 385.4 acres of lowland shrub habitat and 115.4 acres of lowland emergent habitat, as well. The remaining acres present on the federal lands have no corresponding MIH classification.

The Alternative B: Smaller Federal Parcel consists of mostly mature (2,574.7 acres) forest stands, with smaller amounts of immature (1,325.9 acres) stands and young (271.1 acres) stands (see Table 4.3.4-8). There are currently no patches of mature upland forest over 300 acres on the Alternative B: Smaller Federal lands (USFS 2012c). However, since smaller patches will grow over time into larger contiguous patches, the USFS predicts that in 2020, there would be one patch (707.8 acres) over 300 acres on the Alternative B: Smaller Federal lands (USFS 2012d).

Table 4.3.4-8 MIH Types and Age Classes (Acres) for the Land Exchange Alternative B Lands

MIH Type	Total of Land Exchange Alternative B Parcel Lands
MIH 1	954.2
MIH 5	1,138.8
MIH 9	2,078.7
MIH 14	0.0
Lowland Shrub	385.4
Lowland Emergent	115.4
Upland Grass	0.0
Age Class	
Young	271.1
Immature	1,325.9
Mature	2,574.7

Source: USFS 2010b; USFS 2011i.

Landscape Ecosystems

The Alternative B: Smaller Federal Parcel lands are located within two landscape ecosystem types. The Jack Pine-Black Spruce landscape ecosystem occupies 2,395.1 acres of the smaller federal parcel lands (represents less than 0.01 percent of Jack Pine-Black Spruce landscape ecosystem), while the Lowland Conifer landscape ecosystem occupies 2,349.1 acres (represents less than 0.01 percent of Lowland Conifer landscape ecosystem) (see Table 4.3.4-9).

Table 4.3.4-9 Landscape Ecosystem Types (Acres) on the Land Exchange Alternative B Lands and Tract 1 Lands[1]

Landscape Ecosystem Type	Alternative B: Smaller Federal Parcel Lands[2]	Tract 1 - Hay Lake
Dry-Mesic Red and White Pine	0.0	589.2
Mesic Red and White Pine	0.0	528.0
Jack Pine-Black Spruce	2,395.1	983.5
Lowland Conifer	2,349.1	2,835.3
Mesic Birch-Aspen-Spruce-Fir	0.0	0.9
Lowland Hardwood	0.0	0.0
Sugar Maple	0.0	0.0

Source: USFS 2011g.

[1] Total acres may be more or less than presented elsewhere due to rounding or GIS layers used.
[2] Data may not have complete coverage of parcel.

Invasive Non-native Plants

The Alternative B: Smaller Federal Parcel lands contain similar invasive non-native species as those that are part of the Land Exchange Proposed Action, since they occupy a smaller portion of the federal lands.

Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

The Alternative B: Smaller Federal Parcel contains the same threatened and endangered species as the federal lands since it occupies the same general area, and the ETSC species located on the federal lands are also located within the boundary of the smaller federal parcel. Section 4.3.4.1.1 provides the list of species that occur on the Alternative B: Smaller Federal Parcel lands.

Regional Foresters Sensitive Species

The RFSS plants located on the smaller federal parcel are the same as those located on the federal lands and Mine Site. Sections 4.2.4.2.3 and 4.3.4.1.1 provide a list and discussion of these species.

4.3.4.2 Non-federal Lands

4.3.4.2.1 Cover Types

The non-federal lands portion of the Land Exchange Proposed Action includes five different private tracts of land that total up to 7,075.0 acres. These lands, which include forest and wetland habitat, are located throughout the Superior National Forest in St. Louis, Lake, and Cook counties.

4.3.4.2.2 Habitat Types

The MDNR GAP land cover types of the combined non-federal lands consist of mostly lowland coniferous forests, shrublands, and upland deciduous forests (see Table 4.3.4-10).

Table 4.3.4-10 Non-federal Lands Cover Types

Cover Types	Total Acres	Percent of Area
Lowland coniferous forest[1]	2,920.5	41
Shrubland	1,845.0	26
Upland deciduous forest[4]	1,232.9	17
Upland coniferous forest[3]	699.4	10
Aquatic environments	266.6	4
Upland conifer-deciduous mixed forest[5]	50.4	1
Cropland/grassland	31.7	<1
Lowland deciduous forest[2]	28.6	<1
Disturbed	0.0	0
Total	**7,075.0**[(6)]	**99**[(7)]

Source: MDNR 2006b.

[1] Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
[2] Includes black ash forest cover types.
[3] Includes pine and spruce/fir forest cover types.
[4] Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
[5] Includes all mixed coniferous-deciduous forest cover types.
[6] Total acres may be more or less than presented due to rounding.
[7] Percent totals less than 100 percent due to rounding.

Management Areas

The non-federal lands currently do not have any management area designations, as they are not managed by the federal government. Section 4.3.1 describes the management areas in detail.

Management Indicator Habitats

MIH types and age classes were determined and mapped for the non-federal lands using several data sources, including field survey maps, aerial maps, surrounding federal MIH data, topographic maps, and USFS review. This analysis limited the MIH types to those mentioned above in Section 4.2.4.2.3, due to risk of misidentification of further subcategories of forests. Lowland shrub habitat, while not an MIH type, was also considered due to its importance to several wildlife species such as moose (Greenlee, USFS, Pers. Comm., October 26, 2011). Additionally, lowland emergent wetlands and upland grass types were included. The non-federal lands are dominated by lowland black spruce-tamarack forest (MIH 9; 3,308.5 acres) and upland forest (MIH 1; 2,694.5 acres), with lesser amounts of aquatic habitats (MIH 14; 226.7 acres) and upland conifer forest (MIH 5; 79.9 acres) (see Table 4.3.4-3). Though not considered MIH types, the non-federal lands also contain 385.7 acres of lowland emergent wetlands, 332.2 acres of lowland shrub habitat, and 43.3 acres of upland grassland.

Of forested plant communities on the non-federal lands, immature forest stands (3,539.7 acres) are most abundant, with lesser amounts of mature (1,824.6 acres) and young (778.2 acres) forest types.

Landscape Ecosystems

The non-federal lands are located within seven landscape ecosystem types, including Jack Pine-Black Spruce, Lowland Conifer, Mesic Red and White Pine, Dry-Mesic Red and White Pine, Lowland Hardwood, Mesic Birch-Aspen-Spruce-Fir, and Sugar Maple (see Table 4.3.4-4). All landscape ecosystem types on each tract represent less than 0.01 percent of that landscape ecosystem type within the Northern Superior Uplands Section.

4.3.4.2.3 Invasive Non-native Plants

The non-federal lands contain similar invasive non-native species as the federal lands, although there are also different species. The subsections on each tract below provide more detailed discussions of these species.

4.3.4.2.4 Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

The non-federal lands contain two state-listed ETSC plant species according to the MDNR NHIS, including *Woodsia scopulina* and *Saxifraga paniculata*. Both of these species are located on the Tract 5 – McFarland Lake lands. No field investigations have occurred on the non-federal lands. Additional information about these two species is presented in the discussion of Tract 5 below. Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013. The FEIS will consider any new listings, or changes in the previous listings, associated with the updated list.

Regional Foresters Sensitive Species

The non-federal lands are located outside the current boundaries of the Superior National Forest; however, following the Land Exchange Proposed Action, some or all of the non-federal lands could become National Forest System lands. The USFS currently manages 58 vascular and non-vascular plant species that are listed as RFSSs in the Superior National Forest (see Table 4.2.4-5). Detailed RFSS plant surveys have not been conducted on the private non-federal lands, but information from other field surveys and habitat preferences (MIH types) for each species is used to determine potential habitat or occurrences of RFSS plant species on the non-federal lands.

Saxifraga paniculata is located on the non-federal lands and it is also an RFSS plant. The non-federal lands consist of mostly lowland black spruce-tamarack forests (MIH 9), which means there is generally more habitat available for the 13 RFSS species listed under that category to occur on the non-federal lands, if suitable habitat exists for them (see Table 4.2.4-5). One of these species is *Pyrola minor*, which is a state-listed ETSC plant species that occurs on the federal lands. The non-federal lands also contain a large portion of upland forest (MIH 1), which means there are many acres for the 17 RFSS species listed under that category to occur on the non-federal lands as well. Three of these species are state-listed ETSC species on the federal lands and include *Botrychium pallidum*, *Botrychium rugulosum*, and *Botrychium simplex*. There is a smaller amount of aquatic habitat (MIH 14) available on the non-federal lands, so there is less available habitat for the eight RFSS species listed under that category. One of these species is *Caltha natans*, which is a state-listed ETSC plant species and occurs on the federal lands. There is very little upland conifer forest habitat (MIH 5) available, meaning there are likely fewer occurrences of some species in the MIH 5 category. There are also 385.7 acres of lowland emergent wetland habitat on the non-federal lands, so the five RFSS plant species listed under this category may occur on the non-federal lands as well. This includes *Eleocharis nitida* and *Juncus stygius*, which are both state-listed ETSC plant species that occur on the federal lands.

4.3.4.2.5 Tract 1 – Hay Lake Lands

The largest non-federal tract is Tract 1, which is 4,926.3 acres in size. It is located in the Laurentian Ranger District (ERM 2011a). The parcel has moderate topographic relief and slopes toward the east-northeast, in the direction of the Pike River (AECOM 2011b).

Cover Types

Tract 1 is located in the Nashwauk Uplands subsection of the Laurentian Mixed Forest Province ecoregion (MDNR 2006a). See Section 4.2.4.1 for a description of the Nashwauk Uplands subsection.

Habitat Types

The primary MDNR GAP land cover types for Tract 1 include shrublands and lowland conifer forests (see Table 4.3.4-11). There are fewer acres of cropland/grassland and lowland deciduous forests. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-11 Tract 1 – Hay Lake Lands Cover Types

Cover Types	Total Acres	Percent of Area
Shrubland	1,664.6	34
Lowland coniferous forest[1]	1,524.2	31
Upland deciduous forest[4]	999.9	20
Upland coniferous forest[3]	437.3	9
Aquatic environments	251.1	5
Cropland/grassland	31.7	1
Lowland deciduous forest[2]	17.4	<1
Disturbed	0.0	0
Upland conifer-deciduous mixed forest[5]	0.0	0
Total	**4,926.3(6)**	**100**

Source: MDNR 2006b.

1 Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
2 Includes black ash forest cover types.
3 Includes pine and spruce/fir forest cover types.
4 Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
5 Includes all mixed coniferous-deciduous forest cover types.
6 Total acres may be more or less than presented due to rounding.

Plant Community Surveys

Much of Tract 1 (59 percent) is wetlands (AECOM 2011b). All of the 33 wetlands evaluated are rated high for wetland functions and values, according to MnRAM 3.2 (AECOM 2009b; AECOM 2011b). Most of the wetland habitats consist of scrub-shrub habitat dominated by speckled alder (*Alnus incana* ssp. *rugosa*), beaked hazel (*Corylus cornuta*), willows (*Salix* spp.), and bog birch (*Betula pumila*); pole and immature size coniferous forests dominated by black spruce, northern white cedar, and tamarack; and emergent/bog wetlands dominated by sedges (*Carex* spp.), cattail (*Typha* spp.), bog-Labrador tea, and leatherleaf (AECOM 2011b). There are several open water features on the parcel as well, including Hay Lake, Little Rice Lake, and the Pike River. See Section 4.3.3 for a more detailed description of wetland habitat types present.

Uplands consist of pole and immature deciduous forests, dominated by trembling aspen and paper birch, with midstories of sapling mountain maple (*Acer spicatum*), trembling aspen, paper birch, balsam fir, and black spruce. Shrub species include beaked hazel, with scattered speckled alder, twining honeysuckle (*Lonicera dioica*), and prickly rose (*Rosa acicularis*) (AECOM

2011b). The ground cover includes sedges, wild strawberry (*Fragaria virginiana*), bunchberry (*Cornus canadensis*), wild raspberry (*Rubus* spp.), horsetail (*Equisetum* spp.), clintonia (*Clintonia borealis*), twinflower (*Linnaea borealis*), large-leaved aster (*Aster macrophyllus*), rose twisted stalk (*Streptopus roseus*), skunk currant (*Ribes glandulosum*), spotted coralroot (*Corallorhiza maculata*), wood anemone (*Anemone quinquefolia*), tall buttercup (*Ranunculus acris*), bracken fern (*Pteridium aquilinum*), and interrupted fern (*Osmunda claytoniana*) (AECOM 2011b).

Disturbed areas and grasslands are primarily associated with abandoned logging roads, landings, and powerline ROWs and are dominated by forbs and grasses, including cow parsnip (*Heracleum lanatum*), white clover (*Trifolium repens*), ox-eye daisy (*Leucanthemum vulgare*), tall buttercup, common sow thistle (*Sonchus arvensis* ssp. *uliginosus*), orange hawkweed (*Hieracium aurantiacum*), American vetch (*Vicia americana*), wild strawberry, wild raspberry, and common tansy (AECOM 2011b).

Almost all forest stands on Tract 1 consist of trees that are 8 to 11 inches dbh, having been harvested in relatively recent years (AECOM 2011b). Upland deciduous trees range up to 16 inches dbh, while upland coniferous trees range up to 10 inches dbh. Upland forest stands in the northern, central, and southwestern portions of the parcel are pole to immature, while upland stands in the western portion of the parcel are sapling to young pole. The majority of the trees on the parcel are estimated to be 60 years or younger (AECOM 2011b).

Minnesota Biological Survey

There are no lands designated as MBS Sites of Biodiversity Significance on Tract 1; however, the entire parcel is located within the preliminary Pike Range and Peatlands MBS Site of Outstanding Biodiversity Significance and could potentially be the only site ranked as Outstanding in the Nashwauk Uplands subsection upon final designation by the MDNR (Wilson, MDNR, Pers. Comm., February 14, 2012; MDNR *In progress*). The preliminary site is approximately 26,000 acres in size, approximately half of which is owned or managed by the Superior National Forest. On a larger landscape level, this site is one of the largest and most contiguous high-quality areas within the subsection or LTA scale. The Pike Mountain cRNA and Loka Lake cRNA abut Tract 1 and are included within this preliminary MBS site.

Native plant community designations are not available for Tract 1. However, native plant communities of the preliminary Pike Range and Peatlands MBS site are generally of high quality and include representative examples of almost all communities known to exist in the subsection (Holmstrom, MDNR, Pers. Comm., April 9, 2012; MDNR *In Progress*).

Scientific and Natural Areas

There are no lands designated as SNAs on Tract 1; however, state, federal, and private land near the southwest corner of the parcel has been identified as a “potential” SNA site (Wilson, MDNR, Pers. Comm., February 14, 2012). The federal lands bordering the southwest corner of the parcel are designated as the Pike Mountain cRNA, and this designation could be extended onto Tract 1 due to high-quality mature hardwood forest stands, rare cliff and rock outcrop features, and low human disturbance.

Culturally Important Plants

Wild rice has been observed on Tract 1, including on Hay Lake, Little Rice Lake, and the Pike River (Barr 2011a and 2012a). Small populations of wild rice have been found on Hay Lake with less than 10 percent coverage, while Little Rice Lake has several locations with greater than 75 percent coverage of wild rice and continuous growth throughout the lake. Wild rice is also found along the Pike River flowing north into Little Rice Lake. Section 4.2.2 provides further discussion of wild rice on the Tract 1 lands.

As with the federal lands, natural resources culturally important to the Bands are discussed in Section 4.2.9.

Management Areas

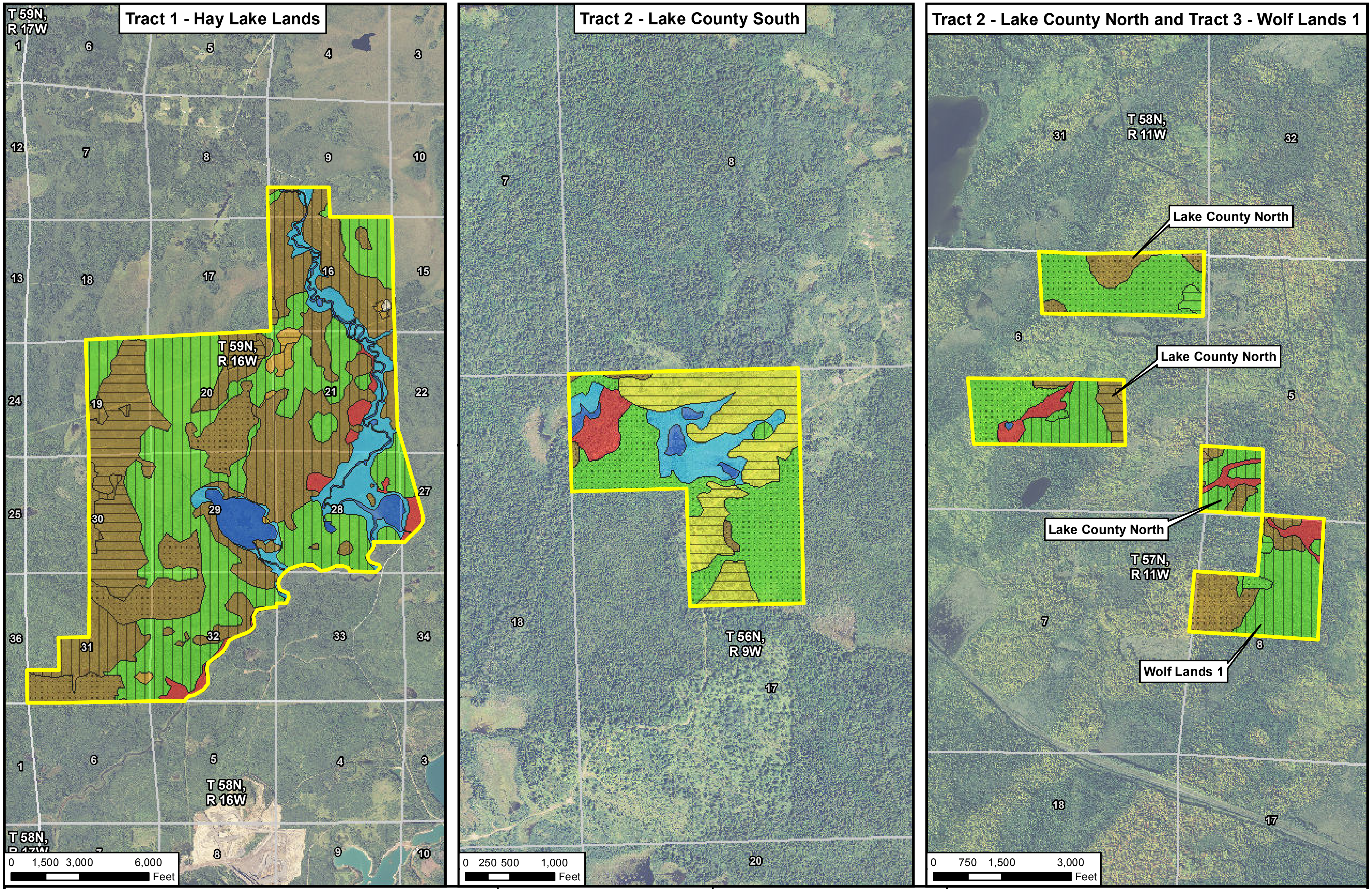
The non-federal lands currently do not have any management area designations, as they are not managed by the federal government. Section 4.3.1 describes the management areas in detail.

Ecological Land Types

Tract 1 contains six categories of ELTs, including Lowland Loamy Moist (ELT 1), Lowland Loamy Wet (ELT 2), Lowland Organic Acid to Neutral (ELT 6), Upland Deep Loamy Over Sandy Dry (ELT 11), Upland Shallow Loamy Dry (ELT 16), and Upland Extremely Shallow Loamy Droughty (ELT 18). The majority of Tract 1 is included within the Pike-Sandy River Sand Plain LTA and the remainder is within the Mesabi Range LTA.

Management Indicator Habitats

Table 4.3.4-3 provides a summary of the MIH types and age classes present on the Tract 1 lands (see Figure 4.3.4-1) (USFS 2010b). Though not considered MIHs, Tract 1 also contains 365.0 acres of lowland emergent wetlands and 113.3 acres of lowland shrub habitat.



Non-federal Lands
Section Boundary
1 Section Label

Management Indicator Habitat
1 - Upland forest
5 - Upland conifer forest
9 - Lowland black spruce-tamarack forest
14 - Aquatic habitats
Other - Lowland Emergent
Other - Lowland Shrub
Other - Upland Grass

Age Classes
N/A
Young
Immature
Mature

Figure 4.3.4-1
Management Indicator Habitat Types and Age Classes
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Landscape Ecosystems

Table 4.3.4-4 provides a summary of the landscape ecosystem types present on Tract 1.

The Lowland Conifer landscape ecosystem occupies 2,835.3 acres of Tract 1. The Jack Pine-Black Spruce landscape ecosystem occupies 983.5 acres of Tract 1. The Mesic Red and White Pine landscape ecosystem occupies 528.0 acres of Tract 1. See the previous federal lands section above (see Section 4.3.4.1.1) for a description of these landscape ecosystem types.

The Dry-Mesic Red and White Pine landscape ecosystem occupies 589.2 acres of Tract 1. It comprises the following species: aspen, paper birch, red pine, white pine, jack pine, balsam fir, black spruce, white spruce, bigtooth aspen, and red maple (USFS 2004a). On drier sites, jack pine, red pine, and black spruce dominate, while the other species dominate on mesic sites. Succession after fire disturbances is similar to the Mesic Red and White Pine landscape ecosystem described above.

The Mesic Birch-Aspen-Spruce-Fir landscape ecosystem occupies less than 1 acre of Tract 1. It is dominated by mixed stands of aspen, paper birch, balsam fir, and white spruce, though northern white cedar, bigtooth aspen, and red maple are sometimes also present (USFS 2004a). Fire disturbances usually result in aspen/birch-dominated stand regeneration, while wind disturbances usually result in balsam fir and white spruce forests. The climax tree stage consists of a multi-aged white spruce and balsam fir forest with components of paper birch and northern white cedar.

Invasive Non-native Plants

According to the Superior National Forest invasive plant geodatabase, Tract 1 contains two known occurrences of common tansy (USFS 2010a). Common tansy can spread vegetatively or reproductively via tufted seeds that are dispersed by wind or water (MDNR 2011b). It is widespread and common along roadsides or abandoned farmyards in northern Minnesota. Common tansy was observed during field investigations along trails near recently installed gates and disturbed earthen berms. Additionally, AECOM (2011b) identified common tansy, orange hawkweed, common sow thistle, and ox-eye daisy within disturbed logging roads, landings, and power line rights-of-way. Orange hawkweed primarily spreads vegetatively through runners, rhizomes, and root buds, but can also spread reproductively (MDNR 2011b). It colonizes newly disturbed sites and early successional habitats quickly. Ox-eye daisy spreads vegetatively and reproductively, but often cannot invade intact grasslands (MDNR 2011b). It can, however, invade newly disturbed areas quickly. Common sow thistle spreads vegetatively and through wind-borne seeds or root cuttings. It colonizes fields, woodlands, and roadsides, but generally is not a threat to intact native plant communities (MDNR 2011b).

Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

Based on a review of the MDNR NHIS and field investigations, no federally or state-listed ETSC plant species are known to occur on Tract 1 (AECOM 2011b; MDNR 2013a).

Regional Foresters Sensitive Species

There is more upland forest (MIH 1) and lowland black spruce-tamarack forest (MIH 9) habitat available than any other type, so the RFSS plants associated with these types would be most likely to occur on Tract 1. There is a moderate amount of aquatic habitat (MIH 14) and a smaller amount of upland conifer forest (MIH 5), so RFSS plants associated with these would be less likely to occur.

4.3.4.2.6 Tract 2 – Lake County Lands

Tract 2 is 381.9 acres in size and includes several subparcels ranging in size from 44 to 117 acres on the Laurentian Ranger District southeast of Seven Beaver Lake that are mostly surrounded by the Superior National Forest (ERM 2011a). Tract 2 is divided into north (Lake County North) and south (Lake County South) parcels, with the north parcel being the larger of the two. Lake County North consists of three subparcels, which are made up of mostly wetland habitats; the majority of Lake County South lands consist of wetland habitats as well (AECOM 2011c).

Lake County North

Cover Types

The Tract 2 is located in the Laurentian Mixed Forest Province ecoregion. Lake County North is located in the Laurentian Uplands subsection of the Laurentian Mixed Forest Province ecoregion (MDNR 2006a). Section 4.2.4.1 provides a description of the Laurentian Uplands subsection.

Habitat Types

The primary MDNR GAP land cover type on the Tract 2 – Lake County North lands is lowland coniferous forest (see Table 4.3.4-12). It contains very few acres of aquatic environments or lowland deciduous forests. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-12 Tract 2 – Lake County North Cover Types

Cover Types	Total Acres	Percent of Area
Lowland coniferous forest[1]	133.0	50
Upland conifer-deciduous mixed forest[5]	34.0	13
Upland deciduous forest[4]	34.0	13
Upland coniferous forest[3]	32.8	12
Shrubland	28.1	11
Aquatic environments	1.8	1
Lowland deciduous forest[2]	1.4	1
Cropland/grassland	0.0	0
Disturbed	0.0	0
Total	**265.1(6)**	**101(7)**

Source: MDNR 2006b.

1 Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
2 Includes black ash forest cover types.
3 Includes pine and spruce/fir forest cover types.
4 Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
5 Includes all mixed coniferous-deciduous forest cover types.
6 Total acres may be more or less than presented due to rounding.
7 Percent totals are greater than 100 percent due to rounding.

Plant Community Surveys

The primary cover types are pole coniferous forest on the wetlands and mature and pole deciduous forests on the uplands (AECOM 2011c). Wetlands are dominated by northern white cedar, black spruce, and tamarack; balsam fir is a common understory species. Lake County North also contains scrub-shrub habitats that are dominated by speckled alder and contain emergent wetlands that consist of sedges and Canada bluejoint (*Calamagrostis canadensis*). Lake County North has several open bog areas, a beaver pond, and drainages as well. See Section 4.3.3 for a more detailed description of wetland habitat types present.

Upland habitats are dominated by immature paper birch and black spruce, but recently logged areas support sapling paper birch stands or shrub habitats. The midstory is comprised of balsam fir, black spruce, and beaked hazel. Areas that have been recently logged are dominated by sapling paper birch with scattered sapling trembling aspen and pole paper birch. Beaked hazel forms a patchy shrub layer, with several grasses and forbs in the ground layer (AECOM 2011c). Older forests near logged areas contain large amounts of downed woody debris, and have a midstory dominated by dense stands of balsam fir, black spruce, and northern white cedar.

Lake County North wetland canopy trees range from 6 to 10 inches dbh, but northern white cedar up to 20 inches dbh and black spruce up to 14 inches dbh are found on the subparcels (AECOM 2011c). The north parcel also contains an immature forested wetland containing black ash (*Fraxinus nigra*) trees up to 16 inches dbh.

Minnesota Biological Survey

There are no MBS Sites of Biodiversity Significance located on the Lake County North subparcels (MDNR 2008a). However, Lake County North is located on the potential Seven Beavers MBS Site, which has not yet been finalized by the MDNR but is ranked as having Moderate to High Biodiversity Significance (MDNR 2007).

Native plant community rankings for Lake County North are not available.

Scientific and Natural Areas

There are no lands designated as SNAs on Tract 2 – Lake County North.

Culturally Important Plants

A discussion of natural resources culturally important to the Bands is presented in Section 4.2.9.

Management Areas

The non-federal lands currently do not have any management area designations, as they are not managed by the federal government. Section 4.3.1 describes the management areas in detail.

Ecological Land Types

The Lake County North parcel contains five categories of ELTs, including Lowland Loamy Moist (ELT 1), Lowland Loamy Wet (ELT 2), Lowland Organic Acid to Neutral (ELT 6), Upland Deep Loamy Dry Course (ELT 13), and Upland Deep Medium Loamy Dry (ELT 14). All three subparcels of the Lake County North parcel are included in the Greenwood Lake Till Plain LTA.

Management Indicator Habitats

Table 4.3.4-3 provides a summary of the MIH types and age classes present on Tract 2 (see Figure 4.3.4-1) (USFS 2010b). Though not considered an MIH, the Lake County North parcel also contains 20.6 acres of lowland shrub habitat.

Landscape Ecosystems

Table 4.3.4-4 provides a summary of the landscape ecosystem types present on Tract 2.

The Lowland Conifer landscape ecosystem occupies 227.6 acres of Lake County North. The Mesic Birch-Aspen-Spruce-Fir landscape ecosystem occupies 37.4 acres of the Lake County North lands. See the federal or non-federal lands sections above for a description of these landscape ecosystem types.

Lake County South

Cover Types

The Lake County South parcel is located in the North Shore Highlands subsection of the Laurentian Mixed Forest Province ecoregion (MDNR 2006a). Most of the vegetative cover types in the North Shore Highlands subsection grow in thin, rocky red and brown glacial till (MDNR 2011g). Upper Precambrian bedrock is often exposed at the surface. The most common soils are loams and sandy loams, which support forest communities of white pine, red pine, jack pine, balsam fir, white spruce, and aspen-birch.

Habitat Types

The primary MDNR GAP land cover types on Tract 2 – Lake County South are lowland coniferous forest and upland coniferous forest (see Table 4.3.4-13). There are fewer acres of aquatic environments. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-13 Tract 2 – Lake County South Cover Types

Cover Types	**Total Acres**	**Percent of Area**
Lowland coniferous forest[1]	53.1	45
Upland coniferous forest[3]	38.8	33
Shrubland	10.8	9
Upland deciduous forest[4]	10.1	9
Aquatic environments	4.0	3
Cropland/grassland	0.0	0
Disturbed	0.0	0
Lowland deciduous forest[2]	0.0	0
Upland conifer-deciduous mixed forest[5]	0.0	0
Total	**116.8[(6)]**	**99[(7)]**

Source: MDNR 2006b.

1 Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
2 Includes black ash forest cover types.
3 Includes pine and spruce/fir forest cover types.
4 Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
5 Includes all mixed coniferous-deciduous forest cover types.
6 Total acres may be more or less than presented due to rounding.
7 Percent totals are less than 100 percent due to rounding.

Plant Community Surveys

The primary cover types on Lake County South are similar to Lake County North, with wetlands dominated by pole coniferous forest and upland areas dominated by immature paper birch, black spruce, jack pine, eastern white pine, and northern white cedar. There are five beaver ponds, surrounded by emergent wetland species, including sedges, narrow-leaved cattail (*Typha angustifolia*), woolgrass (*Scirpus cyperinus*), and Canada bluejoint (AECOM 2011c). Please see Section 4.3.3 for a more detailed description of wetland habitat types present.

Most upland areas on Lake County South have been recently clear-cut, except the southwest portion of the parcel. This area has been partially thinned, leaving areas where immature paper birch, black spruce, jack pine, eastern white pine, and northern white cedar trees remain ranging from 12 to 24 inches dbh (AECOM 2011c). The midstory includes balsam fir and beaked hazel. Grasses and forbs dominate the ground layer.

Minnesota Biological Survey

The entire 116.9 acres of the Lake County South parcel are located within the Marble Beaver River MBS Site of High Biodiversity Significance (MDNR 2008a). This site is located within the North Shore Highlands subsection.

Native plant communities have been identified for the Lake County South parcel. It contains one vegetation community, sugar maple (*Acer saccharum*) forest (MHn45c; 8 percent of parcel), which has been characterized as "vulnerable" in the state (MDNR 2008b). Black ash-conifer swamps (WFn64a; less than 1 percent of parcel) and lowland white cedar forests (WFn53a;

29 percent of parcel) are also present on the parcel and are ranked as "apparently secure" in Minnesota based on abundance, distribution, trends, and threats (MDNR 2008b).

Scientific and Natural Areas

There are no lands designated as SNAs on Tract 2 – Lake County South.

Culturally Important Plants

A discussion of natural resources culturally important to the Bands is presented in Section 4.2.9.

Management Areas

The non-federal lands currently do not have any management area designations, as they are not managed by the federal government. Section 4.3.1 describes the management areas in detail.

Ecological Land Types

Lake County South contains two categories of ELTs, including Lowland Loamy Wet (ELT 2), and Upland Deep Medium Loamy Dry (ELT 14). The entire Lake County South parcel is included in the Tettegouche Till Plain LTA.

Management Indicator Habitats

Table 4.3.4-3 provides a summary of the MIH types and age classes present on Tract 2 lands (see Figure 4.3.4-1) (USFS 2010b). Though not considered MIHs, the Lake County South parcel also contains 43.3 acres of upland grassland, 15.6 acres of lowland emergent wetland, and 6.4 acres of lowland shrub habitat.

Landscape Ecosystems

Table 4.3.4-4 provides a summary of the landscape ecosystem types present on Tract 2 lands.

The Lowland Conifer landscape ecosystem occupies 80.2 acres of Lake County South. See the federal or non-federal lands sections above for a description of this landscape ecosystem type.

The Sugar Maple landscape ecosystem occupies 36.7 acres of Lake County South. It generally is located in a band within 15 miles of Lake Superior and is dominated by sugar maple with yellow birch, although northern white cedar, basswood, red maple, and northern red oak may also be present (USFS 2004a). Fire and wind disturbances are very infrequent, leaving individual tree mortality as the principal disturbance.

Invasive Non-native Plants

According to the Superior National Forest invasive plant geodatabase, there are no known occurrences of invasive species on the Tract 2 lands (USFS 2010a). Field studies indicate that one area of Lake County North and several areas in the Lake County South parcel contain occurrences of thistles and ox-eye daisy in a recently clear-cut habitat (AECOM 2011c).

Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

Based on a review of the MDNR NHIS and field investigations, no federally or state-listed ETSC plant species are known to occur on the Tract 2 lands.

Regional Foresters Sensitive Species

There is more lowland black spruce-tamarack forest (MIH 9) and upland forest (MIH 1) habitat available than any other type, so the RFSS plants associated with these types would be most likely to occur on the Tract 2 lands. There is a very small amount of upland conifer forest (MIH 5) or aquatic habitat (MIH 14) so RFSS plants associated with these would be less likely to occur.

4.3.4.2.7 Tract 3 – Wolf Lands

Tract 3 is 1,575.8 acres in size and is located on the Laurentian and Tofte Ranger Districts. Tract 3 includes four separate parcels ranging in size from 126 to 768 acres, referred to here as Wolf Lands 1 through 4, which would complement Superior National Forest ownership by reducing federal exterior boundaries and eliminating several private ownership patterns (ERM 2011a). Tract 3 lands are located east to southeast of the federal lands and Wolf Land 1 is adjacent to Tract 2 – Lake County North.

Cover Types

Tract 3 lands are located in the Laurentian Uplands subsection of the Laurentian Mixed Forest Province ecoregion (MDNR 2006a). Section 4.2.4.1 provides a description of the Laurentian Uplands subsection.

Wolf Lands 1

Habitat Types

The primary MDNR GAP land cover type on the Tract 3 – Wolf Lands 1 parcel is lowland coniferous forest (see Table 4.3.4-14). It has fewer acres of shrubland and mixed upland forests. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-14 Tract 3 – Wolf Lands 1 Cover Types

Cover Types	Total Acres	Percent of Area
Lowland coniferous forest[1]	74.8	59
Upland deciduous forest[4]	27.2	22
Upland coniferous forest[3]	13.3	11
Shrubland	6.9	5
Upland conifer-deciduous mixed forest[5]	3.7	3
Aquatic environments	0.0	0
Cropland/grassland	0.0	0
Disturbed	0.0	0
Lowland deciduous forest[2]	0.0	0
Total	**125.9[(6)]**	**100**

Source: MDNR 2006b.

1 Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
2 Includes black ash forest cover types.
3 Includes pine and spruce/fir forest cover types.
4 Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
5 Includes all mixed coniferous-deciduous forest cover types.
6 Total acres may be more or less than presented due to rounding.

Plant Community Surveys

The primary cover types on Wolf Lands 1 are pole coniferous forest on the wetlands, and immature mixed forest on the uplands (AECOM 2011c). The wetlands contain equal amounts of open, bog-like communities of sapling black spruce, northern white cedar, and tamarack, and denser pole forests of these same species, in addition to balsam fir. Please see Section 4.3.3 for a more detailed description of wetland habitat types present. Uplands are dominated by deciduous and coniferous immature forest with paper birch, trembling aspen, and balsam fir. Shrub species include beaked hazel and red-osier dogwood (*Cornus stolonifera*) (AECOM 2011c).

The majority of the Wolf Lands 1 consists of wetland pole coniferous trees from 6 to 10 inches dbh, while the mature mixed forest trees on uplands are 12 inches dbh or greater (AECOM 2011c).

Minnesota Biological Survey

Wolf Lands 1 is located on a potential MBS Site of Moderate to High Biodiversity Significance that has not yet been finalized by the MDNR (MDNR 2007).

Native plant community rankings for Tract 3 are not available.

Scientific and Natural Areas

There are no SNAs located on the Tract 3 parcels.

Culturally Important Plants

A discussion of natural resources culturally important to the Bands is presented in Section 4.2.9.

Management Areas

The non-federal lands currently do not have any management area designations, as they are not managed by the federal government. Section 4.3.1 describes the management areas in detail.

Ecological Land Types

Wolf Lands 1 contains three categories of ELTs, including Lowland Loamy Wet (ELT 2), Lowland Organic Acid to Neutral (ELT 6), and Upland Deep Medium Loamy Dry (ELT 14). The entire Wolf Lands 1 parcel is included in the Greenwood Lake Till Plain LTA.

Management Indicator Habitats

Table 4.3.4-3 provides a summary of the MIH types and age classes present on Tract 3 lands (see Figure 4.3.4-1) (USFS 2010b). Though not considered an MIH, the Wolf Lands 1 parcel also contains 9.7 acres of lowland shrub habitat.

Landscape Ecosystems

Table 4.3.4-4 provides a summary of the landscape ecosystem types present on Tract 3 lands.

The Lowland Conifer landscape ecosystem occupies 84.3 acres of the Wolf Lands 1 parcel. The Mesic Birch-Aspen-Spruce-Fir landscape ecosystem occupies 41.5 acres of the Wolf Lands 1 parcel. See the federal or non-federal lands sections above for a description of these landscape ecosystem types.

Wolf Lands 2

Habitat Types

The primary MDNR GAP land cover type on the Tract 3 – Wolf Lands 2 parcel is lowland coniferous forest (see Table 4.3.4-15). The least abundant cover types include lowland deciduous forest and mixed upland forests. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-15 Tract 3 – Wolf Lands 2 Cover Types

Cover Types	Total Acres	Percent of Area
Lowland coniferous forest[1]	586.2	76
Upland coniferous forest[3]	86.5	11
Shrubland	54.0	7
Upland deciduous forest[4]	29.9	4
Lowland deciduous forest[2]	5.8	1
Upland conifer-deciduous mixed forest[5]	5.5	1
Aquatic environments	0.0	0
Cropland/grassland	0.0	0
Disturbed	0.0	0
Total	**767.9**	**100**

Source: MDNR 2006b.

[1] Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
[2] Includes black ash forest cover types.
[3] Includes pine and spruce/fir forest cover types.
[4] Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
[5] Includes all mixed coniferous-deciduous forest cover types.

Plant Community Surveys

Wolf Lands 2 consists of mostly wetland habitats dominated by either pole black spruce, northern white cedar, or a mix of the two (AECOM 2011c). Midstory cover types in these forests consist of sapling black spruce, northern white cedar, or balsam fir. Scrub-shrub habitats of speckled alder dominate drainage areas. Some bogs, emergent wetlands, and beaver ponds exist on the parcel. Section 4.3.3 presents a more detailed description of wetland habitat types present.

Upland habitats consist of pole or immature mixed coniferous-deciduous forest types, including paper birch, trembling aspen, and black spruce, with a midstory of balsam fir and shrub layer of beaked hazel (AECOM 2011c).

The majority of Wolf Lands 2 consists of wetland coniferous forests with canopy trees ranging from 4 to 8 inches dbh. An upland area in the northern portion of the parcel was logged in the past, and so the canopy cover in this area consists of immature coniferous and deciduous trees ranging from 5 to 12 inches dbh (AECOM 2011c).

Minnesota Biological Survey

The entire 767.9 acres of the Wolf Lands 2 parcel is located within the East Greenwood MBS Site of Moderate Biodiversity Significance (MDNR 2007; MDNR 2008a). This site is located in the Laurentian Uplands subsection. Sites of Moderate Biodiversity Significance are sites that contain occurrences of rare species and/or moderately disturbed native plant communities or landscapes that have a strong potential for recovery.

Native plant community rankings for Tract 3 are not available.

Scientific and Natural Areas

There are no SNAs located on the Tract 3 parcels.

Culturally Important Plants

A discussion of natural resources culturally important to the Bands is presented in Section 4.2.9.

Management Areas

The non-federal lands currently do not have any management area designations, as they are not managed by the federal government. Section 4.3.1 describes the management areas in detail.

Ecological Land Types

Wolf Lands 2 contains four categories of ELTs, including Lowland Loamy Moist (ELT 1), Lowland Loamy Wet (ELT 2), Upland Deep Loamy Dry Course (ELT 13), and Upland Deep Medium Loamy Dry (ELT 14). The entire Wolf Lands 2 parcel is included in the Greenwood Lake Till Plain LTA.

Management Indicator Habitats

Table 4.3.4-3 provides a summary of the MIH types and age classes present on Tract 3 lands (see Figure 4.3.4-2) (USFS 2010b). Though not considered an MIH, the Wolf Lands 2 parcel also contains 76 acres of lowland shrub habitat. The Wolf Lands 2 parcel contains one patch of mature forest over 300 acres (598.2 acres), which is an important habitat type. However, this is different from the USFS Patch layer discussed in Section 4.3.4.1.1.

Landscape Ecosystems

Table 4.3.4-4 provides a summary of the landscape ecosystem types present on Tract 3 lands.

The Lowland Conifer landscape ecosystem occupies 653.2 acres of the Wolf Lands 2 parcel. The Mesic Birch-Aspen-Spruce-Fir landscape ecosystem occupies 114.7 acres of the Wolf Lands 2 parcel. Previous federal or non-federal land sections present descriptions of these landscape ecosystem types.

Wolf Lands 3

Habitat Types

The primary MDNR GAP land cover type on the Tract 3 – Wolf Lands 3 parcel is lowland coniferous forest (see Table 4.3.4-16). The upland deciduous forest and mixed upland forest types are least represented. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

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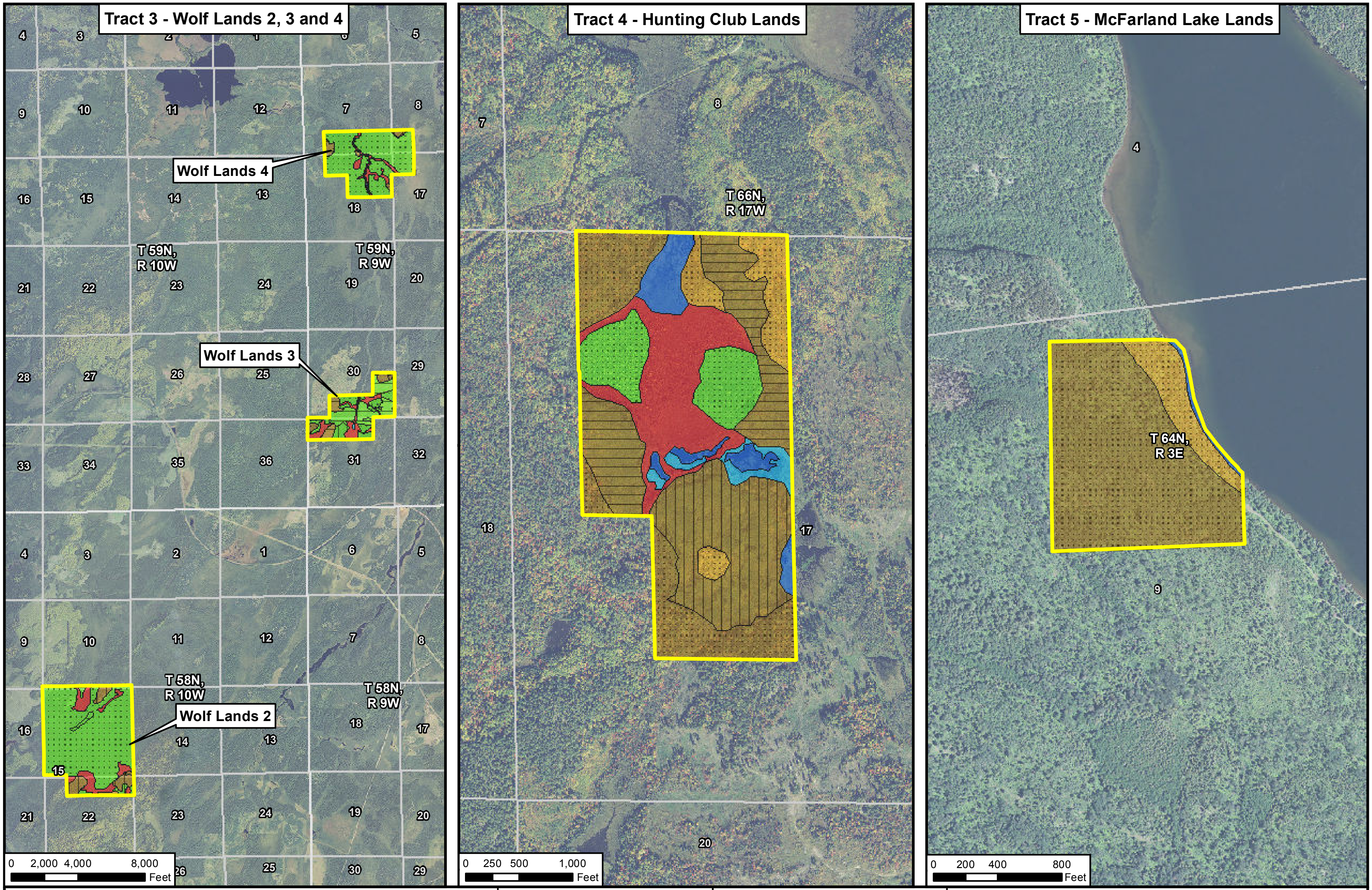

Non-federal Lands

Section Boundary

1 Section Label

Management Indicator Habitat

1 - Upland forest

5 - Upland conifer forest

9 - Lowland black spruce-tamarack forest

14 - Aquatic habitats

Other - Lowland Emergent

Other - Lowland Shrub

Other - Upland Grass

Age Classes

N/A

Young

Immature

Mature

US Army Corps of Engineers
St Paul District

N W E S

Figure 4.3.4-2

Management Indicator Habitat Types and Age Classes

Tracts 3, 4 and 5

NorthMet Mining Project and Land Exchange SDEIS

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Table 4.3.4-16 Tract 3 – Wolf Lands 3 Cover Types

Cover Types	Total Acres	Percent of Area
Lowland coniferous forest[1]	183.8	66
Upland coniferous forest[3]	46.4	17
Shrubland	31.7	11
Upland deciduous forest[4]	12.4	4
Upland conifer-deciduous mixed forest[5]	3.1	1
Aquatic environments	0.0	0
Cropland/grassland	0.0	0
Disturbed	0.0	0
Lowland deciduous forest[2]	0.0	0
Total	**277.4**	**99[(6)]**

Source: MDNR 2006b.

1 Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
2 Includes black ash forest cover types.
3 Includes pine and spruce/fir forest cover types.
4 Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
5 Includes all mixed coniferous-deciduous forest cover types.
6 Percent totals less than 100 percent due to rounding.

Plant Community Surveys

The Wolf Lands 3 parcel also consists of mostly wetland habitats (AECOM 2011c). Coyote Creek runs through the parcel and is bordered by sedge meadow wetlands, consisting of sedges, narrow-leaved cattail, and Canada bluejoint. Roughly half of the parcel has been recently logged. Logged wetlands are dominated by grasses, forbs, and shrubs, including red-osier dogwood and speckled alder. Unlogged wetlands consist of pole black spruce, with tamarack and balsam fir also present. Please see Section 4.3.3 for a more detailed description of wetland habitat types.

Upland areas within the parcel have been recently logged and most of these areas have few remaining trees. Logged uplands are dominated by grasses, forbs, and beaked hazel, but some areas still support paper birch and scattered balsam fir. The upland habitat bordering the parcel consists of young and mature paper birch with scattered black spruce and northern white cedar over an understory of balsam fir (AECOM 2011c).

Wolf Lands 3 consists of pole coniferous trees in wetlands and sapling or mature mixed forest trees on uplands, which range from 0 to 4 inches dbh or 12 inches dbh or greater, respectively (AECOM 2011c). Unlogged wetland forests on the Wolf Lands 3 parcel range from 4 to 10 inches dbh. Logged upland areas still support paper birches that are up to 16 inches dbh.

Minnesota Biological Survey

Wolf Lands 3 is located on a potential MBS Site of Moderate to High Biodiversity Significance that has not yet been finalized by the MDNR (MDNR 2007).

Native plant community rankings for Tract 3 are not available.

Scientific and Natural Areas

There are no SNAs located on the Tract 3 parcels.

Culturally Important Plants

A discussion of natural resources culturally important to the Bands is presented in Section 4.2.9.

Management Areas

The non-federal lands currently do not have any management area designations, as they are not managed by the federal government. Section 4.3.1 describes the management areas in detail.

Ecological Land Types

Wolf Lands 3 contains three categories of ELTs, including Lowland Loamy Moist (ELT 1), Lowland Loamy Wet (ELT 2), and Lowland Organic Acid to Neutral (ELT 6). The entire Wolf Lands 3 parcel is included in the Greenwood Lake Till Plain LTA.

Management Indicator Habitats

Table 4.3.4-3 provides a summary of the MIH types and age classes present on Tract 3 lands (see Figure 4.3.4-2) (USFS 2010b). Though not considered MIHs, the Wolf Lands 3 parcel also contains 48.6 acres of lowland shrub habitat and less than an acre of lowland emergent habitat.

Landscape Ecosystems

Table 4.3.4-4 provides a summary of the landscape ecosystem types present on Tract 3 lands.

The Lowland Conifer landscape ecosystem occupies 217.7 acres of the Wolf Lands 3 parcel. The Mesic Birch-Aspen-Spruce-Fir landscape ecosystem occupies 59.7 acres of the Wolf Lands 3 parcel. Please see previous federal or non-federal lands sections above for a description of these landscape ecosystem types.

Wolf Lands 4

Habitat Types

The primary MDNR GAP land cover type on the Tract 3 – Wolf Lands 4 parcel is lowland coniferous forest (see Table 4.3.4-17). The shrubland and mixed upland forest cover types are least represented. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-17 Tract 3 – Wolf Lands 4 Cover Types

Cover Types	Total Acres	Percent of Area
Lowland coniferous forest[1]	356.5	88
Upland coniferous forest[3]	32.0	8
Upland deciduous forest[4]	8.2	2
Upland conifer-deciduous mixed forest[5]	4.1	1
Shrubland	3.9	1
Aquatic environments	0.0	0
Cropland/grassland	0.0	0
Disturbed	0.0	0
Lowland deciduous forest[2]	0.0	0
Total	**404.7**	**100**

Source: MDNR 2006b.

1 Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
2 Includes black ash forest cover types.
3 Includes pine and spruce/fir forest cover types.
4 Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
5 Includes all mixed coniferous-deciduous forest cover types.

Plant Community Surveys

The Wolf Lands 4 parcel consists of approximately 90 percent wetland habitats (AECOM 2011c). Coyote Creek bisects the parcel and is bordered on either side by emergent wetland habitats similar to Wolf Lands 3. Wetlands are dominated by pole black spruce in the northern half of the parcel and pole northern white cedar in the southern half. Scrub-shrub wetlands consist of speckled alder, leatherleaf, and bog-Labrador tea. See Section 4.3.3 for a more detailed description of wetland habitat types present.

Upland habitats consist of immature paper birch and black spruce, with balsam fir, beaked hazel, and raspberry also present. In areas that have been logged recently, sapling trembling aspen and paper birch are common over a shrub layer of beaked hazel, raspberry, and bog Labrador-tea (AECOM 2011c).

The majority of the black spruce/northern white cedar wetlands are dominated by trees ranging from 4 to 8 inches dbh (AECOM 2011c). Upland mature coniferous and deciduous trees range up to 18 inches dbh, although a 30-inch-dbh jack pine and several red pines up to 24 inches dbh have been found.

Minnesota Biological Survey

Wolf Lands 4 is located on a potential MBS Site of Moderate to High Biodiversity Significance that has not yet been finalized by the MDNR (MDNR 2007).

Native plant community rankings for Tract 3 are not available.

Scientific and Natural Areas

There are no SNAs located on the Tract 3 parcels.

Culturally Important Plants

A discussion of natural resources culturally important to the Bands is presented in Section 4.2.9.

Management Areas

The non-federal lands currently do not have any management area designations, as they are not managed by the federal government. Section 4.3.1 describes the management areas in detail.

Ecological Land Types

Wolf Lands 4 contains four categories of ELTs, including Lowland Loamy Moist (ELT 1), Lowland Loamy Wet (ELT 2), Lowland Organic Acid to Neutral (ELT 6), and Upland Deep Medium Loamy Dry (ELT 14). The entire Wolf Lands 4 parcel is included in the Greenwood Lake Till Plain LTA.

Management Indicator Habitats

Table 4.3.4-3 provides a summary of the MIH types and age classes present on Tract 3 lands (see Figure 4.3.4-2) (USFS 2010b). Though not considered an MIH, the Wolf Lands 4 parcel also contains 31.0 acres of lowland shrub habitat.

Landscape Ecosystems

Table 4.3.4-4 provides a summary of the landscape ecosystem types present on Tract 3 lands.

The Lowland Conifer landscape ecosystem occupies 356.7 acres of the Wolf Lands 4 parcel. The Mesic Birch-Aspen-Spruce-Fir landscape ecosystem occupies 47.9 acres of the Wolf Lands 4 parcel. Please see previous federal or non-federal lands sections above for a description of these landscape ecosystem types.

Invasive Non-native Plants

According to the Superior National Forest invasive plant geodatabase, there are no known occurrences of invasive species on any of the Tract 3 parcels (USFS 2010a). Field studies indicate that one area of Wolf Lands 3 contains an occurrence of thistles and ox-eye daisy in a recently clear-cut habitat (AECOM 2011c).

Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

Based on a review of the MDNR NHIS and field investigations, no federally or state-listed ETSC plant species are known to occur on the Tract 3 – Wolf Lands.

Regional Foresters Sensitive Species

There is more lowland black spruce-tamarack forest (MIH 9) and upland forest (MIH 1) habitat available than any other type, so the RFSS plants associated with these types would be most likely to occur on the Tract 3 lands. There is a very small amount of upland conifer forest (MIH 5) or aquatic habitats (MIH 14) so RFSS plants associated with these would be less likely to occur.

4.3.4.2.8 Tract 4 – Hunting Club Lands

Tract 4 is 160.2 acres in size, located on the LaCroix Ranger District, 5 miles southwest of Crane Lake. Tract 4 is surrounded by the Superior National Forest, St. Louis County lands, and privately owned lands (ERM 2011f).

Cover Types

Tract 4 is located in the Laurentian Mixed Forest Province Ecoregion and in the Border Lakes subsection of the Laurentian Mixed Forest Province ecoregion (MDNR 2006a). Most of the vegetative cover types in this subsection grow in thin, acid, cobbly to gravelly glacial materials over Precambrian bedrock (MDNR 2011g). Lakes and rocky ridges dominate this type of landscape. Soils vary from coarse-loamy to coarse texture, and support forest communities of aspen-birch, aspen-birch-conifer, and, on dry sites, jack pine barrens. Many such communities within this subsection are fire-dependent.

Habitat Types

The primary MDNR GAP land cover type on Tract 4 is upland deciduous forest (see Table 4.3.4-18). The upland conifer forest and lowland deciduous forest types are least represented. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-18 Tract 4 – Hunting Club Lands Cover Types

Cover Types	Total Acres	Percent of Area
Upland deciduous forest[4]	84.6	53
Shrubland	45.0	28
Aquatic environments	9.6	6
Lowland coniferous forest[1]	8.9	6
Upland coniferous forest[3]	8.2	5
Lowland deciduous forest[2]	4.0	2
Cropland/grassland	0.0	0
Disturbed	0.0	0
Upland conifer-deciduous mixed forest[5]	0.0	0
Total	**160.3[(6)]**	**100**

Source: MDNR 2006b.

[1] Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
[2] Includes black ash forest cover types.
[3] Includes pine and spruce/fir forest cover types.
[4] Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
[5] Includes all mixed coniferous-deciduous forest cover types.
[6] Total acres may be more or less than presented due to rounding.

Plant Community Surveys

The primary cover types on Tract 4 are pole and mature deciduous forests on the uplands and scrub-shrub and emergent wetlands (AECOM 2011c). An unnamed creek bisects the parcel, and beaver ponds and dams are common wetland features. Emergent vegetation surrounding open water consists of Canada bluejoint, narrow-leaved cattail, and sedges, while speckled alder dominates scrub-shrub wetlands. Pole black spruce and scattered tamarack dominate the wetlands on the interior of the parcel. Please see Section 4.3.3 for a more detailed description of wetland habitat types present.

Upland habitats in the northwestern, northeastern, and southern portions of the parcel are dominated by mature white pine, red pine, paper birch, and trembling aspen, with balsam fir and beaked hazel also present, though some areas consist of sapling and immature trees. The upland habitats in the eastern and southern portions of the parcel consist of patches of sapling and pole trembling aspen, with beaked hazel, black spruce, and balsam fir. An “island” of immature white pine, trembling aspen, and black spruce exists within this patch of sapling trembling aspen (AECOM 2011c).

The Tract 4 uplands are dominated by mostly deciduous sapling trees from 0 to 4 inches dbh, but mature white pines up to 24 inches dbh, and paper birch and trembling aspen up to 12 inches dbh occupy a large area as well (AECOM 2011c). Other upland areas on the parcel contain trembling aspen and white pine up to 16 inches dbh, and black spruce up to 12 inches dbh. Wetlands are dominated by immature coniferous forest trees ranging from 5 to 12 inches dbh.

Minnesota Biological Survey

There are no lands designated as MBS Sites of Biodiversity Significance on Tract 4 (MDNR 2008a).

Native plant community rankings are not available for Tract 4.

Scientific and Natural Areas

There are no lands designated as SNAs on Tract 4.

Culturally Important Plants

A discussion of natural resources culturally important to the Bands is presented in Section 4.2.9.

Management Areas

The non-federal lands currently do not have any management area designations, as they are not managed by the federal government. Section 4.3.1 describes the management areas in detail.

Ecological Land Types

Tract 4 contains seven different categories of ELTs, including Lowland Clayey Moist (ELT 3), Lowland Clayey Wet (ELT 4), Lowland Organic Acid to Neutral (ELT 6), Upland Deep Clayey Dry (ELT 10), Upland Shallow Loamy Dry (ELT 16), Upland Very Shallow Loamy Droughty (ELT 17), and Upland Extremely Shallow Loamy Droughty (ELT 18). The entire Tract 4 is included in the Johnson Lake Bedrock Complex LTA.

Management Indicator Habitats

Table 4.3.4-3 provides a summary of the MIH types and age classes present on Tract 4 (see Figure 4.3.4-2) (USFS 2010b). Though not considered MIHs, Tract 4 also contains 26.6 acres of lowland shrub habitat and 4.2 acres of lowland emergent habitat.

Landscape Ecosystems

Table 4.3.4-4 provides a summary of the landscape ecosystem types present on Tract 4.

The Dry-Mesic Red and White Pine landscape ecosystem occupies 93.7 acres of Tract 4. Please see previous federal or non-federal lands sections above for a description of this landscape ecosystem type.

The Lowland Hardwood landscape ecosystem occupies 66.5 acres of Tract 4. It is dominated by black ash and/or balsam poplar, although elm, green ash, paper birch, aspen, yellow birch, balsam fir, northern white cedar, and white spruce may also be present (USFS 2004a). This landscape ecosystem typically occurs on sites that are seasonally wet or wet year-round. Stand replacement disturbances are infrequent, resulting in a multi-aged stand of black ash and balsam poplar.

Invasive Non-native Plants

According to the Superior National Forest invasive plant geodatabase, there are no known occurrences of invasive species on Tract 4 (USFS 2010a).

Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

Based on a review of the MDNR NHIS and field investigations, no federally or state-listed ETSC plant species are known to occur on Tract 4.

Regional Foresters Sensitive Species

There is more upland forest (MIH 1) habitat available than any other type, so the RFSS plants associated with this type would be most likely to occur on Tract 4. There is a similar smaller amount of upland conifer forest (MIH 5), lowland black spruce-tamarack forest (MIH 9), and aquatic habitats (MIH 14), so RFSS plants associated with these would be less likely to occur.

4.3.4.2.9 Tract 5 – McFarland Lake Lands

Tract 5 is 30.8 acres in size on the Gunflint Ranger District in northeastern Cook County. The tract adds to Superior National Forest ownership and includes lakefront property on McFarland Lake, which is an entry point to the BWCAW. The parcel reaches an approximate maximum elevation of 1,762 ft amsl and the topography slopes steeply to the east toward its eastern border of McFarland Lake (NTS 2010b).

Cover Types

Tract 5 is located in the Border Lakes subsection of the Laurentian Mixed Forest Province ecoregion (MDNR 2006a). See Tract 4 above for a description of the Border Lakes subsection.

Habitat Types

The primary MDNR GAP land cover type on Tract 5 is upland deciduous forest (see Table 4.3.4-19). The remaining cover types on the parcel are upland conifer forest and aquatic environments. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-19 Tract 5 – McFarland Lake Lands Cover Types

Cover Types	Total Acres	Percent of Area
Upland deciduous forest[4]	26.6	86
Upland coniferous forest[3]	4.0	13
Aquatic environments	0.2	1
Cropland/grassland	0.0	0
Disturbed	0.0	0
Lowland coniferous forest[1]	0.0	0
Lowland deciduous forest[2]	0.0	0
Shrubland	0.0	0
Upland conifer-deciduous mixed forest[5]	0.0	0
Total	**30.8**	**100**

Source: MDNR 2006b.

[1] Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
[2] Includes black ash forest cover types.
[3] Includes pine and spruce/fir forest cover types.
[4] Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
[5] Includes all mixed coniferous-deciduous forest cover types.

Plant Community Surveys

Tract 5 consists of upland habitats, dominated by pole and mature deciduous and coniferous forests (AECOM 2009b; AECOM 2011b). The parcel is located on McFarland Lake, and a narrow band of horsetail and white cedar was observed along the shoreline (AECOM 2011b). Section 4.3.3 presents a more detailed description of wetland habitat types present.

Upland forest types on the hill slope of the parcel consist of trembling aspen, paper birch, mountain maple, northern white cedar, black spruce, and balsam fir. Mountain maple and northern white cedar are common on the lower hill slopes, while red pine and trembling aspen are more prevalent at the top of the hill slope. The shrub layer includes smooth sumac (*Rhus glabra*) and beaked hazel, while the ground layer includes forbs such as bunchberry, twining honeysuckle, clintonia, large-leaved aster, twinflower, false lily-of-the-valley (*Maianthemum canadense*), ox-eye daisy, thimbleberry (*Rubus parviflorus*), wild raspberry, wild strawberry, bog rosemary (*Andromeda glaucophylla*), bog cranberry (*Vaccinium oxycoccus*), wild sarsaparilla (*Aralia nudicaulis*), bracken fern and other ferns, and club moss (*Lycopodium* spp.) (AECOM 2011b). Some recent logging has occurred along the hill slope of the western boundary of the parcel. Steep rocky cliffs about 150 ft in height exist toward this western boundary (AECOM 2011b). Enchanter’s nightshade (*Circaea quadrisulcata*) and wild columbine (*Aquilegia canadensis*) have been observed on the rocky cliffs.

Upland forests on the parcel contain trembling aspen, red pine, and eastern white pine up to 18 inches dbh, balsam fir up to 16 inches dbh, and paper birch up to 12 inches dbh (AECOM 2011b). Wetland forests along McFarland Lake contain northern white cedar up to 24 inches dbh.

Minnesota Biological Survey

There are no lands designated as MBS Sites of Biodiversity Significance on the Tract 5 lands (MDNR 2008a).

Native plant community rankings are not available for the Tract 5 lands.

Scientific and Natural Areas

There are no lands designated as SNAs on the Tract 5 lands.

Culturally Important Plants

A discussion of natural resources culturally important to the Bands is presented in Section 4.2.9.

Management Areas

The non-federal lands currently do not have any management area designations, as they are not managed by the federal government. Section 4.3.1 describes the management areas in detail.

Ecological Land Types

Tract 5 contains four different categories of ELTs, including Lowland Loamy Wet (ELT 2), Upland Deep Medium Loamy Dry (ELT 14), Upland Shallow Loamy Dry (ELT 16), and Upland Extremely Shallow Loamy Droughty (ELT 18), though categories are not available for the entire parcel. All of Tract 5 is included in the Rove Slate Bedrock Complex LTA.

Management Indicator Habitats

Table 4.3.4-3 provides a summary of the MIH types and age classes present on Tract 5 (see Figure 4.3.4-2) (USFS 2010b).

Landscape Ecosystems

Table 4.3.4-4 provides a summary of the landscape ecosystem types present on Tract 5.

The Mesic Red and White Pine landscape ecosystem occupies 30.8 acres of the Tract 5. See the federal or non-federal lands sections above for a description of these landscape ecosystem types.

Invasive Non-native Plants

According to the Superior National Forest invasive plant geodatabase, there are no known occurrences of invasive species on the Tract 5 lands (USFS 2010a).

Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

No federally listed ETSC plant species are known to occur on Tract 5. Based on a review of the MDNR NHIS, two state-listed threatened species have been identified on Tract 5 (see Table 4.3.4-20 and Figure 4.3.4-3). Encrusted saxifrage is also tracked by the USFS as an RFSS. No other state-listed species are known to occur on Tract 5.

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013. The FEIS will consider any new listings, or changes in the previous listings, associated with the updated list.

Non-federal Lands

Endangered, Threatened and Special Concern Vegetation Species

1 - Section Number

US Army Corps of Engineers
St. Paul District

0 150 300 600
Feet

Figure 4.3.4-3

ETSC Vegetation - Tract 5 - McFarland Lake Lands

NorthMet Mining Project and Land Exchange SDEIS

Minnesota

November 2013

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Table 4.3.4-20 Endangered, Threatened, and Special Concern Plant Species Identified on the Tract 5 Lands [4]

Common Name	Scientific Name	State Status[1]	No. of Populations	No. of Individuals[3]	Habitat and Location
Encrusted saxifrage[3]	*Saxifraga paniculata* (=*aizoon*)	T	1	1000+	Shaded rock crevices and mossy ledges of north-facing sedimentary rock cliffs.
Rocky Mountain woodsia	*Woodsia scopulina*	T	1	2+	Cool, moist moss-covered chutes of north-facing sedimentary rock cliffs.

Sources: MDNR 2013a; MDNR 2011m.

1 E - Endangered, T - Threatened, SC - Species of Concern.
2 Where the number of individuals cannot be determined without damaging the population, then patch size is used as a representative abundance measure.
3 These species are also RFSS as tracked by the USFS.
4 Data included here were provided by the Division of Ecological Resources, MDNR, and were current as of March 13, 2013. These data are not based on an exhaustive inventory of the state. The lack of data for any geographic area shall not be construed to mean that no significant features are present.

<u>*Species Life Histories*</u>

The following summary provides descriptions of the life histories, state-wide distributions, and sensitivity to disturbance for each of the two threatened species found on Tract 5.

Encrusted saxifrage (*Saxifraga paniculata*) (synonyms: *Saxifraga aizoon* var. *neogaea*, white mountain saxifrage) is listed as a threatened species in Minnesota and as an RFSS in the Superior National Forest. The species was first documented in Cook County, Minnesota in 1932, and has since only been reported in Cook and Lake counties (Bell Museum of Natural History 2011). *S. paniculata* is an arctic-alpine species that reaches the southern end of its range in Minnesota (MDNR 2011m). It typically occurs in rock crevices and on ledges of shaded north-facing cliffs with bedrock of diabase, gabbro/diorite, basalt, or Rove Formation rocks. *S. paniculata* is a perennial herb species that flowers from early June to July and bears fruit from late July through August, though it can also spread vegetatively via stolons. There is very little suitable cliff habitat for *S. paniculata* in Minnesota, and threats to the species could include climate change, changes in the biotic community, and recreational exploration of vulnerable cliff faces.

Rocky Mountain woodsia (*Woodsia scopulina*) (Synonyms: *Woodsia scopulina* ssp. *laurentiana*) is listed as a threatened species in Minnesota; it is not listed as an RFSS in the Superior National Forest. The species was first documented in Cook County, Minnesota in 1929 amidst slate rocks, and has since only been reported in Cook County (Bell Museum of Natural History 2011). Though it is common in the Rocky Mountains, it is limited primarily to cool, moist north-facing cliffs of the Rove Slate Formation in northeast Minnesota (MDNR 2011m). *W. scopulina* is a perennial fern that grows in small clumps, and produces spores from summer to fall (eFlora 2011). There is very little suitable cliff habitat for *W. scopulina* in Minnesota, as it requires diabase and slate bedrock and east-west oriented valleys. Threats to the species could include climate change, introduction of non-native species, erosion events, forest management activities that alter the biotic community, or recreational exploration of vulnerable cliff faces.

Regional Foresters Sensitive Species

Based on a review of the MDNR NHIS, *Saxifraga paniculata* is located on Tract 5, and it is also an RFSS plant. There is more upland forest (MIH 1) habitat available than any other type, so the RFSS plants associated with this type would be most likely to occur on the Tract 5 lands. There is a smaller amount of upland conifer forest (MIH 5) and aquatic habitats (MIH 14) so RFSS plants associated with these would be less likely to occur. There is no lowland black spruce-tamarack forest (MIH 9) available, and so RFSS plants associated with this habitat would likely not exist. The cliff habitat present on Tract 5 is important to the 12 RFSS plants that utilize exposed rock habitats in the Superior National Forest (see Table 4.2.4-5), including *Saxifraga paniculata*, as there is very little suitable cliff microhabitat for these species in Minnesota. *Woodsia scopulina* also utilizes this habitat type.

4.3.5 Wildlife

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013. The FEIS will consider any new listings, or changes in the previous listings, associated with the updated list. A Biological Assessment (with further information on federally listed species) and a Biological Evaluation (containing further information about RFSS species) have been prepared and are posted on the USFS website (http://www.fs.usda.gov/goto/superior/northmet).

4.3.5.1 Federal Lands

4.3.5.1.1 Land Exchange Proposed Action

The federal land portion of the Land Exchange Proposed Action is similar to the Mine Site previously discussed, but extends further north and west and excludes the privately owned land bordering Dunka Road to the south of the Mine Site. Section 4.2.5.1 provides further discussion of the existing conditions on the Mine Site and associated federal lands.

The acres of key habitat present on the federal lands, along with the associated SGCN (and RFSS), are included in Table 4.3.5-1 below.

Table 4.3.5-1 Key Habitat, Cover Types, and Associated Species for the Federal Lands under the Land Exchange Proposed Action and Land Exchange Alternative B

Key Habitat Type, Cover Types, and Management Indicator Habitats	Associated Wildlife Species[1]	Land Exchange Proposed Action (Acres)	Land Exchange Alternative B (Acres)
1. Mature Upland Forest, Continuous Upland/Lowland Forest: aspen forest/aspen-birch forest, jack pine forest, mixed pine-hardwood forest (MIHs 1-13)	Rock vole, *northern goshawk*, veery, whip-poor-will, eastern wood-peewee, yellow-bellied sapsucker, ovenbird, Canada warbler, spruce grouse, Cape May warbler, winter wren, Boreal chickadee, *boreal owl*, wood thrush, black-backed woodpecker, *bald eagle*, black-throated blue warbler, *bay-breasted warbler*, *great gray owl*, *three-toed woodpecker*	5,719.7	4,258.1
2. Open Ground, Bare Soils: disturbed/ developed (no MIH)	Laurentian tiger beetle	63.8	29.1
3. Grassland and Brushland, Early Successional Forest (no MIH)	Franklin's ground squirrel, American badger, Le Conte's sparrow, eastern meadowlark, brown thrasher, white-throated sparrow, sharp-tailed grouse, golden-winged warbler, American woodcock, northern harrier, sedge wren, common nighthawk, black-billed cuckoo, bobolink, tawny crescent	651.8	439.1
4. Aquatic Environments: rivers, lakes, ponds, wetlands, etc. (MIH 14)	American black duck, American bittern, swamp sparrow, common loon, northern rough-winged swallow, semipalmated sandpiper, American golden-plover, greater yellowlegs, buff-breasted sandpiper, eastern red-backed salamander, common snapping turtle, bog copper, *disa alpine*	60.1	26.3

Key Habitat Type, Cover Types, and Management Indicator Habitats	Associated Wildlife Species[1]	Land Exchange Proposed Action (Acres)	Land Exchange Alternative B (Acres)
5. Multiple Habitats (MIHs 1-14)	Gray wolf[2] (1-4[(3)]), *Canada lynx*[2] (1-4), rose-breasted grosbeak (1, 3), Macoun's arctic (1, 3), least flycatcher (1, 3), *Connecticut warbler* (1, 3), *olive-sided flycatcher (1, 4)*, grizzled skipper (2, 3), Nabokov's blue (2, 4), wood turtle[2] (1, 3, 4)	NA[4]	NA
Total		6,495.4	4,752.6

Source: MDNR 2006b.

1 Plain text indicates SGCN species; italicized text indicates RFSS species; plain text indicates SGCN species identified as likely to be present at the Mine Site or Plant Site but not targeted in surveys.
2 Canada lynx, gray wolf, bald eagle, and wood turtle are or have recently been listed as ETSC species as discussed in detail in the ETSC species section.
3 Numbers refer to the Key Habitat Types (1-4) where those species may occur or are known to occur.
4 NA = not applicable

4.3.5.1.2 Land Exchange Alternative B

As shown on Table 4.3.5-1, each of the key habitat types and MIH categories that are found on the federal lands of the Land Exchange Proposed Action are also found on federal lands of the Land Exchange Alternative B. Acreages of each habitat category are correspondingly reduced for the Land Exchange Alternative B.

4.3.5.2 Non-federal Lands

4.3.5.2.1 Tract 1 – Hay Lake Lands

Federally and State-listed Species and Species of Special Concern

Tract 1 is not located in an LAU but is located in designated lynx critical habitat. No Canada lynx or their sign have been observed on the non-federal lands during surveys (AECOM 2011b; AECOM 2011c). The Tract 1 parcel is also located in Wolf Zone 2. Radio-collared wolves have been recorded in the vicinity and evidence of wolves was observed during 2009 wildlife surveys. Trumpeter swans, state-listed as threatened, were identified on the Hay Lake parcel during wildlife surveys (AECOM 2011b) and habitat for the Laurentian tiger beetle, state-listed as threatened, is present at the former sand and gravel pit on the parcel. Both NHIS records and surveys of the parcel failed to identify individuals or signs of the remaining federally and state-listed species, including wood turtle, horned grebe, Wilson's phalarope, or common tern.

Wildlife surveys also looked for species of special concern. No federally or state-listed species of special concern were observed. Though bats were observed on the parcel, the species was not determined and may potentially include eastern pipstrelle and/or northern myotis.

Species of Greatest Conservation Need

As discussed in Section 4.2.5.1.2, the potential presence of SGCN can be correlated to the presence of their corresponding habitat. Table 4.3.5-2 below lists the SGCN (and RFSS) by the key habitat types and cover types present in the Nashwauk Uplands ecological subsection.

Tract 1 is located in the Nashwauk Uplands ecological subsection. The species found in this subsection are listed in Table 4.3.5-2 below.

Table 4.3.5-2 Key Habitat and Cover Types of Species of Greatest Conservation Need and Regional Forester Sensitive Species for Tract 1 in the Nashwauk Ecological Subsection

Key Habitat Type, Cover Types, and Management Indicator Habitats	Associated Wildlife Species[1]	Tract 1 (Acres)
1. Mature Upland Forest, Continuous Upland/Lowland Forest: aspen forest/aspen-birch forest, jack pine forest, mixed pine-hardwood forest (MIHs 1-13)	*Northern goshawk*, veery, whip-poor-will, eastern wood-peewee, yellow-bellied sapsucker, ovenbird, Canada warbler, spruce grouse, Cape May warbler, winter wren, boreal chickadee, wood thrush, black-backed woodpecker, *bald eagle, great gray owl, three-toed woodpecker*	2,978.8
2. Open Ground, Bare Soils: disturbed/developed (no MIH)		0.0
3. Grassland and Brushland, Early Successional Forest (no MIH)	Franklin's ground squirrel, American badger, Le Conte's sparrow, eastern meadowlark, brown thrasher, white-throated sparrow, sharp-tailed grouse, golden-winged warbler, American woodcock, northern harrier, sedge wren, common nighthawk, black-billed cuckoo, red-headed woodpecker, bobolink, tawny crescent	1,696.3
4. Aquatic Environments: rivers, lakes, ponds, wetlands, etc. (MIH 14)	American black duck, American bittern, swamp sparrow, common loon, red-necked grebe, northern rough-winged swallow, dunlin, semipalmated sandpiper, short-billed dowitcher, American golden-plover, Virginia rail, greater yellowlegs, buff-breasted sandpiper, eastern red-backed salamander, common snapping turtle, bog copper, *disa alpine, ebony boghaunter*	251.1
5. Multiple Habitats (MIHs 1-14)	Gray wolf[2] (1-4[(3)]), Canada lynx[2] (1-4), *eastern pipistrelle* (1,3), rose-breasted grosbeak(1,3), least flycatcher (1,3), *olive-sided flycatcher* (1,4), *Connecticut warbler* (1,3), peregrine falcon(1-3), Macoun's arctic (1,3), *Nabokov's blue* (2,4), *grizzled skipper* (2,3), *Quebec emerald* (3,4)	NA[5]
Total[4]		4,926.2

Source: MDNR 2006b.

[1] Plain text indicates SGCN species, italicized text indicates RFSS species.
[2] Canada lynx, gray wolf, bald eagle, and wood turtle are or have recently been listed as ETSC species as discussed in detail in the ETSC species section.
[3] Numbers refer to the Key Habitat Types (1-4) where those species may occur or are known to occur.
[4] Total acres may be more or less than presented due to rounding.
[5] NA = not applicable

Regional Forester Sensitive Species

An active goshawk territory is present on Tract 1, and is currently being monitored by the MDNR. With this and the possible exception of the northern myotis, no RFSS species were observed during surveys of Tract 1. Potential Superior National Forest RFSS and their habitat on Tract 1 are listed on Table 4.3.5-2.

Other Wildlife Species

Other wildlife species, including species of tribal concern, were observed during surveys of Tract 1. Species observed, or their sign, include bear, white-tailed deer, fox, otter, beaver, and moose.

Sections 4.2.5, 4.2.9, 5.2.5, and 5.2.9 discuss species of importance to the Bands.

4.3.5.2.2 Tract 2 – Lake County Lands

Federally and State-listed Species and Species of Special Concern

Tract 2 is split into two parcels, Lake County Lands North and Lake County Lands South. Lake County North is located in LAU 16 and Lake County South is located in LAU 22. Both are in designated lynx critical habitat. No Canada lynx or their sign have been observed on the non-federal lands during surveys (AECOM 2011b; AECOM 2011c). While no lynx or their sign have been observed on the Tract 2 parcels, denning habitat may be present. Areas of blowdown or logging slash where there is both vertical and horizontal cover may be used by lynx for denning sites (Moen 2009).

Both Tract 2 parcels are located in federal Wolf Zone 2 and Minnesota Wolf Zone A. Wolf sign was observed on Lake County North during 2010 wildlife surveys. Both NHIS records and surveys of the parcel failed to identify individuals or signs of the remaining federally and state-listed species or species of special concern.

Species of Greatest Conservation Need

The Lake County North parcel is located in the Laurentian Uplands ecological subsection and the Lake County South parcel is located in the North Shore Highlands ecological subsection. Table 4.3.5-3 below lists the SGCN (and RFSS) by the key habitat types and cover types present at Tract 2.

Table 4.3.5-3 Key Habitat and Cover Types of Species of Greatest Conservation Need and Regional Forester Sensitive Species for Tract 2 in the Laurentian Uplands and North Shore Highlands Ecological Subsections

Key Habitat Type, Cover Types, and Management Indicator Habitats	Associated Wildlife Species[1]	Tract 2 (Acres)
1. Mature Upland Forest, Continuous Upland/Lowland Forest: aspen forest/aspen-birch forest, jack pine forest, mixed pine-hardwood forest (MIHs 1-13)	Rock vole, *northern goshawk*, veery, whip-poor-will, eastern wood-peewee, yellow-bellied sapsucker, ovenbird, Canada warbler, spruce grouse, Cape May warbler, winter wren, boreal chickadee, *boreal owl*, wood thrush, black-backed woodpecker, *bald eagle*, black-throated blue warbler, *bay-breasted warbler*, *great gray owl*, *three-toed woodpecker*	337.2
2. Open Ground, Bare Soils: disturbed/ developed (no MIH)	Laurentian tiger beetle	0.0
3. Grassland and Brushland, Early Successional Forest (no MIH)	Franklin's ground squirrel, American badger, Le Conte's sparrow, eastern meadowlark, brown thrasher, white-throated sparrow, sharp-tailed grouse, golden-winged warbler, American woodcock, northern harrier, sedge wren, common nighthawk, black-billed cuckoo, bobolink, red-headed woodpecker, tawny crescent	38.9
4. Aquatic Environments: rivers, lakes, ponds, wetlands, etc. (MIH 14)	American black duck, American bittern, swamp sparrow, common loon, northern rough-winged swallow, dunlin, semipalmated sandpiper, short-billed dowitcher, American golden-plover, Virginia rail, greater yellowlegs, buff-breasted sandpiper, ruddy turnstone, white-rumped sandpiper, marsh wren, Hudsonian godwit, whimbrel, common tern, eastern red-backed salamander, common snapping turtle, Blanding's turtle, bog copper, *disa alpine*, extra-striped snaketail, *ebony boghaunter*	5.8
5. Multiple Habitats (MIHs 1-14)	Gray wolf[2] (1-4[(3)]), Canada lynx[2] (1-4), *eastern heather vole* (1,3), eastern pipistrelle (1,4), smoky shrew (1,3), *northern myotis* (1,4), *eastern pipistrelle* (1,3), eastern spotted skunk (1,3), rose-breasted grosbeak (1,3), least flycatcher (1,3), *olive-sided flycatcher* (1,4), *Connecticut warbler* (1,3), peregrine falcon(1-3), *wood turtle*[2] (1,3,4), four-toed salamander (1,4), Macoun's arctic (1,3), *Nabokov's blue* (2,4), *grizzled skipper* (2,3), *Quebec emerald* (3,4)	NA[4]
Total		381.9

Source: MDNR 2006b.

[1] Plain text indicates SGCN species, italicized text indicates RFSS species.
[2] Canada lynx, gray wolf, bald eagle, and wood turtle are or have recently been listed as ETSC species as discussed in detail in the ETSC species section.
[3] Numbers refer to the Key Habitat Types (1-5) where those species may occur or are known to occur.
[4] NA = not applicable

Regional Forester Sensitive Species

No RFSS species were observed during surveys of Tract 2. Potential Superior National Forest RFSS and their habitat on Tract 2 are listed on Table 4.3.5-3.

Other Wildlife Species

Other wildlife species, including species of tribal concern, were observed during surveys of Tract 2. Species observed, or their sign, include grouse, white-tailed deer, beaver, raven, snowshoe hare, and moose.

Sections 4.2.5, 4.2.9, 5.2.5, and 5.2.9 discuss species of importance to the Bands.

4.3.5.2.3 Tract 3 – Wolf Lands

Federally and State-listed Species and Species of Special Concern

Tract 3 is split into four parcels, Wolf Lands 1, 2, 3, and 4. Wolf Lands 1 is located in LAU 16 and Wolf Lands 2 through 4 are located in LAU 22. All are within designated lynx critical habitat. No Canada lynx or their sign have been observed on the non-federal lands during surveys (AECOM 2011b; AECOM 2011c). While no lynx or their sign have been observed on the Tract 3 parcels, denning habitat may be present. Areas of blowdown or logging slash where there is both vertical and horizontal cover may be used by lynx for denning sites (Moen 2009).

All Tract 3 parcels are located in federal Wolf Zone 2 and Minnesota Wolf Zone A. Wolf sign was observed on Wolf Lands 3 and 4 during 2010 wildlife surveys. Both NHIS records and surveys of the parcel failed to identify individuals or signs of the remaining federally and state-listed species or species of special concern.

Species of Greatest Conservation Need

The Wolf Lands parcels are located in the Laurentian Uplands ecological subsection. The species of greatest conservation need and habitat that may be found in this subsection are listed on Table 4.3.5-4.

Table 4.3.5-4 Key Habitat and Cover Types of Species of Greatest Conservation Need and Regional Forester Sensitive Species for Tract 3 in the Laurentian Uplands Ecological Subsection

Key Habitat Type, Cover Types, and Management Indicator Habitats	Associated Wildlife Species[1]	Tract 3 (Acres)
1. Mature Upland Forest, Continuous Upland/Lowland Forest: aspen forest/aspen-birch forest, jack pine forest, mixed pine-hardwood forest (MIHs 1-13)	Rock vole, *northern goshawk*, veery, whip-poor-will, eastern wood-peewee, yellow-bellied sapsucker, ovenbird, Canada warbler, spruce grouse, Cape May warbler, winter wren, boreal chickadee, *boreal owl*, wood thrush, black-backed woodpecker, *bald eagle,* black-throated blue warbler, *bay-breasted warbler, great gray owl, three-toed woodpecker*	1,479.4
2. Open Ground, Bare Soils: disturbed/ developed (no MIH)	Tiger beetle	0.0
3. Grassland and Brushland, Early Successional Forest (no MIH)	Franklin's ground squirrel, American badger, Le Conte's sparrow, eastern meadowlark, brown thrasher, white-throated sparrow, sharp-tailed grouse, golden-winged warbler, American woodcock, northern harrier, sedge wren, common nighthawk, black-billed cuckoo, bobolink, tawny crescent	96.5
4. Aquatic Environments: rivers, lakes, ponds, wetlands, etc. (MIH 14)	American black duck, American bittern, swamp sparrow, common loon, northern rough-winged swallow, semipalmated sandpiper, American golden-plover, greater yellowlegs, buff-breasted sandpiper, eastern red-backed salamander, common snapping turtle, bog copper, *disa alpine, ebony boghaunter*	0.0
5. Multiple Habitats (MIHs 1-14)	Gray wolf[2] (1-4[(3)]), Canada lynx[2] (1-4), *eastern heather vole* (1,3), eastern pipistrelle (1,4), smoky shrew (1,3), *eastern pipistrelle* (1,3), rose-breasted grosbeak (1,3), least flycatcher (1,3), *olive-sided flycatcher* (1,4), *Connecticut warbler* (1,3), Macoun's arctic (1,3), *Nabokov's blue* (2,4), *grizzled skipper* (2,3), *Quebec emerald* (3,4)	NA[5]
Total[4]		1,575.9

Source: MDNR 2006b.

1 Plain text indicates SGCN species, italicized text indicates RFSS species.
2 Canada lynx, gray wolf, and bald eagle are or have recently been listed as ETSC species as discussed in detail in the ETSC species section.
3 Numbers refer to the Key Habitat Types (1-4) where those species may occur or are known to occur.
4 Total acres may be more or less than presented due to rounding.
5 NA = not applicable

Regional Forester Sensitive Species

No RFSS species were observed during surveys of Tract 3. Potential Superior National Forest RFSS and their habitat on Tract 3 are listed on Table 4.3.5-4.

Other Wildlife Species

Other wildlife species, including species of tribal concern, were observed during surveys of Tract 3. Species observed, or their sign, include white-tailed deer, fox, marten, snowshoe hare, beaver, and moose.

Sections 4.2.5, 4.2.9, 5.2.5, and 5.2.9 discuss species of importance to the Bands.

4.3.5.2.4 Tract 4 – Hunting Club Lands

Federally and State-listed Species and Species of Special Concern

Tract 4 is located in LAU 4 and is located in designated lynx critical habitat. No Canada lynx or their sign have been observed on the non-federal lands during surveys (AECOM 2011b; AECOM 2011c). The Tract 4 parcel is also located in Federal Wolf Zone 2 and Minnesota Wolf Zone A. Both NHIS records and surveys of the parcel failed to identify individuals or signs of federally and state-listed species and species of special concern.

Species of Greatest Conservation Need

Tract 4 is located in the Border Lakes ecological subsection. Table 4.3.5-5 lists the species of greatest conservation need and habitat that may be found in this subsection.

Table 4.3.5-5 Key Habitat and Cover Types of Species of Greatest Conservation Need and Regional Forester Sensitive Species for Tracts 4 and 5 in the Border Lakes Ecological Subsection

Key Habitat Type, Cover Types, and Management Indicator Habitats	Associated Wildlife Species[1]	Tract 4 (Acres)	Tract 5 (Acres)
1. Mature Upland Forest, Continuous Upland/Lowland Forest: aspen forest/aspen-birch forest, jack pine forest, mixed pine-hardwood forest (MIHs 1-13)	Rock vole, *northern goshawk*, veery, whip-poor-will, eastern wood-peewee, yellow-bellied sapsucker, ovenbird, Canada warbler, spruce grouse, Cape May warbler, winter wren, boreal chickadee, *boreal owl*, wood thrush, black-backed woodpecker, *bald eagle*, black-throated blue warbler, *bay-breasted warbler, great gray owl, three-toed woodpecker*	105.7	30.6
2. Open Ground, Bare Soils: disturbed/ developed (no MIH)	Laurentian tiger beetle	0.0	0.0
3. Grassland and Brushland, Early Successional Forest (no MIH)	Le Conte's sparrow, eastern meadowlark, brown thrasher, white-throated sparrow, golden-winged warbler, American woodcock, northern harrier, sedge wren, common nighthawk, black-billed cuckoo, bobolink, tawny crescent	45.0	0.0
4. Aquatic Environments: rivers, lakes, ponds, wetlands, etc. (MIH 14)	American black duck, American bittern, swamp sparrow, common loon, northern rough-winged swallow, semipalmated sandpiper, American golden-plover, greater yellowlegs, buff-breasted sandpiper, ruddy turnstone, white-rumped sandpiper, black tern, red-necked grebe, eastern red-backed salamander, common snapping turtle, *disa alpine, ebony boghaunter*	9.6	0.2
5. Multiple Habitats (MIHs 1-14)	Gray wolf[2] (1-4[3]), Canada lynx[2] (1-4), *eastern heather vole* (1,3), smoky shrew (1,3), *eastern pipistrelle* (1,3), rose-breasted grosbeak (1,3), least flycatcher (1,3), *olive-sided flycatcher* (1,4), *Connecticut warbler* (1,3), rusty blackbird (1,4), Macoun's arctic (1,3), *Nabokov's blue* (2,4), *grizzled skipper* (2,3), *Quebec emerald* (3,4)	NA	NA[5]
Total[4]		160.3	30.8

Source: MDNR 2006b.

1 Plain text indicates SGCN species, italicized text indicates RFSS species.
2 Canada lynx, gray wolf, and bald eagle are or have recently been listed as ETSC species as discussed in detail in the ETSC species section.
3 Numbers refer to the Key Habitat Types (1-4) where those species may occur or are known to occur.
4 Total acres may be more or less than presented due to rounding.
5 NA = not applicable

Regional Forester Sensitive Species

No RFSS species were observed during surveys of Tract 4. Potential Superior National Forest RFSS and their habitat on Tract 4 are listed on Tables 4.3.5-5.

Other Wildlife Species

Other wildlife species, including species of tribal concern, were observed during surveys of Tract 4. Species observed, or their sign, include white-tailed deer, fox, marten, snowshoe hare, beaver, and moose.

Sections 4.2.5, 4.2.9, 5.2.5, and 5.2.9 discuss species of importance to the Bands.

4.3.5.2.5 Tract 5 – McFarland Lake Lands

Federally and State-listed Species and Species of Special Concern

Tract 5 is located in LAU 42 and is located in designated lynx critical habitat. No Canada lynx or their sign have been observed on the non-federal lands during surveys (AECOM 2011b; AECOM 2011c). The Tract 5 parcel is also located in federal Wolf Zone 2 and Minnesota Wolf Zone A. Wolf sign was observed on the parcel in October 2011. Both NHIS records and surveys of the parcel failed to identify individuals or signs of the remaining federally and state-listed species.

Wildlife surveys also looked for species of special concern. No federally or state-listed species of special concern were observed. Though bats were observed on the parcel, the species was not determined and may potentially include eastern pipstrelle and/or northern myotis.

Species of Greatest Conservation Need

Like Tract 4, Tract 5 is located in the Border Lakes ecological subsection. Table 4.3.5-5 provides a list of species of greatest conservation need and habitat that may be found in this subsection.

Regional Forester Sensitive Species

With the possible exception of the northern myotis, no RFSS species were observed during surveys of Tract 5. Potential Superior National Forest RFSS and their habitat on Tract 5 are listed on Table 4.3.5-5.

Other Wildlife Species

Other wildlife species, including species of tribal concern, were observed during surveys of Tract 5. Species observed, or their sign, include bear, white-tailed deer, fox, raven, and beaver.

Sections 4.2.5, 4.2.9, 5.2.5, and 5.2.9 discuss species of importance to the Bands.

4.3.6 Aquatic Species

The federal lands are discussed in Section 4.2.6.1 along with the Mine Site. The Alternative B: Smaller Federal Parcel contains similar surface waters, but smaller acreages or linear distances than the federal lands.

The non-federal lands contain streams, creeks, rivers, and lakes. Tract 1 contains three lakes and one river, comprising approximately 90,000 linear ft of shoreline and approximately 129 acres of surface area. Tract 3 – Wolf Lands 3 and Wolf Lands 4 contain Coyote Creek, with approximately 12 linear ft of river frontage per acre. Tract 5 contains 506 ft of shoreline due to McFarland Lake frontage. Tract 2 and Tract 4 do not contain surface water features.

There are no SGCN, state, federal, or RFSS species known to occur at or in the immediate vicinity of the non-federal lands. According to available data, however, there are several SGCN or RFSS that are associated with the Superior National Forest or various ecoregions on which the non-federal lands are located.

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013. The FEIS will consider any new listings, or changes in the previous listings, associated with the updated list. A Biological Evaluation (containing further information about RFSS species) has been prepared and is posted on the USFS website (http://www.fs.usda.gov/goto/superior/northmet).

4.3.6.1 Federal Lands

4.3.6.1.1 Land Exchange Proposed Action

The existing conditions found within the federal lands area are discussed in Section 4.2.6.1.

4.3.6.1.2 Land Exchange Alternative B

The existing conditions found within the Alternative B area are discussed in Section 4.2.6.1. However, site-specific information is presented below.

Surface Water Features

A portion of Mud Lake, covering 8.9 acres with approximately 1,200 ft of lake frontage, is located within the Alternative B lands. The length of lake frontage per acre of this alternative boundary is 0.3 ft.

As with the federal lands within the Land Exchange Proposed Action, Yelp Creek and the Partridge River, which originates at the Northshore Mine, flow out of the One Hundred Mile Swamp and through portions of the smaller federal parcel within the Land Exchange Alternative B. Collectively, the creek and river are 5.3 miles in length in the Alternative B, corresponding to 55,968 linear ft of creek/river frontage (counting both sides of the water feature). The combined Yelp Creek and Partridge River frontage per acre of the smaller federal parcel within the Land Exchange Alternative B is 11.8 ft (see Table 4.3.6-1).

The MIH represented within the boundaries of the Alternative B: Smaller Federal Parcel includes 8.9 acres for Mud Lake and 55,968 linear ft for the combined Yelp Creek and Partridge River.

Table 4.3.6-1 Alternative B Surface Water Characteristics

Surface Water	Size on Parcel	Approximate Shoreline Frontage (ft)	MIH	Frontage Index (ft/acre)
Mud Lake	8.9 acres	1,200.0	8.9 acres	0.3
Yelp Creek	1.1 miles	*	*	*
Partridge River	4.2 miles	55,968.0	55,968.0 linear ft	11.8

Source: Adapted from AECOM 2011d.

* Combined with Partridge River.

4.3.6.2 Non-federal Lands

4.3.6.2.1 Tract 1 – Hay Lake Lands

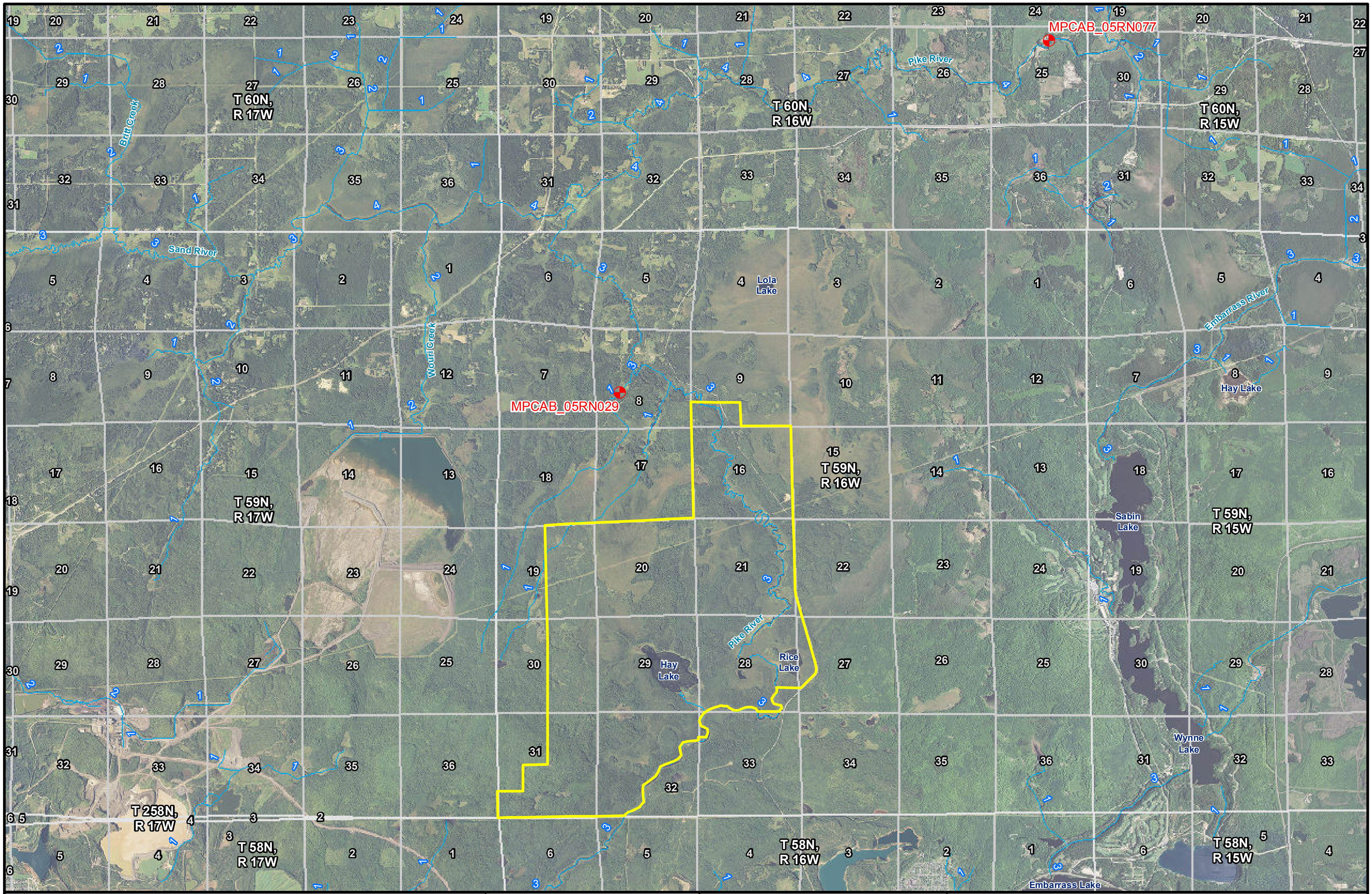
Surface Water Features

Surface water features on Tract 1 include three lakes and one river. Aerial photograph review of the three lakes associated with the parcel indicates a mix of deep water and shallow, submergent/emergent vegetation habitats in the open water portions of the lakes, which provide fish and macroinvertebrate habitats.

The Pike River, which flows north through the tract, is classified as a third-order stream (see Figure 4.3.6-1) within Tract 1 and includes approximately 376 acres of floodplain. The heavily vegetated riparian habitats and associated floodplains adjacent to the river's edge likely provide important fish and macroinvertebrate habitats.

The USFS MIH categories within Tract 1 include 129.6 acres of lakes, 16,424 linear ft of lake shoreline, and 72,864 linear ft of river shoreline (see Table 4.3.6-2).

Riparian habitats, which surround all surface water features on the parcel, include shrub-carr, coniferous swamp, sedge meadow, alder thicket, shallow open water, and deep marsh wetlands (AECOM 2011d). Aerial photograph review indicates a wide riparian buffer and minimal disturbance along each surface water feature. All wetlands adjacent to the surface water features scored high for fish habitat according to the MnRAM 3.2 rating (AECOM 2011d).



Non-federal Lands
Monitoring Station
Stream / River
Section Boundary
Section Label
Stream Order Number

US Army Corps of Engineers
St. Paul District

0 0.5 1 2 Miles

Figure 4.3.6-1
Monitoring Sample Site Locations
Tract 1 - Hay Lake Lands
NorthMet Mining Project and Land Exchange SDEIS
Minnesota

November 2013

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Table 4.3.6-2 Tract 1 Surface Water Characteristics

Surface Water	Surface Area (acres)	Approximate Shoreline Frontage (linear ft)	MIH
Hay Lake	96.2	9,894.4	96.2 acres
Rice Lake	29.5	4,829.6	29.5 acres
Unnamed lake	3.9	1,700	3.9 acres
Pike River	na	72,864[1]	72,864 linear ft
Total	129.6	89,288	

Source: Adapted from AECOM 2011d.

na = Not available
[1] Includes riparian distance on both sides of river except along property boundary to the southeast where only the west side of the river is included.

Aquatic Biota Studies

No aquatic biota studies were performed within the surface water features associated with Tract 1; however, studies were completed by the MPCA (MPCA 2011c) for two locations downstream from the parcel's northern boundary (see Figure 4.3.6-1). Aquatic biota sampling station MPCAB_05RN029 is located within an unnamed tributary approximately 1 river mile downstream from Tract 1's northern boundary. The sampling station MPCAB_05RN077 is located approximately 12 river miles downstream of the parcel's northern boundary in a fourth-order section of the Pike River. These aquatic biota sampling stations recorded predominant stream substrate and fish assemblages at both locations and benthic macroinvertebrate assemblages at the first-order segment of the unnamed tributary to the Pike River, as summarized in Table 4.3.6-3 and 4.3.6-4.

Table 4.3.6-3 Fish Species Collected at the MPCA Sampling Sites in the Vicinity of the Tract 1 Parcel

			Site	
Scientific Name	**Common Name**	**Tolerance Designation[1]**	**MPCAB_ 05RN029 (individuals recorded)**	**MPCAB_ 05RN077 (individuals recorded)**
Catostomus commersonii	White sucker	Tolerant	9	1
Notemigonus crysoleucas	Golden shiner	Tolerant		3
Notropis hudsonius	Spottail shiner	Intermediate		6
Etheostoma nigrum	Johnny darter	Intermediate		19
Lota lota	Burbot	Intermediate		12
Ambloplites rupestris	Rock bass	Intermediate		1
Esox lucius	Northern pike	Intermediate		2
Culaea inconstans	Brook stickleback	Intermediate	8	
Umbra limi	Central mudminnow	Tolerant	7	43
Phoxinus neogaeus	Finescale dace	Intermediate	1	
Semotilus atromaculatus	Creek chub	Tolerant	3	2
Study year			2005	2009
Species observed			5	9
# intolerant species			0	0

Scientific Name	Common Name	Tolerance Designation[1]	Site: MPCAB_ 05RN029 (individuals recorded)	Site: MPCAB_ 05RN077 (individuals recorded)
Total abundance			28	89
Index of Biological Integrity (IBI)[2]			25	60
Predominant Substrate			sand	sand

Source: MPCA 2011c.

[1] Adapted from NCDENR 2006, Ohio EPA 1989, and Hubbs and Lagler 2007. Tolerance values indicate qualitative tolerances of physical and chemical disturbances.
[2] IBI is the sum of study specific metrics where 0 represents the worst fish assemblage conditions and 100 represents the best fish assemblage conditions (USEPA 2011a).
-- = no designation assigned.

Table 4.3.6-4 Benthic Macroinvertebrate Attributes for Aquatic Biota Sampling Site MPCAB_05RN029

Benthic Macroinvertebrate Attributes[1]	MPCAB_ 05RN029
EPT (mayfly, stonefly, caddisfly) Taxa	1
Ephemeroptera (mayfly) Taxa	1
Hilsenhoff's Biotic Index (HBI)	5.7
Intolerant Families	2
Percent Pollution Tolerant	3
Percent Chironomidae (midges)	69.5
Percent Diptera (true flies)	71.3
Percent Dominant Taxa	69.5
Percent Dominant Two Taxa	91.1
Percent Filterers	0.9
Percent Gatherers	92.3
Percent Hydropsychidae (net- spinning caddisflies)	0
Percent Scraper	0
Plecoptera (stonefly) Families	0
Total Families	11
Trichoptera (caddisfly) Families	0

Source: MPCA 2011c.

The majority of fish species found at the two sample sites were pollution-tolerant and intermediate species. The IBI score of 25 at sample location MPCAB_05RN029 was at the low end of the scale, indicating below-average fish communities existed. This is likely a function of the sampling location, as less diverse fish habitat may exist at headwater stream locations (Barbour et al. 1999).

The MPCAB_05RN077 fourth-order stream sampling site results did not identify any intolerant fish species; however, with increasing stream order, fish diversity increases (Barbour et al. 1999) but is variable, as exhibited by the abundance values of 28 and 89 fish, respectively, in the first- and fourth-order study site locations. The IBI score of 60 at this fourth-order sampling location indicates above-average fish communities and habitat exist. The dominant sand substrates, as opposed to silt substrate, and apparent wide riparian shoreline characteristics at these two sampling sites would also indicate quality fish habitat exists at the sampling sites.

The third-order sections of the Pike River within Tract 1 likely display similar fish habitats and communities compared to the two study locations.

Macroinvertebrate assemblages exhibited low Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa and were dominated by midges and true flies at the headwater sampling location referenced above for fish assemblages. The attributes collected for macroinvertebrates at this sampling site suggest diverse macroinvertebrate habitats were not present, which may be attributed to the headwater characteristics and substrate of the sampling site. The macroinvertebrate habitat available for the third-order segments of the Pike River within the Tract 1 parcel likely exhibit more diverse and high-quality habitats than the headwater macroinvertebrate sampling location.

Special Status Fish and Macroinvertebrates

No SGCN, state, federal, or RFSS species are known to occur within or in the immediate vicinity of Tract 1. Of the species listed as potentially occurring in the Nashwauk Uplands ecoregion or Superior National Forest (see Table 4.3.6-5), the northern brook lamprey and creek heelsplitter are the most likely species to occur at this parcel.

Suitable habitat for northern brook lamprey is likely to exist within Tract 1; however, the nearest known occurrence of this species is more than 19 miles from Tract 1.

Suitable habitat likely exists for the creek heelsplitter in the third-order segments of the Pike River within Tract 1, as the substrate likely contains adequate sand substrate and flow to provide habitat for this freshwater mussel species. Additionally, this species has been documented 0.5 mile upstream of the Sand and Pike rivers confluence, where the Pike River becomes a fourth-order stream (see Figure 4.3.6-2).

Table 4.3.6-5 SGCN and RFSS Species Identified Within Portions of the Nashwauk Uplands Ecoregion or Superior National Forest

Scientific Name	Common Name	Nashwauk Uplands Ecoregion SGCN	RFSS
Insects			
Chilostigma itascae	Headwaters chilostigman caddisfly		X
Somatochlora brevicincta	Quebec emerald		X
Williamsonia flechen	Ebony boghaunter		X
Fish			
Acipenser fulvescens	Lake sturgeon		X
Coregonus nipigon	Nipigon cisco		X
Coregonus zenithicus	Shortjaw cisco		X
Ichthyomyzon fossor	Brook lamprey	X	X
Mussels			
Lasmigona compressa	Creek heelsplitter	X	X
Ligumia recta	Black sandshell	X	X

Source: MDNR 2006d; USFS 2011d.

4.3.6.2.2 Tract 2 - Lake County Lands

No lakes or waterbodies are known to exist within Tract 2 (AECOM 2011d); therefore, no fish or macroinvertebrate habitats are present.

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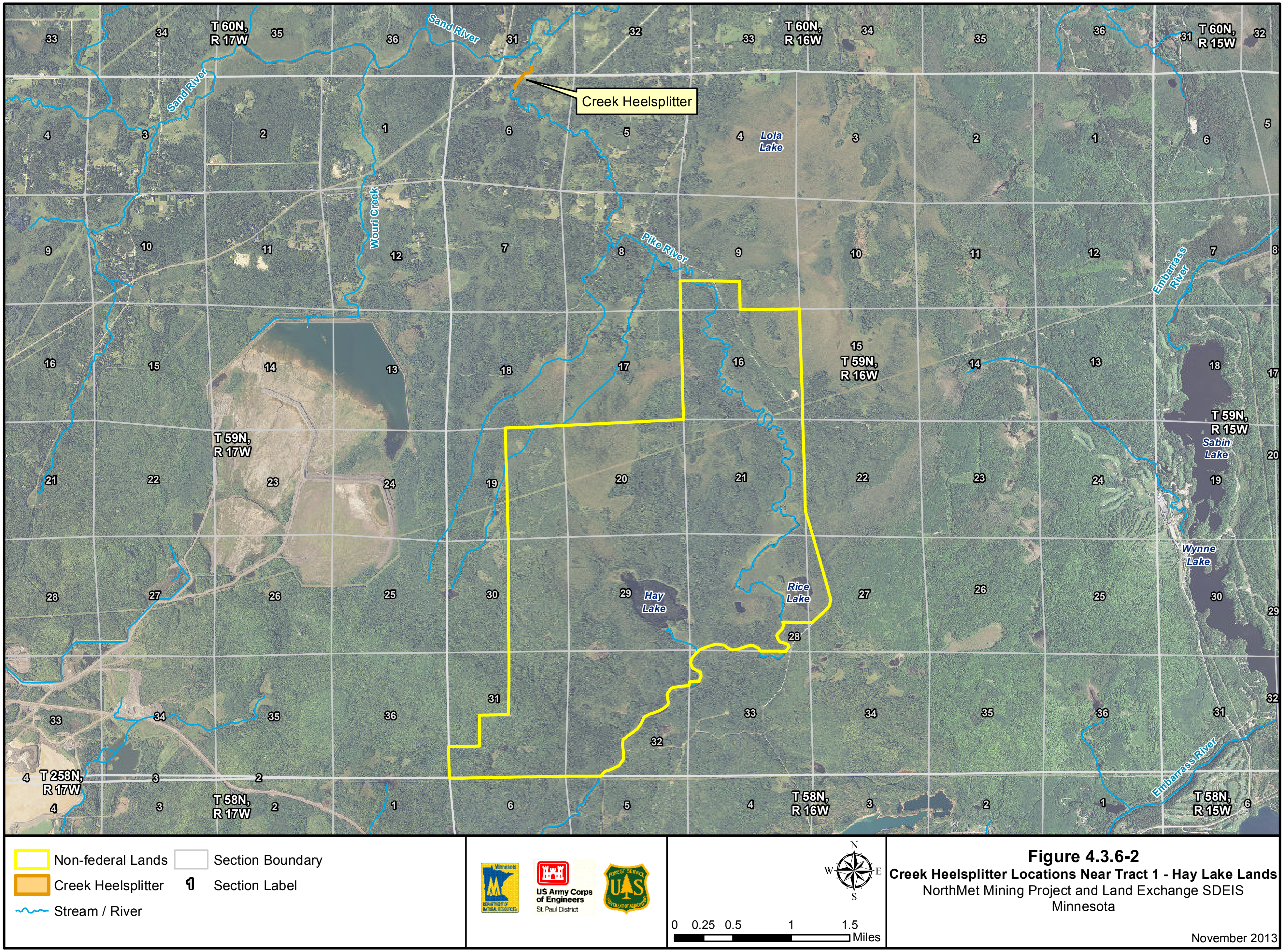

Figure 4.3.6-2
Creek Heelsplitter Locations Near Tract 1 - Hay Lake Lands
NorthMet Mining Project and Land Exchange SDEIS
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4.3.6.2.3 Tract 3 - Wolf Lands

Surface Water Features

Coyote Creek is the only surface water feature within the Wolf Lands 3 and 4. Wolf Lands 1 and 2 do not have surface water features. Coyote Creek is a headwater stream that begins in Wolf Lands 3 where it flows north for 0.1 mile within the parcel boundary and includes approximately 33 acres of floodplain. Coyote Creek continues north and flows for 0.9 mile within Wolf Lands 4 before continuing further north, and includes approximately 79 acres of floodplain. The heavily vegetated riparian habitats and associated floodplains adjacent to the river's edge likely provide important fish and macroinvertebrate habitats. Coyote Creek flows through two of the three lakes in the McDougal Lakes chain and becomes a third-order stream (see Figure 4.3.6-3) at its confluence with the Stony River approximately 4 river miles downstream from the northern boundary of Wolf Lands 4. Wolf Lands 3 and 4 exhibit a combined 16.1 ft of river frontage per acre. Aerial photograph review indicates a wide riparian vegetative buffer with minimal human disturbance where emergent sedge-meadow wetlands are adjacent to the creek within the Wolf Lands 3 parcel, and both emergent and scrub-shrub wetlands are adjacent to the creek within the Wolf Lands 4 parcel (AECOM 2011c). The riparian vegetative buffer adjacent to the creek segments offers shade, structure, and erosion control.

Much of the emergent wetlands adjacent to Coyote Creek within the Wolf Lands 3 parcel exhibited 18 to 24 inches of standing water (AECOM 2011c), which could provide high-quality headwater stream fish and macroinvertebrate habitats because wetlands provide nutrient-rich environments that would be accessible to fish and macroinvertebrates at the documented water depth. Additionally, these wetlands likely provide potential spawning habitat for fish species that require headwater wetland habitats for spawning.

The USFS MIH categories within the combined Wolf Lands parcels 3 and 4 boundaries include approximately 10,560 linear ft of creek shoreline.

Aquatic Biota Studies

No fish or macroinvertebrate studies have been completed along Coyote Creek within the two parcels; however, two MPCA aquatic biota studies (MPCAB_05RN024 and MPCAB_05RN074) were completed within the third- and fourth-order stretches of the Stony River, approximately 2 river miles and 4 river miles, respectively, downstream of the Coyote Creek and Stony River confluence, as indicated in Figure 4.3.6-3 (6 and 8 miles downstream of northern boundary of parcel Wolf Lands 4) (MPCA 2011c). Results from the two sampling events are summarized below in Table 4.3.6–6 and Table 4.3.6-7. The fish communities for both sampling sites appeared diverse and abundance was high. IBI scores for each site were high, indicating good to excellent fish habitat was likely present. Although high-quality fish habitat likely exists at the Coyote Creek stream locations within Wolf Lands 3 and 4, some, but not all, of the fish species observed at the Stony River sampling locations are likely present, as fish community diversity is likely less in headwater stream habitats.

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Non-federal Lands
Monitoring Station
Stream / River
Section Boundary
Section Label
Stream Order Number

0 0.25 0.5 1 1.5 Miles

Figure 4.3.6-3
Monitoring Sample Site Locations
Tract 3 - Wolf Lands
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A qualitative assessment of the benthic macroinvertebrate data below indicates a diverse community with attributes indicating little human disturbance or sedimentation at the Stony Creek sampling sites. The Coyote Creek headwater stretches of stream likely exhibit more siltation due to slower moving water typically observed in headwater streams in the region and, therefore, likely offer less diverse habitats for benthic macroinvertebrates compared to the two sampling sites summarized below.

Table 4.3.6-6 Fish Species Collected at Two Sites in the Vicinity of the Wolf Lands Parcels within the Stony River

			Site	
Scientific Name	**Common Name**	**Tolerance Designation[1]**	**MPCAB_ 05RN024 (number recorded)**	**MPCAB_ 05RN074 (number recorded)**
Catostomus commersonii	White sucker	Tolerant	21	4
Luxilus cornutus	Common shiner	Intermediate		23
Notemigonus crysoleucas	Golden shiner	Tolerant	2	84
Notropis hudsonius	Spottail shiner	Intermediate	19	11
Notropis heterolepis	Blacknose shiner	Intolerant	1	123
Notropis volucellus	Mimic shiner	Intolerant	6	29
Etheostoma nigrum	Johnny darter	Intermediate	8	2
Perca flavescens	Yellow perch	Intermediate	31	93
Sander vitreus	Walleye	Intermediate		2
Percina caprodes	Logperch	Intermediate	4	3
Lota lota	Burbot	Intermediate	85	3
Ambloplites rupestris	Rock bass	Intermediate		2
Esox lucius	Northern pike	Intermediate		12
Umbra limi	Central mudminnow	Tolerant	1	
Pimephales promales	Fathead minnow	Tolerant	6	
Rhinichthys cataractae	Longnose dace	Intolerant	177	
Noturus gyrinus	Tadpole madtom	Intermediate	7	7
Cottus bairdii	Mottled sculpin	Intolerant	19	
Study year			2005	2005
Species observed			14	14
# intolerant species			4	2
Total Abundance			387	398
Index of Biological Integrity (IBI)[2]			86	77
Predominant Substrate			rubble/cobble	na

Source: MPCA 2011c.

[1] Adapted from NCDENR 2006, Ohio EPA 1989, and Hubbs and Lagler 2007. Tolerance values indicate qualitative tolerances of physical and chemical disturbances.
[2] IBI is the sum of study specific metrics where 0 represents the worst fish assemblage conditions and 100 represents the best fish assemblage conditions (USEPA 2011b).
na = Not available
-- = no designation assigned.

Table 4.3.6-7 Benthic Macroinvertebrate Attributes for Aquatic Biota Sampling Sites within the Stony River

Benthic Macroinvertebrate Attributes[1]	MPCAB_ 05RN024	MPCAB_ 05RN074
EPT (mayfly, stonefly, caddisfly) Taxa	11	11
Ephemeroptera (mayfly) Taxa	5	5
Hilsenhoff's Biotic Index (HBI)	5.9	5.2
Intolerant Families	4	1
% Pollution Tolerant	10.3	26.1
% Chironomidae (midges)	55.5	17.2
% Diptera (true flies)	58.7	17.5
% Dominant Taxa	55.5	18.8
% Dominant Two Taxa	63.7	36
% Filterers	11.7	17.8
% Gatherers	75.4	50.2
% Hydropsychidae (net- spinning caddisflies)	1.4	11.9
% Scraper	5	25.4
Plecoptera (stonefly) Families	0	0
Total Families	23	27
Trichoptera (caddisfly) Families	6	6

Source: MPCA 2011c.

Special Status Fish and Macroinvertebrates

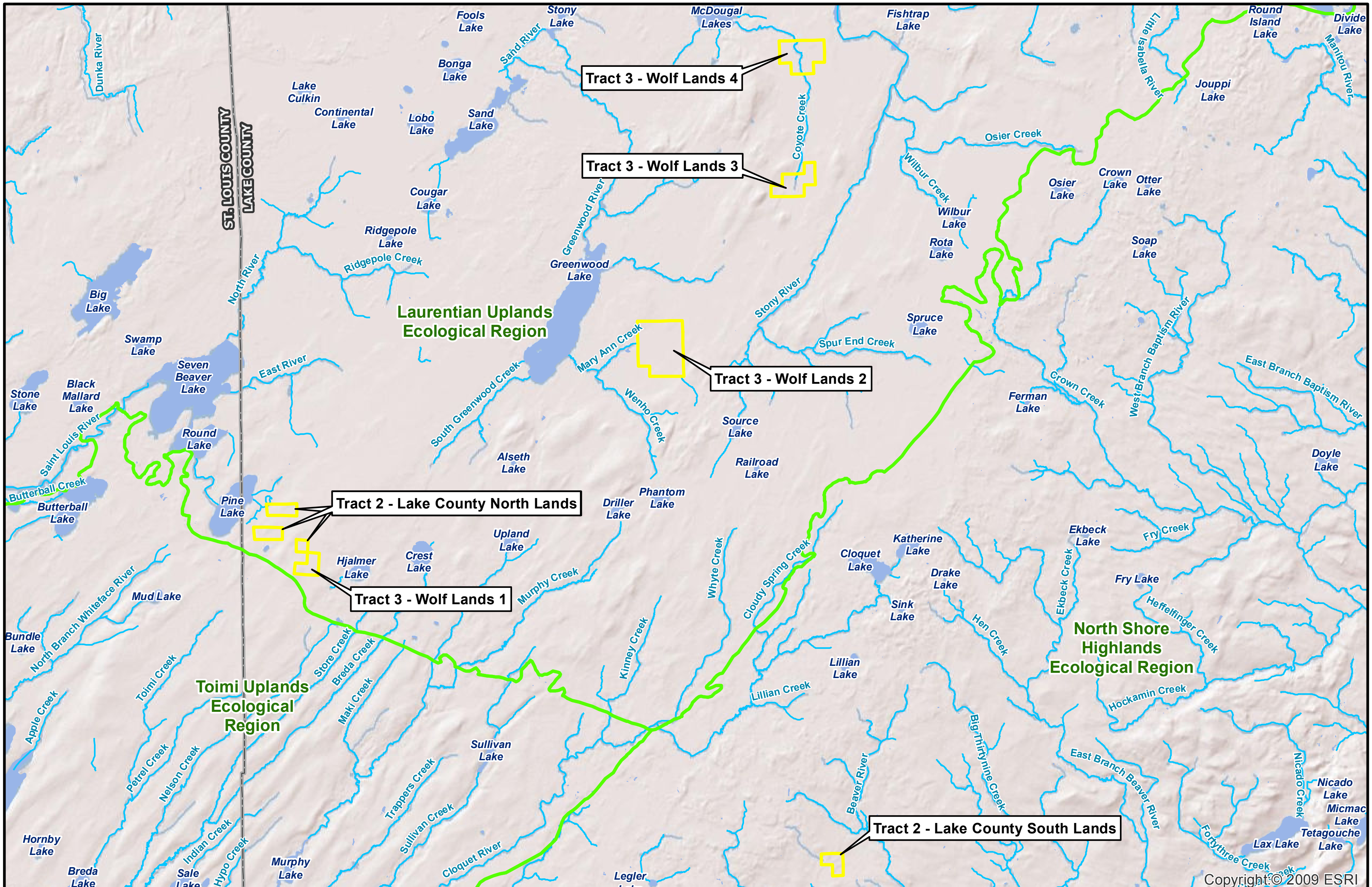
No SGCN, state, federal, or RFSS species are known to occur at or in the immediate vicinity of Tract 3. Of the species listed to potentially occur in the Laurentian Uplands ecoregion (see Figure 4.3.6-4) or Superior National Forest (see Table 4.3.6-8), the northern brook lamprey and creek heelsplitter are the most likely species to occur within Tract 3.

Suitable habitat for northern brook lamprey is likely to exist in Tract 3, although the nearest known occurrence of this species is more than 52 miles from the Wolf Lands parcels.

The creek heelsplitter has historically been found near the east and west confluence of the northernmost lake in the chain of McDougal Lakes and the Stony River in the third-order stretch of the Stony River (see Figure 4.3.6-5). The aquatic species habitat in the stretches of Coyote Creek within Wolf Lands 3 and 4 is unknown, but likely would display first-order headwater stream characteristics; it is unknown if the necessary aquatic species habitat for the creek heelsplitter is present on the parcels. However, the presence of the creek heelsplitter within the parcel boundary is possible but not likely, since Coyote Creek is a first-order stream.

Habitats for the other special status species described in Table 4.3.6-8 likely do not exist within the parcel boundary.

No invasive fish or macroinvertebrate species are known to exist on Tract 3.



Non-federal Lands

Ecological Regions

Stream / River

Lake / Pond

N
W E
S

0 1 2 4 Miles

Figure 4.3.6-4
Ecological Regions
Tract 2 - Lake County and Tract 3 - Wolf Lands
NorthMet Mining Project and Land Exchange SDEIS
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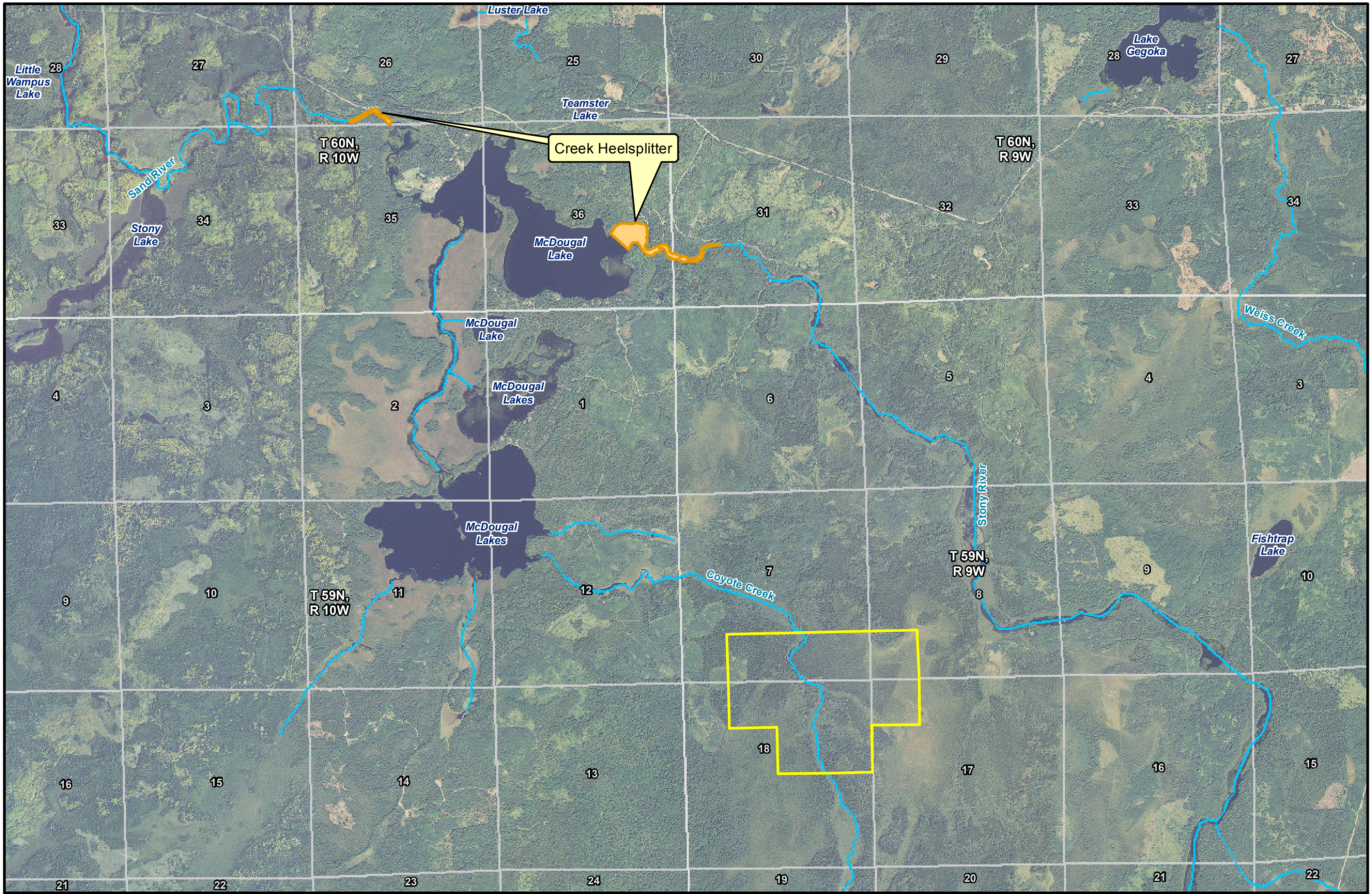

Non-federal Lands	Section Boundary
Creek Heelsplitter	1 Section Label
Stream / River	

US Army Corps of Engineers St. Paul District

0 0.25 0.5 1 Miles

Figure 4.3.6-5
Creek Heelsplitter Locations Near
Tract 3 - Wolf Lands 4
NorthMet Mining Project and Land Exchange SDEIS
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Table 4.3.6-8 SGCN and RFSS Species Identified Within Portions of the Laurentian Uplands Ecoregion or Superior National Forest

Scientific Name	Common Name	Laurentian Uplands Ecoregion SGCN	RFSS
Insects			
Chilostigma itascae	Headwaters chilostigman caddisfly		X
Somatochlora brevicincta	Quebec emerald		X
Williamsonia flechen	Ebony boghaunter		X
Fish			
Acipenser fulvescens	Lake sturgeon		X
Coregonus nipigon	Nipigon cisco		X
Coregonus zenithicus	Shortjaw cisco		X
Ichthyomyzon fossor	Brook lamprey		X
Mussels			
Lasmigona compressa	Creek heelsplitter	X	X
Ligumia recta	Black sandshell	X	X

Source: MDNR 2006d; USFS 2011d.

4.3.6.2.4 Tract 4 - Hunting Club Lands

Surface Water Features

No lakes or waterbodies are known to exist within Tract 4 (AECOM 2011d); therefore, no fish or macroinvertebrate habitats exist.

4.3.6.2.5 Tract 5 - McFarland Lake Lands

Surface Water Features

The only surface water feature within Tract 5 is the 990 ft of shoreline associated with McFarland Lake along the eastern parcel boundary. McFarland Lake is classified as an oligotrophic lake (MPCA 2011c) with a surface area of 384 acres and a maximum depth of 49 ft (MDNR 2011c). Aerial photograph review indicates minimal shoreline disturbance and a wide riparian vegetative buffer along the entire parcel boundary with McFarland Lake.

The MIH 14 category would include 990 linear ft of lake shoreline.

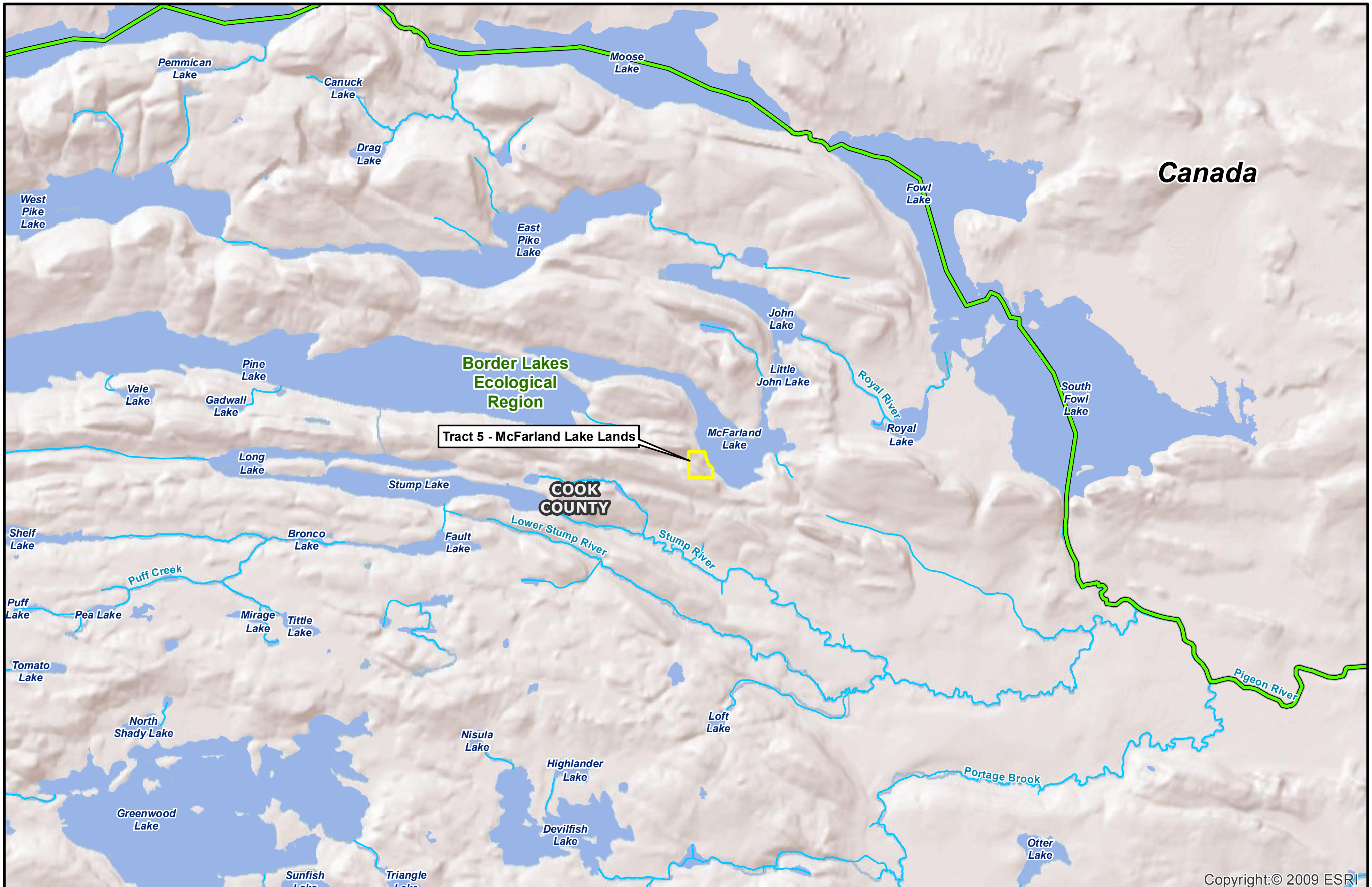
Aquatic Biota Studies

MDNR conducted a fishery assessment within McFarland Lake in 2003 and reported several game fish species including lake whitefish, northern pike, smallmouth bass, walleye, and yellow perch (MDNR 2011c). Tulibee and white sucker species were also recorded. These species are typical for large and deep lakes within the region.

Special Status Fish and Macroinvertebrates

No special status fish or macroinvertebrates are known to exist within Tract 5. A summary of the SGCN and RFSS species is provided in Table 4.3.6-9. The spoonhead sculpin, lake chub, and longear sunfish are known to occur within the Border Lakes ecoregion and could occur at Tract 5 (see Figure 4.3.6-6). These species are described below. Due to limiting habitat requirements and limited distribution, the remaining species listed in Table 4.6.3-9 likely are not present in McFarland Lake.

The invasive species, spiny water flea (*Bythotrephes longimanus*), has been documented in McFarland Lake. The spiny water flea is a species of zooplankton native to Europe and Asia that competes for food sources with other zooplankton species and fish.



Non-federal Lands
Ecological Regions
Stream / River
Lake / Pond

US Army Corps of Engineers
St. Paul District

N W E S

0 0.25 0.5 1 1.5 Miles

Figure 4.3.6-6
Ecological Regions
Tract 5 - McFarland Lake Lands
NorthMet Mining Project and Land Exchange SDEIS
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Table 4.3.6-9 SGCN Species for the Border Lakes Ecoregion and the USFS RFSS Species List

Scientific Name	Common Name	Border Lakes Ecoregion SGCN	RFSS
Insects			
Chilostigma itascae	Headwaters chilostigman caddisfly		X
Somatochlora brevicincta	Quebec emerald		X
Williamsonia flechen	Ebony boghaunter		X
Fish			
Acipenser fulvescens	Lake sturgeon	X	X
Coregonus nipigon	Nipigon cisco	X	X
Coregonus zenithicus	Shortjaw cisco	X	X
Cottus ricei	Spoonhead sculpin	X	
Couesius plumbeus	Lake chub	X	
Ichthyomyzon fossor	Brook lamprey	X	X
Lepomis megalotis	Longear sunfish	X	
Mussels			
Lasmigona compressa	Creek heelsplitter	X	X
Ligumia recta	Black sandshell	X	X

Source: MDNR 2006d; USFS 2011d.

Spoonhead Sculpin

The spoonhead sculpin is a bottom dwelling fish that inhabits rocky areas of swift creeks and rivers; however, this species can also be found in lakes. They primarily feed on planktonic crustaceans and aquatic insect larvae and are native to Minnesota (Froese & Pauly 2011). Much of the fish and macroinvertebrate habitat and substrate information are not currently known about the lake features associated with McFarland Lake. Although the habitat characteristics for McFarland Lake were not readily known, it is possible the spoonhead sculpin species exists in McFarland Lake.

Lake Chub

Lake chubs have a secure distribution in Lake Superior, but have shown declining distribution in Minnesota inland lakes. Their preferred habitat includes shallow areas of deep lakes, especially near river mouths (Stasiak 2006). The habitat needs for the lake chub likely exist in McFarland Lake.

Longear Sunfish

The longear sunfish is found in lake and stream habitats, which include high-quality waters with shallow (less than 3 ft) shorelines exhibiting firm, detritus rich substrates and extensive submerged vegetation. Only 37 Minnesota lakes and streams have confirmed populations of this fish species (Porterfield & Ceas 2008). The physical attributes of McFarland Lake are not widely available; however, the habitat requirements for the longear sunfish likely exist in portions of McFarland Lake.

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4.3.7 Air Quality

The NorthMet Project Proposed Action is subject to various federal and State of Minnesota air quality regulations. The State of Minnesota has been granted permitting authority by the USEPA and, therefore, the NorthMet Project Proposed Action will be issued a single permit by the State of Minnesota.

4.3.7.1 Federal Lands

The federal lands of the Land Exchange Proposed Action are similar to the Mine Site previously discussed, but exclude the privately owned land bordering Dunka Road to the south of the Mine Site. Section 4.2.7.1 provides a discussion of the existing conditions on the federal lands.

4.3.7.2 Non-federal Lands

The non-federal parcels are all privately owned. No current operations or activities are proposed on the non-federal lands that would result in a change to ambient air quality as part of the Land Exchange Proposed Action.

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4.3.8 Noise and Vibration

4.3.8.1 Federal Lands

The topography and land cover of the federal lands in the Land Exchange Proposed Action and the Land Exchange Alternative B are similar to that of the Mine Site, as previously discussed, but extend further north and west (mostly wetlands) and exclude the privately owned land bordering Dunka Road to the south of the Mine Site. Section 4.2.8.2 provides a discussion of the existing noise and vibration conditions on the federal lands.

4.3.8.2 Non-federal Lands

The non-federal lands in the Land Exchange Proposed Action consist of up to five tracts totaling 7,075.0 acres that are located within the Superior National Forest proclamation boundary, a sparsely populated rural region in northeast Minnesota. The tracts are predominantly forest and wetland habitat. Tracts 1, 2, and 3 are 13 to 27 miles from the federal lands, while Tracts 4 and 5 are 46 and 91 miles from the federal lands, respectively (see Table 4.3.8-1 and Figure 4.3.8-1).

Table 4.3.8-1 Approximate Distances and Direction of Non-federal Lands to Federal Lands and the Plant Site

Tract	Approximate Distance to Federal Lands (miles)	Approximate Distance to Plant Site (miles)	Direction from Federal Lands and Plant Site
Tract 1 – Hay Lake	15	10	West
Tract 2 – Lake County			
Lake County North	13	20	Southeast
Lake County South	27	34	Southeast
Tract 3 – Wolf Lands			
Wolf Lands 1	14	20	Southeast
Wolf Lands 2	18	26	Southeast
Wolf Lands 3	18	26	Southeast
Wolf Lands 4	18	26	East
Tract 4 – Hunting Club	46	43	Northwest
Tract 5 – McFarland Lake	91	100	Northeast

Review of the most-up-to-date aerial maps indicates that there are no noise-sensitive areas or receptors (e.g., residences, schools, campgrounds, or national wilderness areas) within the non-federal lands. However, people currently hunt within Tract 1 and Tract 4 due to the presence of wildlife. Wildlife species within each tract are described in Section 4.3.5. There are a few residential receptors outside the non-federal lands. Figure 4.3.8-1 shows the locations of the closest receptors to the non-federal lands.

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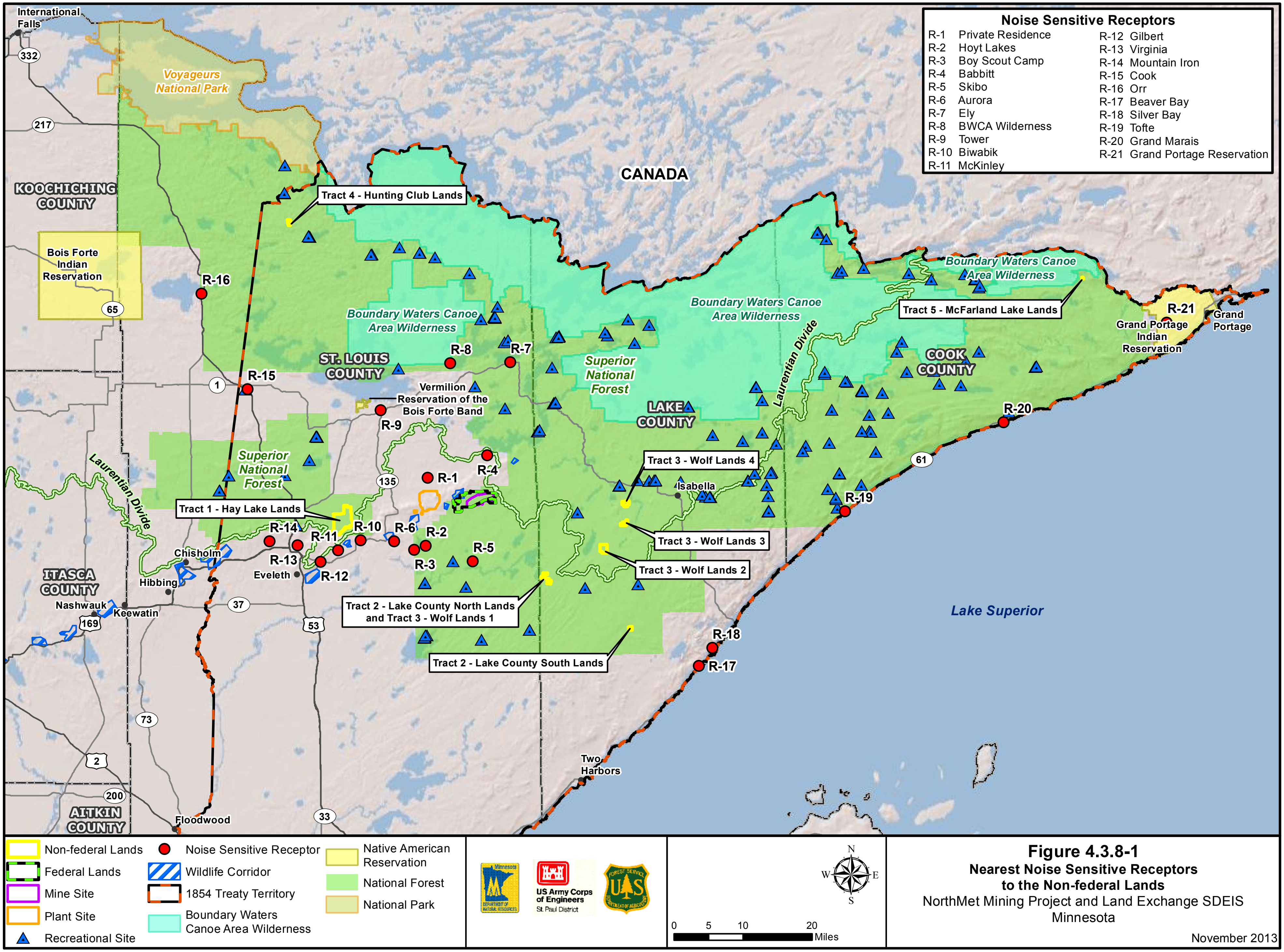

Figure 4.3.8-1
Nearest Noise Sensitive Receptors to the Non-federal Lands
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The non-federal lands would be managed consistent with the adjacent forest lands (see Section 4.3.1), and the USFS currently has no plans for operations on the non-federal lands. Since the non-federal lands are located in a forested and rural environment, the existing ambient L_{eq} at the five tracts has been assumed to be 5 dB lower than the levels shown in Table 4.2.8-2 for the Mine Site and Plant Site. This means that existing daytime and nighttime ambient L_{eq} for all non-federal lands are not expected to exceed 40 and 30 dB, respectively. The estimated L_{eq} for the statistical distribution was converted to other noise percentile metrics, such as L_{50} and L_{10}, using a USEPA calculation methodology (USEPA 1974). The calculation was based on an assumed standard deviation of 3 dB for the sound level statistical distribution. A summary of the estimated daytime and nighttime ambient L_{eq}, L_{50}, and L_{10} levels expected at the tracts is presented in Table 4.3.8-2.

Table 4.3.8-2 Summary of Estimated Existing Ambient Noise Levels at the Non-federal Lands

Ambient Noise Level Metric	Daytime (dBA)	Nighttime (dBA)
L_{eq}	40	30
L_{50}	39	29
L_{10}	42.8	32.8

Currently, no ground- or air-vibrating sources or activities (e.g., mine blasting or pile driving) exist within a 15-mile radius of the non-federal lands. The closest vibration-generating activities include operation of the coal and flux pulverizer and rotary hearth furnace at the Mesabi Phase I Plant in Hoyt Lakes (approximately 9 miles west of Tract 1, which is the closest non-federal tract) and blasting at the Northshore Mine (approximately 16 miles northwest of the closest tract [Tract 2]). Since ground and air vibration effects diminish with distance from the source, existing levels of vibration at the sensitive receptors are expected to be negligible.

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4.3.9 Cultural Resources

4.3.9.1 Federal Lands

4.3.9.1.1 Land Exchange Proposed Action

The federal lands within the Land Exchange Proposed Action area is similar to the Mine Site portion of the NorthMet Project area previously discussed, but extends further north and west and excludes the privately-owned land bordering Dunka Road to the south of the Mine Site. The Land Exchange Proposed Action APE for both direct and indirect effects consists of the entire land exchange boundary. Section 4.2.9 provides further discussion of the existing conditions on the Mine Site and associated federal lands. Cultural resources identified within the Land Exchange Proposed Action area consisted of archaeological sites and properties and natural resources of religious and cultural significance to the Bands.

As a result of Phase I cultural resources surveys and consultation with the Bands and the SHPO concerning the results of identification efforts for properties of religious and cultural significance to the Bands, three cultural resources have been identified within the Land Exchange area: the BBLV Trail, NorthMet Archaeological Site, and Knot Logging Camp. For detailed property descriptions and discussions of eligibilities, please see Section 4.2.9.

The federal Co-lead Agencies continue consultation with the Bands and the Minnesota SHPO as determinations are made concerning NRHP eligibility of identified resources, NorthMet Project Proposed Action effects on historic properties, and resolution of any adverse effects.

The investigations completed to date in the Land Exchange Proposed Action area have identified cultural resources as summarized in Table 4.3.9-1 below.

Table 4.3.9-1 Cultural Resources Identified in the Land Exchange Area

Resource ID	Resource Name	Resource Type	NRHP Determination by Co-lead Agencies	SHPO Concurrence with Co-lead Agencies' Findings
SL-HLC-pending	BBLV Trail[1]	Archaeological Site	Eligible	Pending
21SL pending	NorthMet Archaeological Site	Archaeological site	Not Eligible	Pending
21SLmn	Knot Logging Camp	Archaeological site	Not Eligible	Concur

[1] USFS designation BBLV Trail Segment #1 (USFS #01-569).

The 1854 Treaty resources located within the Land Exchange Proposed Action would be similar to the Mine Site portion of the NorthMet Project area previously discussed in Section 4.2.9. Section 4.2.9 provides further discussion of the existing conditions on the Mine Site and associated federal lands.

An analysis of whether any particular property associated with the Bands' exercise of their usufructuary rights may be considered a TCP is limited by lack of available information regarding Band members' traditional exercise of those rights. Determining how the Bands have traditionally conducted their usufructuary rights on or near the Land Exchange Proposed Action area would only be available through a detailed ethnographic study of individual Band members and their families. The cultural resources investigations included Band member interviews with Bois Forte, Fond du Lac, and Grand Portage, although only Bois Forte's results were made available. The results of the interviews and the cultural resources investigation did not find any natural resources that would be considered a TCP or other traditional cultural place.

4.3.9.1.2 Land Exchange Alternative B

All of the cultural resources and 1854 Treaty resources identified and discussed in Section 4.3.9.1.1 are located within the Land Exchange Alternative B.

4.3.9.2 Non-federal Lands

The non-federal lands that would be going into federal ownership would not be of primary concern for cultural resources since future management of these lands would be as per the Forest Plan direction for cultural resources. As such, any cultural resources that may occur on these lands would receive greater protection under NHPA than they are currently receiving.

The Land Exchange Alternative B represents an exchange of private and federal land, but it is also represents an exchange of access to natural resources expressed in treaties made between the United States and Bands of Ojibwe Indians in the 19th Century. Due to the nature of a land exchange, therefore, the 1854 Treaty resources would be available for resource gathering and subsistence use by the Bands and would receive greater protection under federal law than they are currently receiving.

4.3.10 Socioeconomics

The Land Exchange Proposed Action study area for socioeconomics is the same as for the NorthMet Project Proposed Action: all of Cook, Lake, and St. Louis counties, as well as individual cities in St. Louis County (see Figure 4.2.10-1). This geography includes the federal and non-federal tracts. Socioeconomic data are not available, and thus are not reported, for the individual non-federal tracts and their parcels.

The federal lands are similar to that of the Mine Site previously discussed, but exclude the privately owned land bordering Dunka Road to the south of the Mine Site. Section 4.2.10.1 provides additional discussion of the existing conditions on the federal lands. The socioeconomic information in Section 4.2.10.1 broadly applies to the study area, which encompasses all of the non-federal parcels involved in the Land Exchange Proposed Action. The following provides additional information as it relates to the federal and non-federal parcels.

4.3.10.1 Economic Activity

There is no ongoing forestry activity on the federal lands and no evidence of recent past forestry activity. The non-federal parcels are all privately owned or otherwise have no official public access. There is some evidence of timber harvesting on Tracts 2, 3, and 4; this activity could generate income, employment, or revenue.

4.3.10.2 Recreation

Recreation in national forests can generate direct revenue to the USFS and the state in the form of entry fees and hunting and fishing license fees, as well as via indirect economic activity related to the multiplier effect of such activity (e.g., purchase of fishing tackle and bait).

In 2006 (the most recent year for which data are available), there were approximately 1,376,000 recreational visits to Superior National Forest (USFS 2012). “Recreational,” as used in USFS 2010, is very broadly defined, and primarily distinguishes (and excludes) transient visitors such as commuters or for restroom visits. On average, visitors to the forest spent $643 per visiting party per day (i.e., the group participating in the visit, such as a family).

Currently, the federal lands are not easily accessible. The non-federal parcels are all privately owned or otherwise have no official public access, although evidence of recreational activity has been observed on some of these parcels. Such activity is discussed in Section 4.2.11.

4.3.10.3 Other Socioeconomic Characteristics

Currently, there is no demand for public safety services on the inaccessible federal lands and only limited demand on the non-federal lands. As described in Section 4.2.11, the non-federal parcels generally consist of undeveloped woodlands, wetlands, and other natural features. There is evidence of past extractive activity (quarrying and/or borrowing of sand and gravel) and ongoing private recreational hunting and fishing on Tract 1. Tract 5 was previously used by Wheaton College. In their current state, the non-federal parcels have minimal, if any, effect on public services and facilities.

Subsistence activity, as it relates to the federal lands, is described in Section 4.2.10.1.6. There is no available information that any of the non-federal tracts are being used for this purpose.

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4.3.11 Recreation and Visual Resources

4.3.11.1 Federal Lands

4.3.11.1.1 Land Exchange Proposed Action

Recreational Resources

The federal lands fall within the Semi-Primitive Motorized and Roaded Natural ROS designations, as shown in Table 4.3.11-1. These designations are defined in Section 4.2.11.1.1.

Table 4.3.11-1 Recreational Opportunity Spectrum Designations within the Land Exchange Proposed Action and Land Exchange Alternative B

Recreational Opportunity Spectrum Designation	Total Acreage
Land Exchange Proposed Action Federal Lands	
Semi-Primitive Motorized	5,528.4
Roaded Natural	967.0
Land Exchange Alternative B Federal Lands	
Semi-Primitive Motorized	4,276.5
Roaded Natural	476.1

Visual Resources

The visual resources surrounding the federal lands, visual receptors near the federal lands, and SIO designation of the federal lands are discussed in Section 4.2.11.1.2. SIO designations are also summarized in Table 4.3.11-2.

Table 4.3.11-2 Scenic Integrity Objective Designations for Lands under the Land Exchange Proposed Action and Land Exchange Alternative B

Scenic Integrity Objective Designation	Total Acreage
Land Exchange Proposed Action Federal Lands	
Low Scenic Integrity Objective	6,495.6
No Designation[1]	30.5
Land Exchange Alternative B Federal Lands	
Low Scenic Integrity Objective	4,743.7
No Designation[1]	8.9

[1] USFS does not designate SIO for bodies of water, such as Mud Lake, which is part of the federal lands. Only a portion of Mud Lake falls within the footprint of the Land Exchange Alternative B.

4.3.11.1.2 Land Exchange Alternative B

The recreational and visual conditions for the federal lands in Land Exchange Alternative B are similar to the federal lands in the Land Exchange Proposed Action. Acreage of ROS and SIO designations for the Land Exchange Alternative B are summarized in Tables 4.3.11-1 and 4.3.11-2.

4.3.11.2 Non-federal Lands

All of the non-federal lands are privately owned; those not already owned by PolyMet are under options to purchase by PolyMet. Thus, there are no current public recreation opportunities on any of the tracts. The amount of private recreational activity on the non-federal lands is described below, based on aerial photography, research, and field visits conducted in October 2011. For reference, ownership surrounding the non-federal lands is shown in Figures 4.3.1-2, 4.3.1-3, and 4.3.1-4.

4.3.11.2.1 Forest Service Recreation Designations

The ROS designations for areas surrounding the non-federal lands are summarized in Table 4.3.11-3. The Semi-Primitive Motorized and Roaded Natural ROS designations are defined in Section 4.2.11.1.1. The Semi-Primitive Non-Motorized designation is similar to the Semi-Primitive Motorized, except that motor vehicles are not permitted.

Table 4.3.11-3 Recreational Opportunity Spectrum Designations in the Vicinity of Non-federal Lands

Tract	Adjacent/Nearby ROS Designations
1 – Hay Lake Lands	Semi-Primitive Motorized, Semi-Primitive Non-Motorized, and Roaded Natural
2 – Lake County Lands	Semi-Primitive Non-Motorized (Lake County South); Semi-Primitive Motorized, and Semi-Primitive Non-Motorized (Lake County North)
3 – Wolf Lands	Semi-Primitive Motorized and Roaded Natural
4 – Hunting Club Lands	Semi-Primitive Motorized
5 – McFarland Lake Lands	Semi-Primitive Non-Motorized and Semi-Primitive Motorized

4.3.11.2.2 Regional Recreational Resources

The Superior National Forest, including the BWCAW, and Voyageurs National Park are important recreation areas in northeastern Minnesota. The Superior National Forest includes approximately 3 million acres and provides recreation opportunities for camping, boating, fishing, hiking, viewing scenery, off-highway vehicle riding, wilderness related recreation, snowmobiling, and cross country skiing. Located 20 miles to the north of the NorthMet Project area, the million–plus-acre BWCAW is protected as part of the National Wilderness Preservation System. Voyageurs National Park is located approximately 50 miles north of the NorthMet Project area (see Figure 1-1). In addition, there are year-round recreation opportunities at Giants Ridge (approximately 15 miles east of the Mine Site) that include downhill skiing, snowboarding, cross-country skiing, snowmobiling, mountain biking, hiking, and golf. There are also opportunities for biking, hiking, roller-blading on the Mesabi Trail which spans 70 miles across the Iron Range.

4.3.11.2.3 Forest Service Scenic Integrity Designations

The non-federal lands are all within the Superior National Forest proclamation boundary and are surrounded by relatively flat terrain covered in forests and wetlands. Some of the tracts are located within a few miles of towns, mines, and active forestry activity. The Mine Site would not be visible from any of the non-federal tracts. SIO designations for portions of Superior National Forest surrounding the five tracts are summarized in Table 4.3.11-4. Definitions of the SIO designations are provided in Section 4.2.11.1.2.

Table 4.3.11-4 Scenic Integrity Objective Designations in the Vicinity of Non-federal Lands

Tract	Adjacent/Nearby SIO Designations
1 – Hay Lake Lands	High, Moderate, Low
2 – Lake County Lands	Moderate (Lake County South); Low, Moderate (Lake County North)
3 – Wolf Lands	Low (Wolf Lands 2, 4); Low, Moderate (Wolf Lands 1); Low, High (Wolf Lands 3)
4 – Hunting Club Lands	Moderate
5 – McFarland Lake Lands	High

4.3.11.2.4 Tract 1 – Hay Lake Lands

Recreation

Tract 1 exhibits evidence of recreational activity. Several trails cross the parcel, including trails that intersect with County Road 715; most of these trails are either bermed or gated and some are signed with No Trespassing signs. Hay Lake and Rice Lake are accessible by canoe on the Pike River. Deer and evidence of bear were observed, as were two deer stands (others are believed to exist) (ERM 2011b). A sand and gravel pit in the northeastern portion of the parcel show evidence of use as a shooting range and/or hunting site. A boat landing and small parking area (not listed or mapped as a MDNR access point) are present near the southeastern corner of the parcel on Rice Lake.

Visual Resources

Tract 1 covers 4,926.3 acres that contain three lakes (see Figure 4.3.11-1). This tract is crossed by County Road (CR) 175 and CR 135 (both of which are known as Pike River Road) and the Pike River. Tract 1 can be viewed from Pike River Road and nearby Pike Mountain. Tract 1 is roughly 3 miles north-northwest of Biwabik; however, the flat terrain prevents the tract from being viewed from the town. The portions of Superior National Forest surrounding this parcel have Low SIO designations, with some Moderate designations near the northeastern and southwestern corners, and High designations to the north.

Figure 4.3.11-1 The Hay Lake Tract: Looking North along the Pike River

4.3.11.2.5 Tract 2 – Lake County Lands

Recreation

The Tract 2 parcels all have very limited access. There is no evidence of recreational activity or hunting on any of these parcels.

Visual Resources

Tract 2 consists of four individual parcels, and is referred to as Lake County North and Lake County South, totaling 381.9 acres. The three Lake County North sub parcels are located southeast of Pine Lake and approximately 13 miles southeast of the federal lands, and are not visible from Pine Lake Road, the nearest public road. The portions of Superior National Forest surrounding these parcels have Low and Moderate SIO designations (see Figure 4.3.11-2). The Lake County South parcel is approximately 27 miles southeast of the federal lands. Due to flat terrain and the remote nature of the southern site, it is not visible from public roads or other public areas. The portions of Superior National Forest surrounding this parcel have Moderate SIO designations.

Figure 4.3.11-2 Looking East from the Northwest Corner of Lake County North, Southern Sub-Parcel

4.3.11.2.6 Tract 3 – Wolf Lands

Recreation

The Tract 3 parcels all have very limited access. A rough forest road provides access to Wolf Lands 3, and a trail accesses Coyote Creek. No trails were observed on any of the other parcels during site visits, and there is no evidence of recreational activity or hunting on any of the Tract 3 lands.

Visual Resources

Tract 3 consists of four separate parcels totaling 1,575.8 acres, and is made up of level land containing wetlands, bogs, and forests. Wolf Lands 1 is located southeast of Pine Lake and may be visible from Nelson Road. The portions of Superior National Forest surrounding this parcel have Low and Moderate SIO designations. Wolf Lands 2 is due east of Greenwood Lake and may be visible from a private road to the east of the property. The portions of Superior National Forest surrounding this parcel have Low SIO designations. Wolf Lands 3 has recently been logged and may be visible from Forest Route 393 (see Figure 4.3.11-3). The portions of Superior National Forest surrounding this parcel have Low SIO designations, with a corridor of High SIO land along the southeastern boundary. Wolf Lands 4 is visible from Forest Routes 103 and 393. The portions of Superior National Forest surrounding this parcel have Low SIO designations.

Figure 4.3.11-3 The Wolf Lands, Looking Northwest along Coyote Creek

4.3.11.2.7 Tract 4 – Hunting Club Lands

Recreation

Tract 4 is currently accessible via a private road. One trail passes close to the southern boundary of the site. There is no evidence of recreational activity or hunting on this parcel.

Visual Resources

Tract 4 is comprised of 160.2 acres and is approximately 50 miles northwest of the federal lands. It is level, remote, and surrounded by other forested lands (see Figure 4.3.11-4). There are no public roads leading into or directly around the parcel. Two small public roads are within two miles of the parcel but are screened from view by vegetation and terrain. The portions of Superior National Forest surrounding this parcel have Moderate SIO designations.

Figure 4.3.11-4 Wetland on the Hunting Club Lands Parcel

4.3.11.2.8 Tract 5 – McFarland Lake Lands

Recreation

Legal access to Tract 5 is limited to water access, although a private cart road exists at the edge of the property, as does a trail along the lake shore. There is no evidence of current recreational activity or hunting on this parcel. However, Tract 5 was previously owned by Wheaton College. A bunk house, fire pit, outhouse, and cistern (all unused and in disrepair) remain on site, indicating past use for recreational activities; however, all structures would be removed upon completion of the Land Exchange Proposed Action.

Visual Resources

Tract 5 encompasses 30.8 acres situated on the western shore of McFarland Lake (see Figure 4.3.11-5). The parcel is visible from the northern, eastern, southern, and portions of the western shore of McFarland Lake. County Road 74 and Woolys Bluff run along the southern and southeastern perimeter of McFarland Lake, but are substantially screened from viewing the parcel due to vegetation and flat terrain. A limited number of lakefront homes, private piers, and a public access point on the eastern shore of the lake have views of the McFarland Lake property. The portions of Superior National Forest surrounding this parcel have High SIO designations.

Figure 4.3.11-5 McFarland Lake from the McFarland Lake Tract

4.3.12 Wilderness and Other Special Designation Areas

4.3.12.1 Federal Lands

4.3.12.1.1 Land Exchange Proposed Action

The federal lands of the Land Exchange Proposed Action are similar to the Mine Site previously discussed, but exclude the privately owned land bordering Dunka Road to the south of the Mine Site. Section 4.2.12.1 provides a discussion of the existing conditions on the federal lands.

4.3.12.1.2 Land Exchange Alternative B

The federal lands included in the Land Exchange Alternative B are similar to the federal lands in the Land Exchange Proposed Action. Section 4.2.12.1 discusses the existing conditions on the federal lands.

4.3.12.2 Non-federal Lands

The non-federal lands comprise five tracts (groups of parcels) assembled by PolyMet for the purpose of the Land Exchange Proposed Action.

4.3.12.2.1 Tract 1 – Hay Lake Lands

Adjacent cRNAs include the Pike Mountain and Loka Lake cRNAs (southwest corner and northeast corner of the tract, respectively). Pike Mountain is a 709-acre research area located on top of the Mesabi Range, characterized by old growth northern hardwood communities (sugar maple and red oak), paper birch forest, and rock/talus communities. The Loka Lake cRNA is part of an extensive peatland dominated by stunted black spruce and tamarack with interspersed upland islands (USFS 2011h).

4.3.12.2.2 Tract 2 – Lake County Lands

There are no wilderness or other special designation areas in or adjacent to Tract 2.

4.3.12.2.3 Tract 3 – Wolf Lands

There are no wilderness or other special designation areas in or adjacent to Tract 3.

4.3.12.2.4 Tract 4 – Hunting Club Lands

There are no wilderness or other special designation areas in or adjacent to Tract 4.

4.3.12.2.5 Tract 5 – McFarland Lake Lands

This tract includes lakefront property on McFarland Lake, an entry point to the BWCAW. Access to the property is available by water from a landing off County Road 16 (Arrowhead Trail) approximately 10 miles north of Hovland, Minnesota. While near the BWCAW, this tract is located outside the BWCAW boundary. There are no other wilderness or other special-designation areas in or adjacent to Tract 5.

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4.3.13 Hazardous Materials

There are no proposed operations or activities that involve the use of hazardous materials on the federal or non-federal lands associated with the Land Exchange Proposed Action. AOCs associated with contamination by hazardous materials from former activities and operations on these lands are discussed in Section 4.3.1.

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4.3.14 Geotechnical Stability

The Land Exchange Proposed Action does not include the creation or modification of geotechnical features. As such, the current geotechnical conditions at lands proposed for exchange are not considered relevant to the EIS. The existing geotechnical conditions underlying the NorthMet Project Proposed Action stockpiles that would be located on federal lands proposed for exchange are discussed in Section 4.2.14.

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