ALTERNATIVE SCREENING EVALUATION

TWIN METALS MINNESOTA PROJECT

Environmental Review Support Document

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REVISION RECORD

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REVISION NARRATIVE

DISCLAIMER

This document is a working document. This document may change over time because of new information, or further analysis or deliberation.

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LIST OF ABBREVIATIONS, ACRONYMS, AND SYMBOLS

%	percent
§	Section
BLM	Bureau of Land Management
BWCAW	Boundary Waters Canoe Area Wilderness
CFR	Code of Federal Regulations
EIS	Environmental Impact Statement
EQB	Environmental Quality Board
ft	feet / foot
km	kilometer
LEDPA	least environmentally damaging practicable alternative
LLR	longitudinal longhole retreat
m	meter
MDNR	Minnesota Department of Natural Resources
MEPA	Minnesota Environmental Policy Act
MPO	Mine Plan of Operation
NEPA	National Environmental Policy Act
NFR	National Forest Road
RGU	Responsible Governmental Unit
SEAW	Scoping Environmental Assessment Worksheet
TH	Trunk Highway
TMM	Twin Metals Minnesota LLC
tpd	tons per day

1.0 INTRODUCTION

The Twin Metals Minnesota LLC (TMM) Project (Project) is focused on designing, permitting, constructing, and operating an underground copper, nickel, cobalt, platinum, palladium, gold, and silver mining project. Located approximately nine miles (14 kilometers [km]) southeast of Ely, Minnesota, and 11 miles (18 km) northeast of Babbitt, Minnesota, the Project targets valuable state, federal, and private minerals within the Maturi deposit, which is a part of the Duluth Complex geologic formation.

All potential Project infrastructure locations presented herein are considered preliminary and are undergoing further design and engineering evaluations which will dictate final design and locations. Further information about TMM and the Project is located at http://www.twin-metals.com/.

The purpose of this document is to provide necessary information for the environmental review and permitting process. TMM retained Foth infrastructure & Environment, LLC to complete an alternative screening evaluation.

1.1 Context of the Document

This document is prepared to inform the state and federal environmental review processes as the Project enters the scoping phase subsequent to submittal of the Mine Plan of Operations (MPO) and Scoping Environmental Assessment Worksheet (SEAW) initial data submittal. TMM is committed to providing the Bureau of Land Management (BLM) and the Minnesota Department of Natural Resources (MDNR) the information they need to meet their obligation to take a hard look at the potential impacts of the Project and selected alternatives in the Environmental Impact Statements (EIS) process. This document is designed to support and document informed alternative selection and not to finalize decisions that may be refined at later stages of public comment and federal and state agency review in the environmental review processes.

TMM acknowledges that the decision on which alternatives to include in the EIS processes lies within the authority of the BLM and MDNR through the respective scoping processes. This document will be revised as scoping progresses to respond to and include reasonable alternatives identified during agency review and public comment periods.

This alternatives evaluation document meets several objectives including enabling TMM to achieve the purpose and need for the Project, ensuring compliance with federal and state regulatory requirements, assisting federal and state agency solicitation of input of all stakeholders through the process, documenting a complete and clear record of analyses, and selection of alternatives. For environmental review purposes, a project alternative is a means of accomplishing the purpose and need by modifying those project elements that fundamentally define the project's business case and the scale of its environmental effects, such as mining rates, processing methods, plant locations, and tailing storage configurations.

Scoping is part of the initial planning process of environmental review under the National Environmental Policy Act (NEPA) and the Minnesota Environmental Policy Act (MEPA). At the federal level, formal scoping begins with the publication of a Notice of Intent, and at the state level it begins with the distribution of the SEAW and the draft scoping decision document. Scoping precedes the development of the draft EIS and is used to reduce the bulk and scope of the EIS by identifying potentially significant issues and defining alternatives that will be addressed during the EIS process.

The purpose of this document is to describe regulatory requirements for alternatives and describe reasonable alternatives that TMM has investigated. For the purposes of this document, “reasonable” is defined as practical or feasible from the technical and economic standpoint and using common sense [reference (1)).This document identifies alternatives that TMM recommends be eliminated from further consideration and those recommended to be carried forward into the EIS.

Additionally, this document is being prepared pursuant to 40 Code of Federal Regulations (CFR) Section (§) 1501.2 which requires federal agencies to provide for the early application of NEPA to private applicants that are subject to federal approval. The purpose of early involvement is to ensure environmental factors are considered early in the planning process and to avoid a situation where the applicant has completed planning and eliminated all alternatives to the proposed action. Alternative screening evaluations presented within this document will help the state and federal agencies and TMM establish better understanding of each other’s analyses and contribute to an alignment of the NEPA and MEPA processes.

The document begins with an overview of the Project based on current design. It then discusses the regulatory requirements for alternatives, reviews the methodology used by TMM to consider alternatives, provides a summary of alternatives considered, and evaluates alternatives to determine whether they should be eliminated from further consideration or carried forward into the EIS.

2.0 PROPOSED ACTION

2.1 Introduction to the Project

The Project would be located at the northeastern end of Minnesota's Iron Range, southeast of Ely, and northeast of Babbitt as shown on Figure 2-1. The Project would recover copper, nickel, cobalt, platinum, palladium, gold, and silver, from the Maturi deposit. The proposed action, Project Option 1, would consist of an Underground Mine Area (UMA.01), Plant Site (PS.01), Tailings Management Site (TMS.01), Non-Contact Water Diversion Area (NCWDA.01), Access Road, (AR.01), Ventilation Raise and Access Road (VR.01), Water Intake Corridor, (WIC.01), and Transmission Corridor (TC.01) as shown on Figure 2-2 and summarized in Table 2-1.

Construction of these Project features would result in up to 1,156 acres (467.8 hectares) of ground disturbance.

The mine would be accessed by portals and declines with mining occurring underground. Mined ore would be crushed underground, then conveyed to the surface and processed in a comminution and flotation circuit at the plant site. The process would produce three products: copper concentrate, nickel concentrate, and gravity concentrate. The concentrates would be thickened and filtered before being transported off site to customers. Tailings from the concentrator would be dewatered and either permanently stored underground as engineered tailings backfill or transported to the lined dry stack facility at the tailings management site for permanent storage. A simplified schematic of the mining process is shown on Figure 2-3.

TMM estimates total production of approximately 180 million tons (163 million tonnes) of ore over 25 years, at an average rate of approximately 7.3 million tons (6.6 million tonnes) per year after Project ramp-up. Annually, the Project would produce on average 174,000 tons (157,000 tonnes) of copper concentrate, 84,000 tons (76,000 tonnes) of nickel concentrate, and 550 tons (500 tonnes) of gravity concentrate. The nominal daily processing rate is 20,000 tons per day (tpd) (18,143 tonnes per day).

2.1.1 Proposer Purpose and Need

The purpose of the Project is to exercise TMM's mineral rights to mine the Maturi deposit by underground methods to produce saleable concentrates containing copper, nickel, cobalt, platinum, palladium, gold, and silver.

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106 **Table 2-1 Project Option 1 Configuration**

Project ID	Project Description	Underground Mine Area ID	Plant Site ID	Tailings Management Site ID	Non-Contact Water Diversion Area ID	Access Road ID	Ventilation Raise and Access Road ID	Water Intake Corridor ID	Transmission Corridor ID
Project Option 1	12-18-2019 Proposed Project	UMA.01	PS.01	TMS.01	NCWDA.01	AR.01	VR.01	WIC.01	TC.01

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2.2 Technical Introduction of the Project

Project components associated with Project Option 1, defined within Section 2.1, are described within this section.

2.2.1 Description of underground Mine

The underground mine would consist of all underground workings and infrastructure necessary to excavate ore from the Maturi deposit over the 25-year operating phase including the ventilation raises that surface at the three ventilation raise sites. The underground mine would be accessed by two side-by-side declines (sloped tunnels to the ore deposit). The declines would start on the surface at the plant site at two locations referred to as mine portals (entrances to the underground mine).

The Project would mine the Maturi deposit using a longitudinal longhole retreat (LLR) mining method within five major mining production zones. Underground mining using the LLR mining method would target only those portions of the deposit considered ore, resulting in less excavation and eliminating the need for above ground waste rock stockpiles as only ore would be transported to the surface. One of the benefits of the LLR mining method is the ability to use waste rock and tailings as backfill, reducing the environmental footprint of the Project.

The LLR mining method would be classified as a stoping method; stoping is the process of extracting ore from an underground mine and leaving behind an open space called a stope. In the LLR mining method, stopes are mined longitudinally along the direction of the ore formation in a backwards fashion and separated by pillars that allow production from other mining units. Stopes would be accessed from different levels (drifts) and the diamond-shaped stope arrangements, conceptually shown on Figure 2-4, would allow for flexibility to have the stopes open for extended periods of time.

Additional details relating to the underground mine construction phase and layout, mining method, underground production cycle, backfilling, support systems, and underground mine reclamation, closure, and post-closure maintenance are outlined in the *Mine Plan of Operations* (TMM, 2019a) and *Scoping Environmental Assessment Worksheet Data Submittal* (TMM, 2020).

2.2.2 Description of Plant Site

The plant site would receive the ore from the underground mine, process the ore to recover the target metals, and pump tailings to the tailings management site.

The surface layout of the plant site is shown on Figure 2-5 and would consist of:

- Portals
- Ore storage facilities
- Concentrator
- Plant site infrastructure
- Plant site water management infrastructure

The ore would be processed in the concentrator which includes the comminution circuit, gravity concentration circuit, the flotation circuit, concentrate dewatering and storage, and the reagent make-up area. The concentrator would produce three concentrate products (separate metal-bearing minerals) and tailings (the remaining ground rock after targeted metals are recovered).

Additional details relating to the plant site construction, ore management, plant site operational activities, detailed processing descriptions, and plant site reclamation, closure, and post-closure maintenance are outlined in the *Mine Plan of Operations* (TMM, 2019a) and *Scoping Environmental Assessment Worksheet Data Submittal* (TMM, 2020).

2.2.3 Description of Tailings Management Site

The tailings management site would have three main components as shown on Figure 2-6:

- The tailings dewatering plant, which would produce both the engineered tailings backfill for the underground workings and a tailings filter cake for the dry stack facility;
- The dry stack facility which would provide permanent above ground storage for the tailings filter cake; and
- The reclamation material stockpile which would stockpile suitable growth mediums stripped from the dry stack facility footprint until use in concurrent reclamation.

The tailings dewatering plant would be compact and located directly south of the plant site. The tailings dewatering plant would dewater the tailings from the concentrator to produce the tailings filter cake to be stored in the lined dry stack facility and the engineered tailings backfill to be pumped back into the underground workings. The tailings filter cake produced by the filter plant would be a dry (13 to 16 percent [%] moisture) silty, sandy material which would be hauled by dump truck to the dry stack facility and placed and compacted to a geotechnically stable state for permanent storage.

The lined dry stack facility would be used to permanently store approximately 60% of the tailings with a total storage capacity of 106 million tons (96 million tonnes) over an operational life of 25 years. The maximum elevation of the dry stack facility would be similar to the elevation of hills in the Project vicinity. The footprint of the dry stack facility at full development would be approximately 429 acres (174 hectares).

Suitable growth medium, consisting of topsoil, minerals soil, and peat would be stripped during subgrade preparation and stored separately in the reclamation material stockpile area. The dry stack facility would be reclaimed concurrently with operations using the reclamation material stockpile.

Additional details relating to the tailings management site construction, site operational activities, reclamation, closure, and post-closure maintenance are

outlined in the *Mine Plan of Operations* (TMM, 2019a) and *Scoping Environmental Assessment Worksheet Data Submittal* (TMM, 2020).

2.2.4 Description of Non-Contact Water Diversion Area

Non-contact water from the adjacent watersheds would be intercepted and diverted around the plant site and the tailings management site to prevent non-contact water from co-mingling with contact water and to protect infrastructure.

To divert non-contact water around the plant site, two non-contact water ditches would be constructed to intercept and divert water south of the plant site. To divert non-contact water around the tailings management site, non-contact water ditches and diversion dikes would be constructed. Interception and diversion of non-contact water from adjacent wetlands and watersheds would be managed through non-contact water ditches and diversion dikes.

Additional details relating to the water management plans and water management at closure are outlined in the *Mine Plan of Operations* (TMM, 2019a) and *Scoping Environmental Assessment Worksheet Data Submittal* (TMM, 2020).

2.2.5 Description of Corridors

2.2.5.1 Access Road Corridor

To access the plant site an access road would extend from Minnesota Highway (HWY) 1 to the northern edge of the plant site as shown on Figure 2-2. The alignment was selected to minimize wetland impacts and avoid identified cultural resources. The road would be a two-lane gravel road with a maximum speed of 30 miles per hour and 14-foot (ft) (4.3 meter [m]) wide lanes designed for a tractor-trailer rig. The access road construction limits would be approximately 200 ft (61 m) wide, depending on corridor grading limits. Ditches would control stormwater with culverts sized to accommodate a 100-year, 24-hour storm event.

2.2.5.2 Transmission Corridor

To supply electrical power to the Project, a transmission corridor would be constructed from the plant site to the south, turning west and terminating at the west side of the Dunka Pit at an off-site electrical substation as shown on Figure 2-2. The transmission corridor would be approximately 10 miles (16 km) long and construction limits would be approximately 150 ft (46 m) wide, depending on corridor grading limits. Transmission corridor maintenance width would be 150 ft (46 m) or less. Transmission line structures would be placed in such a way as to avoid wetlands and sensitive habitats.

The transmission corridor would include a two-track, unpaved maintenance road and the power transmission line, which would originate from an off-site electrical substation and terminate at the plant site electrical substation. At the off-site electrical substation, the Project transmission line would connect to an existing transmission line, and a regional power provider would supply the Project with sufficient power. The transmission line would feed the plant site electrical substation.

2.2.5.3 Water Intake Corridor

The water intake corridor would contain the infrastructure needed to transport water from Birch Lake Reservoir (Birch Lake) to the plant site, including a pipeline, power line, and maintenance road. It would extend from the northwestern corner of the plant site to Birch Lake approximately 3,000 ft (914 m) to the west as shown on Figure 2-2. The water intake corridor construction limits would be approximately 100 ft (30.5 m) wide, depending on corridor grading limits. A water intake pump house would be located 100 ft (30.5 m) from the ordinary high water mark of Birch Lake. From the intake pumphouse a water intake pipeline (approximately 18 inches [0.46 m] in diameter) would be installed underground and a screened low-flow intake would extend out 550 ft (170 m) from the shore of Birch Lake.

2.2.5.4 Ventilation Raise Access Road Corridor

Access to the ventilation raise sites would be provided by the ventilation raise access road. This corridor would be along existing National Forest Road (NFR) 1900 from HWY 1. Currently the maximum width of NFR 1900 is 20 ft (6 m). If necessary, NFR 1900 would be extended or improved to one-lane gravel roads sufficient for construction and propane delivery truck access. The 200 ft (61 m) corridor construction limit width represents the maximum width needed for construction and actual width would likely be less.

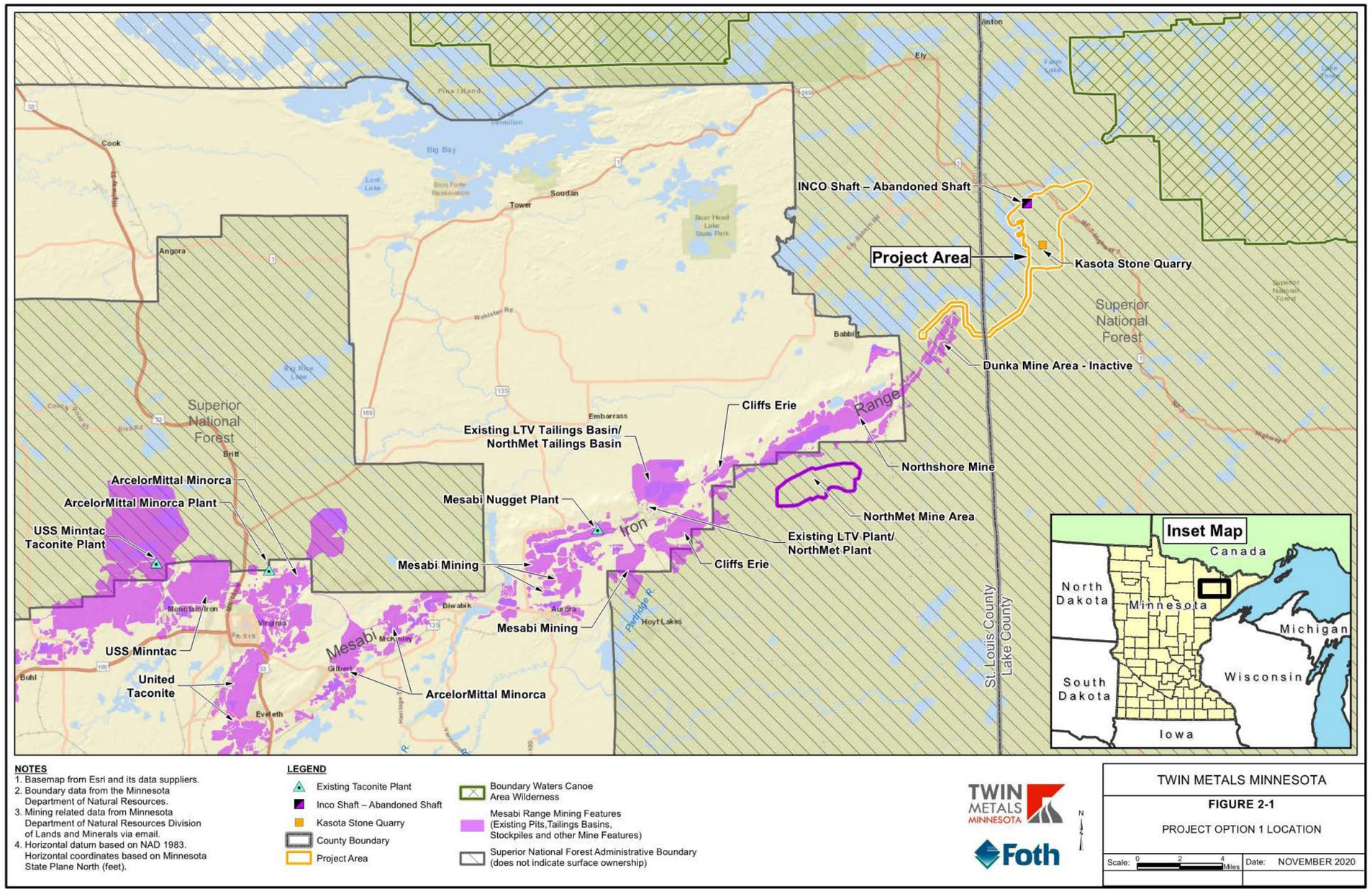

Figure 2-1 Project Option 1 Location

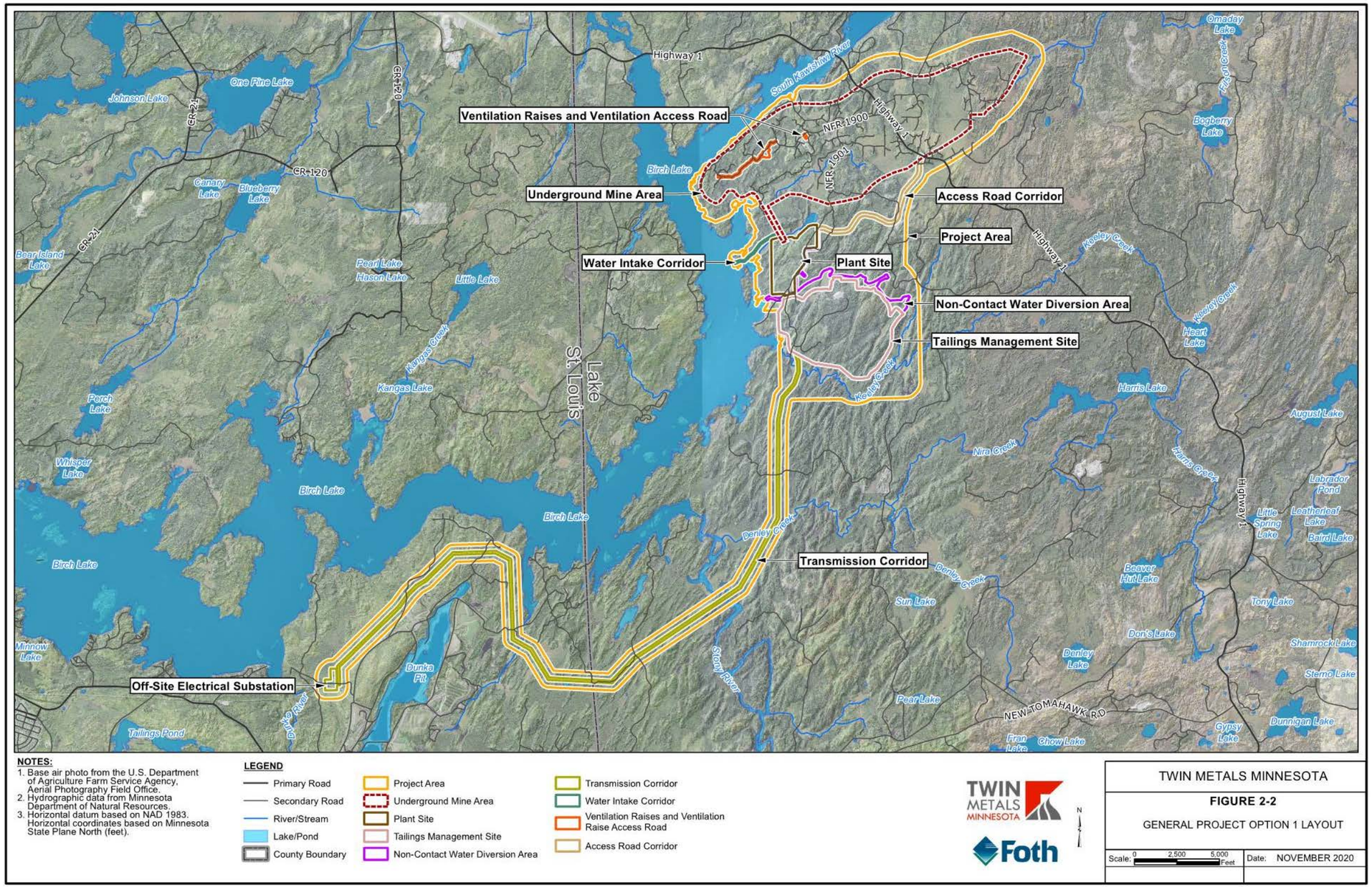

Figure 2-2 General Project Option 1 Layout

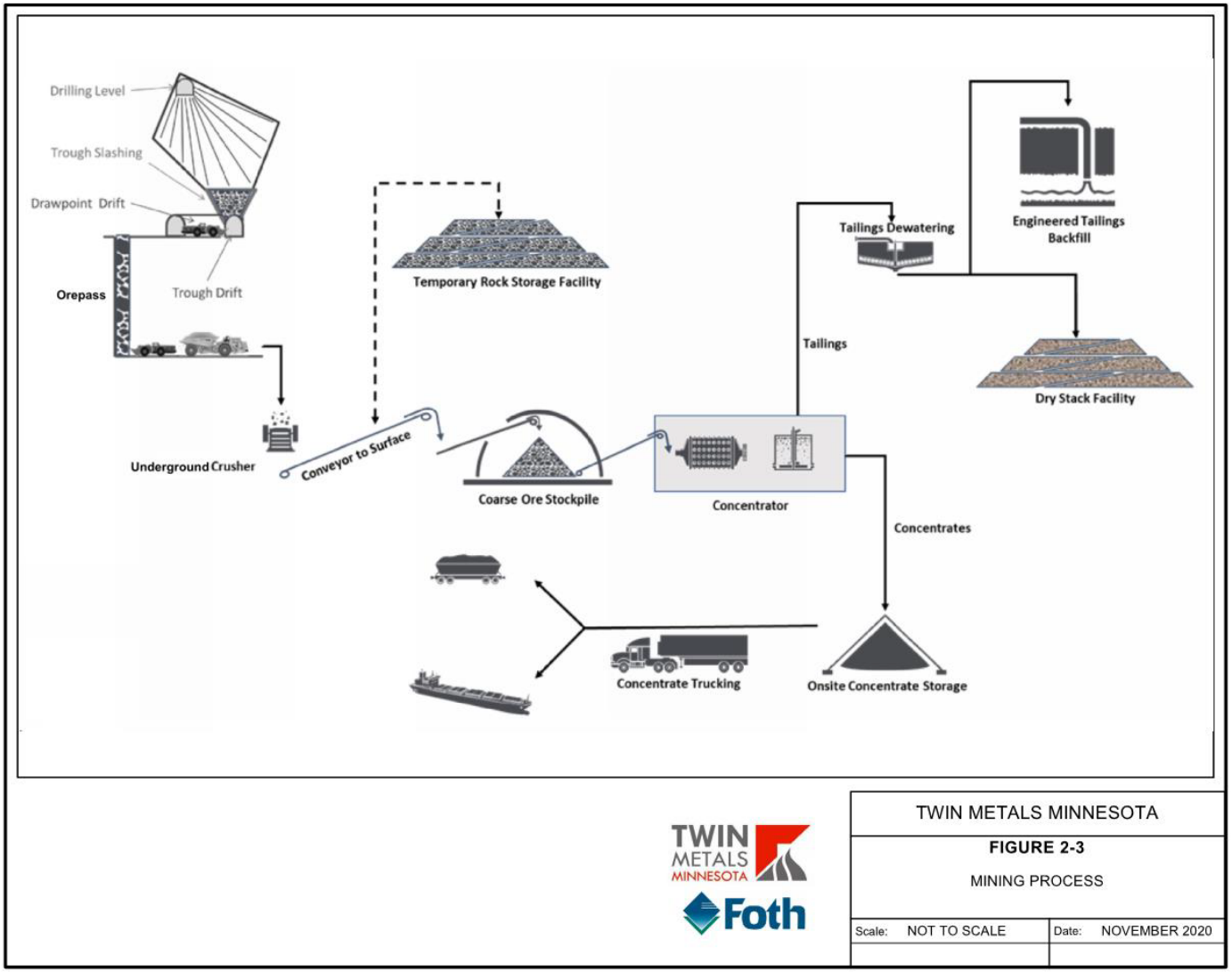

Figure 2-3 Mining Process

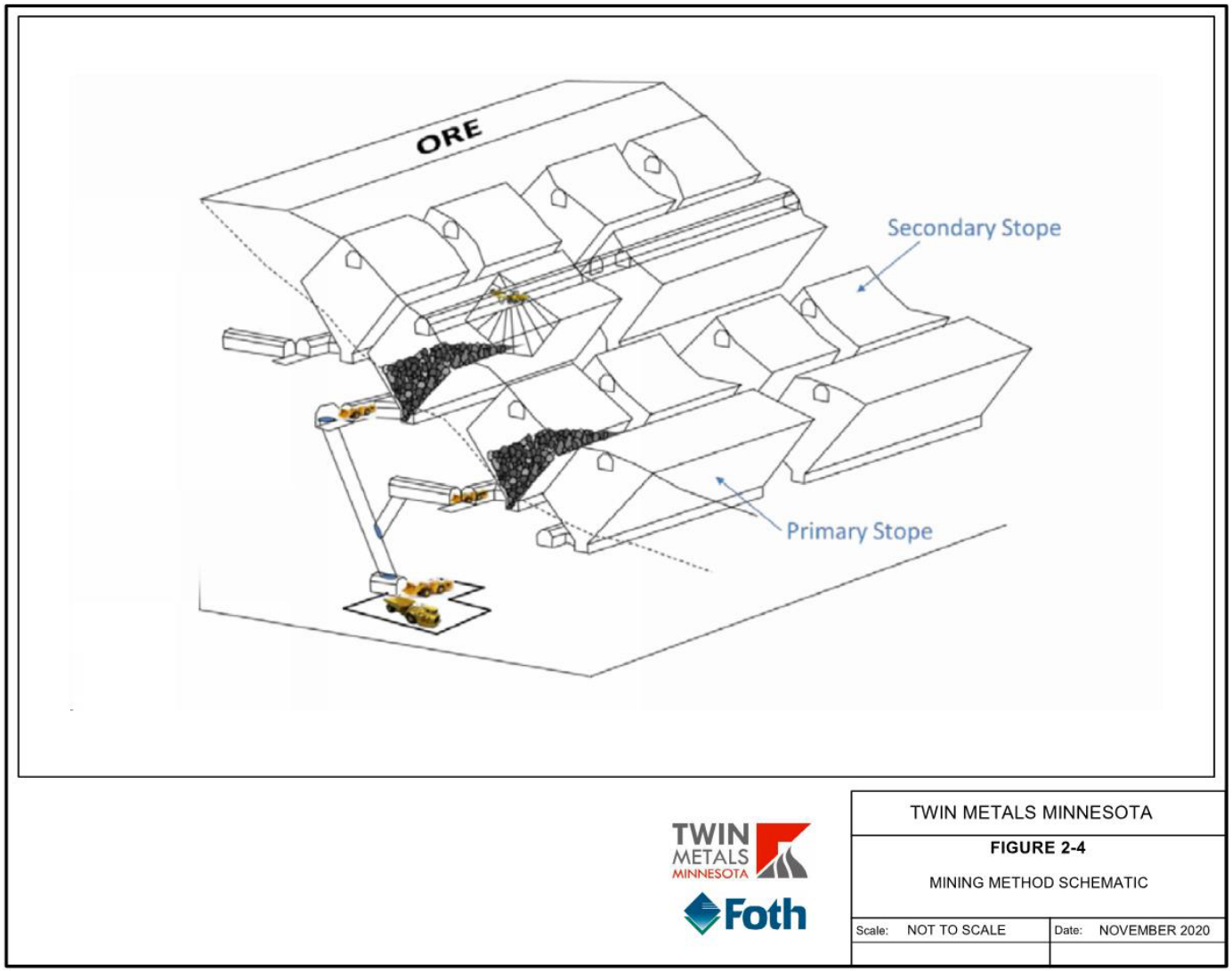

Figure 2-4 Mining Method Schematic

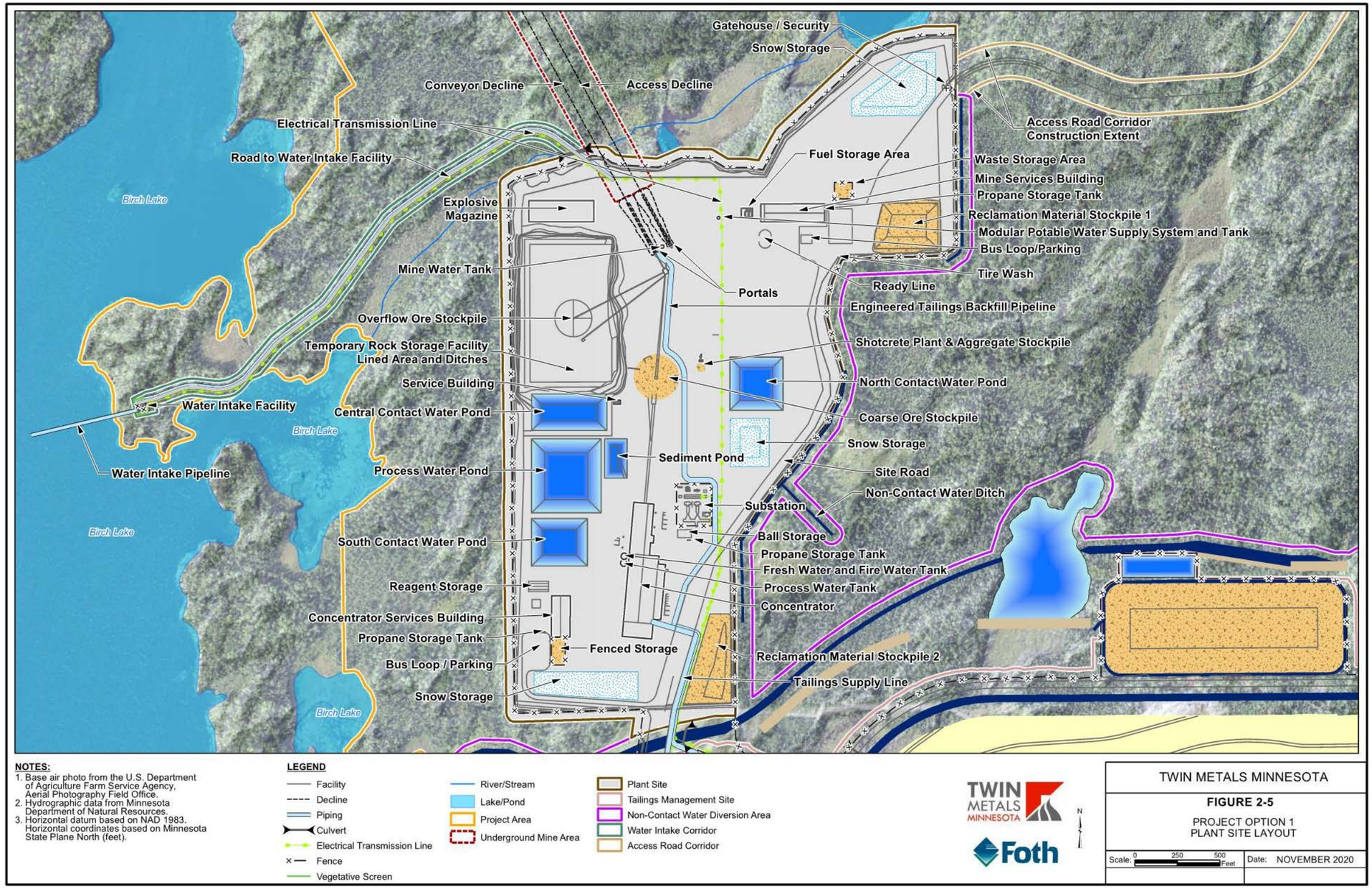

Figure 2-5 Project Option 1 Plant Site Layout

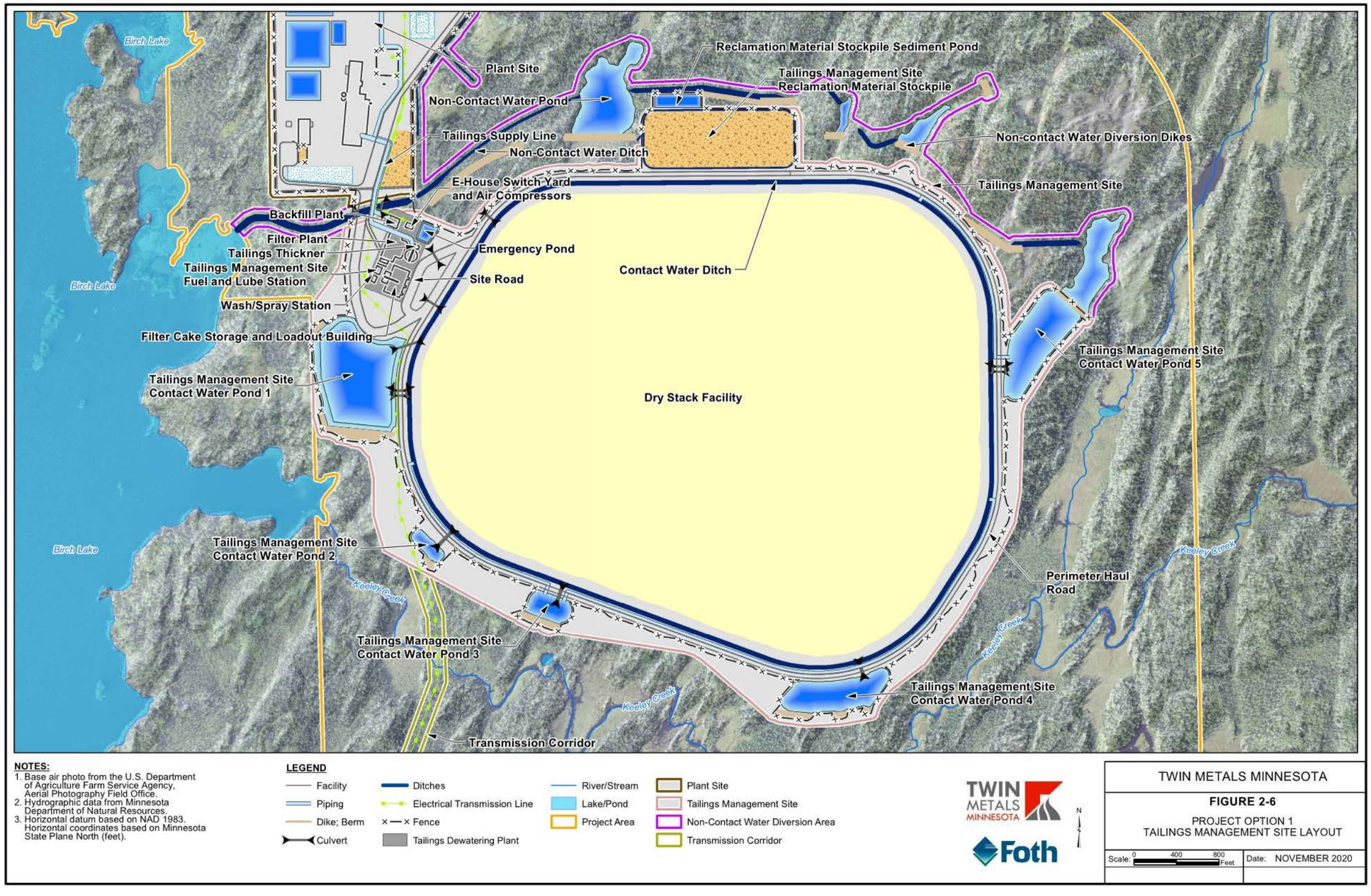

Figure 2-6 Project Option 1 Tailings Management Site Layout

3.0 REGULATORY FRAMEWORK AND METHODOLOGY

3.1 NEPA and MEPA Regulatory Framework

The Project will require approval of an MPO by the U.S. Department of the Interior BLM to address requirements for leasable minerals per 43 CFR § 3592, as the Project targets federal minerals. The approval of the MPO is a major federal action and will require completion of an EIS under NEPA. The MPO was submitted to the BLM on December 18, 2019 (reference (2)). The BLM is the lead federal agency for conducting the environmental review under NEPA.

As a metallic mineral mine in the state of Minnesota, the Project exceeds the threshold for mandatory completion of an EIS under MEPA. The first step in the environmental review process (MEPA) is the submission of a SEAW data submittal. The initial SEAW data submittal was submitted to the MDNR on December 18, 2019. The MDNR is the Responsible Governmental Unit (RGU) for conducting the environmental review for metallic mineral mines (Minnesota Statutes, §116D.04 and Minnesota Rules , part 4410.4400, subpart 8). A revised SEAW data submittal was submitted to the MDNR on July 24, 2020 (reference (3)), in order to provide additional Project details and clarity requested by the MDNR.

A component of the wetland regulatory framework that will also influence the selection of the agency preferred alternative. Both the state Wetland Conservation Act (Minnesota Rules, part 8420.0520) and Section 404 of the Clean Water Act (Section 404(b)(1) 33 U.S.C. 1344) require sequencing of wetland decisions. Sequencing is generally described as wetland impact avoidance, minimization, and mitigation in descending order. The 404(b)(1) guidelines further identify that practicable alternatives that have less environmental impact on aquatic ecosystems, and do not have other adverse environmental consequences shall be permitted over other alternatives. This is also referred to commonly as the least environmentally damaging practicable alternative or “LEDPA.” The LEDPA will need to be considered in subsequent alternative selection reviews.

3.1.1 Overview of NEPA Alternative Requirements

The importance of the alternatives section of an EIS required by 40 CFR § 1502.14 is described by the Council on Environmental Quality as follows:

- *The alternatives section should present the environmental impacts of the proposed action and the alternatives in comparative form based on the information and analysis presented in the sections on the affected environment (§ 1502.15) and the environmental consequences (§ 1502.16). In this section, agencies shall:*
    - *Evaluate reasonable alternatives to the proposed action, and, for alternatives that the agency eliminated from detailed study, briefly discuss the reasons for their elimination.*
    - *Discuss each alternative considered in detail, including the proposed action, so that reviewers may evaluate their comparative merits.*

- *Include the no action alternative.*
- *Identify the agency's preferred alternative or alternatives, if one or more exists, in the draft statement and identify such alternative in the final statement unless another law prohibits the expression of such a preference.*
- *Include appropriate mitigation measures not already included in the proposed action or alternatives.*
- *Limit their consideration to a reasonable number of alternatives.*

The BLM NEPA Handbook (reference (1)) describes the purpose of alternative development as exploring the range of "alternative means of meeting the purpose and need for the action." The NEPA Handbook emphasizes the alternatives evaluation should be done only on reasonable alternatives. If there are potentially a large number of reasonable alternatives, only a reasonable number need to be analyzed to cover the full spectrum of alternatives. The NEPA Handbook defines reasonable as:

- *Reasonable alternatives include those that are practical or feasible from the technical and economic standpoint and using common sense, rather than simply desirable from the standpoint of the applicant.*

The NEPA Handbook directs that alternatives should be eliminated from detailed analysis if they are not reasonable; specifically, an alternative should be eliminated if:

- *It is ineffective (it would not respond to the purpose and need).*
- *It is technically or economically infeasible (consider whether implementation of the alternative is likely given past and current practice and technology; this does not require cost-benefit analysis or speculation about an applicant's costs and profits).*
- *It is inconsistent with the basic policy objectives for the management of the area.*
- *Its implementation is remote or speculative.*
- *It is substantially similar in design to an alternative that is analyzed.*
- *It would have substantially similar effects to an alternative that is analyzed.*

The NEPA Handbook repeats the requirement of 40 CFR § 1502.14 that alternatives considered but not analyzed in detail must be identified and briefly discussed as to why they were eliminated from detailed analysis.

Recent guidance from the U.S. Department of the Interior in the Additional Direction for Implementing Secretary's Order 3355 (reference (4)) required NEPA coordinators for each bureau to develop a list of pre- Notice of Intent best practices to be implemented in support of streamlining environmental review. In response, the BLM

identified and compiled pre- Notice of Intent best practices, which included the following items related to alternatives:

- Develop project purpose and need.
    - Evaluate and articulate the need for action and develop a clear purpose.
    - Define the scope for a range of reasonable alternatives.
- Identify and analyze preliminary issues and alternatives.
    - Document the consideration of and rationale for dismissing any issues and alternatives found not to warrant analysis in detail.
    - Provide an opportunity for public feedback on preliminary alternatives and issues identified from coordination with federal, state, and local governments and Indian tribes.

3.1.2 Overview of MEPA Alternative Requirements

Under MEPA, identification of potentially significant issues relevant to a proposed project, including alternatives, is required during the EIS scoping process as described in Minnesota Rules, part 4410.2100, subpart 1. Following scoping, Minnesota Rules, part 4410.2300 (G) requires that *the EIS must address one or more alternatives of each of the following types of alternatives or provide a concise explanation of why no alternative of a particular type is included in the EIS:*

- *alternative sites;*
- *alternative technologies;*
- *modified designs or layouts;*
- *modified scale or magnitude; and*
- *alternatives incorporating reasonable mitigation measures identified through comments received during the comment periods for EIS scoping or for the draft Environmental Impact Statement.*

MEPA has similar criteria in establishing reasonable alternatives to the proposed project as NEPA. The Minnesota Environmental Quality Board (EQB) provides the following alternative scoping guidance, specifically *alternatives may be excluded only if they meet one (or more) of the following criteria*:

- *underlying need for or purpose of the project is not met;*
- *significant environmental benefit over the proposed project is not provided; or*
- *another alternative is likely to be similar in environmental benefits but will have less socioeconomic impact.*

Alternatives that were considered within the scope of the EIS but eliminated based on information developed through the EIS analysis shall be discussed briefly in the EIS and the reasons for their elimination shall be addressed.

Additionally, the EQB provides the following guidance on alternative sites (reference (5)):

The following factors should be considered by the RGU when deciding whether alternative sites would meet the underlying need and purpose criterion:

- *Whether the proposer owns the proposed site;*
- *How long the proposer has owned the site;*
- *The likelihood that the proposer could sell or otherwise use the proposed site if the project was moved;*
- *Whether the proposer has access to other sites…;*
- *Whether the site is an integral part of the project or whether the project could be built on other sites in the general area…;*
- *The likely use of the proposed site if the project did not take place on it and the environmental impacts of other uses.*

3.2 Methodology

The TMM screening methodology was developed with consideration for federal NEPA and state MEPA alternative guidelines and standards to maintain a consistent framework between the federal and state scoping processes. Screening criteria are used to indicate whether an alternative is available, logistically feasible, technologically achievable, cost acceptable, capable of meeting the project purpose and need, and avoiding unacceptable environmental impacts. The screening process is used to identify alternatives that should be carried forward for more detailed analysis and to eliminate other alternatives from further analysis.

The alternatives are grouped into categories based on MEPA requirements: alternative sites, alternative technologies, modified designs or layouts, and modified scale or magnitude. TMM recognizes that MEPA also provides that final alternatives selected for the EIS might also include alternatives incorporating reasonable mitigation measures identified through comments received during the comment periods for EIS scoping or for the draft EIS.

Brief conceptual overviews of the alternatives are presented and the alternatives are evaluated by TMM qualitatively to compare them to the proposed action using the following screening criteria categories:

- Purpose and need – does the alternative meet the purpose and need statement;
- Economically feasible – can the alternative be implemented (that is designed, constructed, or operated) considering the costs and revenues the Project would incur;
- Technically feasible – can the alternative be implemented using accepted engineering and other technical principles and concepts; and
- Environmentally beneficial – when qualitatively compared against the proposed action, does the alternative have reduced environmental impacts; or is there potential for additional / increased environmental impacts when

compared to the proposed action, resulting in an alternative not being environmentally beneficial?

Alternatives failing to meet one or more of these screening criteria are proposed by TMM to be screened out of further consideration in an EIS, notwithstanding consideration of the LEDPA.

Appropriate mitigation measures, as required by 40 CFR § 1502.14 and reasonable mitigation measures, as required by Minnesota Rules, part 4410.2300 (G), are not discussed as part of this document. Appropriate / reasonable mitigation measures will be evaluated during the public comment period and agency review, including those already incorporated into the Project by TMM.

4.0 ALTERNATIVES SUMMARY

TMM has conducted a screening evaluation for multiple alternatives utilizing the screening methodology described in Section 3.2. Conceptual overviews of alternatives and the evaluation of those alternatives are presented within this section. Alternatives TMM proposes to be screened out of further consideration within an EIS are presented in Section 4.1. Alternatives TMM proposes for further consideration within an EIS are presented in Section 4.2.

4.1 TMM Proposed Alternatives to be Screened Out of Further Consideration

4.1.1 Siting

Three conceptual siting alternatives are described in this section:

- Siting the portals, concentrator, and tailings management site together at a location greater than 2 miles (3.2 km) from the Maturi deposit;
- Separating the portals from the concentrator and tailings management site; and
- Locating the tailings management site greater than 2 miles away from the portals and concentrator.

The following aspects of the proposed action apply to all three conceptual siting alternatives:

- Underground mining methods and rates would remain consistent with the proposed action;
- Ore processing method would remain consistent with the proposed action;
- Ventilation raises and ventilation raise access would remain sited as defined within the proposed action; and
- Access corridor, water intake corridor, transmission corridor, and other support infrastructure (e.g., mine service building, concentrator services building, contact water ponds, filter plant, and backfill plant) associated with the propose action would be relocated along with and distributed amongst the portal, concentrator, and tailings management site, as appropriate.

To support the assessment of environmentally beneficial, two screening criteria were assessed for each conceptual sitting alternative within and in the vicinity of the proposed action: wetland densities, and relative abundance of land cover and habitats. The distribution of National Wetlands Inventory Circular 39 classification system (reference (6)) wetlands within and in the vicinity of the proposed action Project area are shown on Figure 4-1.

Wetland density within the portion of the proposed action Project area contained within the 2 miles (3.2 km) radius of the plant site, labeled as modified Project area within Figure 4-1, is 0.28 acres of wetlands per surface acre. In comparison, the density of wetlands between the 2 miles (3.2 km) and 4 miles (6.4 km) radius from

plant site boundaries displayed on Figure 4-1 is 0.30 acres of wetlands per surface acre. Areas outside of the two comparison areas are shaded within Figure 4-1 to emphasize the areas being compared.

Since the density of wetlands is similar for the two areas, the qualitative evaluation of wetlands associated with the environmentally beneficial screening criteria is based on the following assumptions:

- An increase in the surface footprint of the alternative is likely to result in increased wetland impacts;
- A decrease in the surface footprint of the alternative is likely to result in decreased wetland impacts; and
- No change in the surface footprint of the alternative is likely to result in wetland impacts similar to the proposed action.

The distribution of land cover types within and in the vicinity of the proposed action Project area are shown on Figure 4-2. Land cover types, as defined by the U.S. Geological Survey National Land Cover Database (reference (7)), are summarized in Table 4-1 as acreages and percentages.

Table 4-1 Land Cover Distribution

National Land Cover Database Classification[1]	Modified Project Area[2] (acres)	Modified Project Area[2] (percent)	Radius Area[3] (acres)	Radius Area[3] (percent)
Barren Land (Rock / Sand / Clay)	0.0	0.0	14.5	0.1
Developed, High Intensity	0.0	0.0	3.1	0.0
Developed, Medium Intensity	0.0	0.0	2.3	0.0
Developed, Low Intensity	0.4	0.0	4.9	0.0
Developed, Open Space	187.7	4.1	468.5	1.7
Developed Total	*188.1*	*4.1*	*478.8*	*1.8*
Decidious Forest	38.5	0.8	2,168.3	8.0
Evergreen Forest	1,625.8	35.4	7,990.5	29.6
Mixed Forest	432.1	9.4	3,244.9	12.0
Forest Total	*2,096.4*	*45.7*	*13,403.6*	*49.7*
Emergent Herbaceous Wetlands	35.0	0.8	327.0	1.2
Woody Wetlands	1,824.6	39.7	8,720.4	32.4
Wetlands Total	*1,859.7*	*40.5*	*9,047.4*	*33.6*
Grassland / Herbaceous	88.9	1.9	311.7	1.2
Open Water	45.3	1.0	1,987.9	7.4
Pasture / Hay	0.0	0.0	3.6	0.0
Shrub / Scrub	312.4	6.8	1,705.2	6.3
Total	**4,590.7**	**100.0**	**26,952.5**	**100.0**

[1] National Land Cover Database Classification is from the U.S. Geological Survey (2011).
[2] Modified Project Area is the portion of the Project Area contained within a 2-mile radius of the plant site as shown on Figure 4-2.
[3] Radius Area is defined as the area between the 2- and 4-mile-radius contours shown on Figure 4-2.

Land cover type and the abundance of each cover type is generally similar between the portion of the proposed action Project area contained within the 2 miles (3.2 km) radius of the plant site, labeled as modified Project area within Figure 4-2 and the area located between the 2 miles (3.2 km) and 4 miles (6.4 km) radius from plant site boundaries depicted on Figure 4-2. Areas outside of the comparison areas are shaded within Figure 4-2 to emphasize the areas being compared.

Since the type and percentages of land types are similar for the two areas, the qualitative evaluation of land cover and habitats associated with the environmentally beneficial screening criteria is based on the following assumptions:

- An increase in the surface footprint of the alternative is likely to result in an increase in the magnitude of habitat impacts with the type of land cover and habitats being impacted remaining similar to the types impacted by the proposed action;
- A decrease in the surface footprint of the alternative is likely to result in a decrease in the magnitude of habitat impacts with the type of land cover and habitats being impacted remaining similar to the types impacted by the proposed action; and
- No change in the surface footprint of the alternative is likely to result in land cover and habitat impacts similar to the proposed action.

4.1.1.1 Portals Located Greater Than 2 Miles from Maturi Deposit

Overview of Alternative

This alternative co-locates the portals, concentrator, and tailings management site at a location greater than 2 miles (3.2 km) away from the Maturi deposit, as defined by the underground mine area shown on Figure 4-3. Siting locations greater than 2 miles (3.2 km) away from the proposed action to the north and east would be limited with this alternative, as potential locations in those directions would generally be within the Boundary Water Canoe Area Wilderness (BWCAW) mineral management corridor where mining related surface disturbances are prohibited (Minnesota Rules, part 6132.2000, subpart 3), or within the BWCAW where mining is excluded (Minnesota Rules, part 6132.2000, subpart 2).

Evaluation of Alternative

Siting the portals greater than 2 miles (3.2 km) from the Maturi deposit meets both the purpose and need and technical feasibility screening criteria; however, the alternative should be eliminated because the following screening criteria are not met:

- Not environmentally beneficial due to the following:
    - Increased energy use required to move material greater distances than the proposed action; and
    - Wetland, land cover, and habitat impacts likely similar to the proposed action.

In addition, this alternative is likely less economical than the proposed action due to the following additional capital costs:

- Construction of additional length of declines;
- Acquisition of additional land; and
- Movement of material greater distances.

4.1.1.2 Concentrator Not Co-Located with Portals

Overview of Alternative

This alternative separates the location of the portals from the concentrator and tailings management site. Example configurations of this alternative would include having the portals remain at the location defined by the proposed action with the concentrator and tailings management site located either west of Birch Lake or south of the proposed action location. This alternative would require an ore transportation system to facilitate ore transportation from the portals to the concentrator. Potential ore transportation systems include:

- Rail – ore would be transported by dedicated rail service;
- Hydraulic – ore slurry would be transported by pipeline;
- Overland conveyors – ore would be transported by overland conveyors connecting the portal to the concentrator;
- Underground conveyors – ore would be transported by conveyor in an underground tunnel; or
- Long combination vehicle trucks – ore would be hauled in long combination vehicle trucks consisting of one tractor unit coupled to multiple trailers.

This alternative would also require a tailings transportation system to transport tailings back to the portals to allow for backfilling of the underground workings with engineered tailings backfill. The tailings transportation system would consist of pumping tailings from the concentrator to the portals in a dedicated pipeline.

Evaluation of Alternative

The alternative of not co-locating the concentrator and tailings management site with the portals meets both the purpose and need and technical feasibility screening criteria; however, the alternative should be eliminated because the following screening criteria are not met:

- Not environmentally beneficial due to the following:
    - Due to the development of an ore and tailings transportation system corridor not present within the proposed action, the Project surface footprint would increase leading to increased ground disturbance, habitat reduction and fragmentation, and wetlands impacts;
    - Risk of ore and tailings spillage along the material transportation system corridor; and
    - Increased energy use required to move material greater distances than the proposed action.

In addition, this alternative is likely less economical than the proposed action as separating the portals from the concentrator and tailings management site would add capital and operational costs associated with transporting ore from the portals to the concentrator and tailings from the concentrator to the portals.

4.1.1.3 Tailings Management Site Located Greater Than 2 Miles from Concentrator and Portals

Overview of Alternative

This alternative considers a tailings management site located greater than 2 miles (3.2 km) from the portals and concentrator, as defined by the plant site shown on Figure 4-4; potentially on the west side of Birch Lake or to the south of the proposed action. Siting the tailings management site at locations north and east of the proposed action becomes limited with this alternative at distances beyond approximately 4 miles (6.4 km), as potential locations in those directions would generally be within the BWCAW mineral management corridor where mining related surface disturbances are prohibited (Minnesota Rules, part 6132.2000, subpart 3), or within the BWCAW where mining is excluded (Minnesota Rules, part 6132.2000, subpart 2).

This alternative would require additional infrastructure including either a pipeline with an additional filter plant or a conveyor to facilitate transporting tailings from the concentrator to the tailings management site within a tailings transportation corridor. If the tailings management site is located on the west side of Birch Lake, a crossing around or under Birch Lake would be required for this alternative to support transporting tailings from the concentrator to the tailings management site.

Evaluation of Alternative

The alternative of locating the tailings management site greater than 2 miles (3.2 km) from the portals and concentrator meets both the purpose and need and technical feasibility screening criteria; however, the alternative should be eliminated because the following screening criteria are not met:

- Not environmentally beneficial due to the following:
    - Development of a tailings transportation corridor not present within the proposed action would increase the Project surface footprint leading to an increase in ground disturbance, habitat reduction and fragmentation, and wetlands impacts;
    - Risk of tailings spillage along the tailings transportation corridor; and
    - Increased energy use required to move tailings greater distances between the concentrator and tailings management site than the proposed action.

In addition, this alternative is likely less economical than the proposed action due to the added capital and operational costs of constructing and operating a pipeline with an additional filter plant or conveyor.

4.1.2 Technologies

Within this section two processing technology alternatives for producing saleable concentrates and one alternative tailings management technology are described and analyzed:

- Heap leach treatment;
- Concentrate treatment; and
- Conventional tailings slurry management.

4.1.2.1 Heap Leach

Overview of Alternative

This alternative considers processing ore using a heap leach process. Heap leach is a process used to extract copper, nickel, and precious metals from ore using a chemical reaction to separate and absorb targeted minerals. In the process, ore is crushed, agglomerated, and placed on an impermeable leach pad. A solution typically made up of cyanide or sulfuric acid is applied to the ore heap and the solution percolates through the heap and leaches target metals into solution.

Evaluation of Alternative

The alternative of using a heap leach process meets the purpose and need screening criteria but should be eliminated because the following screening criteria is not met:

- Not environmentally beneficial as heap leach would require stockpiles not present within the proposed action, leading to increased ground disturbance, habitat reduction, and wetland impacts. Additionally, potential for impacts to water resources resulting from a risk of seepage of hazardous chemicals utilized in the heap leach process, out of the leaching pad would exist.

Technical and economic feasibility has not been assessed for this alternative.

4.1.2.2 Concentrate Treatment (Hydrometallurgy / Pyrometallurgy)

Overview of Alternative

This alternative considers processing ore through flotation to produce a concentrate as an intermediate product. The concentrate would then be processed to produce copper metal, nickel metal, and platinum group metals product. Hydrometallurgy and pyrometallurgy are processes in the field of extractive metallurgy that remove valuable metals from an ore and refine the extracted raw metals into a purer form. Hydrometallurgy involves the use of aqueous solution to extract and purify metals while pyrometallurgy uses high temperatures to extract and purify metals. In evaluating concentrate treatment options for the Project, two main paths were identified that showed the most promise:

- Processing the concentrate with hydrometallurgy; and

- Processing the concentrate through a pyrometallurgy process (smelter) to produce a matte that is further treated with a hydrometallurgy process.

For the Project, use of these technologies would produce copper cathode, nickel cathode, and a high-grade platinum group metal concentrate.

Evaluation of Alternative

The alternative of concentrate treatment by hydrometallurgy or pyrometallurgy processes should be eliminated because the following screening criteria are not met:

- Does not meet purpose and need because alternative does not produce saleable concentrates;
- Not technically feasible because the alternative is not a mature technology and there are not any known operational facilities using this process; and
- Not environmentally beneficial due to the process requiring additional Project infrastructure leading to ground disturbance, potential habitat reduction, and potential wetland impacts.

Economic feasibility is not assessed as this alternative does not meet the purpose and need, and is not technically feasible.

4.1.2.3 Tailings Management Technology - Conventional Tailings Slurry

Overview of Alternative

This alternative considers the use of a conventional tailings slurry management method. Tailings not utilized for backfill would be transported as a slurry from the concentrator to a tailings storage facility estimated to have a footprint approximately three times larger than the proposed action dry stack facility described in Section 2.2.3. The tailings storage facility would contain the conventional tailings slurry within compacted engineered embankments. For dam embankment construction, tailings would be cycloned to separate the fine tailings particles (cyclone overflow) from the coarse tailings particles (cyclone underflow). The coarse particles from the cyclone underflow would be used to construct the outer embankment of the tailings impoundment and the overflow would be deposited into the interior of the impoundment.

Evaluation of Alternative

The alternative of using a conventional tailings slurry meets the purpose and need, technical feasibility, and economic feasibility screening criteria but should be eliminated because the following screening criteria is not met:

- Not environmentally beneficial due to the following:
    - Increased ground disturbance, habitat reduction, and wetlands impacts resulting from the larger surface footprint; and

Potential for impacts to water resources resulting from a potential risk of seepage due to the amount of water entrained in the tailings.

4.1.3 Modified Designs

Within this section two different mining designs are considered by TMM:

- Open pit mining; and
- Block caving underground mining.

4.1.3.1 Open Pit Mining

Overview of Alternative

This alternative considers the use of open pit mining methods, which are prohibited on federal mineral Preference Right Leases MNES-1352 and MNES-1353. The alternative of using open pit mining methods to access the Maturi deposit would excavate soil and waste rock overlying the mineral deposit to access the ore. Removing the overlying soil and waste rock would result in a large pit and the soil and waste rock would be stored above ground in stockpiles. To mine all the ore encompassed within the proposed action, the open pit would need, at a minimum, to excavate the entire underground mine area depicted within Figure 2-2, which is approximately 1,987 acres (804.1 hectare). This minimum acreage would need to be substantially increased to allow the open pit walls to be sloped at angles that would allow an open pit to be excavated in a safe and stable manner. The anticipated result would be hundreds to thousands of additional acres of ground disturbance beyond the minimum acreage of approximately 1,987 acres (804.1 hectare). At the conclusion of mining, the open pit would either be backfilled with some of the excavated waste rock or would be allowed to refill with water.

Evaluation of Alternative

The alternative of using an open pit mining method should be eliminated because the following screening criteria are not met:

- Does not meet purpose and need because alternative does not meet the underground mine requirement, which is the only mining method allowed under federal mineral Preference Right Leases MNES-1352 and MNES-1353; and
- Not environmentally beneficial because using an open pit mining method would result in a larger surface footprint due to the surface area of the open pit and the surface area required to site the stockpiles needed to manage waste materials. This alternative would likely result in several thousand acres of ground disturbance beyond the proposed action ground disturbance of 1,156 acres (467.8 hectares). This would lead to increased habitat reduction and wetland impacts. Additionally, there is potential for impacts to water resources resulting from a potential seepage risk related to the need for additional stockpiles to manage the additional waste material generated by the open pit mining method would exist.

Technical and economic feasibility are not evaluated since this alternative does not meet the purpose and need, is prohibited on federal mineral Preference Right Leases MNES-1352 and MNES-1353, and is not environmentally beneficial.

4.1.3.2 Block Caving as Underground Mining Method

Overview of Alternative

The alternative of using block caving as the underground mining method would involve undermining the Maturi deposit and allowing it to progressively collapse under its own weight. The process involves drilling access shafts below the ore body and raises to provide access for drilling and blasting to initiate caving. The rock is funneled through drawbells, excavated, crushed, and transported to the above ground concentrator.

Evaluation of Alternative

The alternative of using block caving as the underground mining method meets the purpose and need screening criteria but should be eliminated because the following screening criteria are not met:

- Not technically feasible due to the tabular geometry of the ore body not being practical for use of the block caving method; and
- Not environmentally beneficial due to the following:
    - Production of ground surface subsidence not produced with the proposed action Project mining method; and
    - Backfilling is limited with block caving resulting in the need to manage additional tailings within a dry stack facility with a larger footprint than the proposed action, which would lead to increased habitat reduction and wetland impacts.

Economic feasibility is not evaluated since this alternative is not technically feasible.

4.1.4 Modified Scale or Magnitude

4.1.4.1 Mining and Processing Rate Less Than 20,000 Tons per Day

Overview of Alternative

The alternative of using a mining and processing rate of less than 20,000 tpd (18,143 tonnes per day) would use the same mining methods, concentrating process, and tailings management practices as the proposed action, albeit at a reduced rate which would lead to a longer mine life.

Evaluation of Alternative

The alternative of using a mining and processing rate of less than 20,000 tpd (18,143 tonnes per day) meets both the purpose and need and technical feasibility screening criteria but should be eliminated because the following screening criteria is not met:

- Not environmentally beneficial because the Project would use the same mining methods, concentrating process, and tailings management practices, which would result in the environmental impacts being equivalent to the proposed action.

In addition, this alternative is likely less economical than the proposed action due to the reduced mining and processing rate eroding revenue.

4.2 TMM Proposed Alternatives to be Progressed for Further Consideration

4.2.1 Siting

4.2.1.1 Alternative Transmission Corridor – Project Option 2

Overview of Alternative

This alternative is to site the transmission corridor along an alternate route based upon engineering and land ownership considerations. Incorporation of the alternative transmission corridor (TC.02) into the Project would result in Project Option 2 as defined in Table 4-2.

The alternative transmission corridor (TC.02), is shown in relationship to the proposed action transmission corridor (TC.01) on Figure 4-5. As shown on Figure 4-5, routing differences mainly occur along the southern portions of the transmission corridors. The overall length of the alternative transmission corridor is approximately 11.4 miles (18.3 km), which is approximately 1.4 miles (2.3 km) longer than the proposed action transmission corridor. With the exception of routing, the design, construction, and operation of the alternative transmission corridor would be in alignment with the proposed action transmission corridor described in Section 2.2.5.

Evaluation of Alternative

The alternative transmission corridor should be carried forward into the EIS due to the following:

- Meets purpose and need;
- Economically feasible – likely similar economics;
- Technically feasible – likely similar technical requirements; and
- Environmentally equivalent – alternative is likely environmentally equivalent to the proposed action as approximately half of the alternative corridor is largely aligned with the proposed action transmission corridor and the footprints of the two corridors are generally similar. However, additional information is needed to compare the environmental impacts of the alternative and the proposed action.

792 **Table 4-2 Project Option 2 Configuration**

Project ID	Project Description	Underground Mine Area ID	Plant Site ID	Tailings Management Site ID	Non-Contact Water Diversion Area ID	Access Road ID	Ventilation Raise and Access Road ID	Water Intake Corridor ID	Transmission Corridor ID
Project Option 2	12-18-2019 proposed Project with updated transmission corridor	UMA.01	PS.01	TMS.01	NCWDA.01	AR.01	VR.01	WIC.01	TC.02

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4.2.1.2 Tailings Management Site (Federal Mineral Preference Right Lease MNES-1352) – Project Option 3

Overview of Alternative

This alternative considers siting the tailings management facility on federal mineral Preference Right Lease MNES-1352 property. Incorporation of the alternative tailings management facility (TMS.02) into the Project would result in Project Option 3 as defined in Table 4-3.

To facilitate the location of the tailings management site on federal mineral Preference Right Lease MNES-1352, modification of the proposed action plant site (PS.01), access road (AR.01), and non-contact water diversion area (NCWDA.01) layouts are necessary. Figure 4-6 shows the layout of the alternative tailings management site (TMS.02), plant site (PS.02) and access road (AR.02) associated with Project Option 3. The non-contact water diversion area (NCWDA.02) associated with Project Option 3 is not shown within Figure 4-6 as this feature is contained within the boundary of the alternative tailings management site (TMS.02). The locations of proposed action Project Option 1 tailings management site, plant site, access road, and non-contact water diversion area are also presented on Figure 4-6, for reference.

Project Option 3 would use the same mining methods, concentrating process, and tailings management practices as the proposed action described in Section 2.0.

Evaluation of Alternative

The alternative of siting the tailings management site (TMS.02) on federal mineral Preference Right Lease MNES-1352 and developing Project Option 3 should be carried forward into the EIS due to the following:

- Meets purpose and need;
- Economically feasible – likely similar economics;
- Technically feasible – likely similar technical requirements; and
- Environmentally equivalent – alternative is likely environmentally equivalent to the proposed action since the alternative tailings management site is located adjacent to the proposed action. With the adjacent sitting, impacts to wetlands, land cover, and habitat are likely to be similar. However, additional information is needed to compare the environmental impacts of the alternative and the proposed action.

828 **Table 4-3 Project Option 3 Configuration**

Project ID	Project Description	Underground Mine Area ID	Plant Site ID	Tailings Management Site ID	Non-Contact Water Diversion Area ID	Access Road ID	Ventilation Raise and Access Road ID	Water Intake Corridor ID	Transmission Corridor ID
Project Option 3	TMS on Federal Mineral Preference Right MNES-1352	UMA.01	PS.02	TMS.02	NCWDA.02	AR.02	VR.01	WIC.01	TC.01

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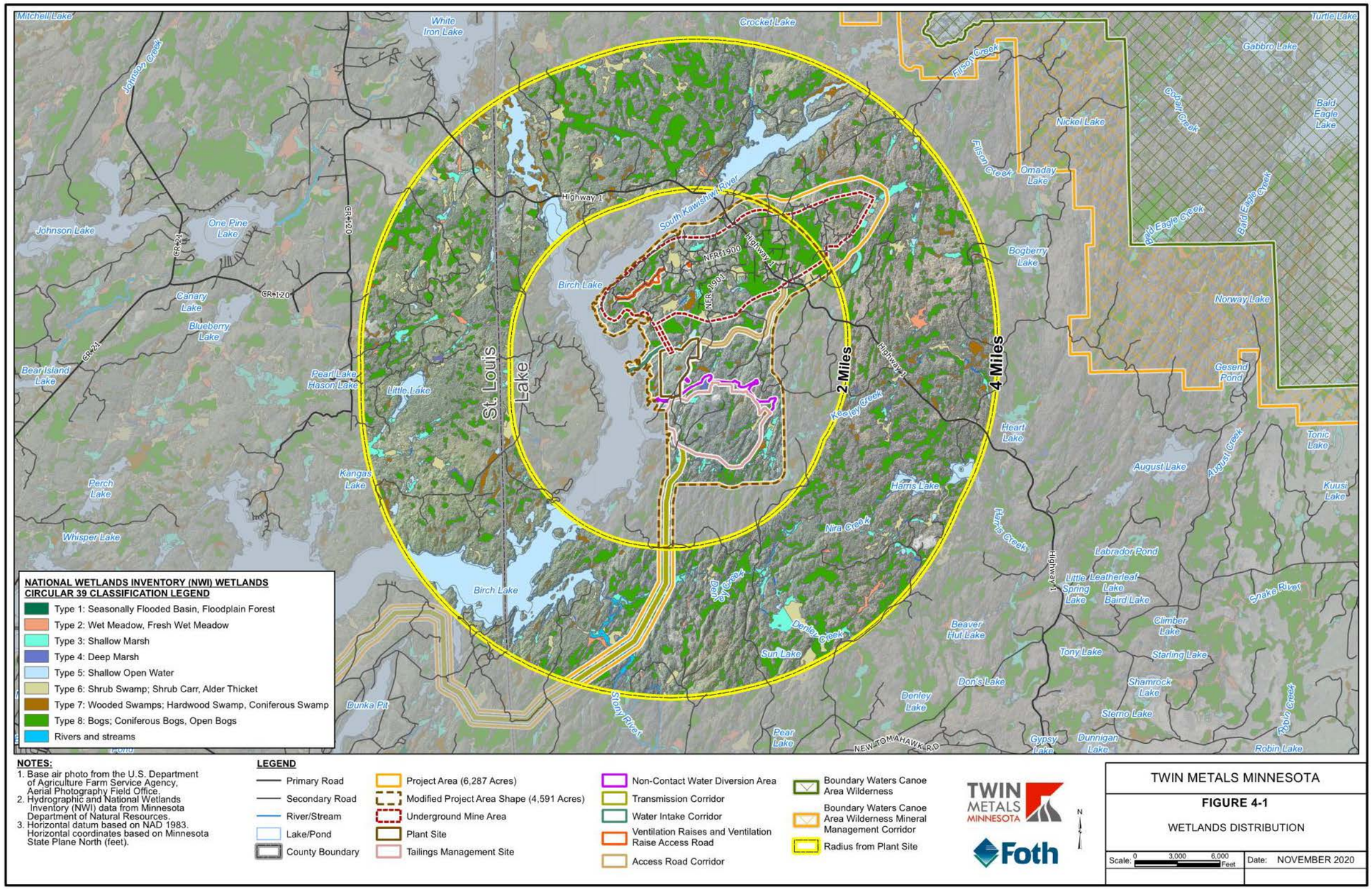

Figure 4-1 Wetlands Distribution

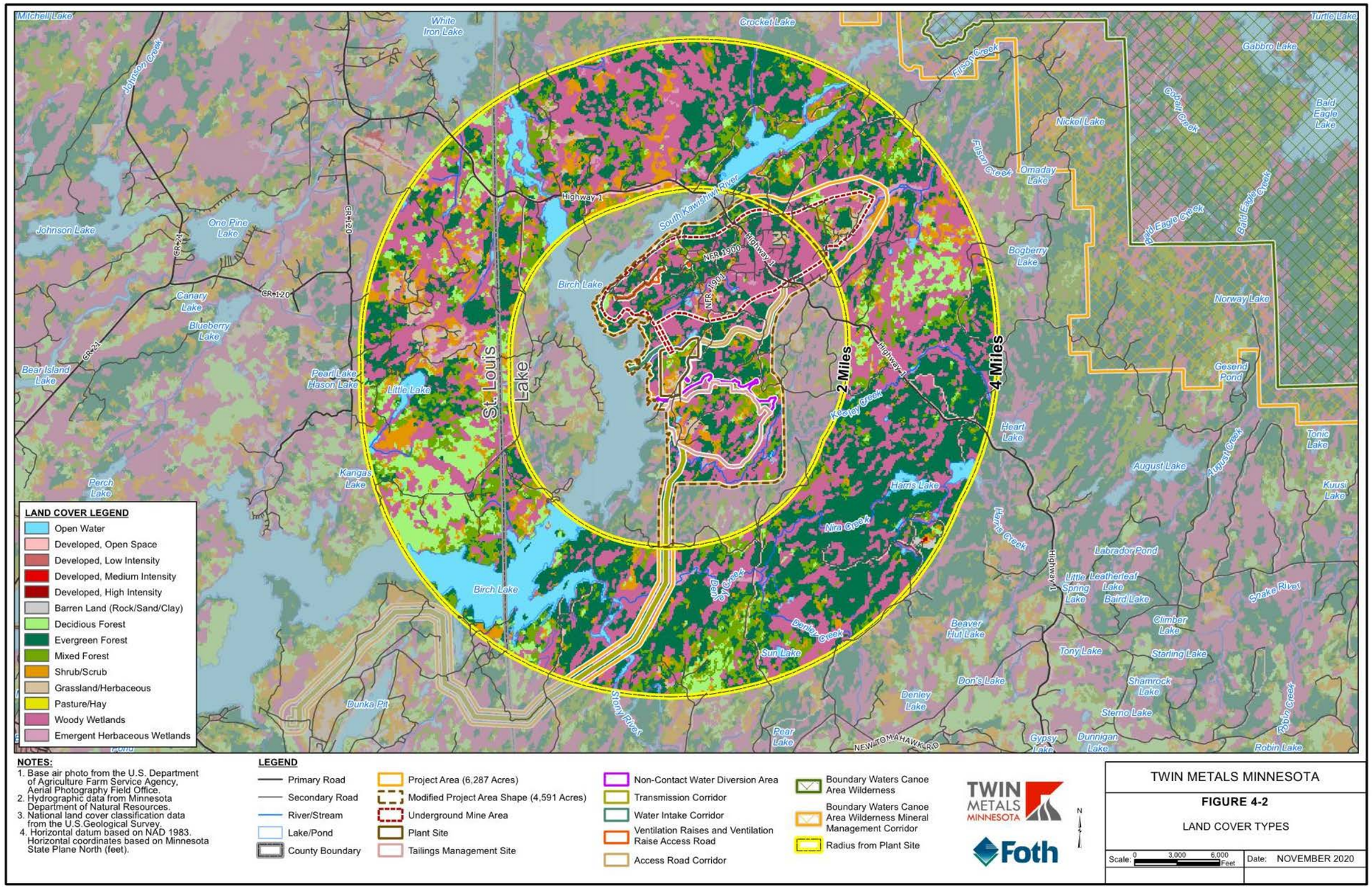

Figure 4-2 Land Cover Types

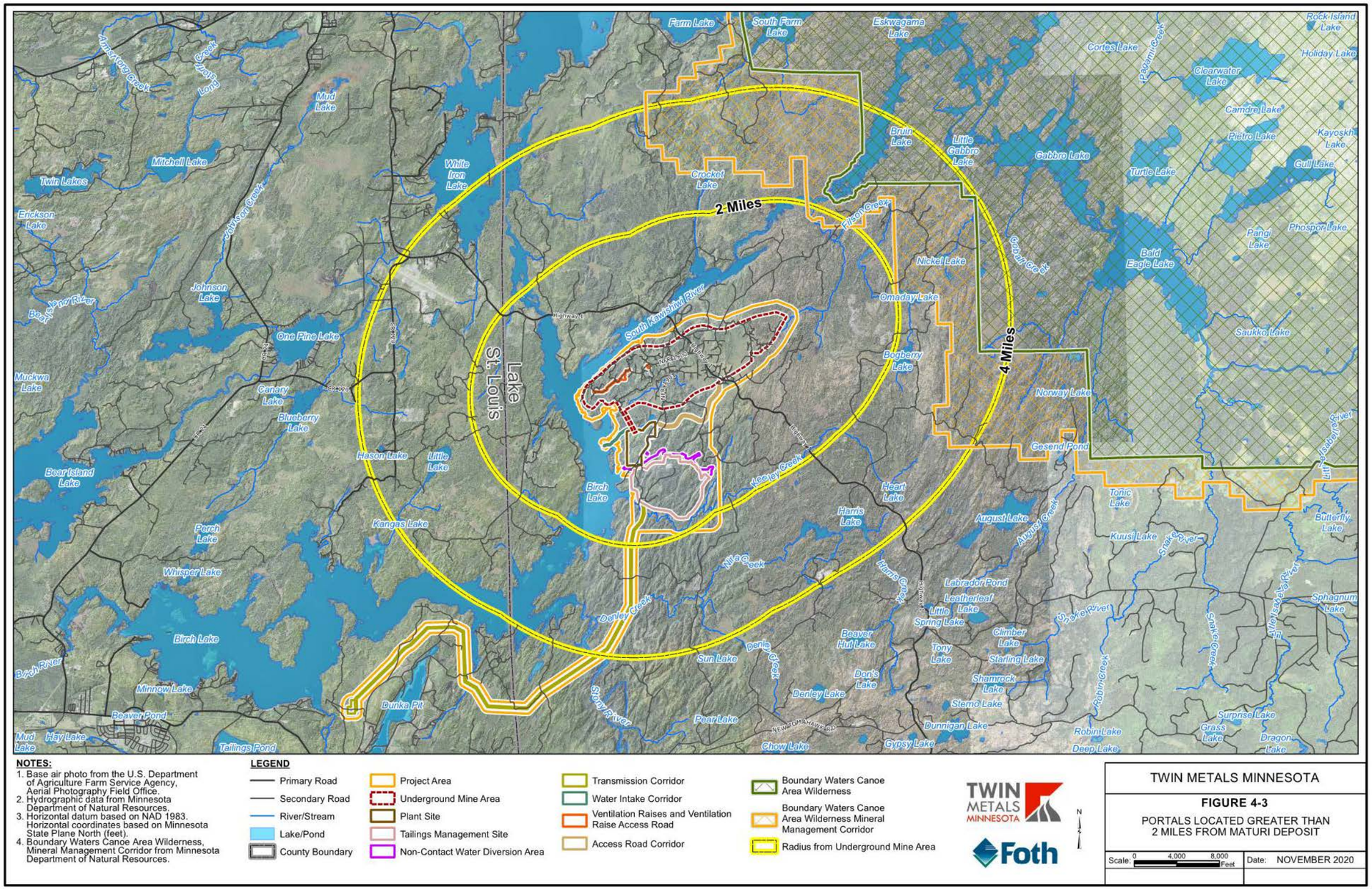

Figure 4-3 Portals Located Greater Than 2 Miles from Maturi Deposit

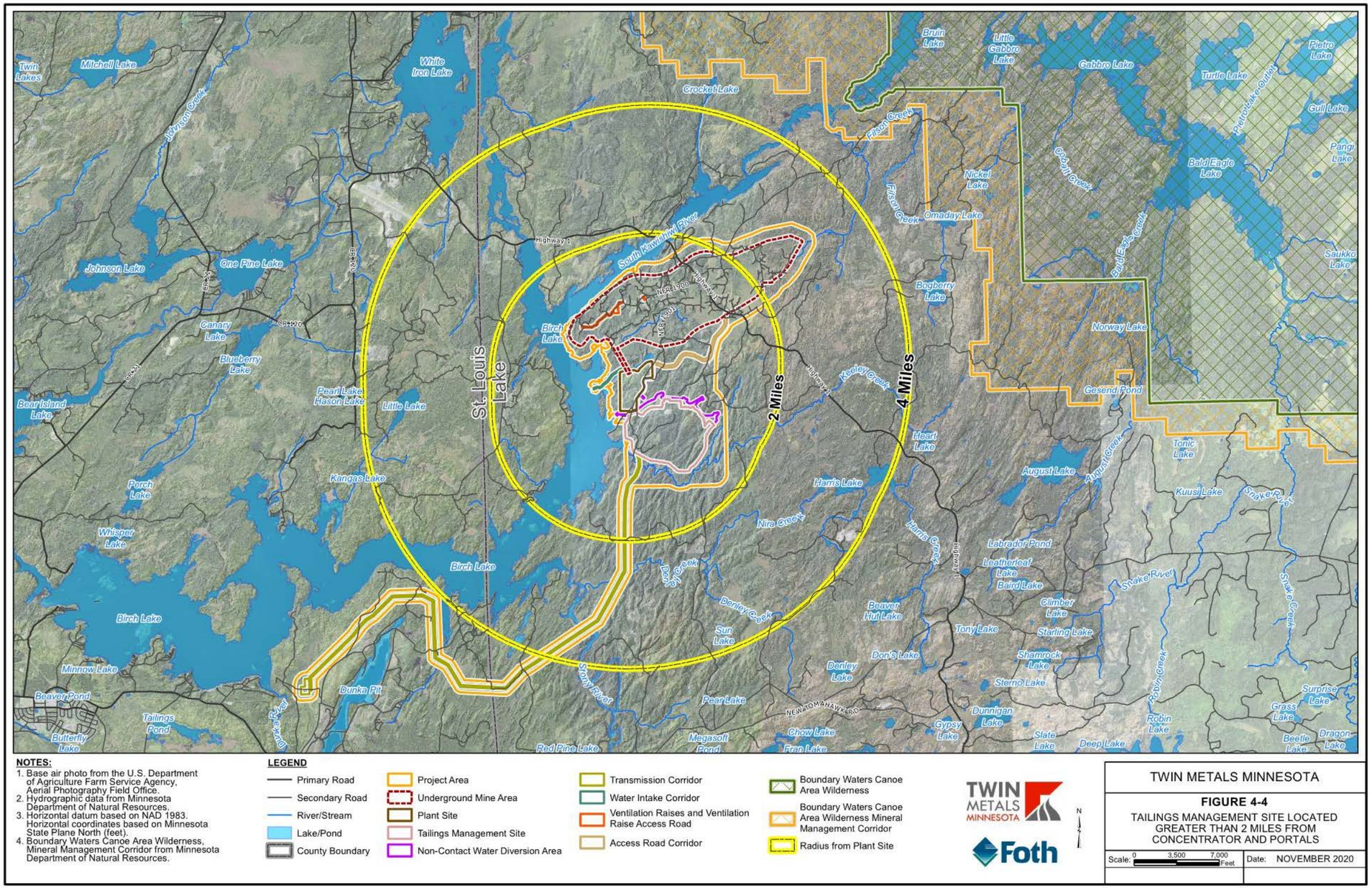

Figure 4-4 Tailings Management Site Located Greater Than 2 Miles From Concentrator and Portals

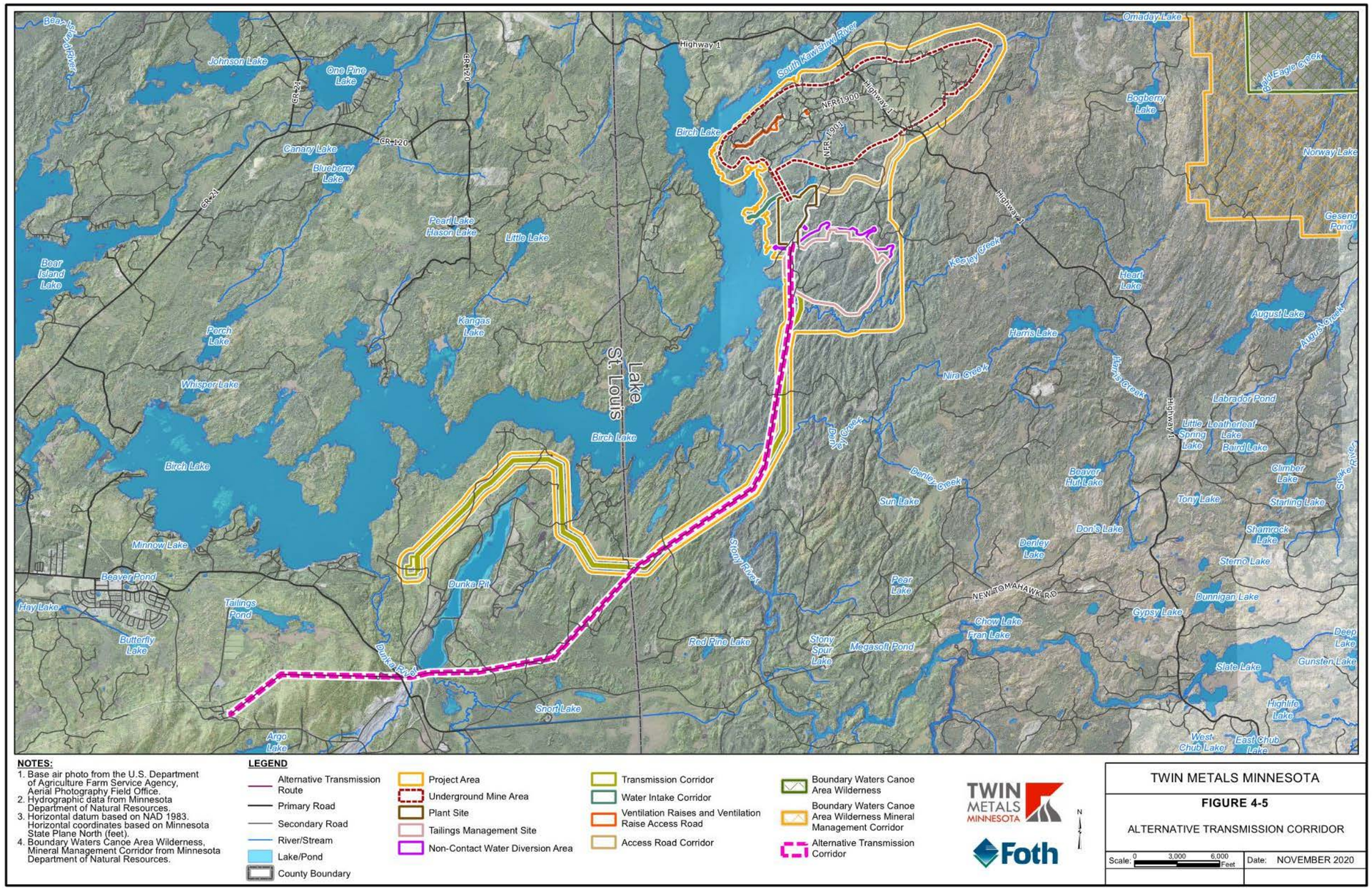

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Figure 4-5 Alternative Transmission Corridor

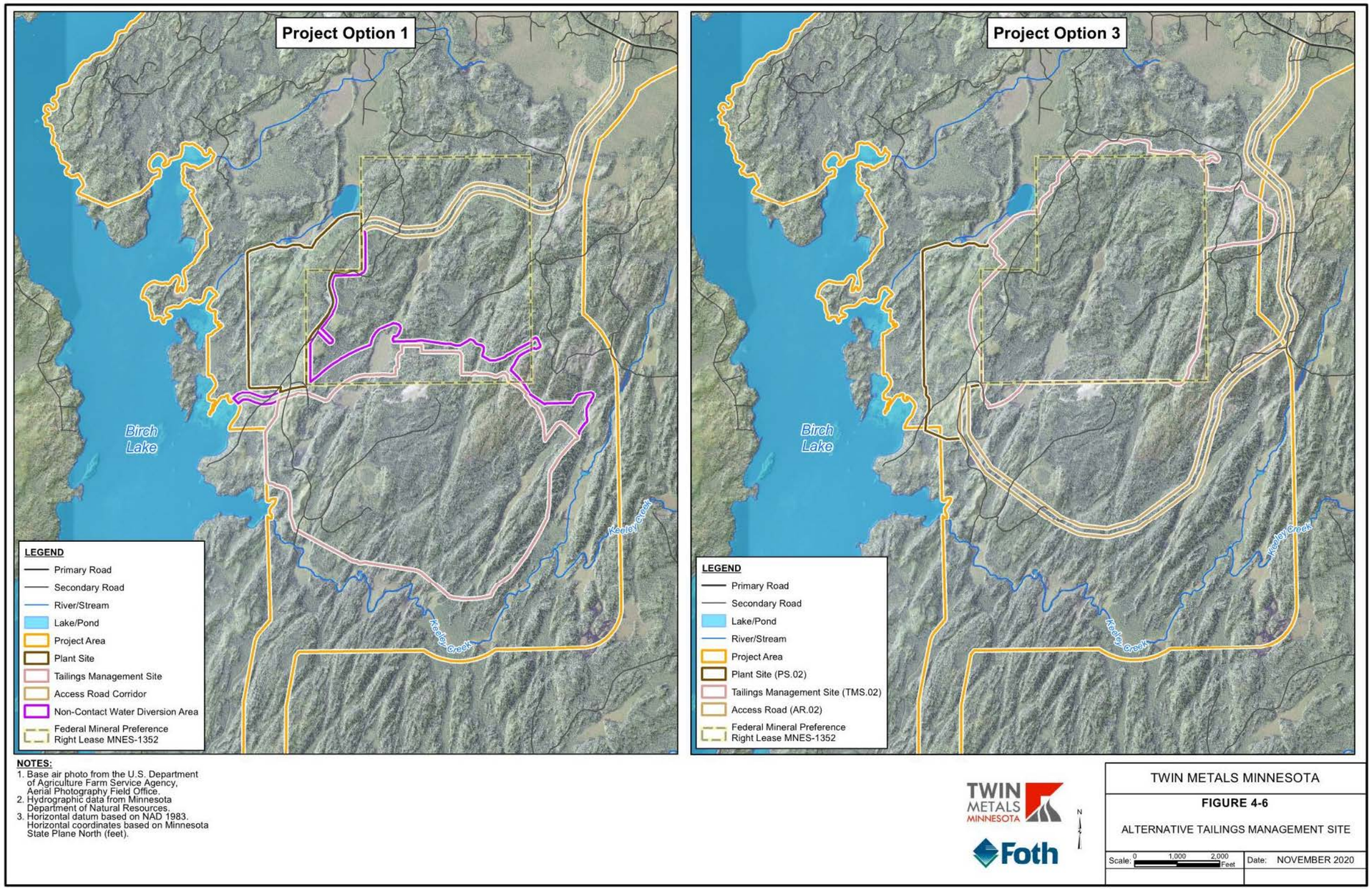

Figure 4-6 Alternative Tailings Management Site

5.0 DOCUMENT SUMMARY

This document defined the proposed action, discussed the regulatory requirements for alternatives, reviewed the methodology TMM developed to screen alternatives, and provided a summary of alternatives screened by TMM. Using the screening methodology described in Section 3.2, the following Project alternatives considered by TMM are proposed to be screened out of further consideration in an EIS:

- Portals Located Greater Than 2 Miles from Maturi Deposit
- Concentrator Not Co-Located With Portals
- Tailings Management Site Located Greater Than 2 Miles from Concentrator and Portals
- Heap Leach
- Concentrate Treatment (Hydrometallurgy / Pyrometallurgy)
- Tailings Management Technology – Conventional Tailings Slurry
- Open Pit Mining
- Block Caving as Underground Mining Method
- Mining and Processing Rate Less Than 20,000 Tons per Day

Alternatives that have not been screened out by TMM and are proposed by TMM to be progressed for further consideration in an EIS include:

- Alternative Transmission Corridor – Project Option 2
- Tailings Management Site (Federal Mineral Preference Right Lease MNES-1352) – Project Option 3

This document is preliminary and will be revised as reasonable alternatives are identified. Future alternative screening will include reviewing additional alternatives identified through agency review and the formal scoping process, including public comment. Upon conclusion of the formal scoping process, the alternatives identified for inclusion in the EIS will be evaluated against the regulatory framework and screening methodology described in Section 3.0. This work will be compiled into an Alternative Screening Evaluation Version 2.

6.0 REFERENCES

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