Volume 1 Annex V1-7 Type A Water Licence Applications

Package P2-1

Amendment No. 2 Type A Water Licence 2AM-DOH1323
(Doris & Madrid)

MAC RESOURCES

Package 2:
Project Description

AMENDMENT NO. 2 TYPE A WATER LICENCE 2AM-DOH1323 (DORIS AND MADRID)

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AMENDMENT NO. 2 TYPE A WATER LICENCE 2AM-DOH1323 (DORIS AND MADRID)

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1. Introduction

The Hope Bay Greenstone Belt ("the Property") is TMAC Resources Inc.'s ("TMAC", "the Proponent") prime holding and is its sole focus for exploration, development and mining. TMAC holds mineral claims, leases and one Inuit Mineral Exploration Agreement that comprise an approximately 20 × 80 km property. These mineral holdings comprise the Hope Bay Greenstone Belt, on which the primary gold deposits Doris, Madrid North, Madrid South and Boston are located. The Hope Bay Belt is host to numerous other prospective areas which suggest that economic reserves will continue to be delineated, permitted and developed, creating a multigenerational operation.

Development of the Belt deposit began with the construction of the Doris North Project which is authorized under Project Certificate No. 003 and Water Licence 2AM-DOH1323. The Madrid Advanced Exploration Program within the Hope Bay Belt is authorized under Water Licence 2BB-MAE1727. Other water licences granted to TMAC include Water Licence 2BB-BOS1217 for exploration activities at Boston deposit, and Licence 2BE-HOP1222 for exploration on other areas of the Belt.

The Madrid-Boston (Phase 2) Project ("the Project") focuses on mining of the Madrid North, Madrid South, and Boston deposits by utilizing and expanding upon the Doris Project infrastructure for the integrated development of the Hope Bay Belt. Madrid-Boston construction activities will overlap with the operation activities at the Doris Site (Phase 1). The proximity of the Madrid area to the Doris Site, process plant, and tailings impoundment area (TIA) means that the Project can utilize existing infrastructure at Doris. This will reduce costs, minimize the footprint, and minimize the time required to develop the Madrid deposits, and support development of the Boston Site. The permitted infrastructure and facilities at Roberts Bay and the Doris Site have sufficient capacity to support Project construction for Phase 2.

The Madrid-Boston Project involves overlapping construction and production activities. The planned sequence of production activities for the Madrid and Boston sites are:

- Commence mining at Madrid North in Year 1 (2019) and continue to Year 13 (2031), with ore processing at the Doris and Madrid North process plants;
- Commence mining at Boston in Year 4 (2022) and continue to Year 14 (2032), with partial ore processing at the Doris Site in Years 4, 5 and 6, during Boston process plant construction and ramp up to full production, expected by the end of Year 6; and
- Commence mining at Madrid South in Year 11 (2029) and continue to Year 14 (2032), with ore processing at the Doris and/or Madrid North sites.

1.1 NIRB-NWB COORDINATED REVIEW PROCESS

For the Madrid-Boston Project Proposal, TMAC has requested a coordinated process with the NIRB and NWB. As such, the pre hearing conference held to review the DEIS and Type A Water licence application, determined that TMAC should submit two water licence applications with the FEIS for the Madrid-Boston proposal. The NWB determined that TMAC should submit a Type A Amendment application for 2AM-DOH1323 and a separate Type A application for the proposed project at Boston.

As part of the NIRB-NWB coordinated review process, TMAC's application for Amendment No. 2 to Water Licence 2AM-DOH1323, and, application for a new Type A water licence for the Boston development are included as Annexes to Volume 1 of the Final Environmental Impact Statement (FEIS) for the Madrid-Boston Project.

At the request of the NWB, to the extent possible, both applications are compiled as stand-alone documents:

- FEIS Volume 1, Annex V1-7 presents the application for Amendment No. 2 to Water Licence 2AM-DOH1323, along with all necessary documentation to support the application review. The Madrid-Boston Final Environmental Impact Statement Document Map presents the structure of this application package.
- FEIS Volume 1, Annex V1-7 presents the NEW application for a Type A Water Licence for the Boston development, along with all necessary documentation to support the application review.

1.2 SCOPE OF THE AMENDMENT NO. 2 TO TYPE A WATER LICENCE 2AM-DOH1323

In addition to the infrastructure and activities listed in PART A of Amendment No. 1 of the Type A Water Licence 2AM-DOH1323, for Amendment No 2 to this licence, TMAC requests that:

1. The scope of all activities and facilities authorized under this Licence be extended to 2037 including the closure and post-closure stages of the Madrid-Boston Project.
2. To expand the scope of Licence 2AM-DOH1323 Amendment No. 1 by incorporating into this Licence the scope of all facilities and activities authorized under the Type B Licence 2BB-MAE1727. TMAC requests that the Madrid Type B Water Licence 2BB-MAE1727 be maintained until such time that the bulk sample is completed and the decision is made to enter into production at Madrid.
3. To expand the scope of Licence Type A 2AM-DOH1323 Amendment No. 1 with the additional activities and facilities listed in Tables 1.2-1.

Table 1.2-1. Scope of TMAC's Existing Water Licences and proposed Amendment No. 2 of 2AM-DOH1323

Roberts Bay Facilities, Infrastructure and Activities				
	Approved under Amendment No. 1 2AM-DOH1323		Request for Amendment No. 2 Type A Water Licence 2AM-DOH1323	Comments
	Existing	Permitted		
Life of Facilities	2022		Year 1 (2019) to Year 19 (2037)	Amendment No. 2 DOH-2AM1323
Site Development	Site largely developed		Footprint extension for cargo dock access road	N/A
Marine Facilities	Jetty		Cargo dock	Not subject to Water Licencing Application
Fuel storage - Diesel	4 @ 5 ML	1 @ 5ML	Diesel - 2 @ 5 ML Total storage: 35 ML	Amendment No. 2 DOH-2AM1323

Roberts Bay Facilities, Infrastructure and Activities *(cont'd)*				
	Approved under Amendment No. 1 2AM-DOH1323		**Request for Amendment No. 2 Type A Water Licence 2AM-DOH1323**	**Comments**
	Existing	**Permitted**		
Fuel storage – Jet fuel	Drums within Sea-Can	500,000 L	No additional storage	No change
Outfall	Outfall pipeline and berm		No additional requirements	No change
Waste management	Storage facilities, incinerators, work area		No additional requirements	No change
Expected shipping traffic			Freight – up to 4 per year (40 kt/year) Fuel – up to 3 tankers per year (35 ML total)	Not subject to Water Licencing Application
Shipping season	Open water		Open water	Not subject to Water Licencing Application
Quarries	Four active quarries permitted		Two additional quarries (Quarry AE and AF)	Amendment No. 2 DOH-2AM1323
Doris Infrastructure, Facilities and Activities				
	Approved under Amendment No. 1 2AM-DOH1323		**Request for Amendment No. 2 Type A Water Licence 2AM-DOH1323**	**Comments**
TIA Construction	North and South dam		Raise south dam and build west dam	Amendment No. 2 DOH-2AM1323
Airstrip	All-weather air strip Ice air strip on Windy Lake/Doris		No change	No change
Fuel Storage - Diesel	5 @ 1.5 ML		No change	No change
Power house	8 gen-set @ 1.2 MW Modularized building with day tanks. Back-up power supply.		Two wind turbines Nominal capacity of 4.2 MW each	Not subject to Water Licencing Application
Processing Facility	2,400 tpd		No change	No change
Overburden stockpile	Located west of the Doris Camp area		No change	No change
Waste rock stockpile (used for backfill of mine)	In use and located to the east and north of the mill building		No change	No change
Ore stockpile	In use and located to the east and south of the mill building		No change	No change

Doris Infrastructure, Facilities and Activities *(cont'd)*			
	Approved under Amendment No. 1 2AM-DOH1323	**Request for Amendment No. 2 Type A Water Licence 2AM-DOH1323**	**Comments**
Tailings Impoundment Area (TIA)	Capacity of 2.5 Mt	Expansion to 18 Mt, roads, raise height of south dam, and construction of west dam, and construction of west dam	Amendment No. 2 DOH-2AM1323
Waste management	Landfill, landfarm and handling/temporary storage of hazardous waste, incineration and open burning for combustible waste	No change	No change
Accommodations	280-person accommodations Mine dry, administration buildings, security, emergency	400-person accommodations	Amendment No. 2 DOH-2AM1323
Potable Water Use (Windy Lake)	22,995 m^3 (with potable treatment plant)	43,800 m^3 (expansion to water treatment plant)	Amendment No. 2 DOH-2AM1323
Industrial Water Use (Doris Lake)	480,000 m^3 (including pump house)	1,930,000 m^3 (inclusive of Madrid Operations)	Amendment No. 2 DOH-2AM1323
Fire protection tank	500,000 m^3	No change	No change
Water management and treatment	Cyanide destruction at mill and placement of detoxified tailings underground Mill water pumped to TIA and water recycled to mill TIA water discharged to Roberts Bay via mixing box Mine water (saline) discharged to Roberts Bay via mixing box Site contact water and domestic waste water pumped to TIA	No change Retain existing water management approach	No change
Contact water ponds	Two contact water ponds, sediment control berm, diversion berm	No change	No change
Sewage treatment	Accommodate 280-persons Discharge to tundra or TIA	Accommodate 400 persons Discharge to tundra or TIA	Amendment No. 2 DOH-2AM1323
Heliport	Heli pad and building	No change	No change
Explosives	Explosives storage and Manufacturing Facility	No change	No change

Madrid North Facilities, Infrastructure and Activities			
Components	**Approved under Madrid Bulk Sample 2BB-MAE1727**	**Request for Amendment No. 2 Type A Water Licence 2AM-DOH1323**	**Comments**
Ore mined	Approximately 50,000 t bulk sample from Madrid North	12,501,000 t	Amendment No. 2 DOH-2AM1323
Mining Method	-	Underground/Crown pillar recovery	No change
Fuel Storage (Portal, vent raise and power station)	75,000 L/60,000 L	3 @ 1.5 ML	Amendment No. 2 DOH-2AM1323
Power Generation	2 self-contained units at 750 MW (within Sea-Can)	3.6 MW (3 units @ 1.2 MW each) Two wind turbines Nominal capacity of 4.2 MW each	Not subject to Water Licencing Application
Waste rock stockpile	285,000 t 158,000 m^3	646,000 t 359,000 m^3	Amendment No. 2 DOH-2AM1323
Ore stockpile	50,000 t 28,000 m^3	50,000 t 28,000 m^3	No change
Explosives use	Not specified	4,700 kg/day	Subject to NRCan permits
Water management	Surface water collected in contact water pond and discharged to tundra	Contact water ponds - discharge to tundra or TIA Mine water (saline) directed to Doris mixing box and discharged to Roberts Bay	Amendment No. 2 DOH-2AM1323
Contact water pond	7,900 m^3 8,350 m^2	15,100 m^3 13,900 m^2	Amendment No. 2 DOH-2AM1323
Concentrator	No plant	Concentrator capacity of 1,200 tpd Mill maintenance shop Warehouse/reagent storage Backhaul of detox tailings to Madrid	Amendment No. 2 DOH-2AM1323
Tailings	No tailings	Tailings pipeline and service road from Madrid North concentrator to Doris TIA	Amendment No. 2 DOH-2AM1323
Madrid South Facilities, Infrastructure and Activities			
Components	**Approved under Madrid Bulk Sample 2BB-MAE1727**	**Request for Amendment No. 2 Type A Water Licence 2AM-DOH1323**	**Comments**
Ore mined	Approximately 50,000 t bulk sample from Madrid South	991,000 t	Amendment No. 2 DOH-2AM1323
Mining Method		Underground/Crown pillar recovery	No change

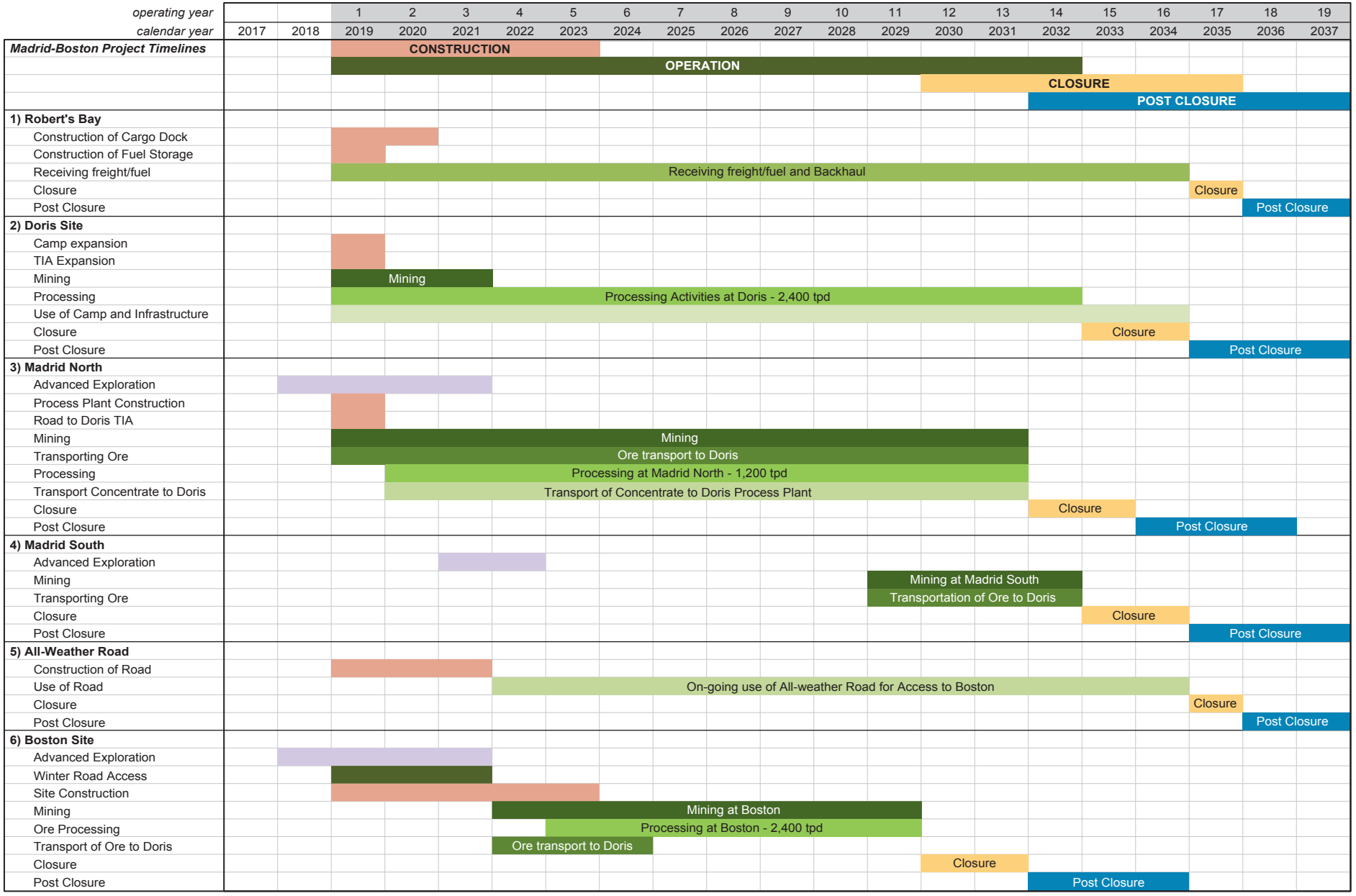
Madrid South Facilities, Infrastructure and Activities *(cont'd)*			
Components	**Approved under Madrid Bulk Sample 2BB-MAE1727**	**Request for Amendment No. 2 Type A Water Licence 2AM-DOH1323**	**Comments**
Waste rock stockpile (used for backfill of mine)	500,000 t 276,000 m^3	826,000 t 459,000 m^3	Amendment No. 2 DOH-2AM1323
Ore stockpile	55,000 t 31,000 m^3	Additional 5,400 t Additional 3,000 m^3	Amendment No. 2 DOH-2AM1323
Explosives use	Ammonium Nitrate and Fuel Oil	4,500 kg/day	Subject to NRCan permits
Contact water pond 1	15,000 m^3 12,300 m^2	No change	No change
Water management	Surface water collected in contact water pond and discharged to tundra	Contact water ponds - discharge to tundra or TIA Mine water (saline) directed to Doris mixing box and discharged to Roberts Bay	Amendment No. 2 DOH-2AM1323
Contact water pond 2	900 m^3 920 m^2	2,300 m^3 1,720 m^2	Amendment No. 2 DOH-2AM1323
Fuel Storage - Diesel	60,000 L	75,000 L	Amendment No. 2 DOH-2AM1323
Power generation	3 self-contained units at 750 KW (within Sea-Can)	No additional units	Not subject to water licencing
Miscellaneous buildings and infrastructure	Mine equipment shops, compressor building, office trailer, emergency trailer, brine mixing facility, laydown areas, air heating units	Upgrades as required. Vent raise and access road.	Amendment No. 2 DOH-2AM1323
Ore haulage to Doris	All bulk sample ore trucked to Doris	Year 12 to Year 14 Three trucks/day	Not subject to Water Licencing Application
Madrid-Boston All Weather Road			
Components	**Not Applicable**	**Request for Amendment No. 2 Type A Water Licence 2AM-DOH1323**	**Comments**
Madrid to Boston AWR	-	All-weather road construction 14 water crossings including 8 bridges and 6 culverts	Amendment No. 2 DOH-2AM1323
Quarries	-	Twenty quarry sites identified along AWR	Amendment No. 2 DOH-2AM1323
Ore haulage and transport of supplies	-	Three years – 42 trucks/day	Not subject to Water Licencing
Wind Turbines (Boston)	None	Two Wind Turbines 4.2 MW each	Not subject to Water Licencing

2. Overview

2.1 PROJECT SCHEDULE

The Project is scheduled to achieve continuous mine operations in the Hope Bay Greenstone Belt through mining at Doris, commercial mining at Madrid North and South, commercial mining of the Boston deposit. The Project schedule (Figure 2.1-1) illustrates TMAC's staged approach to conducting the Project Permitting, Construction, Operation, Reclamation and Closure, and Post-closure phases at Madrid and Boston deposits.

Figure 2.1-1
Project Schedule



3. Construction

The proximity of the Madrid area to the Doris Site, process plant, and TIA provides the opportunity for the Project to utilize existing infrastructure at Doris as an integral part of the Madrid-Boston Project. It is anticipated that this will reduce costs, minimize the footprint and minimize the time required to complete the development, and production at the Madrid deposits. The permitted infrastructure and facilities at Roberts Bay and Doris (Project Certificate No. 003 and Type A Water Licence 2AM-DOH1323) have sufficient capacity to support Project construction for Madrid-Boston Project during the initial stages. Construction activities related to Amendment No. 2 of 2AM-DOH1323 are described below.

The Project construction will include:

- expansion of the Doris TIA (raising of south dam and construction of west dam);
- construction of an off-loading fuel and cargo dock and additional fuel storage at Roberts Bay;
- complete development of the Madrid North and Madrid South mine workings to commercial scale;
- incremental expansion of surface infrastructure at Madrid North and Madrid South to accommodate production mining;
- construction of a 1,200 tpd concentrator and a power plant at Madrid North;
- all weather access road and tailings line from Madrid North to the south end of the TIA;
- all-weather road (AWR) linking Madrid to Boston;
- infrastructure necessary to support ongoing exploration activities at both Madrid North and South; and
- wind turbines near the Doris and Madrid sites.

3.1 ROBERTS BAY

Roberts Bay is located approximately 5 km north of the Doris Site and is the sea borne entry point for the Belt. The port has an existing jetty for offloading cargo and fuel, and a fuel storage facility. In order to provide for the economic supply of material and equipment into the Belt, an annual sealift is required. This sealift occurs in the open water period, generally August through October, when vessels and barges can access Roberts Bay.

TMAC proposes to continue using the infrastructure at Roberts Bay permitted under Amendment No. 1 of the Type A Water Licence 2AM-DOH1323 until 2037. In order to support the safe and efficient off-loading of fuel, equipment and supplies, a cargo dock (P5-10), access road (P5-14) and a fuel pipeline connecting the dock to fuel facilities at Roberts Bay along the access road will be required at Roberts Bay. In addition to this infrastructure the Project requires the construction of additional fuel storage at Roberts Bay. Additional details of these facilities are provided in Package 5 of this Application. Refer to Hope Bay Project: Roberts Bay Cargo Dock Access Road Preliminary Design (P5-14) and Hope Bay Project Roberts Bay 10ML Fuel Storage Preliminary Design (P5-15) for additional details.

The proposed location of these facilities at Roberts Bay is shown in Figure 3.1-1: Roberts Bay Site Layout.

3.2 DORIS SITE

The Project construction activities at Doris include expansion of the TIA (increase capacity from 2.5 Mt to 18 Mt of tailings), minor relocation of the explosives facility to accommodate the increased tailings capacity, the expansion of the camp to accommodate up to 400 persons (an increase of 120 beds), construction of two wind turbines, construction of the Windy Lake north freshwater intake, and, an increase in water supply. An additional 100 beds may be required for the peak construction period.

The expansion of the TIA is described in Package P5-16 and a description of the design of the Windy Lake north freshwater intake is provided in Package P5-23 of this application.

Figure 3.2-1 Site Layout of Doris shows approved infrastructure footprints for Doris and Roberts Bay and the proposed infrastructure for Madrid-Boston Project, including the expanded TIA.

3.3 MADRID NORTH

The construction activities for Madrid North are those required to modify the site from its configuration for the Madrid Advanced Exploration Program to commercial mining. The Project construction activities required to modify the site include:

- expansion of the site pad, primarily to accommodate a larger waste rock stockpile;
- construction of a tailings pipeline and service road to the TIA;
- expansion of the Contact Water Pond (CWP) to accommodate the larger pad area;
- use of a local quarry to produce construction bulk rock fill and aggregate;
- construction of a 1,200 tpd capacity concentrator;
- construction of a 3.6 MW capacity power plant;
- construction of two wind turbines
- construction of a 4.5 ML fuel storage facility; and
- construction of three vent raise pads and associated access roads.

The site layout of the Madrid North is illustrated in Figure 3.3-1. The production-level design of Madrid North is described in Package P5-17 Hope Bay Project – Madrid North Surface Infrastructure Preliminary Design.

Figure 3.3-1 outlines the PDA for the Madrid North facilities. The facilities listed above will be re-positioned as required based on detailed design, ground conditions, water management considerations and mine engineering requirements. All facilities are expected to remain within the boundaries of the PDA. In order to capture conservative scenarios for the effects assessments, TMAC assumes that for terrestrial VCs the entire PDA is considered disturbed and occupied by infrastructure. The approach for water management, air quality, and noise remains unchanged, regardless of the final consideration of the site.

Figure 3.1-1
Roberts Bay Site Layout

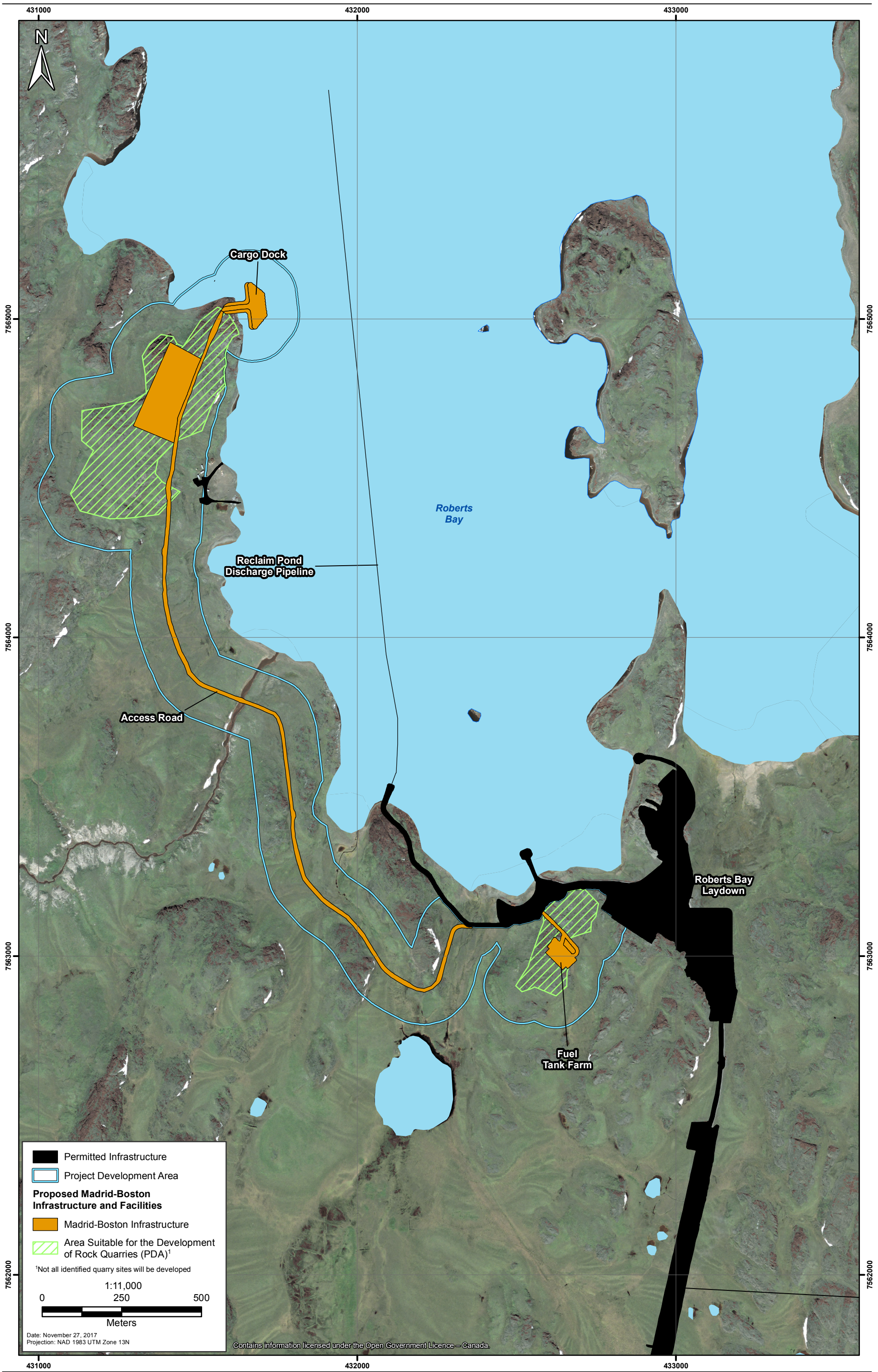


Figure 3.2-1
Doris Site Layout

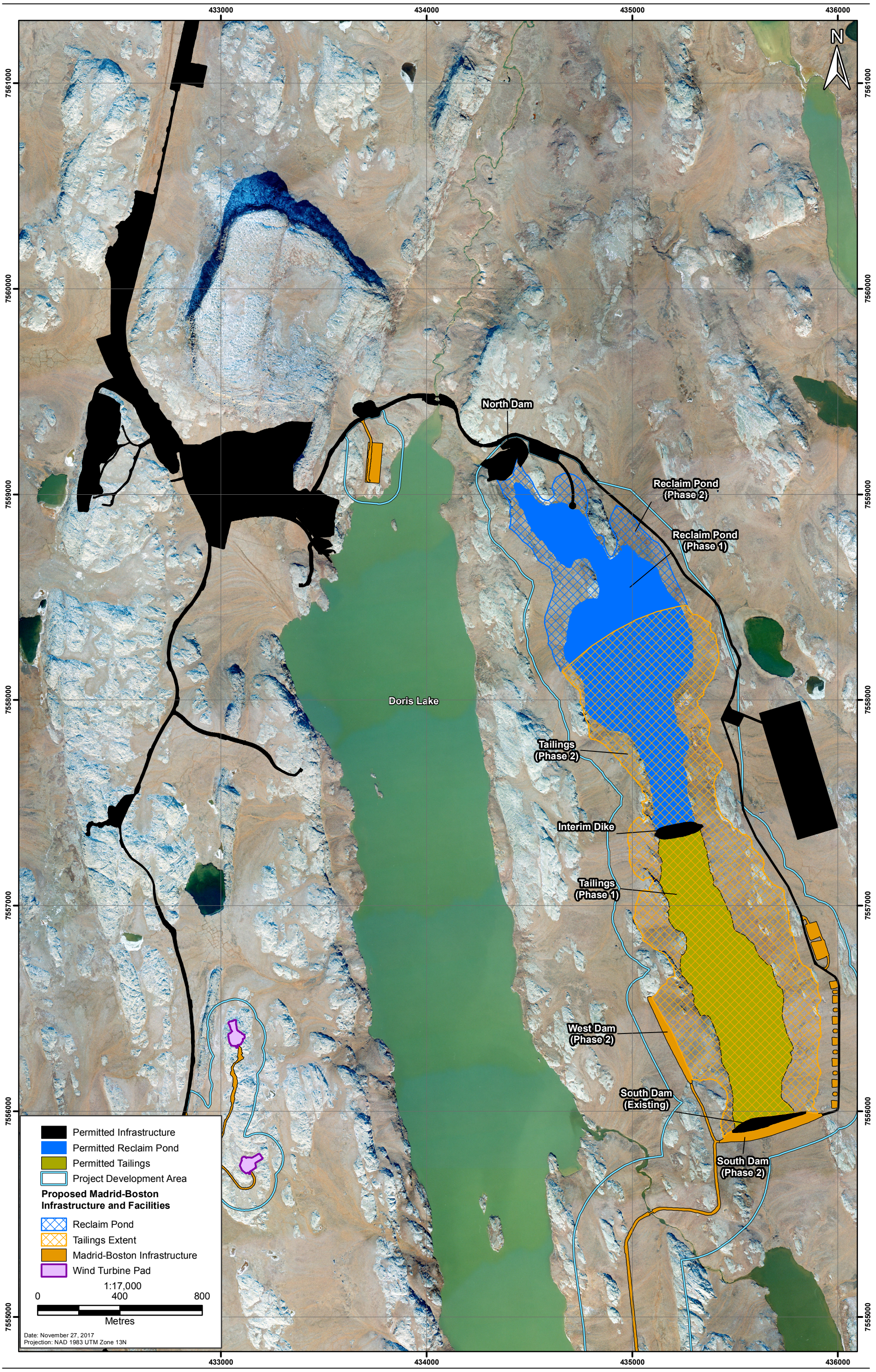
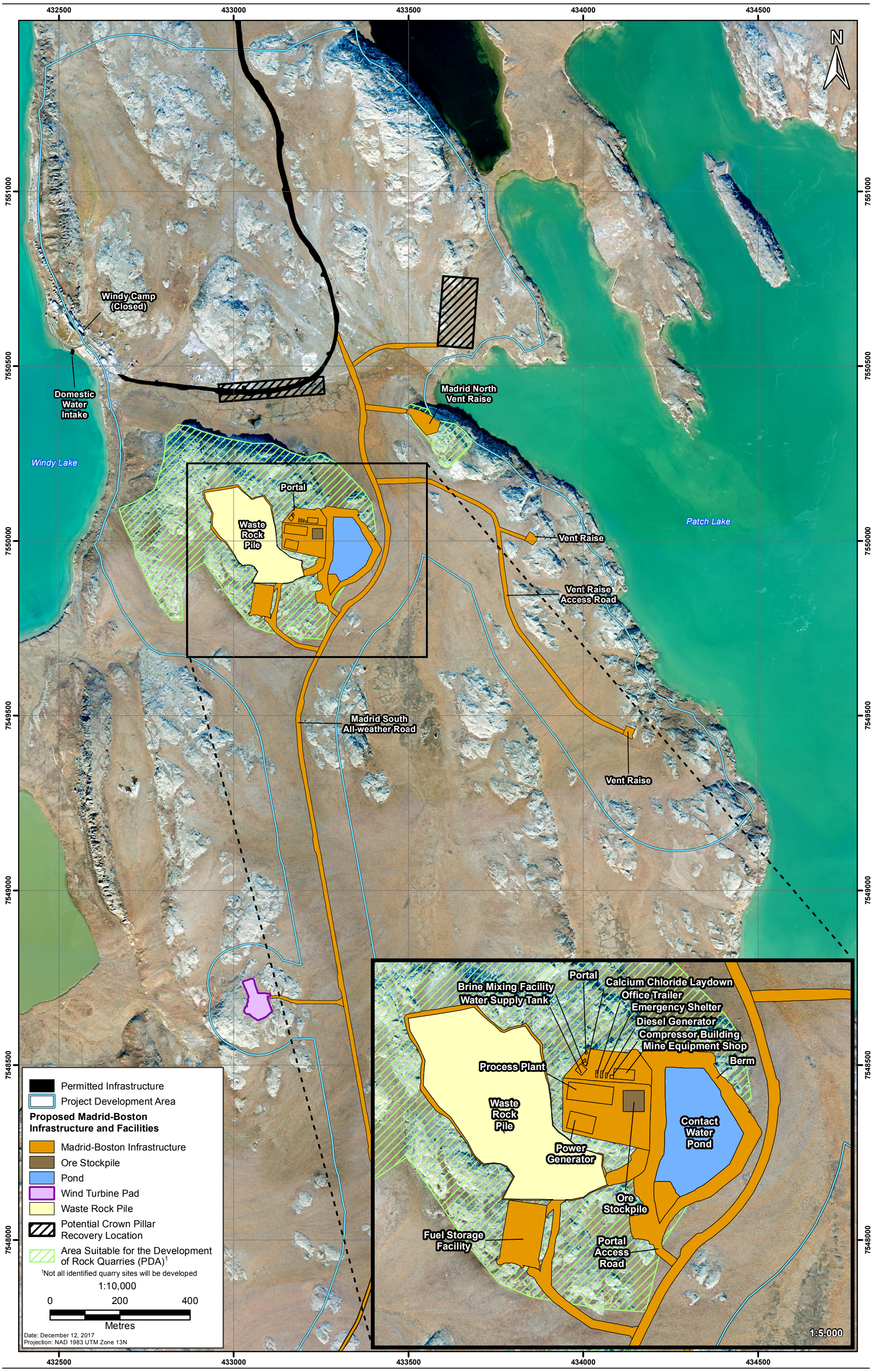


Figure 3.3-1
Madrid North Layout



3.4 MADRID SOUTH

The construction activities for Madrid South are those required to modify the site from its configuration for the Madrid Advanced Exploration Program to facilitate commercial mining. The Project construction activities required to modify the site include:

- expansion of the site pads, primarily to accommodate a larger waste rock stockpile;
- vent raise and access roads;
- expansion of the primary contact water pond to accommodate the larger pad area; and
- use of a local quarry to produce construction bulk rock fill and aggregate.

The site layout of Madrid South is illustrated on Figure 3.4-1. The design of the Madrid South site is described in Package P5-18 Hope Bay Project – Madrid South Surface Preliminary Infrastructure Design.

3.5 MADRID-BOSTON ALL-WEATHER ROAD

An All Weather Road (AWR) connecting Madrid to Boston mining areas is required to provide year round access between the three mining areas (Doris, Boston and Madrid). This will also enable the haulage of fuel and material to, and ore from Boston.

The Project construction activities associated with the AWR include:

- development and use of quarries to produce construction bulk rock fill and aggregate;
- construction of the AWR;
- installation of culverts and bridges at water crossings;
- use of the established Madrid-Boston winter road route or other short localized winter routes as required to enable efficient construction of the all-weather road; and
- construction of two wind turbines (Nominal capacity of 4.2 MW each) near Boston.

The design of the Madrid-Boston AWR and all potential quarry locations are illustrated on Figure 3.5-1. The design of the Madrid-Boston AWR (Figure 3.5-1) is described in Package P5-11 the Hope Bay Project Madrid–Boston All-Weather Road Preliminary Design. Geochemical characterization of potential quarries for construction of the AWR is provided in Package P5-6.

3.5.1 Road Design

The selected road alignment extends south from the Madrid South AWR and roughly follows the east side of Aimaokatalok Lake before terminating in the Boston mining area. The road alignment is presented on Figure 3.5-1. This alignment considered cultural and environmentally sensitive areas and minimizes the required bridge spans at stream crossings. Thermal modelling was completed to determine fill thickness required to preserve permafrost under infrastructure such as the AWR.

It is expected that animals will be able to move freely across the majority of the all-weather road. Prior to the final design of the road, community members will be consulted as to locations along the road where road bank could be modified with a more gradual slope to ensure easier passage (if required). These crossing locations will likely consist of 5-10 m wide sections of the roadway where the shoulders are flattened to 5H:1V and topped with surfacing material.

3.5.1.1 Stream Crossings

Crossings locations and features are based on air photo interpretation, topography, available hydrology data, and photos and descriptions from previous studies. Four crossing types have been identified as culverts, fish-bearing culverts, bridges with pile foundations, and bridges with frozen abutment foundations. Table 3.5-1 provides details on the 16 stream crossings on the proposed AWR.

Table 3.5-1. Stream Crossing Details

Crossing ID	Expected Crossing Type	Minimum Span Length* (m)	Comments
C-MBR-7	End bearing pile bridge	15 m	Fish presence confirmed (Arctic Grayling)
C-MBR-8	End bearing pile bridge	14 m	Fish presence confirmed (species not confirmed)
C-MBR-9	End bearing pile bridge	20 m	Assumed fish-bearing
C-MBR-10	Culvert	N/A	Generally wet area; preferential flow path not identified; investigate for presence of fish
C-MBR-11	Fish-bearing Culvert	N/A	Generally wet area; preferential flow path not identified; fish presence confirmed (Ninespine Stickleback)
C-MBR-12	End bearing pile bridge	20 m	Fish presence confirmed (Arctic Grayling and Ninespine Stickleback)
C-MBR-13	Fish-bearing culvert	N/A	Very small stream; fish investigate for presence of fish
C-MBR-14	Fish-bearing culvert	N/A	Very small stream; investigate for presence of fish
C-MBR-15	End bearing pile bridge	10 m	Fish presence confirmed (Ninespine Stickleback)
C-MBR-16	End bearing pile bridge	12 m	End bearing pile span would reduce the required width. Fish presence confirmed (Arctic Grayling and Ninespine Stickleback)
C-MBR-17	Culvert	N/A	Very small stream; investigate for presence of fish
C-MBR-18	Culvert	N/A	Generally wet area; preferential flow path not identified; investigate for presence of fish
C-MBR-19	End bearing pile bridge	12 m	Fish presence confirmed (Lake Trout, Arctic Grayling, Burbot, Slimy Sculpin and Ninespine Stickleback)
C-MBR-20	Frozen abutment bridge	N/A	Very small stream; fish presence confirmed (Ninespine Stickleback and Slimy Sculpin)

**Typical supplier bridge span lengths will be used where possible to avoid custom manufacturing.*

Culvert Crossings (Non-fish-bearing)

Stream crossings confirmed not to be fish habitat will be spanned using 1 m diameter culverts.

Culvert Crossing (Fish-bearing)

For fish-bearing streams with minimal flow, culverts sized to allow fish passage will be used. A typical fish-bearing culvert will have a minimum diameter of 1 m and riprap will be placed inside the culvert to dampen the flow velocity to allow the passage of fish. Culvert diameter and rip-rap size will vary depending on the catchment area reporting to the crossing and the type of fish expected. A frozen abutment clear span crossing will be used in cases where detailed analysis indicates that conditions to sustain fish cannot be achieved using a fish-bearing culvert crossing.

Bridge Crossings

A crossing structure will be constructed at all stream crossings that are fish-bearing and free flowing. The bridge structure will be above the ordinary high water mark (HWM).

Silt fences will be installed along the toe of the roadway to ensure that sediments do not enter the streams. The silt fences will start a minimum of 3 m before the abutment of the clear-span structure.

Figure 3.4-1
Madrid South Layout

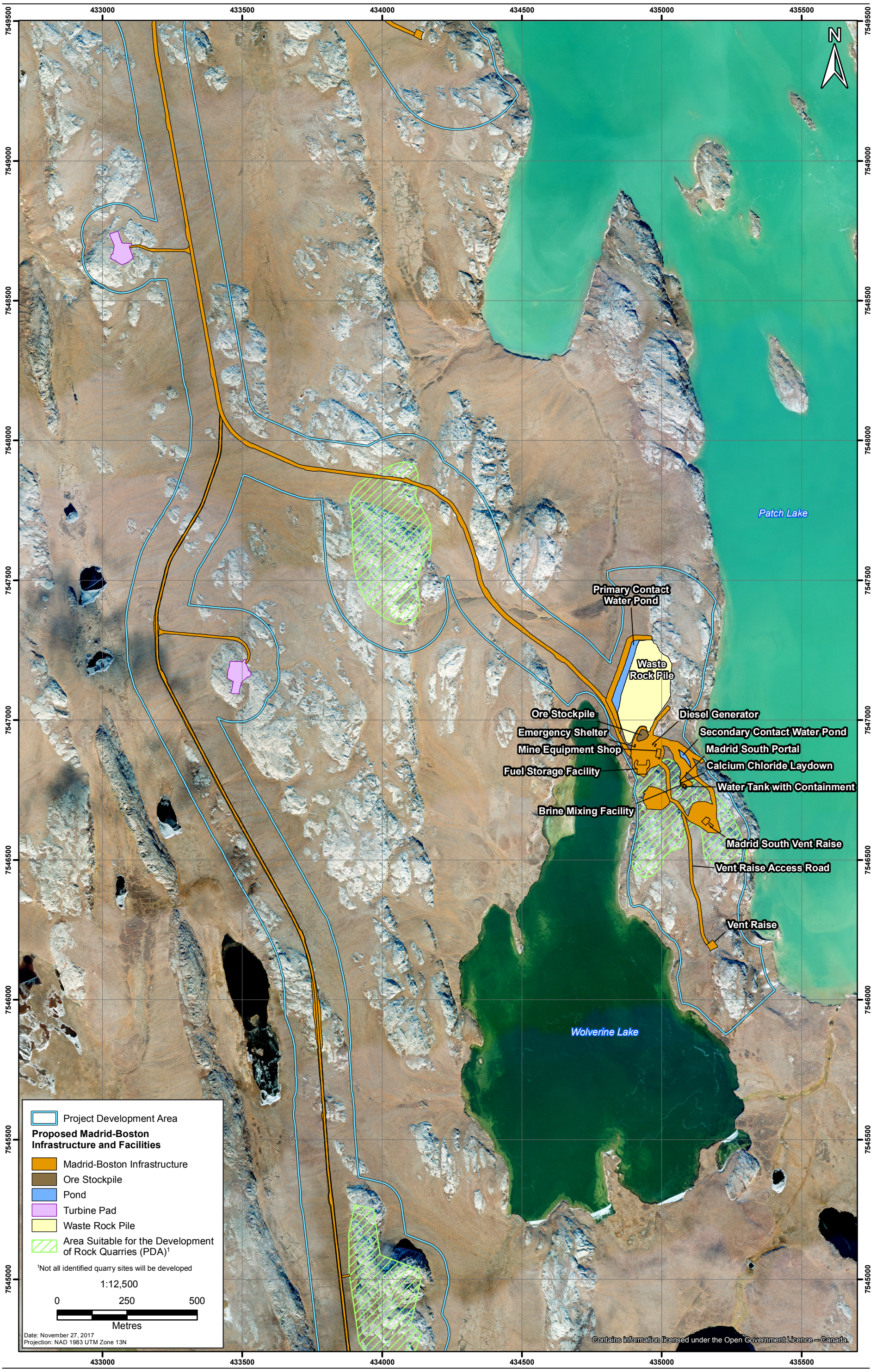
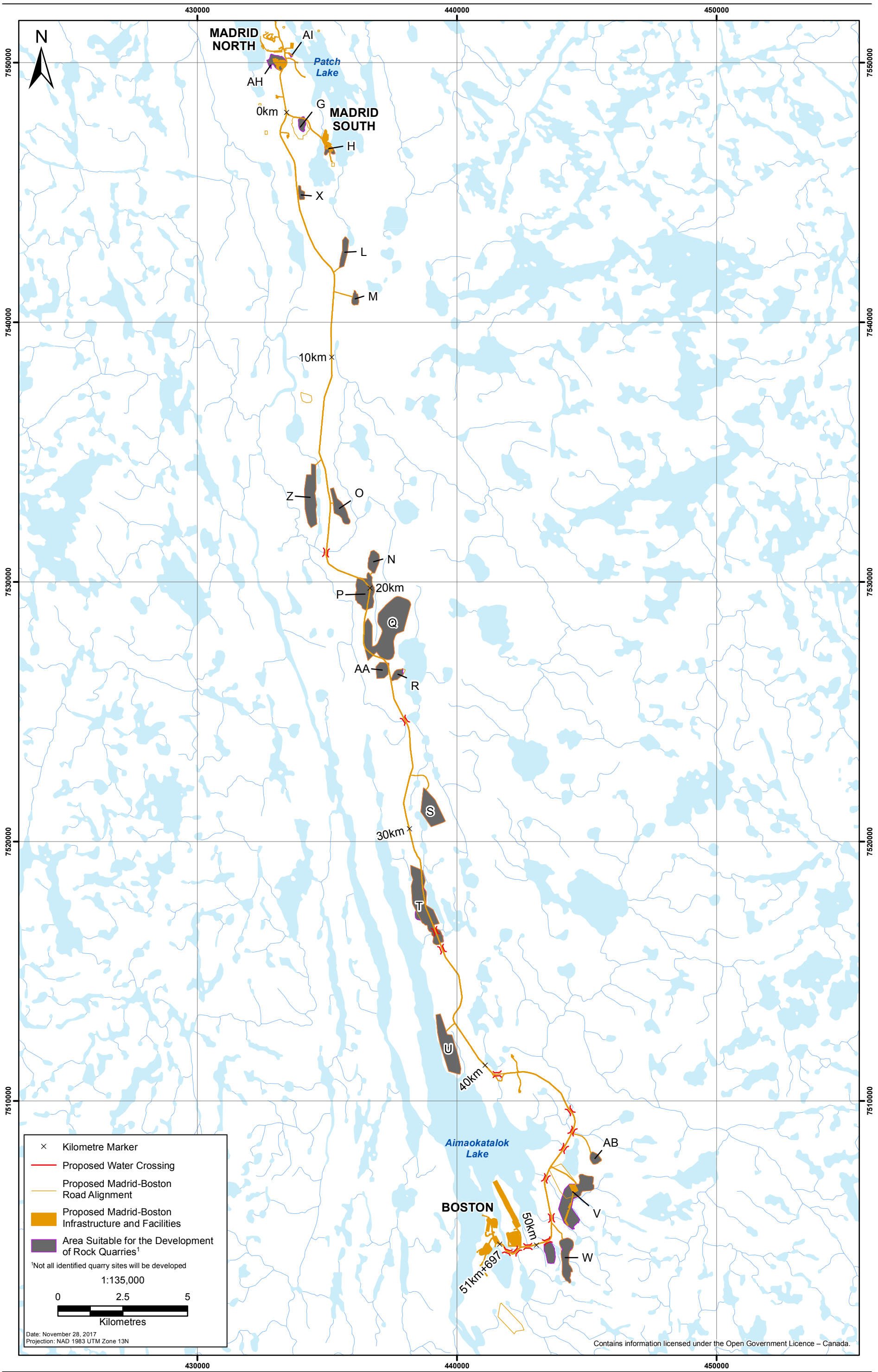


Figure 3.5-1
Madrid–Boston All-Weather Road and Potential Quarry Locations



4. Ore and Waste Rock Management

4.1 CONCENTRATOR AT MADRID NORTH

However, both the Madrid North ore bodies are large deposits with significant upside potential in terms of ore resources. TMAC anticipates that on-going exploration activities will significantly increase the ore reserves and thus increase the life of mine for Madrid North.

The Madrid ore processing plant essentially consists of primary crushing, ore sorting to minimize waste rock, crushing and the gravity concentration circuit (concentrator) which does not utilize hazardous chemicals for concentration of the gold bearing material. The gravity concentration process utilizes crushing, grinding, spiral concentration and flotation, for concentration of the gold bearing content of the ore (refer to flowsheet presented in Figure 4.4-1).

The gravity concentration line of the Doris process plant will be fully utilized until the Doris mine is exhausted, which is expected to occur by Year 3 of the Madrid-Boston Project (2022). Since the Madrid North mine is expected to ramp up to full ore production of 3,200 tpd of ore by Year 3, ore mined at the Madrid North site will be used to supplement the Doris mine ore production to maintain the Doris process plant operation at its full design capacity. However, mining at Madrid North is expected to exceed the Doris process plant capacity by up to 1,200 tpd. Hence an additional gravity concentration line will be required to treat all the ore mined from Madrid North.

4.2 ORE STOCKPILES

The ore stockpile area at Doris will continue to be utilized for Madrid and Boston ores as required. Ore stockpiles will also be located at Madrid North, Madrid South. Ore stockpiles at all mine sites will be continually drawn down and replenished as ore is processed at Doris and Madrid North.

4.2.1 Geochemical Characterization of the Ore

Geochemical characterization of the ore produced at each site has been completed and details can be found in Packages P5-20 and P5-21 of this application.

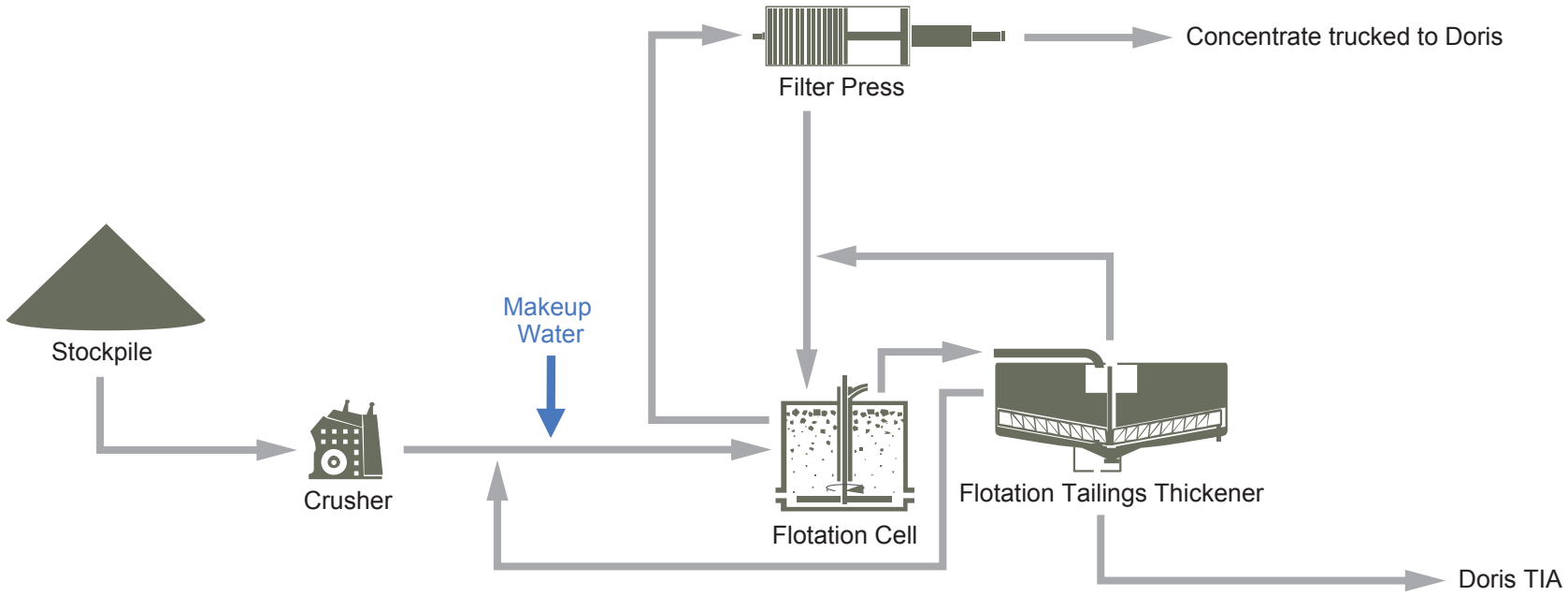
4.3 WASTE ROCK

Each of the mine sites has waste rock piles (WRP). Generally, WRPs are located as close as practical to the mine openings to minimize haul distances. All waste rock piles are within the Project Development Area (PDA).

4.3.1 Geochemical Characterization of the Waste Rock

Geochemical characterization of the waste rock produced at each site has been completed. Refer to Package 5 for the detailed geochemical reports. Waste rock generated by the Project does not pose a risk of ARD. A potential of neutral metal leaching does however exist for select material.

Figure 4.4-1
Processing Plant Simplified Flowsheet Madrid



4.3.2 Waste Rock Deposition Strategies

Available waste rock deposition strategies that have been considered include:

- use as underground backfill;
- sub-aqueous deposition in the Doris TIA; and
- on-land storage.

Waste rock will be used as underground backfill to the maximum extent possible. Backfilling is an integral part of the mining operation and is predicted to consume all of the Project waste rock. A predicted shortfall in available backfill will be made up from surface quarries, as required. Sub-aqueous deposition is not expected to be necessary given the geochemical composition of the rock, nor is it desirable given the expected need for backfill. Therefore, the preferred method is on-land deposition on engineered waste rock pads until placement as backfill.

4.3.3 Operations

All waste rock piles will be engineered structures to ensure geotechnical stability. Waste rock will be transported to the piles using underground mine trucks and be placed at its natural angle of repose with safety berms spaced at regular vertical intervals. The waste rock piles will be contoured using bulldozers. The material in the piles will generally remain in place temporarily after which it is returned underground for use as backfill.

4.3.4 Water Management around Waste Rock Piles

Contact water ponds will be constructed downstream of all waste rock piles to ensure containment of contact water, surface runoff and melt water. Berms will be strategically constructed to ensure complete containment of runoff water and seepage, as well as prevent any clean water run-off of surface waters to the waste rock. As appropriate, upstream surface water diversion structures will be constructed to minimize contact water. Location of contact water ponds can be found the site layouts provided.

4.3.5 Tailings Management

Geochemical characterization of tailings from processing Madrid North and Madrid South ore is described in following packages P5-7 of this application.

4.3.5.1 Expansion of Doris TIA

The operation of the Doris TIA will continue as currently authorized under the Type A Water Licence 2AM-DOH1323. Details of the TIA management are described in package P5-16 Doris Tailings Management System Phase 2 Design Hope Bay Project.

The tailings deposition plan ensures that the supernatant pond will be located away from the South and West Dams. Deposition will be started from the crest of the South and West Dams, to create beaches that would push the supernatant water away from these structures. Once these beaches are created, the spigot points will be moved to the east side of the TIA. This will create a long and even tailings surface sloping toward the North Dam and ensuring that the water in the existing TIA is displaced and pushed away from the south end of the facility.

Tailings deposition will minimize the area of exposed inactive tailings surface that might be prone to dusting. Beyond such mitigation by design, dust control measures available for the TIA include the use

of environmentally suitable chemical dust suppressants. In addition to chemical dust suppressants, natural dust control in the form of packed snow when available could be used as far as practical. In addition, a suitable water cannon could be used for dust suppression by wetting the areas of concern, if required.

Throughout the operational phase of the Project, the containment structures (North, South and West dams) will be subject to monitoring to evaluate their performance. This will include thermal, settlement and deformation monitoring. All TIA components and activities will be subject to annual inspections by a qualified engineer. The frequency of these inspections may be reduced as time progresses in accordance with the qualified engineer's recommendations.

4.3.5.2 Madrid North

The tailings produced at the Madrid concentrator will be pumped to the Doris TIA along the access road to be constructed from Madrid North to the south end of the TIA.

4.3.5.3 Detoxified Tailings

Following the detoxification stage (cyanide destruction) at the Doris process plant, the residual detoxified tailings will be dewatered (filtration) prior to disposal within the underground workings.

5. Water Management

Detailed water management plans for the Project have been updated and can be found in Package 4 of this application and modelled as described in package P5-4 Madrid-Boston Project Water and Load Balance Hope Bay Project. Geochemistry source terms for input to the Madrid-Boston Project – Water and Load Balance is provided in Source Term Predictions for the Proposed Madrid North, Madrid South and Boston Mines Report found in package P5-9. Details on water management and monitoring are outline in associated water management plans found in package 4 of this application.

5.1 DORIS

Water management for Doris follows the authorizations under the Project Certificate No. 003 and Amendment No. 1 Water Licence 2AM-DOH1323. With the addition of Madrid-Boston activities water management is modified at Doris to include the following connections between the other mining areas:

- water collected in the Madrid North and Madrid South CWPs may be deposited in the Doris TIA;
- A portion of Madrid North ore and Madrid North concentrate and Madrid South ore will be processed at the Doris process plant with flotation tailings deposited in the Doris TIA;
- detoxified tailings produced at Doris from concentrate produced at Madrid North will be placed underground with waste rock;
- intercepted groundwater from Madrid mines will be discharged to the marine outfall mixing box or the Doris TIA; and
- Additional Windy Lake north freshwater intake location.

During the Operation phase, all site surface and underground mine water that does not meet tundra discharge criteria will be redirected to the TIA. Reclaim water from the TIA will be pumped to the Doris process plant. The reclaim volume will be maximized so as to minimize the need for freshwater make-up from Doris Lake. A reclaim barge on the reclaim pond in the TIA will house the reclaim pump. The reclaim barge will be equipped with a bubbler system to ensure it remains functional during winter months.

Water that meets discharge criteria set forth in the Metal Mining Effluent Regulation (MMER) will be discharged to the approved and engineered outfall in Roberts Bay. Since the TIA is located in a small isolated headwaters catchment, there is no diversion of non-contact water. All precipitation and runoff that fall within the catchment area of the TIA reports to the TIA.

5.2 MADRID NORTH AND SOUTH

Madrid North is located in the Doris and Windy watersheds. The Windy Lake watershed flows through Windy Lake to Glenn Lake and then to Roberts Bay. Madrid South is located within the Doris Watershed. The Doris watershed flows through Imniagut and Wolverine Lakes to Patch Lake, PO Lake, Ogama Lake and eventually to Doris Lake.

5.2.1 Mine Water

The Madrid North mine will intercept the talik below Patch, Windy, and Imniagut Lakes. Mining at the Madrid South mine is expected to intercept the talik below Wolverine and Patch Lakes. This intercepted ground water is expected to be high in salinity. The goal of the water management system

will be to use underground mine water within the underground workings. Mine water collected in underground settling sumps (this includes groundwater seepage into the workings and drilling wastewater) will be recycled for underground use. Underground mine water will also be transferred to a tank to be used as water supply for the Brine Mixing Facility. Excess groundwater will be pumped or hauled to Doris for transfer to the TIA or discharge via the marine outfall mixing box and discharge to the ocean.

5.2.2 Domestic Water

Domestic water for additional Madrid North and South workforce housed at Doris will come from the potable water drawn from Windy Lake under the Type A Water Licence for the Doris Mine. The total volume allocated under the authorization is 22,995 m^3/year for Doris, Madrid-Boston Project will make use of this allocation in addition to a further 20,805 m^3/year. Domestic water will be trucked to Madrid North, Madrid South and pumped to Doris via the Windy Lake north or south freshwater intake.

5.2.3 Industrial Water

Industrial water (dust suppression, wash bays, machine shops, etc.) is sourced from Doris Lake. The total volume currently allocated for industrial use under the Type A Water Licence is 480,000 m^3/year. The Madrid-Boston Project will increase this water demand as indicated in Table 5.2-1.

Table 5.2-1. Industrial Water Use for Doris Process Plant and Madrid Concentrator

Source	Uses	Expected m^3/year	Peak m^3/year
Doris Lake	Doris process plant	320,000	1,100,000
	Madrid concentrator	40,000	460,000
	Doris and Madrid other industrial uses	370,000	370,000
Total draw - Doris Lake		**730,000**	**1,930,000**
TIA	Doris process plant recycled water	1,100,000	0
	Madrid concentrator	630,000	0
Total draw - TIA		**1,730,000**	**0**
	Percent from TIA in total process water draw	80%	No TIA Draw

5.2.4 Contact Water

Contact water (surface water runoff) from the waste rock piles, ore stockpiles, and all other surface infrastructure pads will be collected in CWPs, one CWP at Madrid North and two CWPs at Madrid South. In order to maximize mine water reuse, runoff collected in CWPs will be transferred by truck or pumped to a tank to be used as water supply for the concentrator or Brine Mixing Facility as practical. Make-up water will be drawn from the freshwater sources when unavailable in or impractical to draw from CWPs. These event ponds will normally be maintained empty. Excess contact water will be sent to the Doris TIA or discharged onto the tundra if water meets discharge criteria.

Water accumulated in the containment berms for the fuel storage facilities will be deposited in the TIA, used as concentrator make-up water, or tested for discharge criteria and used for dust suppression or discharged to the tundra.

5.2.5 Sewage Treatment

There will not be permanent accommodations at the Madrid North or South sites. A portable wash car containing toilets, washbasins and showers will be equipped with heated black and gray water day tanks (Pacto unit). These tanks will be emptied via a vacuum sewage truck and transported to a holding tank at the Doris Site for blending into the Doris Site sewage treatment facility. Treated effluent for the Sewage treatment plant discharged to tundra will meet criteria outlined in the Doris Type A Water licence (Part G, Article 3b). Additional details on sewage treatment at existing and proposed Boston site can be found in Hope Bay Project Domestic Wastewater Management Plan (P4-4).

5.2.6 Quarry Contact Water

The development of each quarry will proceed in a manner that, to the extent possible, all water generated as a result of precipitation or snow melt is retained within the quarry boundaries. This will be accomplished by sloping and contouring quarry floors toward the natural low area and, if required the creation of a pit and installation of a quarry sump to collect the waters and settle out suspended solids.

Quarry sumps will be inspected and emptied as required. Prior to discharge, water will be sampled to confirm compliance with discharge criteria. Compliant water will be discharged to the tundra or used for dust suppression. Non-compliant water may be treated on site or disposed of in the Doris TIA. Discharge compliance criteria are expected to be aligned with those outlined in Part D Item 18 Type B Water Licence 2BE-HOP1222. Sampling results will be reported as part of the monthly monitoring reporting.

Additionally, notification will be provided to the Inspector, at least ten (10) days prior to the planned pumping. The notification will include the volume proposed for discharge and the discharge location.

Care will be taken not to disturb settled solids in the bottom of the sump and pumping of the sump will only take place when conditions are suitable. Care will also be taken to discharge water such that it does not enter fish bearing waters and that the pump discharge is positioned in a manner that minimizes erosion and siltation of the area downstream of the discharge.

6. Waste Management

Waste management activities, including training of employees in waste handling and minimization of waste generation, will continue to be undertaken in accordance with existing management plans for the Hope Bay Project found in Package 4 of this application.

6.1 NON-HAZARDOUS WASTE

Non-Hazardous waste will be segregated and disposed of either in an incinerator, landfill, or will be open burnt. Incinerators will comply with appropriate Environment Canada (*Canadian Environmental Protection Act*) and Government of Nunavut (GN) legislation (*Consolidation of Environmental Protection Act*) and guidelines (Department of the Environment 2012) as well as TMAC's own Incinerator Management Plan, (Volume 1, Annex V1-7, Package P4-16). Incinerated wastes will include food waste, sewage sludge, and limited portions of paper products and/or oily rags. Where practical, waste oil will be used to fuel these incinerators. Incinerators are currently permitted under the Doris Project Certificate and the Type A Water Licence 2AM-DOH1323. Domestic waste generated at Madrid will be trucked to Doris and integrated with the Doris waste stream for handling and disposal.

A non-hazardous, non-leachable waste materials from Madrid North and South will be trucked to the Doris Site for disposal. The landfill at Doris is authorized under the Project Certificate and the Type A Water Licence.

Prior to landfill development or to reduce the quantity of material landfilled, clean wood and cardboard will be open burnt within the existing Doris burn pan. Bottom ash generated from open burning and incineration will be characterized, and ash which conforms with criteria outlined in the *Environmental Guideline for Industrial Waste Discharges into Municipal Solid Waste and Sewage Treatment Facilities* (GN 2011) will be disposed of in the landfill, and ash which does not meet these criteria will be placed underground with backfill material or shipped off site for disposal. Additional details are described in the Hope Bay Project Non-Hazardous Waste Management Plan (Volume 1, Annex V1-7, Package P4-13).

6.2 HAZARDOUS WASTE DISPOSAL

There will be no hazardous waste disposal facilities on site. All hazardous waste will be stored using standard industry best practice methods and shipped off site, either via sealift or airlift backhaul as the opportunities arise. Final disposal will be under contract at a designated licenced hazardous waste disposal site close to the designated port or airport. Hydrocarbon and ammonium nitrate fuel oil contaminated solids will be placed underground as backfill. Additional details can be found in the Hope Bay Project Hazardous Waste Management Plan in (Volume 1, Annex V1-7, Package P4-15).

6.3 CONTAMINATED SOILS

Hydrocarbon contaminated solids will be placed underground. Hydrocarbon contaminated snow and ice will be treated within designated landfarms or mobile oil-water separation units. A landfarm is currently located at Doris. Smaller quantities of hydrocarbon contaminated snow or ice may be melted in barrels and the oil fraction decanted for reuse or disposal and the remaining water fraction returned to the landfarm. Water pooling within the landfarm will be managed similarly to contact pond water, with water directed to the Doris TIA, or discharged to the tundra if it meets discharge criteria as per the existing Type A Water Licence, Part G, Article 24c. Details are described in the Hope Bay Project Hydrocarbon Contaminated Material Management Plan found in Volume 1, Annex V1-7, Package P4-14.

6.4 WASTE OIL AND LUBRICANTS

Waste oil and lubricants will be managed and disposed of in accordance with existing management plans for the Doris Project (Volume 8, Annex 15). As far as practical, waste oil will be re-used as fuel for the garbage incinerator or as a heat source in non-inhabited areas. If necessary, excess waste oil and lubricants will be collected and disposed of off-site, at a designated and licenced disposal site. Transport of these products will be by either sea or air backhaul.

6.5 ANTICIPATED WASTE QUANTITIES

A summary of expected waste types and quantities is presented in Table 6.5-5 for Madrid North and Madrid South, and Table 6.5-1 for Boston in Package 2-2.

Table 6.5-5. Expected Types and Quantities of Solid Waste for Madrid North and Madrid South

Type of Waste	Composition	Quantity Generated	Treatment Method	Disposal Method
Solid Waste	Mixed non-hazardous waste typically generated at a work site	< 5 m^3/d	Collected for transport to the Doris Site	Disposal as per approved 2AM-DOH1323 waste management plan.
Waste Oil	Waste oil generated from mining equipment (electrical generators, trucks, drills)	< 1 m^3/d	Collected for transport to the Doris Site	Disposal as per approved 2AM-DOH1323 waste management plan.
Waste, Scrap metal, and Contaminated sludges	Waste generated from drilling activities and accidents	Unknown	Collected for transport to the Doris Site	Disposal as per approved 2AM-DOH1323 waste management plan and Spill Contingency Plan.
Drill Cuttings	Drill waste, including water, chips, muds and salts ($CaCl_2$) from land-based and on-ice diamond drilling.	Unknown	Cuttings are dewatered, and the separated water or brine is recycled back into the drilling process.	Saline cuttings: removed from the drill site and deposited in a contained location (i.e., designated tundra or manmade sump, waste rock pile or tailings area) where runoff is captured for treatment or disposal to an appropriate facility (i.e., TIA, TMA). Non-saline cuttings: disposed in a sump or natural depression proximal to the drill where direct flow into a water body is not possible and no additional impacts are created. May be used for reclamation purposes. Excess Brine: removed from the drill site and deposited onto waste rock piles, into Pollution Control Ponds, or discharged to the TIA.

7. Hazardous Materials and Fuel Storage Facilities

All hazardous materials received, handled and stored on site will be managed in accordance with TMAC's Hazardous Material Management Plan already approved under Type A Water Licence 2AM-DOH1323.

All fuel storage and facilities located on the Hope Bay Belt that contain hazardous materials are constructed within secondary containment to capture potential spill or leakage that may occur and to retain run off from these storage areas. The secondary containment facility is designed to contain 110% of the fuel tank volume, all the rainfall from the 1:100 year, 24-hour storm runoff, and the maximum daily snowmelt.

In addition, the fuel facility meets the following codes and guidelines:

- NFPA (2014) 30, Flammable and Combustible Liquids Code, 2015 Edition;
- Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products (CCME 2015); and
- All Hazardous and flammable material are transported stored and handled in accordance with Transportation of Dangerous Goods Act and the Spill Contingency Planning and Reporting in Nunavut.

Site emergency response will be achieved through the training and equipping of an emergency response team. The emergency response team (ERT) will be trained in surface and underground rescue to maximize the number of available responders among the relatively small site population. All operating sites will have mine rescue station that is fully compliant and with requirements of the Inspector of Mines and to support operations.

8. Closure and Reclamation

Over the life of the Project, it is expected that techniques and methodology for mine site reclamation will continue to evolve with changes to our understanding of the Project site, stakeholder's views and technologies for cost effective and practical reclamation in northern conditions. Planning for the mine site reclamation will be risk based and remain dynamic in order to take into account results of on-going studies and identified practices for the site specific conditions as this knowledge base is expanded over time.

The site has been designed with closure in mind and throughout operations progressive reclamation will be evaluated and implemented where practical and beneficial to do so. The overall objectives of the closure and reclamation plan are to establish stable chemical and physical conditions and ensure the future use of the site following reclamation, and meet the requirements of Aboriginal, Federal and Territorial governments, landowners, local communities and regulatory authorities. These objectives and the closure and reclamation criteria and strategies presented have been developed in accordance with the Nunavut Mine Site Reclamation Policy (DIAND 2010) and the *2007 Northwest Territories Mine Site Reclamation Guidelines* (INAC 2007).

In terms of future land use, some infrastructure at the site is a substantial contribution to the development of Nunavut and could be left in place after closure following consultation with the KIA. For example, the fuel storage, airstrip, port/jetty, roads and rock pads can be used as a base for other projects in the area. However, the EIS assumes these structures and facilities will all be removed and/or reclaimed to acceptable standards.

The Hope Bay Project Doris-Madrid Interim Mine Closure and Reclamation Plan (ICRP) and the detailed Cost Estimate submitted in support of this application for an Amended Type A Water Licence can be found in Volume 1, Annex V1-7, Package 4 P4-21 and P4-22 of this Application.

9. Management Plans

TMAC has a functioning environmental health and safety management system (EHSMS) composed of numerous management plans that were developed and approved under its NIRB Project Certificate No. 003, and, Type A Water Licence 2AM-DOH1323 for the Doris mine of the Hope Bay Belt development. TMAC's vision is to continue to utilize existing plans for all developments on the Hope Bay belt, and modify the plans as required and at the appropriate stage of permitting or development of the Project. A complete list of management plans that have been built upon existing and approved Management Plans are listed in Table 9-1 below and also provided in Volume 1, Annex V1-7, Package 4 of the application.

Table 9-1. Updated TMAC Management Plans

Package 4	Management and Other Plans
P4-1	Surface Emergency Response Plan
P4-2	Underground Emergency Responses Plan
P4-3	Hope Bay Project Spill Contingency Plan
P4-4	Domestic Wastewater Treatment Management Plan
P4-5	Hope Bay Project: Boston Sewage Treatment Operations and Maintenance Management Plan
P4-6	Hope Bay Project Groundwater Management Plan
P4-7	Hope Bay Project Doris-Madrid Water Management Plan
P4-8	Hope Bay Project Boston Water Management Plan
P4-9	Hope Bay Project, Phase 2, Doris-Madrid Tailings Impoundment Area Operations, Maintenance, and Surveillance Manual
P4-10	Hope Bay Project Boston Tailings Management Area - Operations, Maintenance, and Surveillance Manual
P4-11	Hope Bay Project Waste Rock, Ore and Mine Backfill Management Plan
P4-12	Hope Bay Project Water and Ore/Waste Rock Management Plan for Boston Site
P4-13	Hope Bay Project Non-hazardous Waste Management Plan
P4-14	Hope Bay Project Hydrocarbon Contaminated Material Management Plan
P4-15	Hope Bay Project Hazardous Waste Management Plan
P4-16	Hope Bay Project Incinerator Management Plan
P4-17	Hope Bay Project Quarry Management and Monitoring Plan
P4-18	Hope Bay Project Aquatic Effects Monitoring Plan
P4-19	Hope Bay Project Boston Conceptual Closure and Reclamation Plan, November 2017
P4-20	Hope Bay Project Boston Conceptual Closure and Reclamation Plan, November 2017, Detailed Cost Estimate
P4-21	Hope Bay Project Doris-Madrid Interim Closure and Reclamation Plan, November 2017
P4-22	Hope Bay Project Doris-Madrid Interim Closure and Reclamation Plan, November 2017, Detailed Cost Estimate
P4-23	Hope Bay Project Explosives Management Plan

9.1 EMERGENCY RESPONSE AND SPILL CONTINGENY

TMAC has an approved Hope Bay Project Spill Contingency Plan as well as a Surface Emergency Response Plan (SERP) and an Underground Emergency Response Plan (UERP) found within Package 4 of this application. The Spill Contingency Plan will be utilized for the proposed Project to safeguard against accidental spills of harmful substances that may negatively affect the environment while the SERP and UERP provide TMAC employees and contractors with guidance on the systematic and effective response to emergency situations.

These plans have been updated for the proposed project and are subject to annual review and revision. These plans may be updated later in the licensing/regulatory process as well as the various development phases to address components of the Madrid-Boston Project as they become refined through Project review with NIRB and NWB. The updates to these plans will build on the existing plans and will be adopted post permitting

References

CCME. 2015. *Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products PN1326*. Canadian Council of Ministers of the Environment, Winnipeg, MB.

DIAND. 2010. *Nunavut Mine Site Reclamation Policy*. Department of Indian Affairs and Northern Development, Government of Canada: Ottawa, ON.

GN. 2011. *Environmental Guideline for Industrial Waste Discharges into Municipal Solid Waste and Sewage Treatment Facilities*. Government of Nunavut: Cambridge Bay, NU.

INAC. 2007. *2007 Northwest Territories Mine Site Reclamation Guidelines*. Indian and Northern Affairs Canada. NWT Region.

NFPA 30. 2015, Flammable and Combustible Liquids Code, 2015 Edition.