Volume 1 Annex V1-7 Type A Water Licence Applications

Package P4-19

Hope Bay Project Boston Conceptual Closure and Reclamation Plan

MAC RESOURCES

Hope Bay Project
Boston Conceptual Closure and Reclamation Plan

Prepared for

TMAC Resources Inc.

Prepared by

SRK Consulting (Canada) Inc.
1CT022.013
November 2017

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Project No: 1CT022.013

File Name: HB_Boston_CCRP_Report_1CT022.013_20171212FNL.docx

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1 Introduction

1.1 Overview

The Hope Bay Project (the Project) is a gold mining and milling undertaking of TMAC Resources Inc. The Project is located 705 km northeast of Yellowknife and 153 km southwest of Cambridge Bay in Nunavut Territory, and is situated east of Bathurst Inlet. The Project comprises of three distinct areas of known mineralization plus extensive exploration potential and targets. The three areas that host mineral resources are Doris, Madrid, and Boston.

The Project consists of two phases: Phase 1 (Doris project), which is currently being carried out under an existing Water Licence, and Phase 2 (Madrid-Boston project) which is in the environmental assessment and regulatory stage. Phase 1 includes mining and infrastructure at Doris, while Phase 2 includes mining and infrastructure at Madrid and Boston located approximately 10 and 60 km due south from Doris, respectively. Boston will be a standalone self-contained mining complex complete with all surface infrastructure to support mining and ore processing required to produce gold doré.

This Conceptual Closure and Reclamation Plan (CCRP) pertains to the Boston site and was written in accordance with the applicable guidelines as described in Section 1.5.2.

1.2 Closure and Reclamation Plan History

Exploration and bulk sampling activities at Boston have been ongoing for more than two decades. Over time, the facilities were updated and extended to their current configuration which is in place since 2010. These facilities were intended to support activities limited to advanced exploration and bulk sampling, and are insufficient to support the full-scale mining and mineral processing activities proposed for the Phase 2 development of the Project. The proposed new camp and mine infrastructure facilities are in the preliminary design stage, and as such are subject to potential changes as final detailed designs are prepared prior to construction. As the regulatory reviews are completed and the final designs are done prior to construction, an Interim Closure Plan will be submitted, as is customary following the issuance of the Type A Water Licence. This plan is considered as superseding the Phase 2 Conceptual Closure and Reclamation Plan Issued as Volume 8-Annex 27 as part of the DEIS for Phase 2 of the Hope Bay Project dated December 2016.

Table 1 below provides a summary of the historic closure planning documents issued for the Boston site. The documents submitted in support of the Phase 2 development of the project are highlighted.

Table 1: Closure and Remediation Plan Revision History

Document Title	Primary Author	Release Date	Document Rationale
Abandonment and Restoration Plan for the Boston Gold Project	Rescan Environmental Services Ltd.	1997	Uncertain
Abandonment and Restoration Plan for the Boston Gold Project	Rescan Environmental Services Ltd.	September 1998	Initial closure cost estimate submitted in support of Type B Water License NWB1BOS9801
Abandonment and Restoration Plan Boston Gold Project Water License NWB1BOS9801	Hope Bay Joint Venture	May 2001	Submitted in support of the Renewal Application for the Type B Water License NWB1BOS9801
Abandonment and Restoration Plan Boston Only Scenario Boston Gold Project	Miramar Hope Bay Limited	October 2002	Update to reflect the transfer of ownership under Type B Water License NWB1BOS0106
Boston Exploration Camp Closure and Reclamation Plan	Miramar Hope Bay Limited	December 2006	Required update in accordance with Type B Water Licence NWB1BOS0106 conditions
Closure and Reclamation Plan for the Boston Advanced Exploration Project Nunavut	Miramar Hope Bay Limited	September 2007	Required update in accordance with Type B Water Licence 2BB-BOS0712 conditions
Hope Bay Project Boston Camp Revised Interim Closure Plan. Hope Bay, Nunavut	SRK Consulting (Canada) Inc.	June 2012	Required update in accordance with Type B Water Licence 2BB-BOS0712 conditions, as the project formally entered Care and Maintenance
Hope Bay Project Boston Camp Revised Interim Closure Plan	SRK Consulting (Canada) Inc.	May 2014	Update to reflect the transfer of ownership under Type B Water License 2BB-BOS1217
Hope Bay Project, Phase 2 Conceptual Closure and Reclamation Plan	**SRK Consulting (Canada) Inc.**	**November 2016**	**Supporting document for the Phase 2 Draft Environmental Impact Statement**
Hope Bay Project Boston Camp Interim Closure Plan	SRK Consulting (Canada) Inc.	January 2017	Submitted in support of the Type B Water License 2BB-BOS1217 Renewal Application
Hope Bay Project Boston Conceptual Closure and Reclamation Plan	**SRK Consulting (Canada) Inc**	**November 2017**	**Supporting document for Phase 2 Final Environmental Impact Statement and Type A Water Licence Application (This Document)**

1.3 Change Log

Chronologically, the most recent version of the Closure Plan for the Boston Mine was completed in support of the renewal application for WL BB-BOS1217 (SRK 2017a). However, that document was reflecting the current state and configuration of the existing facilities, with no regard to the proposed expansion. Therefore, the changes in this revision of the CCRP are comparative to the previous Phase 2 Conceptual Closure and Reclamation Plan submitted in 2016 as a supporting document for the DEIS, issued as Volume 8-Annex 27 dated December 2016, and are summarised in Table 2. Comments and requests for changes received as part of the DEIS review process were incorporated in this current revision.

Table 2: Changes by Section

Information Request, Technical Comment, or Other Change	Section	Comments
Global change	All sections	Boston site is assessed as an individual operation, with its own water license, separate from Doris-Madrid
INAC-TRC17	9.2	Monitoring of Contact Water Ponds
INAC-TRC18	4.4.2, 4.4.12	Use of revegetation as a possible reclamation measure for disturbed overburden surfaces when appropriate
TM-NIRB-01	6.4	Pipeline management under temporary closure

1.4 Current Conditions

Boston is a brownfield site with existing infrastructure supporting advanced exploration and bulk sampling activities. Specific infrastructure which exists on-site includes:

- Exploration camp and mechanical shop building;
- Underground workings including portal and vent raise;
- Fuel storage facility;
- Ore piles; and
- Boston airstrip.

All buildings and facilities listed above will be decommissioned and reclaimed as part of the development of the proposed facilities for Phase 2. Rock fill pads and the existing airstrip will be left in place and repurposed, while the existing portal to the underground will be rehabilitated and used as point of access for the new mine development.

While most of the site disturbance is due to infrastructure development, extensive exploration drilling has taken place throughout the Boston area and this has resulted in disturbance of areas outside of the infrastructure development footprint. Specifically, there are disturbances and localized permafrost degradation associated with drilling activities.

1.5 Regulatory Context

1.5.1 Legislation Applicable to Mine Closure

Legislation applicable to mine Closure and Reclamation Plans in Nunavut includes:

- Nunavut Land Claims Agreement (Canada 1993);
- Territorial Lands Act (Canada 1985a);
- Territorial Lands Regulations (Canada undated);
- Nunavut Waters and Nunavut Surface Rights Tribunal Act (Canada 2002);
- Nunavut Waters Regulations (Canada 2013);
- Fisheries Act (Canada 1985b), and applicable regulations;
- Arctic Waters Pollution Prevention Act (Canada 1985c);
- Arctic Waters Pollution Prevention Regulations (Canada undated);
- Transportation of Dangerous Goods Act (Canada 1992);
- Transportation of Dangerous Goods Regulations (Canada 2001);
- Environmental Protection Act (Nunavut 1988a);
- Environmental Rights Act (Nunavut 1988b);
- Mine Health and Safety Act (Nunavut 1994); and
- Mine Health and Safety Regulations (Nunavut 1995).

The primary regulatory instruments applicable to mine closure in Nunavut are however land use authorizations and water licences.

Surface rights for Inuit Owned Land (IOL) are vested in the Kitikmeot Inuit Association (KIA), which administers the access and management of the IOL for the benefit of the Inuit in the region. This is done through land use permits and lease agreements.

Use of water resources and waste disposal in Nunavut is regulated by the Nunavut Water Board (NWB), and the Project will require a Type A Water Licence for mine development, pursuant to the Nunavut Waters Act. The Conceptual Closure and Reclamation Plan, including the associated cost estimate, will require approval under the water licence.

1.5.2 Applicable Guidelines Related to Mine Closure

The following guidelines are applicable to mine closure planning in Nunavut:

- Mine Site Reclamation Policy for Nunavut (INAC 2002); and
- Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories (MVLWB and AANDC 2013).

Although the NWT guideline applies outside of the Nunavut jurisdiction, it is considered as current best practice. This CCRP adheres to the content and reporting structure recommended in the NWT guideline, where no contradictions were found with the applicable NU policy.

1.5.3 Environmental Assessment Requirements

This CCRP accompanies the final environmental impact statement (FEIS) prepared for the Phase 2 Project and incorporates changes requested during the review process of the Phase 2 draft environmental impact statement (DEIS) submitted to the Nunavut Impact Review Board (NIRB) in December 2016.

As Project development advances, the level of detail contained in the CCRP will undergo further revisions to reflect the progress of the Project as well as changes in technology and/or standards or legislation. As required, the CCRP will include thresholds and identified adaptive management responses. Revisions will consider input from consultations with communities and other stakeholders.

1.6 Closure Objectives and Criteria

The Project has been designed with closure in mind and throughout operations, every effort to apply progressive reclamation will be evaluated and implemented where practical to do so.

With the above in mind, the overall objectives of this CCRP are to leave the site in a manner safe for humans, wildlife and the environment that meets future land use goals. This will be done by establishing stable chemical and physical conditions and ensuring the future use and aesthetics of the site following reclamation meet the requirements of Aboriginal, Federal and Territorial governments, landowners, local communities and regulatory authorities.

The physical and chemical stability are defined as follows:

- Physical Stability: A mine is considered physically stable when all mine components that remain after closure shall not erode, subside or move under the conditions they will be subject to after closure; and.
- Chemical Stability: A mine is considered chemically stable when all chemical constituents released from the mine components at closure shall not adversely affect long term water, air or soil quality.

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 all interested parties. For example, the fuel storage facilities, airstrip, roads and rock pads can be used as a base for other projects in the area. However, for the purposes of this CCRP it has been assumed these structures and facilities will all be removed and/or reclaimed. Closure and reclamation of these facilities is also accounted for in the supporting closure and reclamation cost estimate.

1.7 Future Iterations of this Closure and Reclamation Plan

This CCRP is a working document that reflects the level of detail available for the current stage of the Project (FEIS). All information requests and technical comments received through the DEIS review process have been incorporated in this updated CCRP. Future updates to this CCRP will reflect refinements and modifications to the Project, and provide additional details and updated closure costs. Changes to guidelines, standards, and legislation will also be accounted for in future Closure and Reclamation Plans.

The following Closure and Reclamation Plans are expected to be developed over the life of the Project for the Boston site:

- Revised CCRP (this document): Prepared taking into consideration the comments and requests of the interveners during the DEIS review process. Further revisions may be completed as part of the FEIS review process.
- Interim Closure and Reclamation Plan (ICRP): Prepared following the issuance of a Type A Water License. The ICRP includes improved Project resolution available immediately before project construction and will be subject to updates as project operations progress and final configurations of various project elements become available.
- Final Closure and Reclamation Plan (FCRP): Prepared immediately before the end of operations, in accordance with a timeline set by the NWB.

Additionally, once active closure and reclamation activities are complete, a Reclamation Completion Report will be prepared. This report will describe the closure and reclamation work, provide a listing of remaining infrastructure, provide as-built reports, and describe continued monitoring requirements as outlined in MVLWB and AANDC (2013).

A Performance Assessment Report will also be written to compare closure site conditions against closure objectives and criteria (MVLWB and AANDC 2013).

2 Project Environment

2.1 Climate

The climate in the Hope Bay Project area is one of extremes. There is relatively little precipitation, and temperatures stay below freezing for most of the year, reaching over 20 degrees for short periods in the summer. Summer is a season of nearly constant light, while darkness, twilight, and extreme cold dominate winter.

Inuit have noted changes in climate trends (as recorded in a Naonaiyaotit Traditional Knowledge Project report), and their observations are supported by historical climate data collected over the last half a century. A detailed analysis was also completed to provide the climate change projections for key climatic and hydrologic design parameters for use in engineering designs (SRK 2017j). The analysis indicates that frequency and quantity of rainfall, and average air temperature is projected to increase. Lake evaporation will also increase and with increased air temperature, the active layer thickness will increase. It was also confirmed that climate change effects develop over very long timescales relative to the Project life and, as such, the trends will manifest as minimal changes over the length of the Project.

Air quality in the Hope Bay Project area and elsewhere in Nunavut is generally of good quality, reflecting the low amount of air pollution from large human populations. Outside of the Hope Bay Project area, most air emissions are from the use of diesel generators, heaters, vehicles, snowmobiles, all-terrain vehicles and boats. Noise levels are generally low.

Detailed climate parameters and air quality data is provided in the corresponding sections of the FEIS.

2.2 Physical Environment

The Boston site is located on the Canadian Shield. Exposed bedrock outcrops are common, and mostly devoid of vegetation. Surface observations and subsurface investigations of the foundation soils found the proposed Boston area is characterized mostly by marine deposits of silty-clay with trace sand, with small pockets of glaciofluvial deposits of coarse sand and some gravel. Eskers are common in the larger Phase 2 project area, but not within the disturbed footprint of the proposed Boston site.

Project wide overburden consists of permafrost soils which are mainly of marine clays, silty clay and clayey silt, with pockets of moraine till underlying these deposits. The marine silts and clays contain ground ice ranging from 10 to 30% by volume on average, but occasionally as high as 50%. The till typically contains low to moderate ice contents ranging from 5 to 25%. Overburden soil pore water is typically saline due to past inundation of the land by seawater following deglaciation of the Project area. The salinity typically ranges from 37 to 47 parts per thousand which depresses the freezing point and contributes to higher unfrozen water content at below freezing temperatures (SRK 2017b).

Permafrost at the Project area extends to depths of about 570 m, with an average geothermal gradient of 0.021°C/m. Active layer depths in overburden soil averages 1.0 m, with a range from 0.5 to 1.7 m (SRK 2017i).

Isopach maps developed from seismic surveys and exploration and geotechnical drill holes indicate that depth of overburden under the infrastructure is expected to range from 0 to 10 m, with most areas having less than 6 m of overburden. The closest geotechnical drill holes (EBA-12259-02 and EBA-12259-03) indicate that the overburden under the infrastructure pads is likely silts, clays, and sands. Ice content of the foundation soils could also be in the higher end of those typically found on the Project, as those drill holes note ice contents up to 70% (EBA 1996).

General foundation conditions, material properties for geotechnical analysis, and development of the overburden isopach surface are described in more detail in SRK (2017b).

2.3 Biological Environment

Where rock outcrops, water, and cliffs are absent on the landscape, trees and summer flowers are numerous and dense in the tundra of the Phase 2 Project area. Trees are short and stunted forms of dwarf birch, green alder, willow, and white and black spruce can be found in some areas. Sedge meadows and wetlands are common in low-lying moist areas. More than 870 plant species grow in the Phase 2 Project area, including many species of lichens, mosses, and algae.

Terrestrial animals in the region include barren-ground caribou (of the Dolphin/Union, and Beverly herds), muskox, grizzly bear, wolverine, and grey wolves, as well as several species of raptor, waterfowl, and upland breeding birds. Caribou and caribou hunting are central to Inuit culture, identity, recreation, and kinship and are of economic importance to the Inuit and other residents of Nunavut.

Four species of cliff-nesting raptors (peregrine falcon, gyrfalcon, rough-legged hawk, and golden eagle) and three ground-nesting raptor species (snowy owl, short-eared owl, and northern harrier) may live in the area. Waterbird species in the Phase 2 Project area include geese, tundra swan, several species of ducks, gulls, Arctic tern, four species of loons, and sandhill crane.

A total of fourteen fish species are found in lakes, ponds, and streams in the Phase 2 Project area. The most common fish species is the Ninespine Stickleback, followed by Lake Trout, Arctic Char, Arctic Grayling, Slimy Sculpin, Lake Whitefish, Cisco, Least Cisco, Burbot, and Broad Whitefish.

3 Project Overview

3.1 Mine Plan

Operations at Boston are an integral part of the Phase 2 development of the Hope Bay Project. It is therefore important to understand the general mine plan as well as the role of the Boston site as a separate unit within the larger Hope Bay Project.

The Project involves the construction, operation and closure of underground mines and processing facilities at Doris North, Madrid North, Madrid South, and Boston (Figure 1). In addition, the Project will consist of extended operations, then closure of supporting facilities at Doris and Roberts Bay. The stages associated with the Project are summarised below, with the Boston-related items being highlighted in bold:

- Operations, Phase 1: Operations of the Doris Mine, already permitted under an existing water license (2016 to 2021)
- Construction, Bulk Sample
  - Madrid North Mine (2018)
  - Madrid South Mine and access road to Madrid South (2019)
- Construction, Phase 2
  - Madrid North Mine (2019)
  - Madrid South Mine (2029)
  - **Boston Mine, and access road to Boston (2019 to 2023)**
  - Expansion of the TIA infrastructure at Doris (2019)
  - Expansion of the Doris infrastructure (cargo dock, fuel storage) to support Phase 2 (2019 and 2020).
- Operations, Phase 2
  - Madrid North Mine (2019 to 2032)
  - Madrid South Mine (2029 to 2032)
  - **Boston Mine (Years 2022 to 2029)**
  - Extended operation of the infrastructure at Doris (2019 to 2032).
- **Closure: Closure of all facilities (2030 to 2035).**
- **Post-closure: Post-closure monitoring (Years 2032 to 2041).**

The mine plan at Boston consists of underground mining of 5.1 Mt of ore, over an approximately 8-year mine life (TMAC 2017). Ore processing will be completed at a maximum rate of 2,400 t/d, with all stages of beneficiation being completed at the Boston Mill to produce a gold doré. The cyanidation tailings will be disposed of underground while flotation tailings will be filtered and deposited in a dry stack tailings facility. The mine plan can be seen in Figure 2.

Gold recovery from ore will involve three generic steps, as follows:

- *Step 1 – milling and flotation*: the ore is crushed and ground followed by classic flotation methods (no cyanide at this stage) to separate a gold concentrate representing about 6% of the original ore. Flotation tailings representing about 94% of the original mass of ore are produced at this stage and will be dewatered and disposed of in a dry stack facility within the Boston TMA.
- *Step 2 – cyanide leaching and resin absorption*: the gold concentrate is ground to finer particle size and mixed with cyanide solution to dissolve the gold. The gold from solution is then captured on a resin. After gold removal from the concentrate is complete, the residual tailings will be detoxified (cyanide destruction). The detoxified tailings will be washed and dewatered prior to ultimate disposal within the Boston underground mine workings.
- *Step 3 – electrowinning and smelting*: the gold bearing resin and the clarified gold-bearing cyanide solution is processed through electrolysis to precipitate the gold which is then smelted to produce gold doré (unrefined gold bars), the final product from the mine.

3.2 Geochemical Characterization

Extensive geochemical testing and characterization have been completed on the Project (SRK 2017c, 2017d, 2017e). This testing includes characterization of the ore, tailings and waste rock from Boston, and characterization of quarry material that will be used in construction.

Waste rock and ore from Boston have a low risk of acid rock drainage (ARD). The primary geochemical concern with respect to waste rock and ore is neutral metal leaching, specifically arsenic.

Two distinct types of tailings will be produced: flotation tailings and detoxified cyanide leach tailings. Flotation tailings are classified as non-potentially acid generating (NPAG), with potential for leaching of arsenic under neutral pH conditions. The detoxified tailings are classified as potentially acid generating (PAG), and metal concentrations are expected to increase under acidic conditions. However, based on humidity cell testing, these tailings are expected to remain neutral for decades. Under neutral pH conditions, there is potential for arsenic leaching from the detoxified tailings.

Only quarry or waste rock with low risk of ARD and metal leaching will be used to construct permanent surface infrastructure.

3.3 Tailings Management

The by-product of milling and processing activities and Boston will be tailings, both from flotation and cyanidation processes.

Filtered flotation tailings from Boston will be disposed of within the Boston tailings management area (TMA). The filtered flotation tailings will be hauled to the TMA by truck, and spread and compacted in thin lifts (SRK 2017f).

Detoxified cyanide leach tailings will be filtered and the filter cake will be mixed with waste rock and used as underground backfill.

3.4 Waste Rock and Ore Storage

The current mine plan requires all mine waste rock be used for underground backfill (TMAC 2017). During operations, a portion of the produced waste rock will be temporarily stored on the surface in waste rock piles while the remainder will remain in the underground mine. Prior to closure, all waste rock stored on the surface will be hauled underground for backfill.

In the event localized acid rock drainage is produced, it is anticipated that the high carbonate content in the overall waste rock stockpiles would provide sufficient buffering capacity that the overall drainage from the stockpile would remain neutral to alkaline. During operations, all runoff from the waste rock piles and ore stockpiles will be collected in contact water ponds.

3.5 Water Management

Water on the Boston site is categorized into five types:

- Non-Contact Water: Water which is Undisturbed runoff or runoff from access roads or overburden piles.
- Contact water: Water which come into contact with waste rock, ore and tailings;
- Freshwater: Water which is pumped from Aimaokatalok Lake and used for camp and mill domestic water demand;
- Treated sewage water: Water from the sewage treatment plant.
- Mine water: Water which enters the underground workings.

Each type of site water is managed separately. Non-contact water will be managed according to Best Management Practices (BMPs) during construction of all roads, pads, and berms, including the use of silt fences. Runoff from the overburden pile will be contained throughout the life of mine to reduce sediment loading prior to discharge to the environment. Mine water is captured in the underground workings, but is not expected in the Boston mining area. Contact water is captured in a series of ponds and pumped to the water treatment plant surge pond. Freshwater is pumped from Aimaokatalok Lake and used for domestic water in the camp and process plant facility. Treated sewage water is treated on site and discharged with the water treatment plant effluent during operations, or discharged to the tundra in construction and closure.

3.6 Ancillary Facilities

The overall design concepts for the Boston surface infrastructure (i.e. pads, roads and water management facilities) are based on the same principles as used for Doris. As far as practical, all facilities will be constructed either on bedrock outcrops, or geochemically suitable rock fill pads designed to protect the permafrost. Site layouts are designed to minimize the overall footprint, and minimize the volume of contact water that must be captured and managed via ponds for appropriate disposal.

Site layouts, including a work breakdown structure, for all expected facilities are provided in Figure 3 and Figure 4. Ancillary facilities at the Project site will include a processing plant, power generation, worker accommodations, administration offices, etc. A complete list of the facilities proposed at Boston is provided in Appendix A.

4 Permanent Closure and Reclamation

4.1 Definition of Permanent Closure

According to the MVLWB and AADNC (2013) "*Permanent closure is the final closure of a mine site with no foreseeable intent by the existing proponent to return to either active exploration or mining*". This indicates that once closure activities on the site are complete, the site is anticipated to have no activity except post-closure monitoring and maintenance. Permanent closure does not preclude future exploration and mining activities.

4.2 Decision to Close

Permanent mine closure will occur when either all mineable and economic mineral reserves have been exhausted, or if for other reasons, over a sustained period of time, the Project is no longer a viable economic proposition.

Since permanent closure will affect mine employees, suppliers and the public, careful consideration will be taken in any decision to close.

4.3 Overview and Schedule

Some mine infrastructure may stay in place should the local communities, KIA, government or other bodies choose to take ownership of it. Additionally, as outlined previously, some mining infrastructure could be reclaimed prior to closure. The closure schedule is outlined in Figure 2; however, assumes that all infrastructure associated with the Project will be removed during the final closure stage. Based on this schedule, closure is expected to take about one year.

4.4 Permanent Closure and Reclamation Requirements

4.4.1 Underground Mine Workings

Description

The underground mine associated with the Project will have a portal and associated vent raises. The historic mine portal will be rehabilitated and used as the access point to the proposed new mine workings.

The entire underground mine will be located within permafrost, therefore no water ingress is expected. No dewatering of the existing mine workings will be required and the mine is expected to remain dry after closure.

Boston mine will use the sublevel long hole retreat (SLR) method followed by a combination of cemented rock fill (where required) and unconsolidated backfill consisting of waste rock. The ore is extracted from sublevel panels and hauled to surface by truck. Once a stope block is finished, backfill can be introduced to fill and stabilise the area. This way a large proportion of the waste rock will be used directly as backfill, without the need of hauling it to surface.

A combined quantity of 7.3 million tonnes of ore and waste rock will be mined, over the 8 years of the proposed mine life, representing 5.1 million tonnes of ore and about 2.2 million tonnes of waste rock. The quantities of waste rock are in fact insufficient to satisfy the backfill requirements, with an additional 0.9 million tonnes of quarry rock being required.

Closure Objectives and Criteria

The specific closure objectives for the underground workings are:

- To prevent access into the workings by humans and animals; and
- To ensure physical stability by stabilizing the workings as necessary to prevent surface expression of underground failures (i.e. surface subsidence).

Chemical stability of the underground workings is not a concern, as the mine is completely within permafrost and no mine water is expected. At closure, all underground utilities and installations will be removed and disposed of as appropriate. As per the mine plan, most workings will be backfilled with waste rock, detox tailings, or quarried rock to provide stability; all of this backfilling will be necessary as part of the mine operations and will therefore occur before closure.
The entrance of the underground portal will be sealed with a 15 m thick rock fill plug. The rock fill used for the plugs will be salvaged from rock fill pads, clean quarry rock or geochemically suitable waste rock.

Ducts, pipes, and cables entering the vent raises will be removed and disposed of or salvaged as appropriate. Vent raises will be capped with appropriately sized concrete plugs to prevent access, and appropriate signage will be posted to warn of existence of these sealed openings. A detailed engineering design will be completed prior to closure to determine the risk of subsidence and determine the most suitable cap design.

The areas surrounding the portals and vent raises will be regraded as required to ensure positive drainage away from the openings and blend in with the surrounding terrain as much as possible.

4.4.2 Rock Fill Pads

Description

Rock fill pads constructed from geochemically suitable material will underlay most infrastructure on the Boston Project. The minimum thickness of the rock fill pads is 1 m to ensure protection of the underlying permafrost. The existing camp pad will be retained and used as basis for the ore stockpile and general staging area for the underground portal access. Two new rockfill pads will be constructed, one underlying the waste rock pile and the second underlying the proposed new camp and mill areas including the laydowns, core storage, and fuel storage facilities. The total surface area covered by these pads is about 16.8 hectares. Figure 3 and Figure 4 show the location and size of these rock fill pads.

Closure Objectives and Criteria

The reclamation objective for rock fill pads is to ensure long-term physical stability by preventing permafrost degradation. Chemical stability is not considered an issue, as the pads will be built with geochemically suitable quarry rock only.

Two broad closure options were considered for the rock fill pads: removing them or reclaiming them in place. Leaving the rock fill in place is the preferred closure option, as removal of the pads would result in permafrost degradation, and would be difficult due to the expected aggradation of permafrost into the rock fill pads. At closure, the vegetation underlying the rock fill pads will have died, thereby eliminating the insulating effect of the vegetation on the permafrost below. Both the lack of vegetation and remnants of the rock fill pads would be expected to accelerate thawing of the permafrost, and therefore not meet the closure objectives.

Since the rock fill pads will be constructed of geochemically suitable material, leachate draining from the pads is not a concern. Therefore, the rock fill pads will be regraded to prevent ponding of water and blend into the original terrain as much as possible, and be left in place. Any depressions where positive drainage cannot be achieved by regrading will be backfilled preferentially with suitable soils from the existing overburden pile to avoid ponding water resulting in permafrost degradation. Temporary erosion protection measures will be implemented, as required.

Where the rock fill pads include lined containment areas (i.e., landfarms), the protective layer of crushed rock above the liner will be tested. If the material is found to exceed remediation limits, it will be disposed of within the nearest underground workings. Any water contained within the containment area will be tested, treated as appropriate, and discharged when water quality criteria are met. The liners of the containment areas will be removed, cleaned, cut in pieces and disposed of as non-hazardous waste. Containment berms will be leveled and the entire footprint regraded to prevent ponding of water.

In areas backfilled with suitable overburden soils, revegetation works may consist of application of seeds collected from the surrounding vegetation. Active revegetation of the barren rock fill pads is not practical because the rock fill pads cannot support vegetation; however, it is expected that lichens will colonise the rock surface in time, likely decades.

4.4.3 Waste Rock, Ore, and Overburden Piles

Description

All ore is expected to be processed prior to the end of the operation; therefore, closure of the ore stockpile areas will consist of testing the top layer of the rock fill pad for excessive metal loading, and disposing of this material underground if present. The remaining rock fill pad will be regraded for positive drainage. Should ore remain on surface after operations cease, it will be disposed of underground.

During operations, waste rock from underground development will be brought to the surface and temporarily stored on rock fill pads. According to the mine plan, all waste rock is required for underground backfill; therefore, no waste rock will be left on the surface at closure.

Closure Objectives and Criteria

Once the waste rock is removed the underlying rock fill pads will be regraded to prevent ponding then left in place as described in Section 4.4.2.

Overburden piles will be constructed with closure in mind, and will be closed throughout the operations period when they are no longer necessary. At closure, if not already complete, the side slopes of all overburden piles will be regraded to no steeper than 3H:1V and the final pile surface will be contoured for drainage control. Erosion protection measures will be installed as appropriate.

4.4.4 Tailings Management Area

Description

The Boston TMA is located approximately 1 km southeast of the Boston portal, directly south of the proposed airstrip. The TMA consists of the drystack tailings pile, three contact water ponds and the contact water pond berms (Figure 4).

The dewatered filtered tailings will be trucked to the dry-stack facility, where it will be spread in thin lifts (0.3 m thick) and compacted. The facility is continuously built up in this fashion to reach a maximum height of about 26 m, with 5 m high intermediate benches. The inter-bench slope will be 3H:1V, with an overall slope of about 3.9H:1V. The footprint occupied by the tailings facility is about 19.8 hectares.

The contact water pond design uses the permafrost and naturally low permeability of the foundation materials to contain the contact water on the bottom of the pond. A geomembrane will act as the impermeable layer within the berm above the permafrost table. This design hinges on the contact between the geomembrane and permafrost soil remaining frozen for the design life of the structures (20 years). The ponds will be operated as normally dry, with water residence time of maximum two weeks.

Closure Objectives and Criteria

The closure objectives for the TMA are:

- Ensure long-term physical stability of tailings;
- Prevent direct contact of the tailings by humans and wildlife;
- Ensure chemical stability by minimizing release of neutral metal leachate to the receiving environment; and
- Restore natural drainage, to prevent the need for long term water management.

To achieve these objectives, the Boston TMA was designed with closure in mind. To ensure physical stability during operations the filtered tailings will be placed and compacted in thin lifts, and benched with a maximum interbench slope of 3H:1V, and maximum overall slope of 3.9H:1V (SRK 2017f). At closure, the top of the facility will be graded to 2% to ensure drainage, but resloping of the sides is not required.

Geochemical characterization of the Boston tailings predicts that the flotation tailings within the TMA will not be acid generating. However, the tailings will have the potential for neutral metal leaching (SRK 2017f) which is expected to result in runoff water quality exceeding discharge guidelines if mitigation measures are not applied (SRK 2017g and 2017h). As a mitigation measure a low infiltration cover will be placed over the tailings at closure to eliminate seepage. The cover will consist of a geomembrane placed directly on the tailings, overlain by a crushed rock protective layer and a run-of-quarry (ROQ) material shell. Both the protective and shell materials will be sourced from geochemically suitable quarried rock or waste rock.

Once the cover is completed, the contact water pond berms will be breached to restore natural drainage but the bulk of the berms will be left in place to preserve the permafrost.

Under the adaptive management approach, water quality in the TMA contact water ponds will be continuously monitored throughout the operations period and predictive water quality models refined. This will allow for refinement of the current closure concept based on updated water quality predictions.

4.4.5 Buildings and Equipment

Description

The buildings and facilities associated with the Project are typical of metal mines.
A comprehensive list of buildings and facilities is provided in Appendix A, with a generic list below:

- Camp with living quarters and service facilities;
- Mine support buildings: mine dry and offices,
- Exploration support facilities: core shack, and geology offices; and
- General mine support infrastructure and facilities: power plant, warehousing, mechanical shop, communications, etc.

Closure Objectives and Criteria

All utilities to buildings and stationary equipment will be decommissioned, disconnected and dismantled, and all buildings will be emptied prior to dismantling or demolition. Seacan containers will be removed from site, or disposed off in the non-hazardous landfill. Non-hazardous and hazardous waste will be segregated and disposed of as discussed in subsequent sections.

When possible, reusable equipment and supplies will be salvaged from any building or facility prior to demolition, and shipped off-site to a third-party destination or point of sale. If practical, furniture, utilities, and structures will be salvaged. Where possible, salvageable structures will be moved intact, or they will be carefully dismantled and catalogued for re-assembly. Unusable or unwanted buildings will be demolished. The resulting waste material will be segregated into burnable and non-burnable waste and disposed of in the non-hazardous waste landfill.

Concrete floors will be broken up and covered in place. Concrete wall foundations will be demolished flush with the existing ground then covered in place with suitable fill. The rock fill pads underlying all buildings and equipment will be regraded as described in Section 1.

The heat traced pipelines for sewage effluent and fresh water intake will be sectioned and disposed of as non-hazardous waste. The heat tracing cables and controllers will be removed and disposed of or salvaged as appropriate.

4.4.6 Mine Infrastructure

Description

The mine infrastructure includes the crushing, milling, and processing facilities as well as ancillary facilities such as brine mixing, ventilation, and air heating facilities. The mill will be constructed to provide a maximum throughput of 2,400 tonnes per day. Grinding, flotation, and cyanidation equipment will be housed in a single steel frame building. In addition, a filtration plant will also be constructed, to serve the dry stack tailings disposal method.

Closure Objectives and Criteria

The facilities directly associated with the ore beneficiation (crusher, mill, and process plant) will be cleaned of all remaining chemicals and process reagents. The resulting hazardous waste will be disposed of in accordance with the hazardous waste disposal procedures. The residual ore and ore dust within the processing equipment will be removed by flushing and/or washing the equipment with high pressure water. The collected solids will be allowed to settle and then disposed of within the Boston TMA or underground, as appropriate. The processing equipment will then be decommissioned, and prepared for shipping off-site. Damaged or unwanted equipment will be disposed of in the non-hazardous landfill.

All other buildings and facilities will be decommissioned, demolished, and the waste will be disposed of in the non-hazardous landfill. Equipment will be decommissioned, cleaned, and either sold to a third party or disposed of in the non-hazardous landfill. For the purpose of the closure cost estimate, no salvage credit is taken.

4.4.7 Transportation Infrastructure

Description

The major transportation infrastructure associated with the Boston site includes the local access roads, the helicopter support infrastructure (helipads and helicopter shack), and the airstrip. A new airstrip is proposed for the Phase 2 development, east of the Boston Camp. All transportation infrastructure can be seen in Appendix A, and Figure 3 and Figure 4.

The Madrid to Boston all weather road is included under the Doris-Madrid part of the Phase 2 Project, and will be dealt with in that corresponding Closure and Reclamation Plan.

Closure Objectives and Criteria

All bridges, culverts and arched culverts associated with the all-weather roads and airstrip will be removed and natural drainage will be restored. The rock fill of the all-weather roads and airstrips will be left in place to ensure the preservation of the permafrost and to allow for long-term access for monitoring and inspections. The surface of the rock-fill will be regraded and/or crowned as necessary to prevent ponding of water.

Reusable equipment and supplies, such as lighting, communications equipment and mobile equipment, will be salvaged from the airstrips and helipads and be shipped off-site to a third-party destination or point of sale. Structures on the airstrip aprons and helipads will be demolished or dismantled and salvaged.

4.4.8 Landfarm, Landfill, and Waste Storage Areas

Description

The currently existing **Landfarm** facility will be decommissioned and reclaimed as part of the development work for Phase 2. A new facility will be built on the lower tier of the camp pad, east of the mill (Figure 3). This new facility will be used to temporarily store hydrocarbon contaminated soils, contaminated snow and/or water, or other deleterious materials until such time that treatment or transport to a disposal facility can be done. Soil will be stored temporarily within the facility until it can be disposed of underground in permafrost areas. Snow and water will be placed in the contaminated snow and water pond, and hydrocarbons will be separated from the water using an oil water separator. Decontaminated water will be moved into the clean water pond until testing can confirm it meets discharge criteria.

The **Non-hazardous Waste Landfill** proposed at Boston will be located in Quarry V, near the Boston Mine (Figure 4). It will be an unlined facility used as permanent disposal site for the non-hazardous waste generated by the mine operations, as well as the non-hazardous demolition debris at closure. The minimum storage capacity will be about 50,000 m^3, with a footprint of about 1.1 hectares. Waste should be placed and compacted within the landfill in 0.85 m thick lifts. A series of 0.15 m thick interim covers of geochemically suitable surfacing material may be placed as needed to prevent wind transport of the deposited waste. Alternatively, non-hazardous waste could be placed in seacans which would then be placed within the landfill and covered with a minimum of 0.3 m thick ROQ cover.

A **Waste Storage Area** will be designated on the camp rockfill pad, in the vicinity of the Landfarm. This area will be used as laydown and sorting area for staging and labeling of waste awaiting shipping to the final disposal sites.

Closure Objectives and Criteria

The **Landfarm** will be decommissioned and the liner protective gravel layer removed, tested, and disposed of as appropriate. The liner will be cleaned, removed, and disposed of in the non-hazardous landfill.

The **Non-hazardous Waste Landfill** will be capped with 0.3 m of rock fill or geochemically suitable waste rock, once all demolition waste was deposited in the landfill following final closure. The final surface of the landfill will be graded at a minimum of 1% to prevent ponding of water and promote run-off. The landfill will contain only non-hazardous waste; leachate is therefore not a concern and the cover will function as an isolation barrier which does not require freeze-thaw protection. The cover thickness will be the minimum thickness that can reasonably be constructed with the available run-of-quarry rock, estimated to be about 0.3 m. This is consistent with the currently approved non-hazardous landfill at the Doris Mine.

The **Waste Storage Area** is part of the larger camp pad, and will be reclaimed in a similar manner with the rest of the rock fill pads, as described in Section 4.4.2.

4.4.9 Water Management Systems

Description

The water management systems on the site will consist of unlined contact water ponds downstream of the waste rock pile, ore pads, mine and processing pads, a lined surge pond for water treatment plant feed, and a unlined non-contact pond downstream of the overburden pile. The tailings contact water berms and ponds are dealt with under Section 4.4.4.

Closure Objectives and Criteria

The overarching closure objective for the water management systems is to restore natural drainage pathways where possible, and to prevent excessive erosion to ensure that long-term care and maintenance is not required. In areas where permanent discharges exist, engineered discharge points (spillways/breaches) must be physically and geotechnically stable in the long-term for safety of humans and wildlife. To achieve these objectives, options for decommissioning, breaching, or removing each of the water management structures will be evaluated on a case-by-case basis. Implementation of the chosen option will only be done when post-closure water quality objectives are met. Erosion protection and sediment control measures will be installed where necessary.

The berms of unlined contact water ponds will be breached to be free draining, with the bulk of the berm remaining in place. Liner and geotextile from the breached area will be removed and disposed of in the non-hazardous landfill. ROQ rock, or riprap will be placed along the breach to prevent erosion and cover any exposed liner. Any sumps within the ponds will be decommissioned and backfilled with crushed rock.

Lined ponds will be decommissioned in a similar manner to the unlined ponds. The liner on the pond floor will be removed and disposed of in the non-hazardous landfill. The pond berms will be breached to restore free drainage, with the bulk of the berms remaining in place. Sumps within the ponds will be decommissioned and backfilled with suitable material.

4.4.10 Fuel Storage Areas

Description

The Boston fuel storage facility will consist of six steel tanks within a lined secondary containment area. The old facility currently existing on site will be decommissioned and reclaimed as part of the proposed Phase 2 project development.

Closure Objectives and Criteria

All fuel storage areas will be closed and the fuel distribution system will be taken out of service. Prior to closure, the facilities will be decommissioned and piping disconnected. The tanks will be drained, steam-washed, cut into manageable pieces for disposal in the non-hazardous landfill. The resulting wash water will be directed to an oil-water separator to remove residual fuel.

The protective gravel layer above the secondary containment system's liner will be tested to identify the type and levels of hydrocarbons present. Contaminated gravel will be disposed of underground. The liner will be cleaned, cut into pieces and disposed of in the non-hazardous landfill. Like tank cleaning, the resulting wash water will be directed to an oil-water separator to remove residual fuel.

The berms making up the secondary containment area will be breached, and the entire footprint will be regraded to promote positive drainage and prevent ponding.

4.4.11 Hazardous Wastes, Chemicals and Explosives

Description

Hazardous wastes, chemicals and explosives remaining on-site at closure will be collected and stored in suitable sealed containers. This includes any remaining fuel, hydraulic oil, antifreeze, batteries, explosives and other lubricating fluids and chemicals.

Closure Objectives and Criteria

All materials will be packaged and manifested at the waste management facility for transport to a licensed facility for reuse or disposal in accordance with appropriate Federal, Provincial, Territorial, or Municipal hazardous waste regulations.

4.4.12 Contaminated Soils

Description

Contaminated soils are soils that contain unacceptable levels of deleterious materials such as hydrocarbons, drilling salt, antifreeze, concentrate, etc. Field investigations will be completed prior to site closure by qualified personnel to identify and define the extent of any contamination.

Closure Objectives and Criteria

An assessment of remediation options will be conducted once the full extent and nature of the contamination is determined. Localized areas with limited contamination may be bioremediated in situ. If large contiguous areas of contamination are found, excavation and disposal in underground mine workings will be considered. Excavations will be backfilled preferentially with suitable soils from the existing overburden piles to avoid ponding water resulting in permafrost degradation. Temporary erosion protection measures will be implemented, as required. Alternatively, rock, overburden, drill cuttings, wood chips and/or a mixture of these could also be used as backfill to prevent surface water ponding and ensure permafrost preservation.

Impacted soils may also be encapsulated in place should it be demonstrated that residual risk is minimal and/or other remediation methods are ineffective or inappropriate for a given area.

4.5 Expected Post-Closure Conditions

The final landscape at the Boston site is expected to consist of a disturbed project footprint that is physically and chemically stable in the long-term. Continual site presence and activity is not expected in the post-closure phase; therefore, post-closure conditions are expected to be like the pre-disturbance conditions, with a disturbed footprint. Post-closure land use as natural habitat should be minimally impacted by the rockfill pads left in place, as these are similar in nature to the barren rock outcrops common in the project area.

5 Progressive Reclamation

5.1 Definition

Progressive reclamation as outlined by MVLWB and AADNC (2013) is:

> "*Progressive reclamation takes place prior to permanent closure to reclaim components and/or decommission facilities that no longer serve a purpose. These activities can be completed during operations with the available resources to reduce future reclamation costs, minimize the duration of environmental exposure, and enhance environmental protection. Progressive reclamation may shorten the time for achieving closure objectives and may provide valuable experience on the effectiveness of certain mitigation measures that might be implemented during closure.*"

5.2 Candidate Facilities/Areas and Reclamation Activities

Based on the mine plan, reclamation of entire mine areas is not expected prior to the end of operations. Opportunities for progressive reclamation of facilities while the facilities are still in operations will be identified whenever possible. Progressive reclamation opportunities that may arise include:

- Cover placement over any area of the TMA that will not be disturbed by future tailings placement;
- Removal, and reclamation of buildings and infrastructure that become unnecessary over the life of the mine;
- Placement of waste rock underground for backfill and the reclamation of the waste rock pile footprint, if additional on-surface storage is no longer required;
- Immediate cleanup of materials (e.g. soil, snow, ice) that may become contaminated during construction and operations due to fuel or other spills; and
- Periodic shipment of hazardous waste off-site to minimize the amount of waste requiring removal at closure.

5.3 Progressive Reclamation Schedule

Progressive reclamation activities will take place as opportunities arise.

6 Temporary Mine Closure

6.1 Definition of Temporary Closure

The MVLWB and AADNC (2013) define temporary closure, or Care and Maintenance as:

> "*When an advanced mineral exploration or mining operations ceases with the intent of resuming activities in the near future"*.

The duration of temporary closure is to be proposed by the owner based on the requirements of their operation, and temporary closure could last weeks or years depending on the factors contributing to the temporary closure. Temporary closure could occur due to economic factors such as severely depressed metal prices, late delivery of critical supplies, major mechanical failures, environmental factors, or social factors such as labour conflicts.

Temporary closure could also lead to permanent closure, without the resumption of mining if the factors contributing to temporary closure cannot be resolved. If the mine were under Care and Maintenance and the decision was made not to resume operations, then TMAC would need to file the FCRP with the NWB, or notify the NWB that they intend to execute the latest ICRP. Following all required approvals, the final closure and reclamation measures would be executed.

6.2 Temporary Closure Principals and Goals

The temporary closure principals and goals are similar to the overall closure criteria: ensure the site is safe for humans, animals and the environment, by ensuring physical and chemical stability; and protecting the future use of the site by, where practicable, maintaining mine infrastructure in a state that is amenable to recommencement of operations.

6.3 Temporary Closure Management and Accountability Structure

Temporary closure activities will be managed by a core team of TMAC site personnel. The level of site presence will be established based on the stage of the Project, expected duration of temporary closure, and level of effort required to reach the temporary closure goals. The site caretakers would report to TMAC management.

6.4 Temporary Closure Activities

The following temporary closure activities will always occur, and are not dependant on the stage of operations when temporary closure is triggered:

- Secure and restrict access to buildings and structures;
- Lockout and secure mechanical, hydraulic and electrical systems and equipment that are not required to operate during the temporary closure period;
- Drain all pipelines on dry land and secure underwater pipelines;
- Park mobile equipment in a no-load condition;
- Guard or block all underground openings and post warning signs;
- Continue all monitoring (physical, chemical, biological) in accordance with the Project licenses and permits;
- Continue all treatments (physical, chemical, biological) in accordance with the Project licenses and permits;
- Record fuel levels in all fuel tanks and regularly monitor for leaks or hazards, or alternatively remove fuel from site;
- Collect and inventory hazardous waste (processing chemicals, reagents, and petroleum products) and properly store or remove from site;
- Collect and inventory explosives, and properly store or remove from site;
- Maintain waste rock dumps, ore piles, and tailings facilities so that they are physically stable;
- Continue surface water management measures throughout temporary closure;
- Maintain infrastructure including plowing of roads and airstrip, repairing culverts and employing sediment and erosion control measures; and
- Secure and isolate unused camp facilities.

Other activities may also be required, depending on the stage of the Project at the time of temporary closure and the expected duration of temporary closure.

6.5 Monitoring and Reporting During Temporary Closure

During temporary closure, programs will be conducted to monitor the physical and chemical stability of mine components and compliance. Reclamation and environmental studies would be continued in accordance with approved license conditions and monitoring will also occur to maintain site security. Physical inspections will be conducted to ensure that all infrastructure are performing as intended. Monitoring, maintenance, and reporting will include:

- Collection of meteorological and hydrological data;
- Physical inspections of TMA berms, access roads, and tailings surface;
- Ongoing water quality and environmental effects monitoring (as prescribed in the Water Licence);
- Monthly site inspections by the Environmental Superintendent or its designate;
- Annual geotechnical inspections by a qualified Geotechnical Engineer;
- Ongoing maintenance of access roads;
- Ongoing enforcement of security and access protocols; and
- Detailed site inspections by the Environmental Superintendent or its designate following any extreme events, including freshet to identify and assess any damage caused by erosion or settlement.

All inspections will be formally recorded and provided to TMAC management. Annual monitoring reports will be prepared to present the findings of the inspections in accordance with licence requirements. Recommendations for maintenance and any suggested modifications to the monitoring program will be included in the reports.

This monitoring and the associated maintenance activities will be conducted until such time as the Project changes status by either resuming operation or advancing to final closure.

6.6 Temporary Closure Schedule

The temporary closure activities will be carried out immediately following the suspension of operations and the decision to prepare the site for an indefinite period of Care and Maintenance. It is expected that several months would be required to complete all the temporary closure activities.

7 Research to Support Reclamation

There are no direct research projects currently undertaken at the Boston Project. However, monitoring data gathered as part of the compliance monitoring program will be continuously collected and periodically reviewed by qualified specialists. Any conclusions drawn from the review of monitoring data and observations collected in the other parts of the Hope Bay property will be integrated in the Boston design as appropriate. The data gathered at Boston will include the following:

- Weather data;
- Seep surveys;
- Water quality;
- Flow monitoring;
- Permafrost monitoring;
- Vegetation studies;
- Dust monitoring;
- Noise monitoring;
- Wildlife surveys;
- Fish surveys and benthic fauna;
- Annual geotechnical inspections (for TMA stability / rock fill pad stability / road stability / permafrost stability); and
- Characterization of geochemical of waste rock and ore samples.

If any of the data is found to be indicative of problematic trends or unforeseen processes, a more detailed evaluation will be undertaken. Where appropriate, dedicated research programs will be undertaken to reduce uncertainty and evaluate the performance of specific closure methods.

8 Contingencies

Specific contingencies were developed for some of the closure elements that have inherent uncertainties that cannot be quantified at this stage in the project. If any of the proposed closure strategies will be ineffective or no longer apply, new strategies will be developed in consultation with stakeholders. The subsections below provide details of these contingencies.

8.1 Water Quality

In the case where water quality standards cannot be met by the end of the post-closure period specified in the water management plan, the monitoring time may be extended as required. Alternatively, water treatment options could be explored once the cause of the delay is known and quantified.

8.2 Waste Rock and Ore

According to the current mine plan there will be no ore and/or waste rock left on surface at closure. During operations, the waste rock will be temporarily stored on surface. Several alternatives were considered as contingency for any ore and/or mineralized waste rock left on surface. One option is moving the piles to the TMA for placement in the tailings area. Another option is consolidating, contouring and covering the piles with an impermeable liner and a 0.3 m thick protective layer of crushed rock. Additional options may also be considered. All above ground storage options are subject to approval by NWB.

8.3 Climate Change Effects

Most closure activities considered climate change to the level it is currently understood. Any changes not anticipated will be dealt with at time of closure and monitored as they develop. Financial security will be updated periodically as mandated by the regulations, to take into account any changes to the environment or operations.

9 Monitoring

9.1 Monitoring During the Closure Phase

During the closure phase, most monitoring activities will remain the same as during operations; however, additional monitoring will be carried out to confirm that closure activities are being carried out as identified in the final approved Closure and Reclamation Plan.

9.2 Post-closure Monitoring

Based on engineering design and analysis, it is expected that post-closure monitoring will be required for ten years. However, post-closure monitoring will take place at the Project site until such time that the objectives of the closure and remediation activities have been met to the satisfaction of the regulatory authorities and all affected parties.

Coupled with the proper implementation of closure and remediation activities as described in this CCRP, the following post-closure monitoring will be required to ensure the closure and remediation objectives are met:

- The Project should be visually inspected on an annual basis by a Professional Engineer, for three consecutive years, and then 6 and 10 years following closure to ensure physical stability.
- Post-closure monitoring of all covers will be performed every two years, for a ten-year period, or until it is confirmed the areas are physically stable. These inspections will be completed by a qualified inspector to ensure the physical integrity of the cover is maintained. Maintenance will be performed on areas identified as needing repairs.
- The annual seep sampling program downstream of the remediated areas will be continued for a period of five years and then 7 and 10 years following closure, or until the leachate is confirmed to be chemically stable and consistent with the site-specific closure criteria.
- The Contact Water Ponds will be monitored as part of the post-closure SNP monitoring network and at a higher frequency determined by the inspector. Dissolved metals will be included in the analytical suite for Contact Water Ponds water quality monitoring.

Post-closure air quality, wildlife and vegetation monitoring is not planned, as once the Project site is closed there is not expected to be any activities occurring that would warrant continued monitoring.

The post-closure monitoring presented herein is based on the CCRP, recognizing that additional post-closure monitoring activities may be required following the implementation of the Project's FCRP, and the subsequent Reclamation Completion Report.

In addition, the post-closure monitoring requirements may change because of the Performance Assessment Report which will be prepared and submitted to the NWB for their review following the initial post-closure monitoring period. The duration of the initial post-closure monitoring period will be defined in consultation with NWB during development of the final closure and remediation plan.

9.3 Adaptive Management

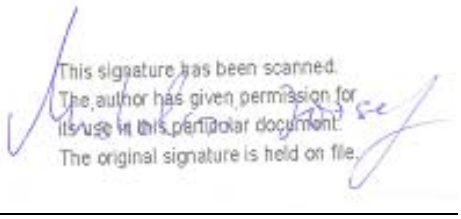
Adaptive management is discussed throughout this CCRP. Adaptive management includes:

- Continuation of post-closure monitoring beyond the stated durations if the closure objectives are not met or cannot be confirmed within the prescribed time period; and
- Continuous monitoring of water quality during operations and updating of predictive models to refine closure requirements.

10 Estimated Closure and Reclamation Costs

The mine closure and reclamation cost estimate developed in conjunction with this CCRP are provided under a separate cover.

This report, *Hope Bay Project Boston Conceptual Closure and Reclamation Plan, November 2017*, was prepared by SRK Consulting (Canada) Inc.



Iozsef Miskolczi, MASc, PEng
Senior Consultant

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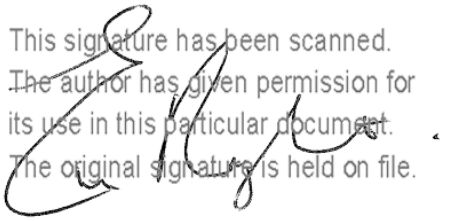

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Principal Consultant

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

11 References

Canada. 1985a. Territorial Lands Act. R.S.C., 1985, c. T-7.

Canada. 1985b. Fisheries Act. R.S.C., 1985, c. F-14.

Canada. 1985c. Arctic Waters Pollution Prevention Act. R.S.C., 1985, c. A-12.

Canada. 1992. Transportation of Dangerous Goods Act, 1992. S.C. 1992, c. 34.

Canada. 1993. Nunavut Land Claims Agreement Act. S.C. 1993, c. 29.

Canada. 2001. Transportation of Dangerous Goods Regulations. SOR/2001-286.

Canada. 2002. Nunavut Waters and Nunavut Surface Rights Tribunal Act. S.C. 2002, c. 10.

Canada. 2013. Nunavut Waters Regulations. SOR/2013-69.

Canada. undated. Arctic Waters Pollution Prevention Regulations. C.R.C., c. 354.

Canada. undated. Territorial Lands Regulations. C.R.C., c. 1525.

INAC 2002 Indian and Northern Affairs Canada. 2002. Mine Site Reclamation Policy for Nunavut.

MVLWB and AANDC 2013. Mackenzie Valley Land and Water Board, and Aboriginal Affairs and Northern Development Canada. 2013. Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories. November 2013.

Nunavut. 1994. Mine Health and Safety Act. SNWT (Nu) 1994, c 25.

Nunavut. 1995. Mine Health and Safety Regulations. NWT Reg. (Nu) 125-95.

Nunavut. 1988a. Environmental Protection Act. RSNWT (Nu) 1988, c E-7.

Nunavut. 1988b. Environmental Rights Act. RSNWT (Nu) 1988, c 83.

SRK Consulting (Canada) Inc., 2016. Hope Bay Project, Phase 2 Conceptual Closure and Reclamation Plan. Report Prepared for TMAC Resources Inc. 1CT022.004. November 2016.

SRK Consulting (Canada) Inc., 2017a. Hope Bay Project Boston Camp Interim Closure Plan. Report Prepared for TMAC Resources Inc. 1CT022.006. January 2017.

SRK Consulting (Canada) Inc., 2017b. Geotechnical Design Parameters and Overburden Summary Report, Hope Bay Project. Report Prepared for TMAC Resources Inc. 1CT022.013. November 2017.

SRK Consulting (Canada) Inc., 2017c. Geochemical Characterization of Waste Rock and Ore from the Boston Deposit, Hope Bay Project. Report Prepared for TMAC Resources Inc. 1CT022.013. November 2017.

SRK Consulting (Canada) Inc., 2017d. Geochemical Characterization of Tailings from the Madrid North, Madrid South and Boston Deposits, Hope Bay Project. Report Prepared for TMAC Resources Inc. 1CT022.013. November 2017.

SRK Consulting (Canada) Inc., 2017e. Geochemical Characterization of Madrid-Boston Project Quarries, Hope Bay Project. Report Prepared for TMAC Resources Inc. 1CT022.013. November 2017.

SRK Consulting (Canada) Inc., 2017f. Boston Tailings Management Area Preliminary Design, Hope Bay Project. Report Prepared for TMAC Resources Inc. 1CT022.013. November 2017.

SRK Consulting (Canada) Inc., 2017g. Madrid-Boston Project Water and Load Balance, Hope Bay Project. Report Prepared for TMAC Resources Inc. 1CT022.013. November 2017.

SRK Consulting (Canada) Inc., 2017h. Source Term Predictions for the Proposed Madrid North, Madrid South and Boston Mines Report, Hope Bay Project. Report Prepared for TMAC Resources Inc. 1CT022.013. November 2017.

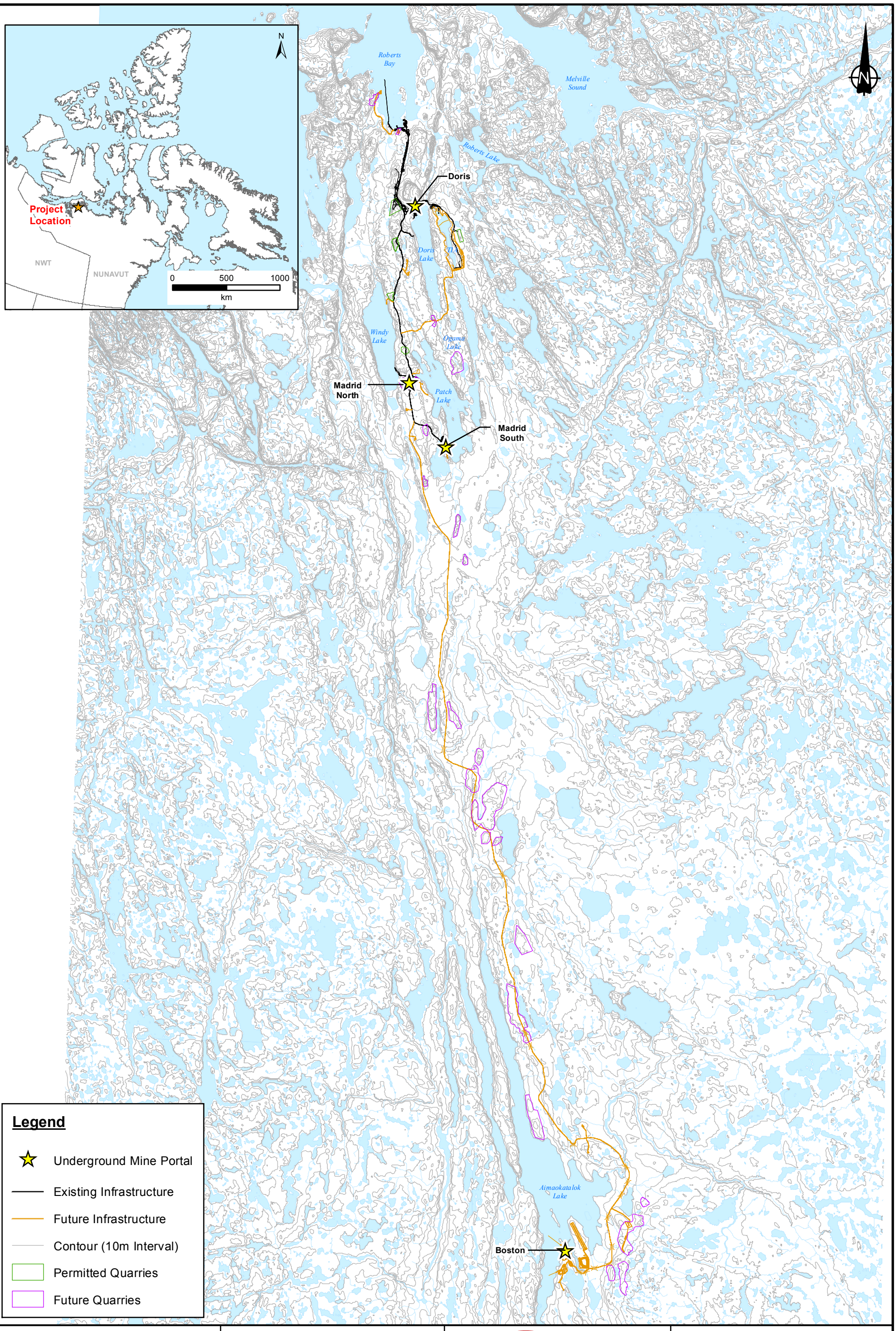
SRK Consulting (Canada) Inc., 2017i. Hope Bay Project: Thermal Modelling to Support Run-of-Quarry Pad Design. Memo Prepared for TMAC Resources Inc. 1CT022.013. November 2017.

SRK Consulting (Canada) Inc., 2017j. Climate Change Analysis Approach Report, Hope Bay Project. Memo Prepared for TMAC Resources Inc. 1CT022.013. November 2017.

TMAC Resources Inc. 2016. Personal Communication with Floyd Varley, Vice President Operations. Mine plan updated from Roscoe Postle Associates Inc. NI 43-101 Technical Report on the Hope Bay Project, Nunavut, Canada, March 2015.

TMAC Resources Inc., 2017, Madrid—Boston of the Hope Bay Project, FINAL ENVIRONMENTAL IMPACT STATEMENT, Volume 3 - Project Description and Alternatives. December 2017

Figures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Underground Mine Portal
Existing Infrastructure
Future Infrastructure
Contour (10m Interval)
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TMAC RESOURCES
HOPE BAY PROJECT
Boston Conceptual Closure and Reclamation Plan
Site Location Map
Date: Dec 2017
Approved: IM
Figure: 1
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Calendar year	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Timeline Summary	Construction Phase			Operation Phase								Closure		Post Closure									
Phase 2 Boston Site																							
Winter Road Access																							
Boston Site Construction																							
Process Plant Construction																							
Mining				Mining at Boston								Closure		Post Closure									
Ore Processing					Processing at Boston - 2,400 tpd																		
Transport of Ore to Doris				Ore transport to Doris																			

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Job No: 1CT022.013

Filename: Figure2_MinePlan.pptx

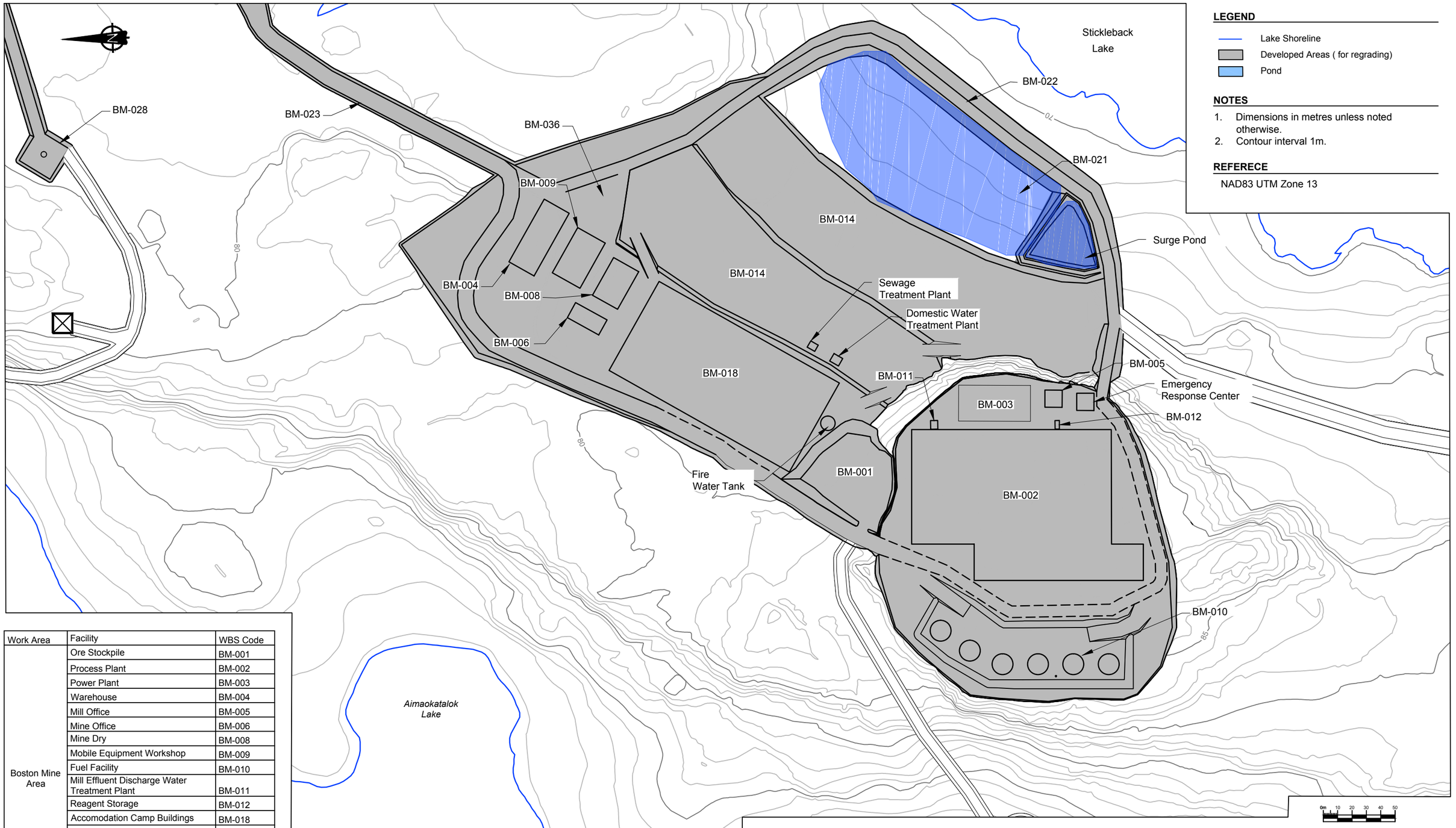
TMAC RESOURCES

HOPE BAY PROJECT

Boston Conceptual closure and Reclamation Plan

Project Timeline

Date: 2017/12/12 | Approved: IM | Figure: **2**



LEGEND

- Lake Shoreline
- Developed Areas (for regrading)
- Pond

NOTES

1. Dimensions in metres unless noted otherwise.
2. Contour interval 1m.

REFERECE

NAD83 UTM Zone 13

Work Area	Facility	WBS Code
Boston Mine Area	Ore Stockpile	BM-001
	Process Plant	BM-002
	Power Plant	BM-003
	Warehouse	BM-004
	Mill Office	BM-005
	Mine Office	BM-006
	Mine Dry	BM-008
	Mobile Equipment Workshop	BM-009
	Fuel Facility	BM-010
	Mill Effluent Discharge Water Treatment Plant	BM-011
	Reagent Storage	BM-012
	Accomodation Camp Buildings	BM-018
	Core Shack	BM-020
	Contact Water Pond #2	BM-021
	Camp Ring Road	BM-022
	Process Plant Haul Raod	BM-023
	Vent Raise	BM-028
	Developed Areas (for regrading)	BM-036

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FILE NAME: 1CT022.004_Boston Camp_Closure.dwg

TMAC RESOURCES

Hope Bay Project

Boston Conceptual Closure and Reclaimation Plan

Camp Area Work
Breakdown Structure

DATE:	APPROVED:	FIGURE:
2017/12/12	KK	3

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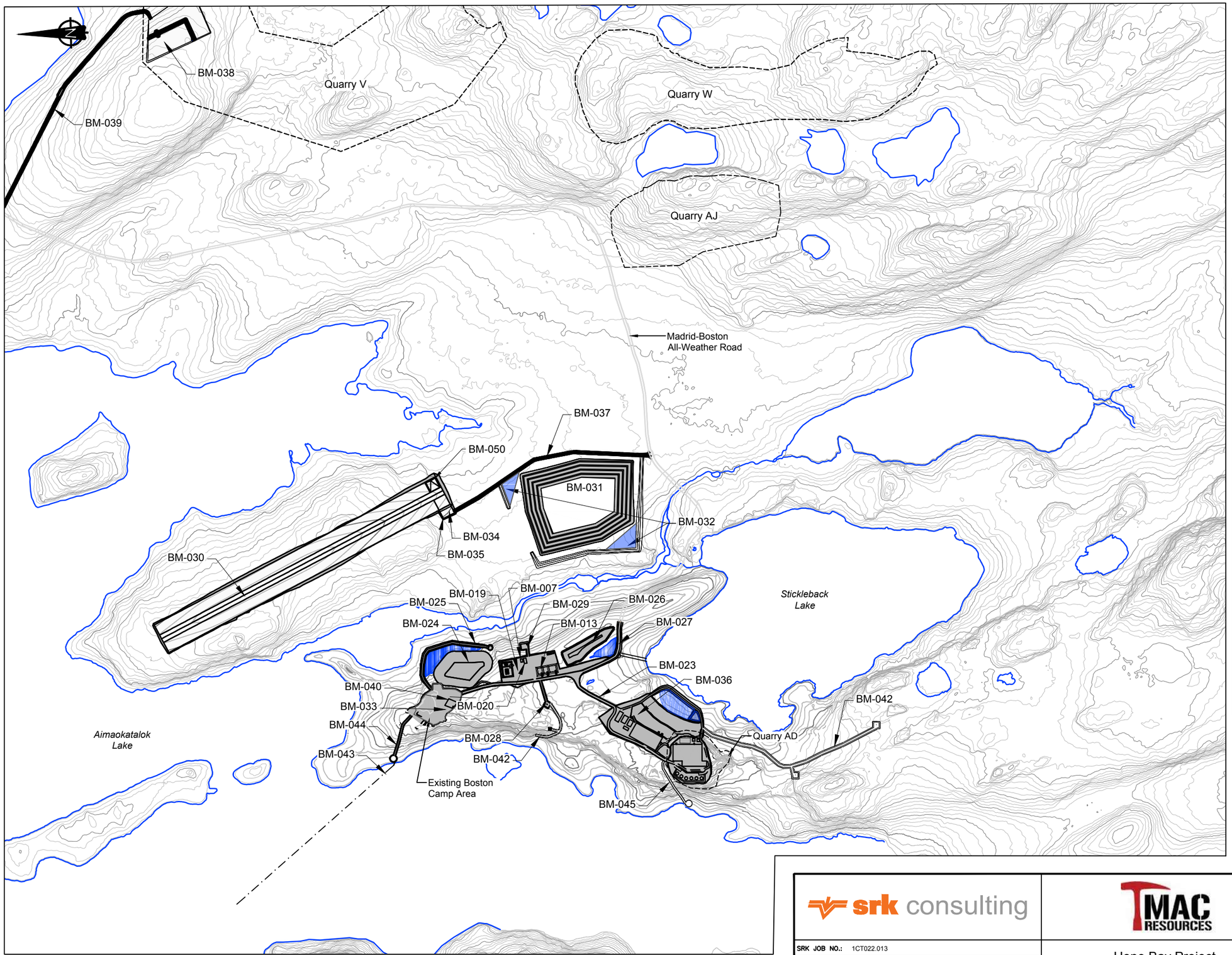

LEGEND

- Discharge Line
- Lake Shoreline
- Developed Areas (for regrading)
- Pond
- Quarry

NOTES

1. Dimensions in metres unless noted otherwise.
2. Contour interval is 1m

REFERECE

NAD83 UTM Zone 13

Work Area	Facility	WBS Code
Boston Mine Area	Exploration Office	BM-007
	Landfarm	BM-013
	Core Storage Pad	BM-019
	Core Pad	BM-020
	Process Plant Haul Road	BM-023
	Waste Rock Dump	BM-024
	Contact Water Pond Berm #1	BM-025
	Overburden Pile	BM-026
	Overburden Pile Contact Water Pond	BM-027
	Vent Raise	BM-028
	Heliport	BM-029
	Airstrip	BM-030
	Tailings Management Area (TMA) Drystack	BM-031
	TMA Contact Water Pond Berms	BM-032
	Portal and Underground Works	BM-033
	South Apron	BM-034
	Airstrip Lighting	BM-035
	Developed area (for regrading)	BM-036
	Airstrip Access Road	BM-037
	Landfill	BM-038
	Landfill Access Road	BM-039
	Old Camp Ore Stockpile	BM-040
	Vent Raise Access Road	BM-042
	Water Discharge Line	BM-043
	Water Discharge Access Road	BM-044
	Water Intake Access Road	BM-045
	Airstrip De-icing Facility	BM-050

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SRK JOB NO.: 1CT022.013

FILE NAME: 1CT022.004_Boston Camp_Closure.dwg

TMAC RESOURCES

Hope Bay Project

Boston Conceptual Closure and Reclaimation Plan

General Layout Work Breakdown Structure

DATE: 2017/12/12 | APPROVED: KK | FIGURE: 4

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Appendices

Appendix A – Summary of Facilities Associated with the Project

Components	Approval under Type B Exploration Licences	Request for Approval for Phase 2 Project
Miscellaneous buildings and infrastructure	Exploration-related maintenance shops, workshops, laydown areas, water pump house, vent raise, warehouse, site service roads	New maintenance shops, workshops Emergency trailer, brine mixing facility, laydown areas, vent raise, warehouse, reagent storage, site service roads
Processing Plant	None	Capacity of 2,400 tpd
Tailings	None	TMA sized for 4.2 Mt Dry stacked tailings
Accommodations and associated infrastructure	Accommodate 120-persons	New 200-person accommodations; Mine dry, office, and administration buildings
Site water management	Surface water and wastewater effluent discharged to tundra.	Surface water from contact water ponds re-used in processing plant. Mine dewatering to processing plant. Wastewater treatment plant with treated effluent discharged to Aimaokatalok Lake via outfall.
Contact water ponds	Containment pond	Pond 1 and 2 sized for 100-year rainfall; TMA pond - 20,500 m^3
Potable Water Supply Aimaokatalok Lake	100 m^3/day using pump house	Domestic - 22,000 m^3/year Industrial - 290,000 m^3/ year Pump house and water treatment plant
Water storage	Not specified	50,000 L
Sewage Treatment Plant	Accommodate 120-persons Discharge to tundra	Accommodate 200-persons Discharge to tundra or to Aimaokatalok Lake
Waste management	Incinerator for site waste Temporary storage of waste Waste transported to Doris or Roberts Bay for disposal	Incinerator for site waste Landfarm and Non-hazardous Waste Landfill
Heliport	Exploration helipad	Helipad and heliport building
Airstrip	Winter air strip Exploration all-weather strip	All-weather air strip (1,524 m) Airstrip building
Ore mined Life of Mine Mining methods Processing facilities	N/A	5,104,000 t Year 1 (2022) to Year 14 (2029) Underground / Box cut 2023 to 2029
Fuel Storage - Diesel	6 @ 77,000 L and 2 @ 33,000 L	Diesel - 5 @ 1.5 ML each
Fuel Storage - Jet fuel	Drums within Seacans	No change
Power Station	Not specified	8 gen-set units @ 1.2 MW and building Emergency power - 750 KW gen-set
Quarries	None	Three potential quarries identified for construction of airstrip Quarry AD used for site development
Overburden stockpile	None	Minimum capacity: 37,000 m^3
Waste rock stockpile (used for backfill of mine)	Waste rock used as construction material	628,000 t 349,000 m^3
Ore stockpile	Bulk sample	Two stockpiles, 8,000 t each 4,500 m^3 each
Explosives use	Not specified	2,770 kg/ day