Tail Lake

Doris Lake

Aerial Photo circa Sept. 2007

0 50 100 150 200 250
Scale in Metres

srk consulting

SRK JOB NO.: 1CT022.002.200.2100

FILE NAME: 1CT022.000_TailLake_Rev2.dwg

TMAC RESOURCES

TMAC Resources Inc.

Interim Closure and Reclamation Plan

Tailings Impoundment Area
Terrain Configuration Before Construction

DATE:	APPROVED:	FIGURE:
May 2015	IM	12

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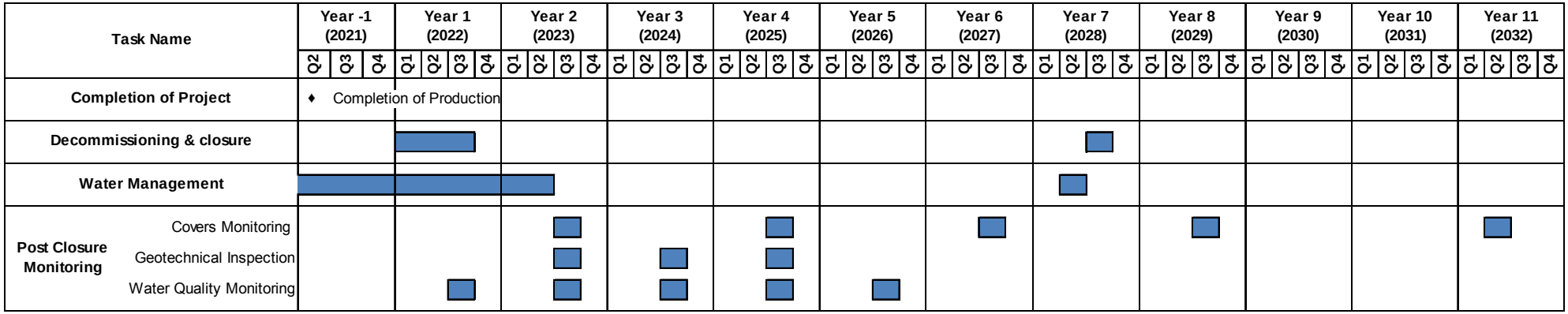

srk consulting

TMAC RESOURCES

Interim Closure and Reclamation Plan

Closure Activities Schedule

Job No: 1CT022.002

Filename: HopeBay_ICRP_Schedule_Fig13.pptx

TMAC Resources Inc.

Date:	Approved:	Figure:
June 2015	IM	13

Package 5
Management and Other Plans

P5-3 Water Management Plan

TMAC RESOURCES

WATER MANAGEMENT PLAN

HOPE BAY, NUNAVUT

June 2015

PLAIN LANGUAGE SUMMARY

This Water Management Plan (WMP) describes the water management practices for the Doris North Project, Hope Bay. This Plan is intended to fulfil the requirements outlined in the Doris North Project Certificate and Type A Water Licence, and is an updated version of the previous plan. It is intended that this Plan be expanded in future to encompass all water management for Hope Bay on a belt-wide basis.

The WMP outlines legislation and guidance relevant to the Plan, and describes the water management facilities. It also identifies various water management issues, and the mitigation measures which TMAC is currently implementing or plans to implement during construction, operations and closure.

The Plan is intended primarily for use by TMAC and its contractors to ensure that best practices are employed throughout all water management activities associated with activities at Hope Bay, thus ensuring water licence conditions are met and minimal potential downstream environmental impacts occur.

REVISION HISTORY

Revision #	Date	Section	Summary of Changes	Author	Approver
0	October 2006	New Document	Initial version of the Water Management Plan submitted with the 2006 water licence application	MHBL	MHBL
1	April 2007	Throughout	Consolidation of information on water management facilities	MMC	MHBL
2	December 2010	Throughout	Updated in accordance with Type A Water License 2AM-DOH0713	SRK	HMBL
3	July 2011		Address monitoring of Doris Lake water levels, address party review comments, RO water treatment	SRK	HBML
4	December 2011		Include Table of Concordance, incorporate underflow sumps	SRK	HBML
5	February 2012		Approved Doris North Interim Water Management Plan under 2AM-DOH1323	SRK	HBML, NWB
6	December 2012		Update to address Part F Item 1.a.,b.,c. of Water License	SRK	HBML
7	June 2015	Throughout	Update to TMAC as current licensee for the Hope Bay region. Changes to document structure for operational suitability and efficiency	TMAC (SRK)	TMAC
		Sections • 1.3; • 2.2; • 2.5; • 2.7; • 2.8; • 4.	Addition of: • Doris North Infrastructure Monitoring Program • Pollution Control Pond 2; • Talik water management • Revised: • Effluent discharge criteria • TIA Decommissioning • Water management contingencies		
		Module A	Underground talik water management, addition of proposed second Pollution Control Pond, TIA discharge to Roberts Bay		

GLOSSARY AND ACRONYMS

TERM	DEFINITION
CCME	Canadian Ministers of the Environment
DFO	Department of Fisheries and Oceans
DOE	Department of Environment
GN	Government of Nunavut
KIA	Kitikmeot Inuit Association
MHBL	Miramar Hope Bay Ltd.
MMC	Miramar Mining Corporation
MMER	Metal Mining Effluent Regulations
NWB	Nunavut Water Board
PCP	Pollution Control Pond
TIA	Tailings Impoundment Area

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1. INTRODUCTION

This Hope Bay *Water Management Plan* (the Plan) has been prepared by TMAC Resources Inc. (TMAC) in accordance with various water licences held by TMAC associated with developments throughout the Hope Bay region.

The Plan is intended primarily for use by TMAC and its contractors to ensure that best practices are employed throughout all water management activities associated with the operation and closure of the Doris North Project, thus ensuring water licence conditions are met and minimal potential downstream environmental impacts occur.

This Plan is structured in a manner such that one document pertaining to water management is approved and implemented across all TMAC Hope Bay project sites, while still addressing site and licence-specific needs: the main document outlines TMAC's approach to water management as it pertains to all TMAC Hope Bay developments; subsequent modules provide details for each site and the associated water licence. In the event of a new water licence, or an existing licence amendment, the specific modules pertaining to that licence and site will be revised. This is intended for consistency and efficiency across operations and for compliance management.

1.1. OBJECTIVES

This plan outlines the water management needs of the Doris North mine area, and components of the project including excess water from the Tailings Impoundment Area (TIA) and underground groundwater management.

The objective of the Plan is to provide guidance and procedures required to operate, monitor and maintain water management on site in accordance with the existing licences associated with development of the Hope Bay Project.

1.2. RELEVANT LEGISLATION AND GUIDANCE

Table 1 provides a summary of federal and territorial regulations governing the Hope Bay *Water Management Plan* and associated guidelines.

Table 1: Regulations and Guidelines Pertinent to the Water Management Plan

Regulation	Year	Governing Body	Relevance
Nunavut Waters Regulations	2013	Nunavut Water Board	License for mining and milling undertaking to use water and deposit of waste in relation to the construction, operation, closure and reclamation.
Environmental Protection Act	2011	Government of Nunavut (GN), Department of Environment (DOE), Environmental Protection division	Legislation to authorize discharge of water
Environmental Rights Act	2011	GN, DOE, Environmental Protection division	Grants all residents the ability to launch an investigation
Metal Mining Effluent Regulation(MMER)	2009 –as amended to date	Federal Department of Fisheries and Oceans & Environment Canada	Allows for the elimination of a water body for the deposition of mine waste
Guideline	**Year**	**Issued by**	**Relevance**
Canadian Environmental Quality Guidelines	1999 – as amended to date	Canadian Council of Ministers of the Environment (CCME)	Provides guidance on water quality for the protection of aquatic life; both freshwater and marine

1.3. Related TMAC Documents and Programs

Table 2 provides a summary of documents related to the Hope Bay Water Management Plan.

Table 2: Documents Related to the Water Management Plan

Document Title	Relevance
Waste Rock and Ore Management Plan	Management of surface contact water
Domestic Wastewater Treatment Management Plan	Management of treated effluent
Hope Bay Spill Contingency Plan	Spill response procedure
Tailings Management Plan	Management of excess water from the TIA
Quality Assurance and Quality Control Plan	Sampling practices document that is reviewed and approved by the NWB
Doris North Infrastructure Monitoring Program	Water Management facility inspections

1.4. PLAN MANAGEMENT AND EXECUTION

The Water Management Plan is valid until August 15, 2013 (the duration of 2AM-DOH1323). The Plan is reviewed annually.

Personnel responsible for implementing and updating the Plan are identified in Table 3.

Table 3: Roles and Responsibilities

Role	Responsibility
VP Operations	• Overall responsibility for and implementation of this management plan; • Provide the on-site resources to operate, manage, and maintain water management infrastructure, such as pipelines, diversion berms, lined ponds and holding tanks; • Provide input on modifications to design and operational procedures to improve operational performance.
Surface Manager	• Conduct regular inspections of the water management facilities and audits of the maintenance records; • Responsible for tracking water movements between the various water management facilities, including from the pollution control ponds and sumps to the tailings impoundment area (TIA); • Maintain records of the source, disposition and volume of water transported/discharged; • Report irregularities identified during visual inspections to the VP Operations.
Environment Manager	• Review and update this management plan as required; • Monitor water quality in the ponds, TIA and discharge points; • Assess whether water quality samples have met applicable regulatory standards and guidelines; • Coordinate with the surface manager responsible for water movements between the various water management facilities to ensure compliance with all licence requirements; • Audit of water management tracking records and all associated required reporting.

2. WATER MANAGEMENT ISSUES

2.1. MANAGEMENT OF CONTACT WATER

The volume of contact water requiring management will determine the size of storage facilities and treatment capacity.

Management Response

Water is diverted upstream of mine areas to reduce the amount of contact water reporting to the Sedimentation and Pollution Control Ponds (PCP).

Pads are constructed of non-mineralized rock with sedimentation and pollution control ponds for the collection of water. Once suspended solids have been allowed to settle in the sedimentation ponds, water quality is expected to meet discharge limits outlined in the Water Licence and the water can actively be discharged to the tundra. Water in the Pollution Control Ponds is directed to the TIA. Site specific details are provided in Module A.

2.2. EXTENT OF INFRASTRUCTURE REQUIRING WATER MANAGEMENT

Water that comes into contact with ore and waste rock may not meet effluent water quality discharge limits following the settling of suspended solids. Additional treatment of the contact water is expected. The areal extent of water coming into contact will determine the volume of water requiring treatment.

Management Response

The facilities have been consolidated and subdivided to reduce the quantity and variance in quality of water requiring management. The deposition of ore and waste rock on surface is restricted to designated areas. For example, at the Doris North mine industrial complex water comes into contact with ore and waste rock on pads in the east half of the complex. This water reports to Pollution Control Pond 1. Water that comes into contact with ore on Pad U reports to Pollution Control Pond 1However, the east half of the Doris North mine industrial complex reports to the sedimentation pond. Water collected in the sedimentation pond can be discharged to the tundra if effluent water quality limits meet effluent discharge limits outlined in the Water Licence thereby reducing the volume of water requiring treatment and the potentially impacted area.

2.3. DESIGN OF INFRASTRUCTURE REQUIRED TO MANAGE WATER

The distribution of facilities across the site will dictate where infrastructure must be developed to manage water.

Management Response

Locating infrastructure pads within diversion berms and grading surfaces towards the pollution control or sedimentation ponds ensures runoff and seepage will flow to the select ponds for management. Diversion berms may be constructed to temporarily route water away from infrastructure as needed, to prevent contact. If areas of underflow or shallow groundwater discharge occurs from the active layer, additional sumps may be constructed to ensure all seepage associated with contact water is captured in the water management system. Site specific details are provided in Module A.

2.4. APPROPRIATE DESIGN CAPACITY OF PONDS AND THE TIA

Pollution control ponds are to be designed to manage water from the overall drainage area during storm events such that the contained volume does not exceed the pumping capacity.

The TIA is an engineered facility designed to receive contact water as tailings slurry. Water levels are managed such that water is available for reclaim in the mill. Excess water in the reclaim pond is discharged to Roberts Bay.

Management Response

The retention pond storage capacity and the storm event are determined based on site specific conditions. It is expected that PCPs will always be operated in a manner allowing pumping to commence as soon as the containment volume is large enough for one continuous hour of pumping. All water will be transferred to the TIA. Site specific details are provided in Module A.

2.5. Appropriate Talik Water Management

During the Doris Central and Connector underground development, it is anticipated that groundwater will be intercepted from development within a talik under Doris Lake.

Inflow estimates have been modeled including management methods and the expected peak daily inflow of water to the Doris Mine is estimated to be 3,000 m^3/d when the mine is fully developed.

Management Response

To prevent excessive groundwater inflows, an investigation and grouting program will be put in place during mining. This will consist of evaluating drilled exploration holes for water in advance of development. Should water be encountered in substantial volumes a program of pressure grouting the area will be initiated. If substantial inflows are anticipated a grout curtain will be put in place prior to blasting. Any leaking drill holes that are encountered will be plugged, likely using Margo type plugs.

Where possible, groundwater will be utilized during underground drilling to reduce fresh water and salt consumption and to minimize groundwater discharge volumes. Excess groundwater will be intercepted in underground sumps and pumped to the mill building and discharged to Roberts Bay. Intercepted groundwater will be discharged to Roberts Bay year round via a diffuser.

2.6. Compliant Effluent Discharge

The location and timing of the discharge of compliant water will be dependent upon the infrastructure available at the time of discharge.

Management Response

During Care and Maintenance stages of the mine life cycle the water management strategy is to convey flows from existing pollution control ponds and non-compliant flows from the Sedimentation Pond to the TIA. As permitted in the project Water Licence, compliant water from the TIA can be discharged to Doris Creek.

During construction, sediment and erosion control measures will be implemented and monitored where needed, as part of the Construction Monitoring Program to ensure runoff meets the effluent discharge criteria specified in the licence

During operations mill effluent, surface runoff water, precipitation and contact water accumulating in the sediment control pond, pollution control pond (PCP) 1, landfill sump and Pad U (PCP 2) will be pumped to the TIA.

An interim dyke will be constructed in the TIA to allow for subaerial tailings deposition. Slurry water and accumulated water from upstream runoff will drain through the interim dyke into the TIA Reclaim Pond where process water will be reclaimed for mill operations.

Excess water will be pumped from the TIA to the Marine Outfall Mixing Box located in the mill building, and then be pumped via a pipeline along existing corridors to the Roberts Bay Discharge System. Water from the TIA will only be discharged during the open-water season (June – September inclusive).

2.7. Appropriate Discharge Criteria

Water quality criteria for the discharge of water into the marine environment is to be listed in the project Water Licence.

The Metal Mining Effluent Regulations (MMER) apply to mine effluent discharge.

Management Response

Marine water quality guidelines, specifically the Canadian Council of Ministers of the Environment (CCME) water quality guidelines for the protection of marine aquatic life (CCME 2015), were used to evaluate the water quality requirements for a proposed discharge to the marine environment for the Project. The (MMER) water quality limits for deleterious substances (MMER 2015) were used as the proposed authorized limits at the end of the Marine Outfall Pipeline.

2.8. Timing for Decommissioning of Dams in the Tailings Impoundment Area

The closure of the TIA will not be complete until the tailings are covered, the interim dyke is lowered to the height of the subaerial tailings and the North Dam has been breached.

Management Response

At closure, water management of the TIA will be discharged to Roberts Bay for 2 years, to lower the water level. The TIA will then be allowed recharge naturally for 5 years, after which it is expected that water quality in the TIA meets Doris Creek water quality guidelines as listed in the Water Licence. Once water quality in the TIA meets Doris Creek water quality guidelines, the North Dam in the TIA can be breached and flow restored to Tail Lake Outflow.

3. Inspection and Evaluation

3.1. Monitoring

Visual inspections of all water management structures will be completed to determine if the facilities are operating as designed and assess maintenance requirements as described in Module A. Monitoring requirements are also described in Module A. The objective of the monitoring is to:

- Ensure water in the ponds, TIA meets the appropriate discharge limits prior to discharge
- Ensure points of discharge to tundra are not negatively affected by pooling or erosion
- Ensure all water movement and volumes are tracked; and
- Assess water quality in the receiving water environment.

During construction, daily visual inspections, and inspections after significant rain events, are completed of construction activities to:

- Monitor for signs of erosion and implement mitigation measures to prevent entry of sediment to any water body; and
- Ensure runoff water quality during construction meets effluent discharge criteria as specified in the licence

3.2. Documentation and Reporting

Documentation and reporting requirements for Doris North are described in Module A. Monitoring data will be compiled into monthly and annual reports submitted to the NWB as part of the Surveillance Network Program, and a Construction Monitoring Report will be prepared in applicable years. Inspection records are maintained on site and available for review upon request.

4. CONTINGENCIES

The following Table 4 provides a list of possible non-compliance/unforeseen events and suggested adaptive management solutions.

Table 4: Water Management Contingencies

Contingency	Adaptive Management Solution
Sedimentation Pond does not meet discharge criteria	In the event that water quality in the sedimentation pond does not meet effluent discharge limits, water will be pumped to the Pollution Control Pond 1 and managed in the TIA.
Low Pollution Control Pond capacity	In the event that the water management for the pollution control ponds cannot be maintained, water can be temporarily stored in the sedimentation pond and ultimately managed in the TIA.
Malfunctioning discharge pipeline to Roberts Bay	In the event that the discharge pipeline to Roberts Bay is malfunctioning, intercepted groundwater inflows will be stored in the underground sumps and pumped to the Pollution Control Pond(s) for temporary management, or to the TIA. Excess water management in the TIA that meets water quality and discharge criteria as described in the water license will be discharged to Doris Creek during the open water season.
Excess water in the TIA	During operations, excess water in the TIA will be pumped to the Mill building and discharged to Roberts Bay.

5. REFERENCES

Canadian Council of Ministers of the Environment (CCME), 2015. Canadian Environmental Quality Guidelines Summary Table. http://st-ts.ccme.ca/. Accessed April 2015.

Metal Mining Effluent Regulations (MMER), 2015. Authorized Limits of Deleterious Substances - Schedule 4. Last amended February 20, 2015. http://laws-lois.justice.gc.ca/eng/regulations/SOR-2002-222/. Accessed April 2015.

DORIS WATER MANAGEMENT PLAN

MODULE A: 2AM-DOH1323 (DORIS)

CONFORMITY TABLE

License	Part	Item	Topic	Plan Section
2AM-DOH1323	D	4	The Licensee shall implement sediment and erosion control measures prior to and maintained during the construction and operation where necessary to prevent entry of sediment into water	Plan Section 2.6, 2.6, Module 1
		5	The Licensee shall undertake appropriate corrective measures to mitigate impacts on surface drainage resulting from the Licensee's operations.	Section 3.1
		16	The Licensee shall monitor all activities for signs of erosion and shall implement and maintain sediment and erosion control measures prior to the undertaking to prevent entry of sediment into any water body.	Module 1
		17	The Licensee shall conduct daily visual inspections for all construction activity during spring freshet and during and after remarkable rainfall events with sampling of runoff/seepage where turbidity is evident.	Section 3.1, 3.2 Module 1
		18	All surface runoff during the construction of any facilities, where flow may directly or indirectly enter a water body, shall meet the following Effluent quality limits.	Section 3.1
		24	The Licensee shall construct and maintain all containment and runoff control structures to prevent escape of wastes to the surface or groundwater systems.	Section 2.1 to 2.4
		27	The Licensee shall direct all runoff and seepage from the Temporary Waste Rock Pad to the Pollution Control Pond for collection and transfer to the Tailings Impoundment Area.	Section 2.2
	F	2	The Licensee shall carry out regular inspections of all water management structures during periods of flow and the records be kept for review upon request of an Inspector.	Section 3.1 and 3.2

	G	2	The Licensee shall perform all land applied discharges in a manner that prevents erosion at the point of discharge and downstream.	Section 3.1
		22	All Water from the Pollution Control Pond shall be directed to the Tailings Impoundment Area, unless otherwise authorized by the Board in writing.	Section 2.1 and 2.4
		23 (a to d)	The Licensee shall operate and maintain the Sedimentation Pond and Reagent and Cyanide Storage Facility sumps in accordance with listed criteria otherwise directed to the TIA.	Module A
		26 (a to n)	The Licensee shall operate and maintain the TIA to engineering standards.	Section 2.4
		28	All Water discharged from the TIA at monitoring station TL-4 shall not exceed specified Effluent quality limits.	Module A
	J	1	The Licensee shall install and maintain flow meters or other such devices, or implement suitable methods required for the measuring of water use and Effluent discharge volumes, to be operated and maintained to the satisfaction of an Inspector.	Section 3.1
		20	The Licensee shall visually monitor and record observations, to be made available to an Inspector upon request, on a daily basis during periods of discharge onto the tundra from: a. Landfill Sump; b. Sedimentation Pond; c. Landfarm Sump; d. Plant Site Fuel Storage and Containment Area Sump; e. Roberts Bay Fuel Storage and Containment Area Sumps; f. Wastewater Treatment Plant (during the construction phase); and h. Reagent and cyanide storage facility sumps.	Section 3.1

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A1. INTRODUCTION

The Plan has been prepared in accordance with Type A Water License No. 2AM-DOH1323. The water license sets out a number of conditions related to the management of water at the Doris North site and is valid until August 15, 2023. All of the terms and condition set out in the licence have been considered throughout the development of the Plan. A conformity table was prepared which provides a summary of the terms and conditions that pertain to the water management and also provides a location within the Plan that the condition is addressed (see start of this Module).

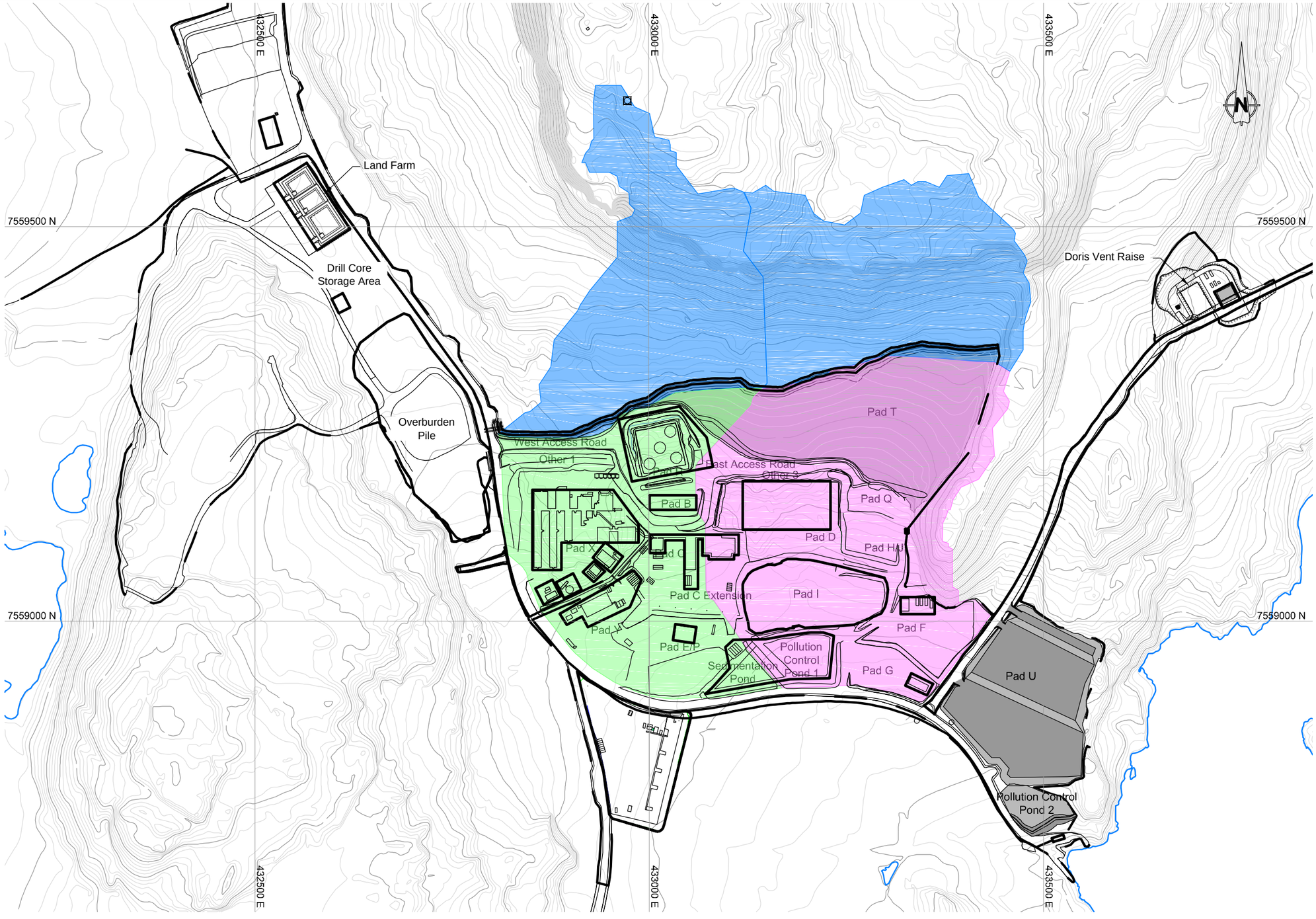
A2. DORIS WATER MANAGEMENT FACILITIES

The mine facilities relevant to this water management plan are a combination of constructed facilities and facilities that are planned for construction as part of Amendment 3. Table A1 provides a summary of mine infrastructure relevant to this water management plan. Figure 1 illustrates the mine area and total catchment areas reporting to the sedimentation and control ponds within the Doris North Mine Area.

Table A1: Facilities within the Mine Area

Facility	Reporting to
Pad X (Main Camp)	Existing Sedimentation Pond
Pad B (Laydown Area)	Existing Sedimentation Pond
Pad C (Administrative Buildings)	Existing Sedimentation Pond
Pad R (Fuel Storage Area)	Existing Sedimentation Pond
Pad Y (Warehouse/Laydown Area)	Existing Sedimentation Pond
Pad E/P (Laydown Area)	Existing Sedimentation Pond
Pad D (Mill Terrace)	Existing Pollution Control Pond 1
Pad T (Waste Rock Storage Area)	Existing Pollution Control Pond 1
Pad Q (Ore Storage Area)	Existing Pollution Control Pond 1
Pad H/J (Ore Storage Area)	Existing Pollution Control Pond 1
Pad I (Existing Waste Rock Storage Area)	Existing Pollution Control Pond 1
Pad F (Laydown Area)	Existing Pollution Control Pond 1
Pad G (Laydown Area)	Existing Pollution Control Pond 1
Pad U (Ore Storage Area)	Proposed Pollution Control Pond 2

The following sections provide a description of water management infrastructure.



LEGEND

- Diverted Area (145,444 m^2)
- Non-Contact Area (83,733 m^2)
- Contact Area (128,369 m^2)

0 20 40 60 80 100
Scale in Metres

srk consulting

SRK JOB NO.: 1CT022.002

FILE NAME: 1CT022.002_Water Management Plan.dwg

TMAC RESOURCES

TMAC Resouces Inc.

Water Management Plan

Doris North Mine Area

DATE:	APPROVED:	FIGURE:
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A2.1 DORIS NORTH DIVERSION

In order to divert water upstream of the mine area and reduce the amount of contact water, the Doris North diversion berm diverts approximately 145,444 m^2 away from the site. The Doris North diversion berm was constructed in 2011 and reduces the total amount of water reporting to the Sedimentation and Pollution Control Ponds to 212,142 m^2.

Pad T is located within the diversion berm and will not need any additional water management as its surface will be graded to ensure runoff and seepage will flow to the existing Pollution Control Pond 1. Pad U does not require any diversion as it is on the downstream side of the existing access road to Doris Lake and Tail Lake. The surface of Pad U will be graded to ensure runoff and seepage flow to the proposed Pollution Control Pond 2.

A2.2 SEDIMENTATION POND

As illustrated in Figure 1, pads located on the west side of the mine area report to the existing sedimentation pond. These pads are constructed of non-mineralized rock where water collected in the pond can be discharged to the tundra if effluent water quality limits meet effluent discharge limits outlined in the Water Licence. The existing sedimentation pond has capacity of 3,325 m^3.

Table A2: Sedimentation Pond Effluent Discharge Limits to Tundra

Parameter	Maximum Average Concentration (mg/L)	Maximum Concentration in any Grab Sample (mg/L)
pH	Between 6.0-9.0	9.0
Total Suspended Solids	15.0	30.0
Total Ammonia	2.0	4.0
Total CN	1.0	2.0
Total Oil and Grease	5 and no visible sheen	10 and no visible sheen on pond
Total Aluminum	1.0	2.0
Total Arsenic	0.05	0.10
Total Copper	0.02	0.30
Total Iron	0.30	0.60
Total Lead	0.01	0.02
Total Nickel	0.05	0.10
Total Zinc	0.01	0.02

Source: Water Licence 2AM-DOH1323 Part G, 23

A3. POLLUTION CONTROL PONDS

A3.1 EXISTING POLLUTION CONTROL POND 1

Pads located on the east side of the mine area that have the potential of being contaminated will be graded to ensure all runoff and seepage will be diverted and collected in the existing Pollution Control Pond. This includes the proposed Pad T which will be composed of a waste rock storage area. The Pollution Control Pond is designed to be a retention pond for the 24 hr 1 in 25 year storm and has a storage capacity of 2,992 m^3. The total volume of runoff captured in this pond will be transferred to the TIA. It is expected that the pond will always be operated in a manner allowing pumping and/or trucking to commence as soon as the containment volume is large enough for one continuous hour of pumping. Associated with Pollution Control Pond 1, on the south east corner of the facility, is an underflow interception sump that captures shallow groundwater discharge from the active layer. This sump is monitored for water quality to ensure any seepage that might be bypassing the pond is captured and returned to the water management system.

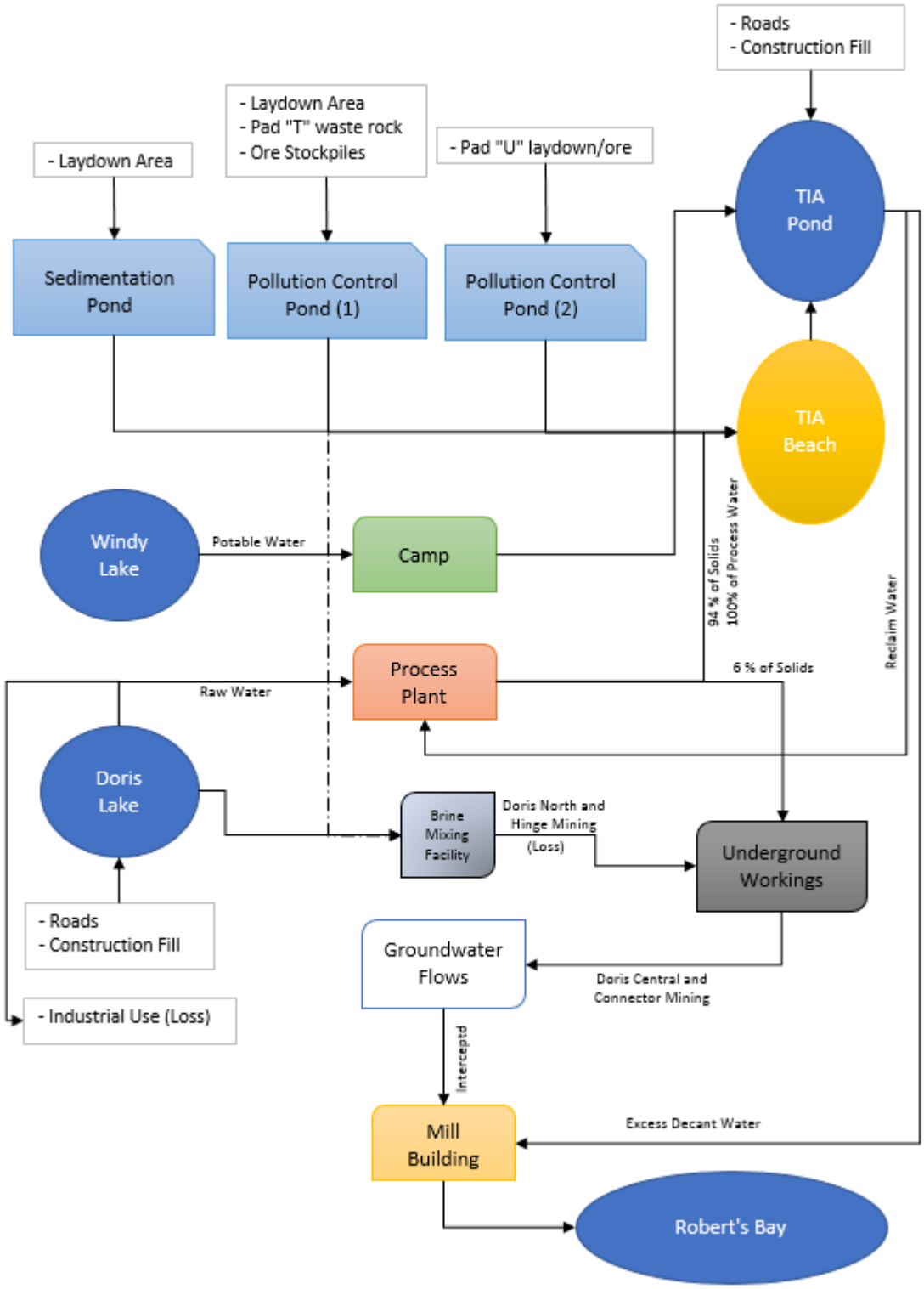
A3.2 PROPOSED POLLUTION CONTROL POND 2

Pad U will be located on the east side of the access road flowing towards Doris Lake. The primary intent of use for Pad U is general laydown and temporary ore storage, if needed. The pad will be graded in a manner to ensure runoff and seepage is collected by a downstream pollution control pond (Figure 1). The proposed pollution control pond will be designed to manage water and contain flow from the overall drainage area for a 100-year, 24 hour storm event. It is expected that this pond will always be operated in a manner allowing pumping to commence as soon as the containment volume is large enough for one continuous hour of pumping. All water will be transferred to the TIA.

A4. UNDERGROUND WATER MANAGEMENT

A4.1 TALIK WATER MANAGEMENT

During the Doris Central and Connector underground development, it is anticipated that groundwater will be intercepted from development within a talik under Doris Lake. Figure 2 provides an illustration of the water management during operations. Groundwater will be intercepted in underground sumps and pumped to the mill building and discharged to Roberts Bay. Intercepted groundwater will be discharged to Roberts Bay year round via a diffuser.



srk consulting	TMAC RESOURCES	Water Management Plan		
		Water Management - Operations		
Job No: 1CT022.002 Filename: Figure 1.pptx	Hope Bay	Date: May 5, 2015	Approved: SPB	Figure: **2**

A5. TIA WATER MANAGEMENT

A5.1 CURRENT WATER MANAGEMENT

The current water management strategy is to convey flows from the existing pollution control pond (Pollution Control Pond 1) and non-compliant flows from the Sedimentation Pond to the TIA. As permitted in the project Water Licence, compliant water from the TIA can be discharged to Doris Creek. Table A3 provides a summary of the effluent water quality limits as described in the Water Licence.

Discharged flows from the TIA shall not exceed 10% of the background flows in Doris Creek and during period of discharge, water quality in Doris Creek should be lower than the limits summarized in Table A4.

Table A3: TIA Effluent Discharge Limits to Doris Creek

Parameter	Maximum Average Concentration (mg/L)	Maximum Concentration in any Grab Sample (mg/L)
pH	Between 6.0-9.5	Between 6.0-9.5
Total Suspended Solids	15.00	30.00
Total Arsenic	0.50	1.00
Total Copper	0.30	0.60
Total Cyanide	1.00	2.00
Total Lead	0.20	0.40
Total Nickel	0.50	1.00
Total Zinc	0.50	1.00
Radium 226	0.37 Bq/L	1.11 Bq/L
Biological Oxygen Demand	80	160
Fecal Coliform	10,000 CFU/100 ml	10,000 CFU/100 ml
Total Ammonia	6	-

Source: Water Licence 2AM-DOH1323 Part G, 28

Table A4: Doris Creek Water Quality Limits during periods of discharges

Parameter	Maximum Concentration of and Grab Sample (mg/L)
pH	Between 6.0-9.0
Total Suspended Solids	15.0
Total Oil and Grease	5
Chloride	150
Free Cyanide	0.005
Total Cyanide	0.010
Total Ammonia	1.54 at pH 7.5 and temperature of 20 degrees C
Nitrate	2.9
Nitrite	0.060
Total Aluminum	0.100
Total Arsenic	0.0050
Total Cadmium	0.000017
Chromium	0.0010
Total Copper	0.002

Parameter	Maximum Concentration of and Grab Sample (mg/L)
Total Iron	0.300
Total Mercury	0.000026
Total Molybdenum	0.073
Total Nickel	0.025
Total Lead	0.001
Total Selenium	0.001
Total Silver	0.0001
Total Thallium	0.0008
Total Zinc	0.030

Source: Water Licence 2AM-DOH1323 Part G, 30

A5.1 WATER MANAGEMENT DURING OPERATIONS

During operations, mill effluent, surface runoff water, precipitation and contact water accumulating in the sediment control pond, pollution control pond (PCP) 1, landfill sump and Pad U (PCP 2) will be pumped to the TIA.

An interim dyke will be constructed in the TIA to allow for subaerial tailings deposition. Slurry water and accumulated water from upstream runoff will drain through the interim dyke into the TIA Reclaim Pond where process water will be reclaimed for mill operations.

Excess water will be pumped from the TIA to the Marine Outfall Mixing Box located in the mill building, and then be pumped via a pipeline along existing corridors to the Roberts Bay Discharge System. Water from the TIA will only be discharged during the open-water season (June – September inclusive).

Water quality criteria for the discharge of water into the marine environment is to be listed in the project Water Licence.

Marine water quality guidelines, specifically the Canadian Council of Ministers of the Environment (CCME) water quality guidelines for the protection of marine aquatic life (CCME 2015), were used to evaluate the water quality requirements for a proposed discharge to the marine environment for the Project. The Metal Mining Effluent Regulations (MMER) water quality limits for deleterious substances (MMER 2015), were used as the proposed authorized limits at the end of the Marine Outfall Pipeline.

Table A5: Effluent Limit and Roberts Bay Water Quality Limits during periods of discharges

Parameter	Units	MMER	CCME
pH		6 to 9.5	7.0 to 8.7
Total Suspended Solids	mg/L	15	
Total Cyanide	mg/L	1	
Salinity	%		10% change
Nitrate Nitrogen (N)	mg/L as N		16
Arsenic (As)	mg/L	0.5	0.0125
Cadmium (Cd)	mg/L		0.00012
Chromium	mg/L		0.0575
Copper	mg/L	0.3	
Lead	mg/L	0.2	
Mercury	mg/L		0.000016
Nickel	mg/L	0.5	
Zinc	mg/L	0.5	
Radium	Bg/L	0.37	

A5.3 WATER MANAGEMENT AT CLOSURE

At closure, water management of the TIA will be discharged to Roberts Bay for 2 years, to lower the water level. The TIA will then be allowed recharge naturally for 5 years, after which it is expected that water quality in the TIA meets Doris Creek water quality guidelines as listed in the Water Licence. Once water quality in the TIA meets Doris Creek water quality guidelines, the North Dam in the TIA can be breached and flow restored to Tail Lake Outflow.

A5.4 CARE AND MAINTENANCE OPTIONS

Should the site go on Care and Maintenance following the commissioning of the TIA water will continue to be discharged to Roberts Bay unless water quality in the TIA meets the Doris Creek water quality guidelines as listed in the Water Licence (Table A3).

A6. MONITORING AND REPORTING

A6.1 RECORD KEEPING

Records of operation and maintenance are required to evaluate the effectiveness of the operation of all water management structures. Daily records include the following information:

- Volume, quality and discharge location of any effluent moved between facilities or discharged to environment; and
- Details of any construction or maintenance undertaken at site.

Record sheets and daily operations or inspection logs are maintained with the Site Surface Operations and Environmental Departments.

A6.2 MONITORING

Continuous monitoring of Doris Lake and TIA water levels and outflows will continue under the hydrologic baseline characterization.

Sediment and Pollution Control ponds will have permanent staff gauges to allow for visual monitoring of water accumulations in each pond. Daily staff gauge readings converted to volumes will be recorded in for each pond.

All volumes of water discharged from the ponds or TIA will be monitored with flow meter or tracked by truck load as appropriate during the transfers.

- Sedimentation Pond to tundra
- Sedimentation Pond to existing Pollution Control Pond
- Sumps to Pollution Control Pond(s)
- Existing Pollution Control Pond to TIA
- Proposed Pollution Control Pond 2 to TIA
- Groundwater to Mill Building
- TIA Water to Doris Creek
- TIA excess water to Mill Building
- Mill Building to Roberts Bay

Water quality in the ponds, TIA and discharge points will be monitored in accordance with the Water Licence. Confirmation of compliance will be required prior to discharging any water from facilities, as applicable. The Environmental Department is responsible for water quality monitoring and compliance reporting.

A6.3 WATER MANAGEMENT FACILITY INSPECTIONS

Visual inspections of water management structures located through the Doris North mine area will be completed by Operations or Environmental staff. These inspections will look for the following type of issues:

- Drainage channels have not been inadvertently blocked or rerouted in a manner that could alter the intended routing of seepage or runoff to the Sediment or Pollution Control Ponds.
- Diversion structures and culverts are functioning as intended
- Integrity of all piping and other water conveyance structures
- Signs of erosion or water pooling occurring during high flow periods
- Volumes of water in the Sediment and Pollution Control Ponds
- Integrity of erosion protection at point of discharge to the tundra; and
- Any irregularities identified during the visual inspection will be recorded and relayed to the VP Operations and/or the Engineer of record for the facility in order to ensure immediate corrective action can be implemented.

A6.4 DOCUMENTATION AND REPORTING

All monitoring data compiled will be documented and incorporated into the existing monthly and annual monitoring reports submitted to the Board. These reports will include but not limited to:

- An assessment of data to identify areas of non-compliance with regulated discharge parameters;
- A summary of all water movement involving the Sedimentation, Pollution Control Ponds, TIA discharges, compliant discharges to tundra, and excess water pumped to Roberts Bay; and
- A annual calibration of the water balance and water quality prediction model.

Water management facility inspection and operations records will be retained on site and available for review upon request.

In accordance with the approval to proceed with the Doris North Project, a construction monitoring report will be prepared documenting the construction of all proposed infrastructure on site.

The report will include but is not limited to the following:

- A summary of all inspections conducted during construction; and
- Updated “As-built” drawings of the constructed infrastructure.

Package 5
Management and Other Plans

P5-4 Waste Rock and Ore Management Plan

TMAC RESOURCES

WASTE ROCK AND ORE MANAGEMENT PLAN

HOPE BAY, NUNAVUT

June 2015

PLAIN LANGUAGE SUMMARY

This Plan describes how rock that is brought to the ground surface during mining is identified and handled to minimize impacts to water quality. The rock includes ore (rock that contains gold) and waste rock (rock that does not contain gold). When ore is brought out of the mine, it is stored in piles until it is processed to take the gold out. As much waste rock as possible is left underground, however, some of it needs to be brought to surface during mining. When waste rock is brought to surface it is stored in piles. Eventually, most of this rock will be taken back into the underground mine, but where suitable, some may be used for construction.

REVISION HISTORY

Revision #	Date	Section	Summary of Changes	Author	Approver
1	2010		Approved Plan under 2AM-DOH1323	SRK	HBML
2	April 2015	Throughout	TMAC as current licensee for the Hope Bay region.	SRK	TMAC
		Throughout	Addition of Pad T for waste rock storage		
		3.3	Introduction of the low salt drilling procedure		
		Throughout	Update classification of Gabbro as Low NP basalt		
3	June 2015	Throughout	Changes to document structure for operational suitability and efficiency	TMAC (SRK)	TMAC
		Sec 1	Addition of Glossary and list of List of Acronyms, related TMAC documents, revised Plan Management responsibilities		
		Sec 2	Revised waste rock classification and segregation		
		Module A	Concordance with 2AM-DOH1323, revised Mine development plan to include placement of waste rock on Pad T, Ore storage on Pad U		

GLOSSARY AND ACRONYMS

TERM	DEFINITION
ARD	Acid rock drainage
ML	Metal leaching
NWB	Nunavut Water Board
TMAC	TMAC Resources Inc.
TIA	Tailings Impoundment Area
PAG	Potentially acid generating
NP	Neutralization potential
AP	Acid potential
TIC	Total inorganic carbon
Non-PAG	Non-potentially acid generating
ABA	Acid base accounting
ANFO	Ammonium nitrate – fuel oil mixture
HBML	Hope Bay Mining Ltd.
pH	Hydrogen ion concentration
EC	Electrical conductivity
ORP	Oxidation-reduction potential
TDS	Total dissolved solids
ICP-MS	Inductively coupled plasma – mass spectrometry
SNP	Surveillance Network Program
GPS	Global positioning system

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1. INTRODUCTION

This Hope Bay Project Waste Rock and Ore Management Plan (the Plan) has been prepared by TMAC Resources Inc. (TMAC) in accordance with various water licences held by TMAC associated with developments throughout the Hope Bay region.

The Plan is intended primarily for use by TMAC and its contractors to ensure that best practices for minimizing potential environmental impacts and liabilities associated with waste rock and ore storage are understood and managed, and that the conditions of the Water Licence are met.

This Plan is structured in a manner such that one document pertaining to waste rock and ore management is approved and implemented across all TMAC Hope Bay project sites, while still addressing site and licence-specific needs: the main document outlines TMAC's approach to waste rock and ore management as it pertains to all TMAC Hope Bay developments; subsequent modules provide details for each site and the associated water licence. In the event of a new water licence, or an existing licence amendment, the specific modules pertaining to that licence and site will be revised. This is intended for consistency and efficiency across operations and for compliance management.

1.1. OBJECTIVES

This plan outlines the waste rock and ore management needs on surface for the Hope Bay project. The objective of the Plan is to provide guidance and procedures required to deposit and manage waste rock and ore stored on site in accordance with the existing licences associated with development of the Hope Bay Project.

1.2. Relevant Legislation and Guidance

The following table lists federal and territorial regulations governing the management of waste rock and ore and associated guidelines.

Table 1 Regulations and Guidelines Pertinent to the Waste Rock and Ore Management Plan

Regulation	Year	Governing Body	Relevance
Nunavut Waters Regulation	2013	Nunavut Water Board	License for mining and milling undertaking to use water and deposit of waste in relation to the construction, operation, closure and reclamation.
Mine Health and Safety Act and Regulations	2011	Workers' Safety and Compensation Commission (WSCC)	Waste dump design and operations safety requirements. Designs to be approved by Chief Inspector.
Guideline	Year	Issued by	Relevance
Prediction Manual for Drainage Chemistry for Sulphidic Geologic Materials, Report 1.20.1	2009	Mine Environmental Neutral Drainage (MEND)	Guidance on determining the type, magnitude, location and timing of measures required to prevent significant environmental impacts by drainage from disturbed rock.
Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories	2013	Aboriginal Affairs and Northern Development (AANDC) and the Land and Water Boards of the Mackenzie Valley	Guidance on closure and reclamation expectations.

1.3. Related TMAC Documents and Programs

Table 2 provides a list documents to be considered in conjunction with this Plan.

Table 2 Documents related to the Hope Bay Waste Rock and Ore Management Plan

Document Title	Relevance
Water Management Plan	Identifies water management areas, facilities and procedures
Quarry Management Plan	Describes management of quarried rock and associated sampling programs, including a description of the monitoring program if approved waste rock is used in construction
Hope Bay Spill Contingency Plan	Spill response procedure
Air Quality Management Plan	Outlines how fugitive dust, associated with blasting, hauling and end dumping is managed and monitored.
Low Salt Underground Brine Water Use Procedure	Describes how salt use is minimized during drilling
Explosives Management Program	Contingency procedure for disposal of spilled ANFO

1.4. PLAN MANAGEMENT

This Plan is valid from date of approval until August 15, 2023 (the duration of 2AM-DOH1323).

This Plan is reviewed annually.

Personnel responsible for implementing and updating the Plan identified in Table 3.

Table 3 Roles and Responsibilities

Role	Responsibility
VP Operations	• Overall responsibility for implementation of this management plan • Provide the on-site resources to operate, manage, and maintain waste rock and ore management infrastructure such as pads, stockpiles and ponds • Ensure underground practices are continually improved to reduce brine and blast residues in waste rock • Provide input on modifications to handling and operational procedures to improve operational performance •
Surface Manager	• Conduct regular inspections of the pads, stockpiles and containment ponds • Facilitate Geotechnical Inspection, when required
Environment Manager	• Review and update this management plan as required • Monitor water quality in pollution control ponds • Conduct or facilitate seep sampling program on surface and underground as required • Conduct monthly and annual regulatory reporting as required
Mine Geologist	• Classify and segregate rock according to this plan • Execute construction qualification sampling program and assisting with any underground seepage monitoring • Inspect the working face on a regular basis to confirm lithology • Tag all waste rock with the intended waste designation • Instruct the mucking crew regarding waste rock and ore placement on surface
Mucking crew	• Place waste rock and ore in the intended and designated location
Mine Engineer	• Record quantity of material sent to each of the stockpiles in daily record • Provide waste rock movement totals to Environment Manager monthly
Blaster	• Inspect blasted area • Make note of and mark blast holes with paint that may not have been completely detonated

2. WASTE ROCK AND ORE MANAGEMENT ISSUES

2.1. METAL LEACHING AND ACID ROCK DRAINAGE (ML/ARD) POTENTIAL-WASTE ROCK

The Hope Bay deposits consist of a series of gold-bearing quartz veins hosted by Archean age folded and metamorphosed mafic volcanic rocks. The waste rock produced during mining contains sulphide minerals.

Acid rock drainage (ARD) is a general term applied to any acidic leachate, seepage, or drainage arising from the weathering of undisturbed or excavated geological materials (rocks and soil) containing sulphide minerals or their weathering products. Weathering reactions intensify due to the acidity generated by the oxidation of sulphide minerals, which results in the release of elements from rocks and soil.

Under the prevailing acidic conditions (low pH), metals released from the solid phase (rocks, soil) remain in solution and this is referred to as metal leaching (ML). While most metals are mobile (remain in solution) under acidic conditions, some metals are only mobile under neutral or alkaline conditions.

The control and treatment of ARD/ML during the mine design and operating stages of the project will enable post- closure reclamation efforts to be minimized.

Management Response

Geochemical Characterization

Based on the geochemical characteristics of the host rocks (at Doris North) within each of the various types of waste rock units, management recommendations are made, including the level of risk for ML/ARD, whether the material should be treated as mineralized or non-mineralized waste, what the segregation criteria is, and the frequency of monitoring that is required.

Actions to manage ML/ARD include classification, segregation, inspection and monitoring of waste rock as well as managing water associated with the waste rock piles. Each of these is presented below.

Waste Classification

All of the waste rock except diabase will be classified and managed as “mineralized” waste rock. The diabase will be stored in a separate stockpile within a designated waste rock storage area. If the material is intended for construction, confirmatory testing will be used to verify that the geochemical characteristics of the diabase are suitable for construction use.,

Mine planning indicates there is sufficient capacity to place all waste rock underground at closure. Given this, mineralised waste rock is temporarily stored on surface, and there is not a need for further detailed characterization campaigns.

All waste rock will be tagged underground with the intended waste designation, destined for either the non-mineralized pile or the mineralized pile. Once tagged, waste rock is hauled to the designated waste rock pile. Waste rock that is not tagged remains underground. Material quantities sent to each stockpile is recorded in the daily record.

Waste Segregation

Mineralised and non-mineralised waste rock will be stored separately within designated waste rock storage areas.

Inspection and Monitoring

The operational monitoring program includes routine the visual inspections and periodic sampling to confirm waste rock classification and segregation, annual inspection of material in the waste rock piles, periodic review of the routine monitoring program by a qualified geochemist, spring seep surveys, and routine monitoring of water quality in the Pollution Control Ponds, as described below.

Surface Water Management

Generally, the mine sites are designed to divert non-contact water around the minesite. Accordingly, all seepage and runoff from the waste rock pile areas are directed to the Pollution Control Ponds and managed according to the Water Management Plan.

Water flows and seepage from waste rock piles are captured in a series of ponds designed to prevent direct discharge of potentially contaminated water to the environment. Discharges from these ponds are directed to the Tailings Impoundment Area (TIA).

All direct discharges to the environment associated with the waste rock must meet the licence discharge criteria for metals, as listed in the modules appended to this plan.

Spring seep surveys are conducted to confirm that an environmentally-significant level of metal leaching is not occurring from the waste rock. Seep surveys are completed annually during freshet each year while waste rock is stored on a surface pad Seep surveys are completed along all safely accessible areas along the down-gradient toe of the waste rock piles and pads below the Pollution Control Ponds and waste rock pile access roads. The surveys are completed during the latter part of the spring freshet, concurrent with other seep surveys completed elsewhere on site.

Seeps are identified by walking along the down-gradient toe of the roads, piles and pads looking and listening for signs of flowing water. Samples of seepage water are collected for analysis where seepage flow exits the pads to the surface. A survey stake is installed to mark the location of each seep sampled and the following information is recorded:

- Description of the seep location;
- Global positioning system (GPS) location of the seep;
- A photographic record of the seep;
- A description of the flow pattern and magnitude of flow; and
- Field pH, Chloride, Electrical Conductivity (EC), Oxidation reduction potential (ORP) and temperature readings.

Field pH, Chloride, EC, ORP and temperature measurements are also to be established at reference sites located in a similar geological, and physiographic setting, but away from the influence of the rock or other mine related activities. These reference stations may also be shared with the quarry monitoring programs.

In the immediate area of the waste rock pile, water samples are collected from all distinct seepage locations. Where there are clusters of seeps within 50 m of each other, the one with the dominant flow will be sampled, appropriately preserved, labelled, and submitted to an accredited laboratory for analysis. The following information is recorded per sample:

- The name of the person who collected the sample;
- Date and time of sampling; and
- Date of analysis.

Following receipt of analytical results, the following are maintained on site to support Annual Water Licence Reporting:

- Name of person who completed the analysis;
- Analytical methods or techniques used; and
- Results of the analyses, including pH, Total Dissolved solids (TDS), acidity and/or alkalinity, sulphate, total ammonia, nitrate, and a full suite of metals by ICP-MS.

2.2. Metal Leaching and Acid Rock Drainage (ML/ARD) Potential-Ore

Similar concerns exist with the ore brought to surface, as they do for waste rock, and the potential for ML/ARD.

Management Response

The ore stockpiles are located within the Pollution Containment System. Therefore, the water management procedures pertaining to waste rock storage also apply to ore stockpiles.

Any waste rock inadvertently placed in the ore stockpile must be re-directed to the mineralized area of the waste rock storage area.

There are no specific monitoring requirements for the ore stockpile. The seepage and routine monitoring programs also address the monitoring of seepage and runoff from this area.

2.3. Nutrient Release

The majority of waste rock is blasted using a bulk form of ammonium nitrate (AN) and fuel oil (FO) mixture to make the blasting product ANFO. From a blasting perspective, ANFO is only ideally suited for dry hole application. In the event that ANFO is inadvertently loaded into a wet blast hole, an incomplete detonation of the product may occur. Further, spills can occur during loading of the holes. In such instances, residual ANFO in the waste rock and spilled ANFO can potentially be a source of soluble ammonia, nitrate and nitrite. Residual ammonium nitrate may remain in the waste rock and be inadvertently transferred to surface causing nutrient loadings to the receiving environment. The residual ammonia, nitrate and nitrite in the waste rock are highly soluble; they are flushed out of the rock during snowmelt and precipitation events, potentially resulting in short-term release of nutrients to water coming into contact with this material.

Water flows and seepage from waste rock piles are captured in a series of ponds designed to prevent direct discharge of potentially contaminated water to the environment. Discharges from these ponds are to the Tailings Impoundment Area (TIA).

Management Response

Residual ANFO

Any wet holes will be evident at the time of drilling and during the cleaning of each blast hole. The blaster, being responsible for the loading and firing of the holes, begins the loading process by checking the actual depth of each hole and records unusual conditions, such as water in the blast-holes.

In the event a wet hole is encountered, one of two charging methods is employed to ensure complete detonation of the explosives:

- The hole is dewatered using compressed air. This is common on the bottom (lifter) holes in underground mining.
- If the hole cannot be dewatered, or if it is seeping water, the hole will be loaded with an alternative explosive that is effective under wet conditions.

After blasting, the blaster is required by regulations to inspect the blasted area, make note of blast holes that may have experienced incomplete detonation, and mark those locations with paint. Information from the blaster's inspection will be noted in the daily operations shift log and will be communicated to all underground supervision personnel.

Material considered un-detonated or high in ANFO residue, which will contain potentially elevated level of nutrients (primarily ammonia), will be hauled to the mineralized area of the waste rock pile, and will eventually be used as backfill in the mine.

ANFO Spill

To minimize the risk of spills during loading, the loader hose is pushed to the end of the hole and is slowly withdrawn as the ANFO is blown into the hole, thereby filling the hole. Once the end of the loading hose is near the top (collar) of the hole, the loader is stopped to prevent spillage of ANFO.

In the unlikely event that a spill of ANFO occurs during charging of the blast holes, the ANFO will be cleaned-up immediately upon the completion of all loading operations. This material will be hauled to the mineralized area of the waste rock pile, and will eventually be used as backfill in the mine.

The clean-up of the spilled material will be initiated immediately and the material disposed of in accordance with the explosives management program.

2.4. UNDERGROUND BRINE WATER

Water is used as a lubricant for drilling, as a means of cleaning off the face and walls for geological mapping, and for dust suppression in the underground mine. Salt is added to the make-up water to lower the freeze point and thereby keep the water supply lines from freezing. This water is called underground brine water. Any excess brine water that ends up at the mine face is pumped to a settling sump and is recycled for use at the face. However, some of the water is absorbed by the blasted rock, which is hauled to the surface stockpiles.

Excessive use of salt can result in impacts to the structural integrity of infrastructure components arising from ground thaw, increased or alternative requirements for wastewater treatment and disposal, increased challenges associated with waste rock and tailings disposal and stabilization, and limitations on using the waste rock for construction.

TMAC have developed procedures for reducing the concentration and amount of brine that is used in the underground mine, as documented in the "Low Salt Underground Brine Water Use Procedure". A summary of this procedure is presented below. As discussed previously, the *Water Management Plan* provides details on the collection and fate of seepage and runoff from this area.

Management Response

TMAC follows the *Low Salt Underground Brine Water Use Procedure* developed to minimize the amount of calcium chloride use in the mine, and therefore minimize the amount of salt that is entrained in waste rock and ore. The procedure includes:

- locating brine mixing tanks in the mine or within an enclosure to control temperatures, and thereby limit the amount of salt used in the brine;
- using hose nozzle atomizers and/or foggers to reduce the amount of water used for dust suppression; and
- recycling brine water during drilling activities, bolt inflation, and washing activities.

2.5. FUEL AND LUBRICANTS

Any fuel or lubricants spills, including leaks from mobile equipment, have the potential to become mixed with the waste rock, and therefore effect the quality of water entrained in the waste rock. Therefore, prevention and management of spills is particularly important for ensuring that the waste rock can be used for construction activities outside of the pollution containment system.

Management Response

If re-fuelling of mobile equipment is required in the mining or waste deposition areas, it will be conducted at a location and time that will ensure that any spill of fuel or lubricants will be effectively contained and clean-up can be easily accomplished.

Every operator is required to inspect their light or heavy equipment at the beginning of every shift. In the event that leaks are detected, the vehicle will be taken out of service and must be repaired prior to resuming use.

In the unlikely event that a spill occurs during re-fuelling activities, clean-up of the spilled material will be initiated immediately and all activities within the immediate area will be suspended until the clean-up is complete and the material is disposed of in an appropriate manner, as per the requirements specified in the Spill Contingency Plan. Waste rock that has been contaminated with hydrocarbons will be placed in the area designated for storage of mineralized waste rock where it will be eventually used as backfill in the mine.

In accordance with the Spill Contingency Plan, all employees are trained as first responders to spills.

2.6. DUST

Fugitive dust can arise from blasting, haul traffic and end dumping. Fugitive dust poses a potential risk to human and ecological health through both ingestion and deposition.

Management Response

The Air Quality Management Plan outlines procedures for managing fugitive dust including:

- watering traffic surfaces and active end dumping areas;
- controlling vehicle speeds;
- applying approved dust suppressants to high traffic areas.

2.7. GEOTECHNICAL STABILITY

The stability of the waste rock piles is an important consideration for traffic safety and for containment of the waste rock.

The waste rock piles are designed such that the foundation pad extends 2.5 to 3 m beyond the toe of the waste rock pile. The outer edge of the pads also has a safety berm that will prevent any large boulders from rolling off of the pad during construction. The waste rock piles have been designed with slopes of 2H:1V, and will be constructed in lifts, which will result in a configuration that provides a high degree of geotechnical stability. Stability calculations confirm that there are no stability concerns associated with stockpile design.

Management Response

Based on a factor of safety of 1.0, a minimum safe distance from the crest of the waste rock pile (1.2 m) should be maintained for haul trucks dumping waste rock close to the crest of the waste rock pile.

3. MONITORING AND EVALUATION

3.1. ANNUAL INSPECTIONS

Material in the waste rock piles is inspected by the mine geologist on an annual basis. The purpose of the inspection is to confirm that the non-mineralized diabase and the mineralized material is being placed separately. The results of this inspection are discussed with operational staff to ensure there is clarity on the classification and segregation procedures. Results of the inspections are provided in an annual report to the Board.

Annual visual inspections of all pads, berms and containment ponds by TMAC staff are completed to determine if the facilities are operating as designed and to assess maintenance requirements as described in subsequent Modules.

Construction

To use non-mineralized diabase from the underground workings for construction, testing is required to demonstrate that salt, ammonia and metals levels are within acceptable limits. Testing includes field contact tests and shake flask extraction tests to assess the amount of soluble salt, nutrients and metals present in the rock. Samples are collected at a frequency of one sample composite for every 20,000 tonnes of rock. The composites are prepared by mixing a minimum of five - 1 kg samples over an area of 100 square metres, and then sieving to recover the -1 cm size fraction. A – 1 kg split of the -1 cm material is submitted to a commercial testing laboratory for shake flask extraction tests. A portion of the remaining -1 cm material is then further sieved to recover the -2mm fines, and the fines are subjected to field contact tests.

The criteria for using non-mineralized diabase for construction outside of the Pollution Containment System will be as follows:

- ABA test results show sulphur concentrations of less than 0.2%
- Shake Flask Extraction tests show ammonia and metal levels below discharge criteria for the site, as specified in the water licence.
- Shake Flask Extraction tests show chloride levels below 150 mg/L.

Once adequately characterized and confirmed suitable for use, waste rock suitable for construction is delineated. Only then are Construction personnel to load and move the material to areas that have been approved for construction.

Post-Construction

If qualified waste rock is used for construction outside of the water control area, an annual seep survey will be carried out in the first 3 years following construction. This will be completed during the freshet and will be reported to the Board in the annual report. Should the material show evidence of acid runoff, the Board and TMAC will determine the best course of action.

Table 4 Hope Bay Waste Rock and Ore Management Plan and Monitoring Summary

Aspect	Monitoring Activity	Monitoring Type	Data Management and Reporting
Mining Operations, including Waste Rock Deposition and Backfill	Pre-blast inspection by blaster	Identify "wet holes" and clean spilled ANFO	Maintain field notes
	Post-blast inspection by blaster	Confirm there were no misfires	Maintain field notes
	Visual inspection of face and muck pile by mine geologist	Confirm rock types and tag for deposition as appropriate	Maintain field notes. Maintain record for Annual Reporting
	Sampling of underground waste rock by mine geologist	ABA on a minimum of one sample per 10,000 tonnes of rock.	Maintain field notes. Manage data. Assess material for suitability in construction. Report findings in Annual Reporting
	Amount of material mined and placed in mineralized and non-mineralized areas of the pile, amount of material used for construction, and amount of material used for backfill is recorded by the mine engineer.	Material quantities (cubic m and tonnes)	Maintain record for Annual Reporting
	Annual inspections and review of regular monitoring program by mine personnel	Visual inspections	Maintain field notes. Discuss findings with site geologists. Report findings in Annual Report
	Semi-annual seep surveys of underground backfilled stopes by mine geologist and/or Environmental personnel	Visual inspections and seep sampling	Report findings in Annual Report
	Annual seep survey of materials on surface by Environmental personnel	Water samples submitted for pH, total sulphate, total ammonia, nitrate, alkalinity, and metals by ICP-MS	Maintain field notes. Report findings in Annual Report
	Monthly SNP monitoring by Environmental personnel	Water samples submitted for pH, TSS, total ammonia, total sulphate, total CN, total oil and grease, alkalinity, chloride, aluminum, arsenic, copper, iron, lead, nickel and zinc	Maintain field notes. Report findings in Monthly or Annual Reports to NWB as required
Infrastructure Construction and Post-Construction	Amount of non-mineralized rock used for construction, and location of placement tracked by Surface Manager	Material quantities (tonnes)	Maintain records for Annual Reporting
	Geochemical inspections and sampling of infrastructure areas constructed using waste rock by Environmental personnel	As per Quarry Management and Monitoring Plan.	As per Quarry Management and Monitoring Plan.
	Annual seep survey by Environmental personnel	As per Quarry Management and Monitoring Plan.	As per Quarry Management and Monitoring Plan.

3.2. DOCUMENTATION AND REPORTING

All documentation related to waste rock classification, segregation, confirmatory sampling, material hauled from underground, and post-blast and waste rock storage facility inspection records are maintained on site.

Annual reporting required under the water licence will include reporting of waste rock tonnages placed on the designated waste rock storage areas by classification of mineralized and non-mineralized as part of the annual report to the Board. Tonnages both above and returned to underground are tracked and reported. Annual geochemical monitoring and waste rock storage assessment is included in the annual report.

TMAC will combine all other results from the inspections and monitoring programs related to waste rock and quarry rock in an annual "Waste Rock and Quarry Monitoring Report". The monitoring report would be prepared and submitted no later than March 31 of the year following the monitoring activities, and would include all data collected prior to December 31 of the preceding year (i.e., within six months of the collection of samples, as prescribed in the Water License).

This brief factual report will address the requirements specified in the Water Licenses and Quarry Permit Agreements. The report will include, but not necessarily be limited to:

- A summary of the geochemical inspections;
- Results of the seep surveys;
- Results of geochemical sampling and analysis, if any; and
- A summary of all mitigation activities undertaken as a result of monitoring.

4. CONTINGENCIES

Inappropriate Material Identified

In the unlikely event that the results of the seep monitoring program or the confirmatory sampling program indicate the presence of material with an elevated potential for ML/ARD is not segregated correctly, or has been used in construction, further investigations will be undertaken to define the extent and assess the potential impacts of the material. If warranted, and after discussion with the appropriate regulatory agencies, the material will be excavated and hauled to the appropriate location waste rock pile for eventual disposal underground.

PAG Quarry Rock Encountered

In addition to waste rock, it is possible to encounter acid-generating material from quarries. While extensive geochemical characterization and testing occurs and quarry rock is very well understood, the potential to encounter PAG rock remains. To date, none of the quarry monitoring programs or characterization data from the quarry sites has identified PAG rock. The quarry monitoring programs are described in the TMAC *Quarry Management Plan*.

Waste rock pads are designed with sufficient capacity to accommodate any PAG rock from quarries. An extra 10% of the total volume expected from the underground mine is adequate to handle future storage requirements.

5. REFERENCES

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SRK Consulting (Canada) Inc., 2015a. Doris North Project: Expanded Waste Rock Storage Pile (Pad T) Design Brief. Technical Memorandum Prepared for TMAC Resources Ltd. Project Number: 1CT022.001.310. January 2015

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WASTE ROCK AND ORE MANAGEMENT PLAN

MODULE A: 2AM-DOH1323 (DORIS)

CONFORMITY TABLE

Licence Condition	Document Reference
Part D, Items 9, 20, 21	The Quarry Management Plan
Part D, Item 10	Section 5.2 addresses the requirement to provide contingency for storage of PAG rock from the quarries.
Part D, Items 22, 23	Sections 2.1 and 3.1.1 and 3.1.2 provide information on how waste rock would be segregated and tested to confirm that non-mineralized rock from the underground mine would be non-PAG and therefore suitable for construction. The updated plan includes additional restrictions on the levels of soluble ammonia and chloride that would be acceptable in this material, but retains the limitations on sulphur content that were approved in an earlier version of the Plan (SRK 2010). However, it is recognized that these additions may require further approval under the provisions in Part G, Item 15.
Part D, Item 27	Section 2.1 addresses management of water from the waste rock storage areas.
Part G, Item 14	This report addresses the requirement for an updated plan.
Part G, Item 16	Sections 2.1 presents management plans for segregation of mineralized waste rock within Pad T. The Plan assumes that Pad T will be approved as the new Temporary Waste Rock Pad.
Part G, Item 17 Schedule D, Items 1f, 1k and 1n	Section 2.1 and Table 4 address the requirements to report the results of geochemical and seepage monitoring in an annual report.
Part G, Item 18, 19, 20	Section 2.1 addresses how mineralized and non-mineralized waste rock will be segregated, while Sections 3.1 and 3.2 addresses separate storage of these materials.
Part J, Items 12d and e	Table 3, Table 4 and Section 4 addresses the requirement to record quantities of mineralized and non-mineralized waste rock deposited in the piles, and quantities of backfill returned to the mine.
Part K, Item 6	Section 2.1 addresses the requirement to monitor for seepage below the Pollution Control Pond.
Schedule B, Item 3c	Table 3, Table 4 and Section 4 addresses the requirement to record quantities of mineralized and non-mineralized waste rock deposited in the piles, and quantities of backfill returned to the mine.

TABLE OF CONTENTS

A1. INTRODUCTION

The Doris North Waste Rock and Ore Monitoring Plan has been prepared in accordance with Type A Water License No. 2AM-DOH1323. The water license sets out a number of conditions related to the management of waste rock and ore at the Doris North site and is valid until August 15, 2023. All of the terms and conditions set out in the licence have been considered throughout the development of the Plan. The conformity table provides a summary of the terms and conditions that pertain to the waste rock and ore management and also provides a location within the Plan that the condition is addressed (see start of this Module).

A1.1 GEOLOGICAL CONTEXT

The Doris ore deposits consist of a series of gold-bearing quartz veins hosted by Archean age folded and metamorphosed mafic volcanic rocks. There is a large diabase intrusive located in the vicinity of the Doris deposits.

Figure A1 shows the location of the Doris North Mine workings relative to the diabase dyke and the ore veins. The portal is collared in the diabase.

The Doris deposits will be mined using underground mining methods. Under the current mine plan, there is capacity to backfill all of the waste rock in the underground mine. At closure, the backfilled waste rock, including the minor amounts of material with ML/ARD potential will be flooded and/or frozen, which will provide an effective means of controlling ML/ARD.

Doris geochemistry is presented in detail in teh following document:

- *Kinetic Testing of Waste Rock and Ore from the Doris Deposits, Hope Bay*. Report prepared for TMAC Resources Inc. by SRK Consulting (Canada) Inc., June 2015.
- *Kinetic Testing of Waste Rock and Ore from the Doris Deposits, Hope Bay – Supporting Data. Report prepared for Hope Bay Mining Ltd. by SRK Consulting (Canada) Inc., June 2015.*
- *Static Testing and Mineralogical Characterization of Waste Rock and Ore from the Doris Deposit, Hope Bay*. Report prepared for TMAC Resources Inc., May 2015.
- *Static Testing and Mineralogical Characterization of Waste Rock and Ore from the Doris Deposit, Hope Bay – Supporting Data*. Report prepared for TMAC Resources Inc., May 2015.

A1.2 SURFACE FACILITIES

The permitted surface facilities in the camp and mill area are shown in Figure A2.The site is currently divided into a series of adjoining rock pads that provide a foundation for all of the facilities in this area. The existing and future pads on the eastern half of this area (Pads D, F, G, H/J, I, Q and T) are located within the Pollution Containment System, which drains to a Pollution Control Pond at the southern edge of the pad complex and collection sumps located at the southeast corner of the pad area. Pad U has a dedicated PCP as it is located adjacent to the existing Pollution Containment System. Water collected at these locations is discharged to the Tailings Impoundment Area (TIA).

The mill is located on Pad D.

Pads Q, H/J, U and possibly T if needed will be used to stockpile ore prior to milling.

Pad T is current main Temporary Waste Rock Pad. Pads I, F and G have been and may continue to be utilized for temporary waste rock storage.

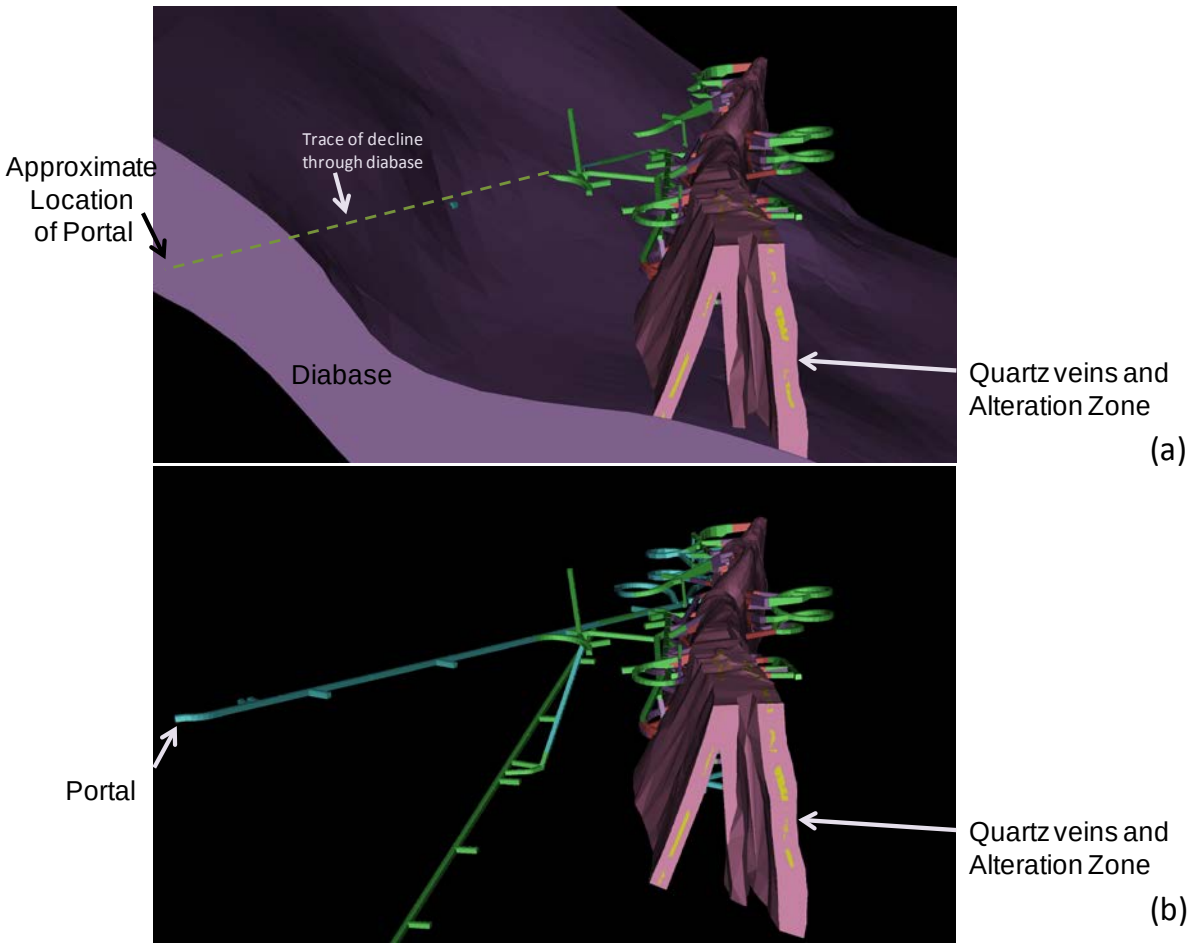

Figure A1 3-D View of the Doris North Deposit and Mine Workings

LEGEND

- New Infrastructure Pads
- Safety Berms

NOTES

1. The co-ordinate system is UTM NAD 83, Zone 13.
2. All dimensions are in metric units, unless specifically mentioned.

0 10 20 30 40 50
Scale in Metres

srk consulting

SRK JOB NO.: 1CT022.002.200.1600

FILE NAME: 1CT022.001_PadU&T Fig 1.dwg

TMAC RESOURCES

Hope Bay Project

Waste Rock & Ore Management Plan

General Arrangement

DATE:	APPROVED:	FIGURE:
June 2015	LW	1

C:\01_SITES\Hope Bay\Doris North\Pad T\1CT022.001_PadU&T Fig 1.dwg

A1.3 Overview of Previous Doris North Underground Development

In 2010 and 2011, approximately 2,670 m of lateral and 76 m of vertical underground development were completed at the Doris North Mine by Hope Bay Mining Ltd. (HBML). This development resulted in production of approximately 189,000 t of waste rock, including 86% non-mineralized and 14% mineralized waste rock. Additionally, 329 m of ore development occurred resulting in the production of 9,400 t of ore.

Throughout this period, HBML placed the rock according to the approved interim management plans described in Revision 01 of the Waste Rock Management Plan (SRK 2010a), which included segregation of mineralized and non-mineralized waste rock within the footprint of the Temporary Waste Rock Pad (on Pad I; Pads F and G were temporarily used as laydown areas), and placement of ore on Pads Q and H/J (2).

No underground development occurred during 2012-2014.

Access to Pad T for waste rock storage is scheduled for 2015.

A1.4 Mine Development Plans

Access is provided via the Doris North Portal situated to the east of the mill area, an approximately 1,800 metre long decline tunnel, and then a series of tunnels, cross cuts and spiral ramps that provide access to the ore. The ore is extracted by both long-hole and cut and fill methods from a series of stopes that follow the gold-bearing quartz veins.

The current production schedule showing production rates for waste rock and ore, backfill rates for waste rock, and requirements for waste rock storage over time is provided in Table 1. As shown, the majority of the waste rock will be produced during the initial years of mining. Once the mill is operating, the rate of ore production and backfill rates will increase, and there will be relatively low volumes of new waste rock produced. As with any mine plan, these production volumes may change in response to changing conditions in the underground mine.

Table A1 Current mine development plan

Mining Year	Calendar Year	Material (tonnes)					
		Doris Hinge and North			Connector and Central		
		Ore Mined	Waste Rock On Surface3	Ore Processed	Ore Mined	Waste Rock On Surface3	Ore Processed
-6	2011	9,400	183,000				
-21	2015		220,000				
-1	2016	160,000	220,000				
1	2017	410,000	290,000	365,000			
2	2018			214,400	530,000	470,000	150,600
3	2019				730,000	140,000	730,000
4	2020				460,000		730,000
52	2021				15,000		124,400

WASTE ROCK AND ORE MANAGEMENT PLAN

MODULE B: 2BB-XXXX (MADRID)