

## Appendix V3-3B

Hope Bay Project: Roberts Bay Cargo Dock  
Preliminary Design



## Memo

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<b>To:</b>	John Roberts, PEng, Vice President Environment	<b>Client:</b>	TMAC Resources Inc.
<b>From:</b>	Kaitlyn Kooy, EIT	<b>Project No:</b>	1CT022.004
<b>Reviewed By:</b>	Maritz Rykaart, PhD, PEng	<b>Date:</b>	November 28, 2016
<b>Subject:</b>	Hope Bay Project: Roberts Bay Cargo Dock Preliminary Design		

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## 1 Introduction

### 1.1 General

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 which is in the environmental assessment 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.

All equipment and supplies needed to support the Project are transported to the site via the annual sealift during the short open water season in the late summer. The existing Roberts Bay jetty is not designed to accommodate the medium-draft cargo vessels that are required to meet the fuel and equipment needs of the expanded project. The proposed Roberts Bay cargo dock will allow cargo vessels to dock and offload cargo more easily and safely.

### 1.2 Objective

This memo provides the preliminary design details for the Roberts Bay cargo dock. Design of the cargo dock access road is provided in SRK (2016b).

## 2 Design Concept

### 2.1 Approach

The overall design concepts for the Roberts Bay cargo dock is based on previous work performed by SRK as part of the Roberts Bay Jetty design (SRK 2007) and the alternatives assessment carried out by PND Engineers Inc. (PND 2012). The cargo dock will be designed to minimize the

footprint and disturbance to the environment. The cargo dock will become the main port where cargo is unloaded.

## **2.2 Components**

The Roberts Bay cargo dock will consist of the cargo dock and causeway. The cargo dock is the marine structure at which cargo vessels will berth and the causeway will connect the dock to the access road on land.

## **2.3 Topographic Data**

Design of the Roberts Bay cargo dock and access road is based on topographic contour maps with 1.0 m vertical resolution, (PhotoSat 2012), and bathymetry data with 1.0 m resolution (Golder 2006). The topographic contour maps were produced from 2012 satellite imagery and bathymetry was produced from bathymetric surveys using Sidescan sonar. Detailed ground surveys have not been completed.

## **2.4 Foundation Conditions**

The offshore overburden in Roberts Bay appear to be of similar origin to those in the rest of the Hope Bay Belt. The bay is characterized by deep low-strength sediments of up to 20 m deep. Typically submarine permafrost is often present in areas of the bay with an average water depth of 1 m. Submarine permafrost is not expected in deep water. For more details on the foundation conditions refer to SRK (2016a).

The Roberts Bay coast consists of a large area of exposed bedrock. The most prevalent rock type on site with surface exposure is mafic volcanics, predominantly basalt. Permafrost soils are comprised 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 on average ranging from 10 to 30% by volume, but occasionally as high as 50%. The till typically contains low to moderate ice contents ranging from 5 to 25%.

## **2.5 Environmental Setbacks**

The following environmental setbacks have been applied when selecting the location of the cargo dock:

- Minimum 30 m buffer zone from known rare plants; and
- Minimum 30 m buffer zone from known archeological sites.

While priority was given to avoid these areas, in some cases the minimum buffer around archeological sites could not be maintained. In these instances, the archeological site will be mitigated in accordance with the Heritage Resources Management Plan.

## 3 Alternatives

### 3.1 Dock Type

An alternatives assessment for dock type was carried out in 2012 (PND 2012). Two of the dock types evaluated in 2012, as well as extending the existing jetty were considered for the current Project. A summary of each type of dock is summarized in Table 3.1.

**Table 3.1: Berth Structure Type Summary**

Alternative	Details
Existing Jetty Extension	Extension of the existing jetty to increase the water depth to allow larger vessels to berth.
Barge Dock	Designed to berth shallow-draft barges. Requires a minimum water depth of 5.5 m. The existing jetty is this type of structure, so construction of an additional barge dock would not greatly improve shipping logistics.
Cargo Dock	Designed to berth medium-draft cargo vessels and large ocean-going barges. Requires a minimum water depth of 9 m.

The cargo dock option was the chosen alternative as it provides the most versatility and allows vessels to unload more safely.

### 3.2 Dock Location

Four different locations of the cargo dock were considered as part of the alternatives assessment carried out in 2012 (PND 2012). No additional locations were considered in this assessment. The cargo dock options are described in Table 3.2 and are shown in Figure 1 (Attachment 1).

**Table 3.2: Alternative Cargo Dock Locations**

Alternative	Details
C1	Located approximately 3 km northwest of the existing Roberts Bay jetty. The water is deep and very near the shore reducing the length of the dock required to meet the minimum depth design criteria.
C2	Located approximately 2 km northwest of the existing Roberts Bay jetty. The water is deep and very near the shore reducing the length of the dock required to meet the minimum depth design criteria.
C3	Located approximately 1.5 km northwest of the existing Roberts Bay jetty. The water is much shallower at this location which requires the dock to be longer to reach the necessary minimum water depth.
C4	Located approximately 1 km northwest of the existing Roberts Bay jetty. The water is much shallower at this location which requires the dock to be longer to reach the necessary minimum water depth. This alternative interferes with the Roberts Bay discharge system.

Location C2 was selected as the preferred location as it requires the least amount of fill to construct the dock, has a relatively short access road, and does not interfere with any other planned infrastructure at Roberts Bay.

## 4 Design

### 4.1 Design Criteria

The design criteria for the Roberts Bay cargo dock are listed below. These design criteria were developed by PND (2012).

- The design vessel for the cargo dock is a general cargo vessel with an overall length of 138.1 m, a breadth of 21.0 m, a draft of 8.0 m, and a deadweight tonnage of 12,744 tonnes;
- The approach channel width will be a minimum of four times the breadth of the design vessel;
- The under keel clearance will be 15% of the design vessel draft while maneuvering and 10% of the design vessel draft while in the berth.
- The turning basin will not be less than 2.5 times the overall length of the design vessel;
- The breasting face length of the cargo dock will be a minimum of 0.4 times the overall length of the design vessel;
- There will be four mooring fixtures: two interior breasting lines and two outer mooring lines at approximately 45° at the bow and stern;
- The dock will withstand the maximum forces generated by the design vessel under action of the most severe wind, waves, and current; and
- The cargo dock will have a minimum factor of safety of 1.6.

### 4.2 Design

The overall cargo dock will have an overall length of 110 m and a total draft depth of 9. The dock will consist of a 70 m long causeway and 40 long, 120 m wide dock face. The total footprint of the cargo dock is approximately 3,850 m<sup>2</sup>.

The cargo dock will have a vertical face, extending 2 m above the normal highwater mark with a scalloped appearance. The cargo dock will consist of a series of interlocking extruded sheet piles that are driven to bedrock and tied back with anchor sheet piles into a mechanically stabilized embankment (MSE). The vertical face sheets are restrained by the tailwall anchor sheet piles that extend into the MSE approximately every 9 m (PND 2012). The MSE will be made up of transition material and covered with 0.15 m of surfacing material.

The causeway will be constructed with run-of-quarry (ROQ) material and armoured with rip rap on either side. The driving surface will be covered with 0.15 m of surfacing material. The causeway will be underlain with geogrid to prevent embedment of the marine sediments in the ROQ. Fill thickness will vary based on the depth to the ocean floor. The causeway slopes into the water will be protected with a minimum of 1 m of rip rap.

Preliminary design drawings for the cargo dock is provided in Drawings CDR-01 and CDR-02 (Attachment 1).

## 5 Construction

All construction fill materials will be obtained from geochemically suitable permitted quarries or geochemically suitable run-of-mine rock. Management and monitoring of these quarries will be according to the quarry monitoring plan which will be submitted under another cover. Surfacing (32 mm minus) and transition (150 mm minus) materials will be produced at an on-site crusher located within a quarry. The estimated construction quantities are provided in Drawing CDR-03 (Attachment 1).

Based on previous surface infrastructure construction on the Project, it is assumed that the construction fleet will consist of CAT 730 haul trucks, CAT 773 haul trucks, CAT D8 dozers, CAT C330 excavator(s), CAT CS563 compactor and a crusher. A vibratory hammer and barge will be required for the installation of the sheet piles.

Prior to construction, a silt curtain should be installed surrounding the cargo dock and remain in place throughout construction. At no time will disturbance of the tundra vegetation or soils be allowed outside of the infrastructure footprint, and no permafrost disturbance will be allowed. Surfacing material and rip rap will not be placed until the transition material or ROQ material layer is at design grade and level. All construction should be performed in accordance with the technical specifications (SRK 2011).

The sheet piles will be installed with a vibratory hammer either from a barge or onshore crane. The cells will be filled by trucks end-dumping from land. While removal of the weak marine sediments is not required prior to construction, removal of obstructions from the sheet pile footprint may be required before the piles are driven.

The cargo dock should be constructed in the open water season (PND 2012). Summer construction will require careful screening of the shoreline for nesting birds, and modifications to the construction schedule may be required to avoid disturbing nesting populations.

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The opinions expressed in this report have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information, except to the extent that SRK was hired to verify the data.

## 6 References

Golder Associates Ltd. 2006. Sidescan Sonar Bathymetry Data prepared for Hope Bay Miramar Ltd.

Photosat. 2012. Digital Elevation Map Data prepared for Hope Bay Mining Ltd. Received on January 12, 2012.

PND Engineers Inc. 2012. Port Facilities Alternatives Assessment, Hope Bay Project Phase 2, Memo prepared for SRK Consulting, August 2012.

SRK Consulting (Canada) Inc. 2007. Design of the Surface Infrastructure Components, Doris North Project, Hope Bay, Nunavut, Canada. Report prepared for Miramar Hope Bay Ltd. Project No.: 1CM014.008.420. March 2007.

SRK Consulting (Canada) Inc. 2011. Technical Specifications Earthworks and Geotechnical Engineering, Hope Bay Project Nunavut, Canada, Revision G – Issued for Construction. Report Prepared for Hope Bay Mining Limited. Project No.: 1CH008.033. March 2011.

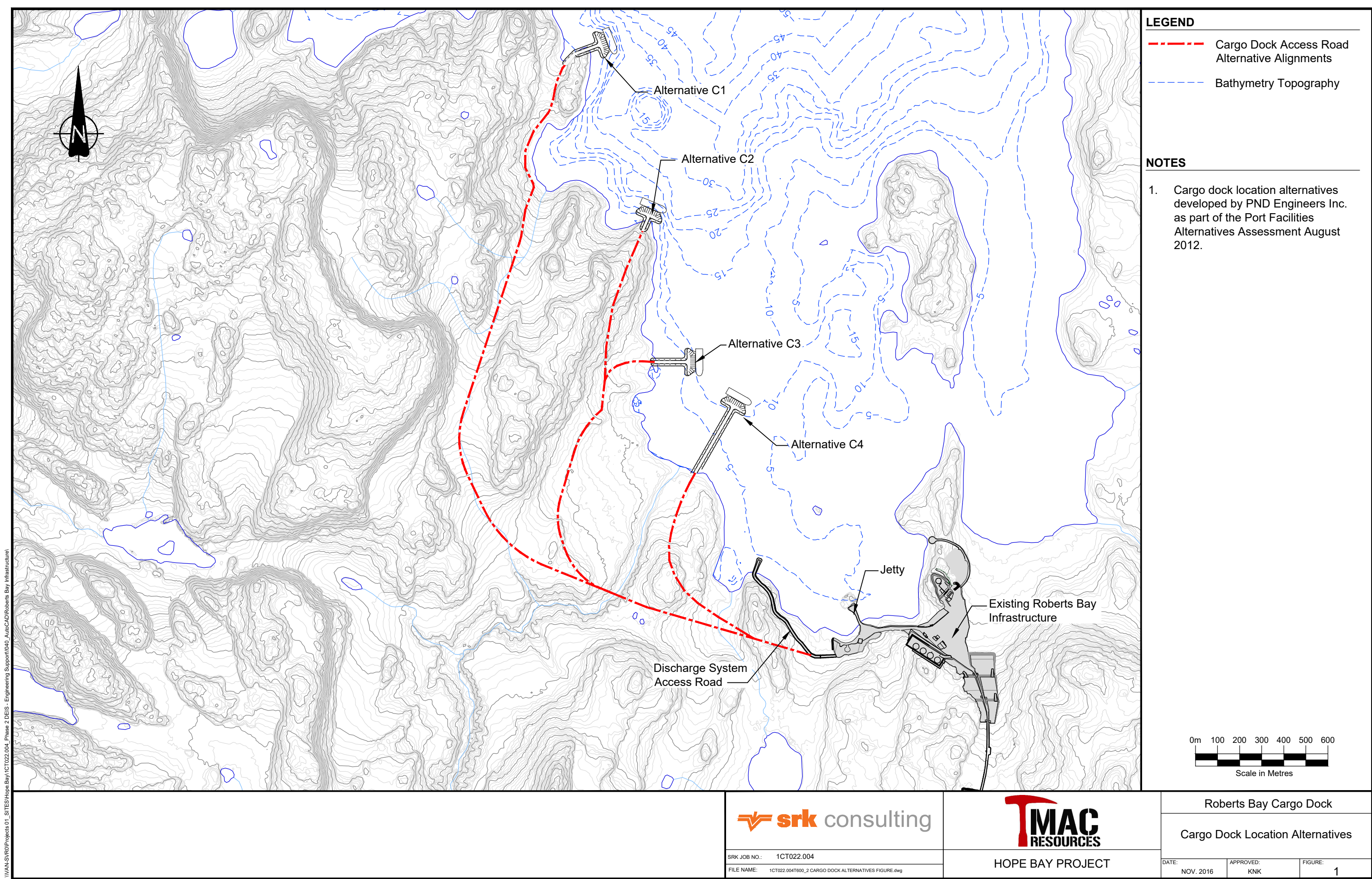
SRK Consulting (Canada) Inc. 2016a. Hope Bay Project, Geotechnical Design Parameters and Overburden Summary Report. Report prepared for TMAC Resources Inc. Project No.: 1CT022.004. 2016.

SRK Consulting (Canada) Inc. 2016b. Hope Bay Project, Roberts Bay Cargo Dock Access Road Preliminary Design. Memo prepared for TMAC Resources Inc. Project No.: 1CT022.004. 2016.

Figure

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Attachment 1:  
Engineering Drawings for the Roberts Bay Cargo Dock

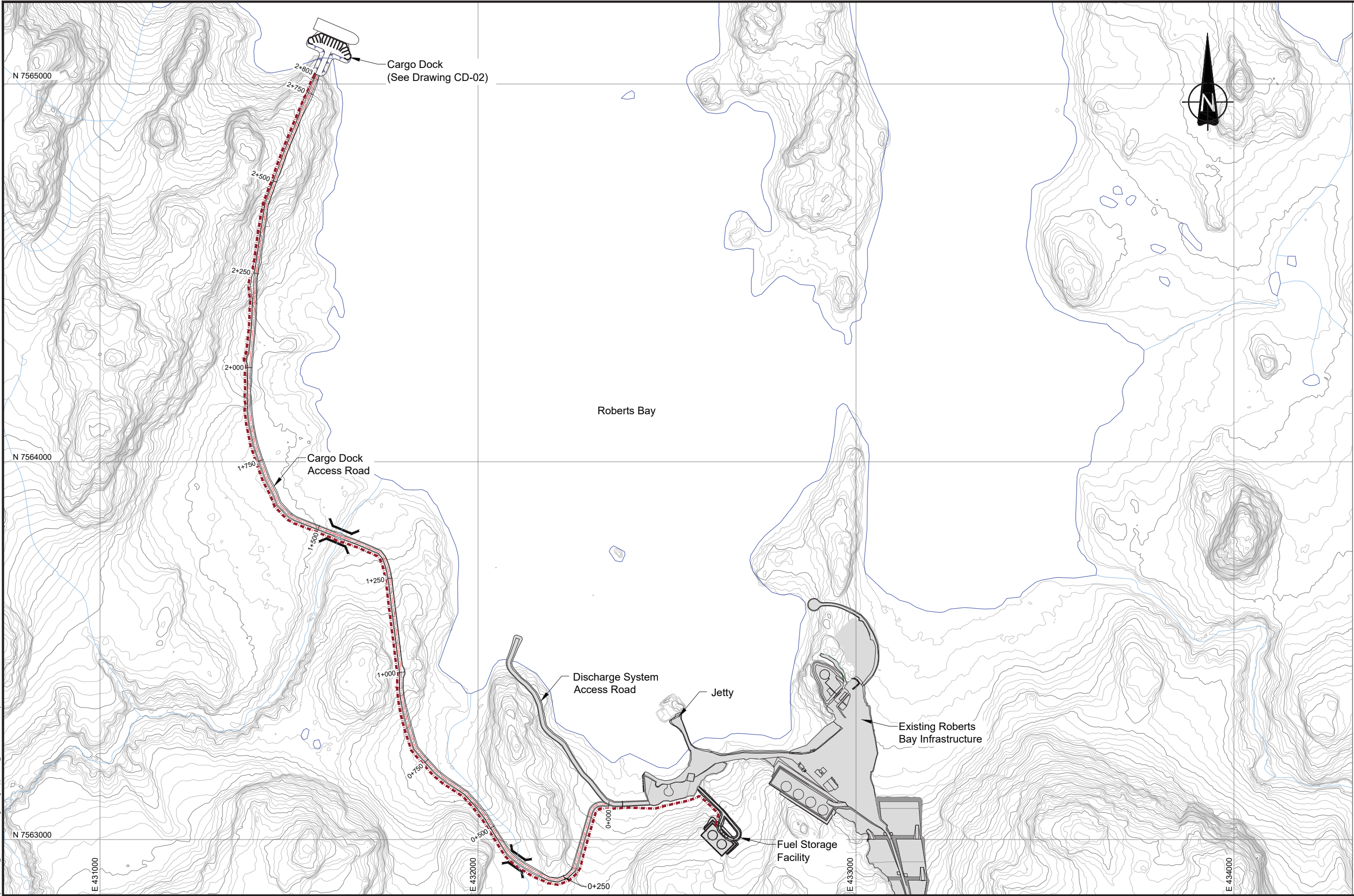
# Engineering Drawings for the Roberts Bay Cargo Dock Hope Bay Project, Nunavut, Canada

ACTIVE DRAWING STATUS

DWG NUMBER	DRAWING TITLE	REVISION	DATE	STATUS
CD-00	Engineering Drawings for the Roberts Bay Cargo Dock Hope Bay Project, Nunavut, Canada	A	Nov. 25, 2016	Issued for Discussion
CD-01	Cargo Dock General Arrangement	A	Nov. 25, 2016	Issued for Discussion
CD-02	Cargo Dock Plan and Sections	A	Nov. 25, 2016	Issued for Discussion
CD-03	Material List and Quantity Estimates	A	Nov. 25, 2016	Issued for Discussion



PROJECT NO: 1CT022.004  
Revision A  
Nov. 25, 2016  
Drawing CD-00

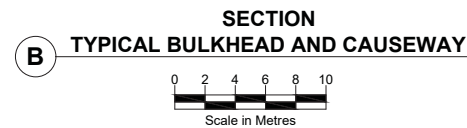
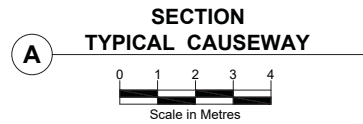
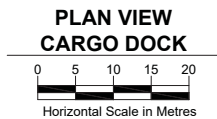


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



- Road Centerline
- Turnout Location
- Crossing Location
- Fuel Pipeline

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## LEGEND

	Surfacing Material
	Transition Material
	Run of Quarry Material
	Filter Rock
	Rip Rap
	Non-woven Geotextile
	Geogrid
	Bathymetry Topo

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DRAWING NO.	DRAWING TITLE	DRAWING NO.	DRAWING TITLE	A NO.	Issued for Discussion DESCRIPTION	KNK CHK'D	EMR APP'D	25NOV16 DATE	
REFERENCE DRAWINGS					REVISIONS				

						Roberts Bay Cargo Dock		
	DESIGN: KNK    DRAWN: MDDS    REVIEWED: KNK CHECKED: KNK    APPROVED: EMR    DATE: Nov. 2016			HOPE BAY PROJECT		DRAWING TITLE:		
	PROFESSIONAL ENGINEERS STAMP    FILE NAME: 1CT022.004T600_2-CD-02.dwg					Cargo Dock Plan and Sections		
	SRK JOB NO.: 1CT022.004			DRAWING NO.		CD-02	SHEET 3 OF 4	REVISION NO. A

## Materials List and Quantity Estimates

Item	Quantity / Area / Volume		Description
1. Run of Quarry Material	Cargo Dock:	6,900m <sup>3</sup>	- no allowance has been made for losses and/or marine sediment embedment) -Approximate In-place Neat-Line Volume
2. Transition Material	Cargo Dock:	28,900m <sup>3</sup>	- no allowance has been made for losses and/or marine sediment embedment) -Approximate In-place Neat-Line Volume
3. Surfacing Material	Cargo Dock:	730m <sup>3</sup>	- no allowance has been made for losses and/or marine sediment embedment) -Approximate In-place Neat-Line Volume
4. Rip Rap	Cargo Dock:	5,000m <sup>3</sup>	- no allowance has been made for losses and/or marine sediment embedment) -Approximate In-place Neat-Line Volume
5. Filter Rock	Cargo Dock:	350m <sup>3</sup>	- no allowance has been made for losses and/or marine sediment embedment) -Approximate In-place Neat-Line Volume
6. Geogrid	Cargo Dock:	1,900m <sup>2</sup>	- Based on 3D Surface Area
7. Geotextile	Cargo Dock:	3,200m <sup>2</sup>	- Based on 3D Surface Area
8. Sheet Piles	Cargo Dock:	13,000m <sup>2</sup>	

[illegible]