IR Responses
Phase 2 Proposal – Mary River Project

Baffinland Iron Mines Corporation
Mary River Project
NIRB File No. 08MN053



TABLE OF CONTENTS

Government of Nunavut **1**
The Qikiqtani Inuit Association **41**
Crown-Indigenous Relations and Northern Affairs Canada **55**
Fisheries and Oceans Canada **59**
Natural Resources Canada **61**
Environment and Climate Change Canada **62**
Health Canada **65**
Parks Canada Agency **66**
Oceans North **68**
World Wildlife Fund **71**

LIST OF ATTACHMENTS

Appendix 1 Government of Nunavut IR Attachments
GN 06 Attachment 1: Typical Cross Section for Caribou Crossing
GN 10 Attachment 1: Climate and Wind Data Summary
GN 10 Attachment 2: Dust Fall Monitoring Program
GN 10 Attachment 3: Detailed Summary of 2017 Continuous Ambient Air Quality Monitoring Results at the Mary River Mine Site and the Milne Inlet Port Site
GN 44 Attachment 1: Figures
GN 46 Attachment 1: List of Assumptions
GN 46 Attachment 2: Tables
GN 49 Attachment 1: Figure 1. The extent of the PDA encompassed by caribou walk paths (lines joining consecutive collar locations that are ≥ 11 hours apart) showing the PDA, mapped trails and movement identified by Inuit Qaujimajatuqangit
GN 55 Attachment 1: Table 1 - Soil and Chemical Characteristics Affecting Oral Bioavailability of Metals
GN 56 Attachment 1: Figures
GN 68 Attachment 1: Full Response to GN 68
GN 73 Attachment 1: Summary of Ship Track Data 2017-2018
GN 76 Attachment 1: Table 1: Project Training Programs Offered in 2017
GN 76 Attachment 2: Table 2: Project Training Programs Offered in Q1-Q3 2018
GN 81 Attachment 1: FEIS Appendix 6A

Appendix 2 The Qikiqtani Inuit Association IR Attachments
QIA 12 Attachment 1: Summary of Planned Engagement Activities for 2018 and 2019 Related to the Phase 2 Proposal
QIA 21 Attachment 1: Typical Cross Section for Caribou Crossing
QIA 86 Attachment 01: Full Response

QIA 90 Attachment 01: Full Response

Appendix 3 CIRNAC IR Attachments

CIRNAC 10 Attachment 1: Appendix 6B-3 Geochemical Evaluation of Railway Quarry Materials
CIRNAC 10 Attachment 2: Geotechnical Investigations - Acid Rock Drainage Assessment
CIRNAC 10 Attachment 3: Trucking Feasibility Study Interim ML/ARD Assessment of Tote Road Quarry and Borrow Pit Samples Rev1 – Issued for DEIS

Appendix 4 DFO IR Attachments

DFO 3.1.1 Attachment 1: List of Stream Crossings (Culverts), Bridges, Cuts/Diversions, and Lake/Pond Encroachments/Infills Along the North Rail Alignment and Tote Road Realignment and Fish Habitat Summary

Appendix 5 ECCC IR Attachments

ECCC WL 02: Attachment 1: Mine Site Layout and MDMER/Water Licence Monitoring Locations

Appendix 6 Health Canada

There are no attachments identified for this group of responses, at this time

Appendix 7 Natural Resources Canada

There are no attachments identified for this group of responses, at this time.

Appendix 8 Parks Canada Agency IR Attachments

There are no attachments identified for this group of responses, at this time

Appendix 9 Oceans North

There are no attachments identified for this group of responses, at this time

Appendix 10 World Wildlife Fund IR Attachments

WWF 04 Attachment 1: Tables
WWF 05 Attachment 1: Fuel Spill Modelling: Northern Shipping Route Open Water Season

Appendix 11 Commitment Register

Appendix 12 Overview of Marine Operations

Appendix 13 Updated Labour Market ANALYSIS

Appendix 14 Tote Road Earthworks Execution Plan

Appendix 15 Memo: Truck transportation of Ore (6 Mtpa)

GOVERNMENT OF NUNAVUT

ID1	Info Request	Response	Attachment
GN 01	Provide the following information: 1. Clarification whether the collector lines will be overhead or buried. 2. Information on the design option(s) being considered for potential overhead collector lines including height above ground, number and diameter of lines, and design and spacing of support structures (i.e. towers, posts). 3. Additional information regarding estimated lengths of collector lines and access roads that will be required, including explanation of the apparent discrepancy between Table 1 and figure 2.1. 4. Clarification about whether collector lines will run parallel to the turbine access road and the Tote Road. 5. Clarification about whether the estimates of total length of collector line include the length of lines that may parallel the Tote Road. 6. Available information on range over which the turbines will be visible from surrounding land.	Technical and financial feasibility studies are ongoing. Specific design parameters will be developed at the preliminary engineering phase. Specific locations and lengths of collector lines, number of poles, and placement above and/or below ground will depend on site-specific factors and will also be assessed during preliminary design work, but fully determined at detailed design in consultation with turbine vendor.	
GN 02	Provide the following information: 1. The proponent should summarize data on public use of the Tote Road since its construction up to the present, including summaries for data on public use collected via; (a) Baffinland's Hunter and Visitor Site Access Procedure; and (b) Incidental observations made by Project personnel along the road. Please summarize the data by year and season. 2. Please provide an assessment of the potential for public access of the Tote Road during the Phase 2 project to increase and whether this could become an important pathway to future effects; providing references to any available evidence to support this. 3. Please provide an assessment on the effects of the potential hunting pressure increase on north Baffin caribou due to enhanced public access via the Tote Road.	1. The Tote Road is a public access road that pre-exists the current Project, and Baffinland did not track public use of the Project area, including the Tote Road, prior to 2013. Baffinland tracks the number of land use visitor 'person-days' at Project sites. Because groups of individuals may travel together and/or use Project sites over multiple days, person-days are useful for calculating the extent of site visitations in a year (i.e. one person-day is equal to one person visiting a site during one day, while ten person-days could equal one person visiting a site for ten days or five people visiting a site for two days). Baffinland maintains a Hunter and Visitor Access Log to track land use parties that pass through or use Project areas. Table 9-1 in Baffinland's 2017 Annual Socio-economic Monitoring Report (Appendix B to TSD 25 Socio-Economic Assessment) presents the number of recorded land use visitor person-days at Project sites from 2013 to 2017. **Table 9-1: Number of recorded land use visitor person-days at Project sites (2013 to 2017)** **Number of Recorded Land Use Visitor Person-Days at Project Sites** Year / Mary River / Milne Port / Total 2013 / 41 / 0 / 41 2014 / 14 / 57 / 71 2015 / 4 / 212 / 216 2016 / 15 / 278 / 293 2017 / 26 / 128 / 154 Source: Baffinland Notes: This table only includes recorded land use visitors at selected Project sites; as such, it may underestimate the total number of land users accessing all Project sites. 2. Public use of the land is expected to continue and is not prohibited or managed by Baffinland, other than Baffinland providing land users safe transport on the public Tote Road. Land use is a potential and important pathway to multiple effects associated with a human presence on the landscape. It is unclear what the Government of Nunavut is requesting of literature to support that supposition. The Tote Road alignment will remain unchanged from what has already been reviewed and approved for the Approved Project. Some upgrades and minor realignments will be required to facilitate railway crossings. There is nothing to suggest that those minor adjustments would result in changes to public access that have not already been assessed.	

ID1	Info Request	Response	Attachment
		3. Public access is not enhanced on the public Tote Road as a result of the Phase 2 Proposal. The Tote Road is not planned to connect to a community. Regardless, Inuit have inherent rights to use the land as defined under the Nunavut Agreement, and that includes the right to harvest wherever they choose (and as permissible under the Nunavut Wildlife Act). Baffinland will not assess the potential impacts of access to harvest by Inuit in the Project area and will not restrict harvest except where directed by the Nunavut Wildlife Act (e.g., no discharge of firearms across roads or near settlements), or for other legislated or operational safety considerations. Harvest of caribou and other resources is managed by the Government of Nunavut and their co-management partners. For Baffin Island caribou, a quota system is in place (Government of Nunavut, Department of Environment 2015) regardless of public access to the land. Given the mandate for the Government of Nunavut to manage harvest, there is no project-related effect of potential hunting pressure on north Baffin caribou due to public access to the land. References Government of Nunavut, Department of Environment. 2015. Limited caribou harvest allowed on Baffin Island | Government of Nunavut. (http://www.gov.nu.ca/environment/news/limited-caribou-harvest-allowed-baffin-island). Accessed July 6, 2017	
GN 03	Provide the following information: 1. In light of inconsistencies identified above, the Proponent should accurately confirm the schedule for construction and commissioning of the north railway, ore production increases and increases in truck traffic on the Tote Road. 2. The Proponent should identify if the production increase from 4.2 to 12 Mtpa (or from 6 to 12 Mtpa) is contingent on operation of the north railway. If construction and operation of the railway is delayed, will the scheduled increases in ore production and Tote Road trucking be similarly delayed such that the timing of these three components relative to one another remains the same as that proposed in the FEIS addendum? 3. What contingency plans have been considered for potential delays associated with railway construction and operation in terms of managing mine production levels, Tote Road traffic levels and environmental monitoring? 4. Considering the current schedule and potential for delays in north railway commissioning, what is the maximum period of time over which the Proponent would use the Tote	1. Presuming approval of the Phase 2 Proposal in the summer of 2019, construction and commissioning of the north railway will occur from 2019 to 2021. Ore production increases and increases to traffic on the Tote Road will occur in 2019 and 2021 as per Appendix C of TSD 2 (Project Description). 2. Increasing production is contingent on the north railway because of the economic and technical efficiencies of this mode of transportation. The Alternatives Analysis (TSD 1) Section 3.4 describes the benefits of operation of the rail over trucking for increased production. Scheduled increases in ore production and Tote Road trucking are linked to the construction of the north railway. Delays in the construction of the railway would result in similar delays to these increases, and the timing of these components relative to one another would remain the same as described in the FEIS Addendum. If unanticipated delays to construction occur, Baffinland would consider all options available to it to increase production in a safe and sustainable method. Please refer to Appendix 15, which describes how trucking of 6 Mtpa has been considered within the Phase 2 Proposal, and will be required through part of the construction period. 3. Increases in ore production and Tote Road traffic levels are linked to the milestones for operation of the north railway. If potential delays are experienced, ore production will be continued at a rate that can be supported by trucking along the Tote Road. Environmental monitoring will be completed as required in Baffinland's applicable management plans irrespective of any delays in the north railway. 4. The current schedule for Phase 2 construction runs from 2019 to 2021. Unanticipated delays may accordingly extend the use of the Tote Road, however as described in TSD 1 (Alternatives Analysis), use of the Tote Road is a less efficient means of ore transportation.	Appendix 15: Memo: Truck Transportation of Ore (6 Mtpa)
GN 04	Provide the following information: 1. The Proponent should explain how increases in ore production rates of 25% and 160% relative to current levels will require 185% and 470% increases, respectively, in the number of trucking trips daily on the Tote Road. Supporting calculations would be useful. 2. The Proponent should clarify the discrepancy between Table 1-1 and Appendix C with respect to the haul traffic rate necessary to support a production rate of 12 Mtpa. 3. The Proponent should provide a definitive table summarizing Tote Road traffic rates for each phase of the Phase 2 Project with the duration of each phase identified (in years). Traffic rates should be presented as the estimated average number of vehicle transits (i.e. one-way trips) per day as well as the minimum	1. Ore transportation traffic rates presented in the Phase 2 Proposal Key Facts Table in Appendix C of TSD 2 (Project Description) were erroneously labelled as round trips per day and should be total trips per day. The values presented should be 280 and 560 **total** trips per day for production rates of 6 and 12 Mtpa, respectively. These trucking rates were determined through extrapolation of the current trucking rate for 4.62 Mtpa with a 10% increase for operational flexibility. Using these revised numbers, ore production rate increases of 30% (not 25% as stated in the IR) and 160% relative to current rates will require 43% and 185% increases in Tote Road trucking traffic, respectively. 2. Ore transportation traffic rates presented in the Phase 2 Proposal Key Facts Table in Appendix C of TSD 2 (Project Description) were erroneously labelled as round trips per day and should be total trips per day. The values presented	

<table>
<tr><th>ID1</th><th>Info Request</th><th>Response</th><th>Attachment</th></tr>
<tr>
<td></td>
<td>and maximum daily rates that are planned or conceivably possible. Please include separate or pooled rates for haul trucks, operations, maintenance, freight/fuel hauling and construction activities. Where pooled rates are provided please indicate the type of traffic they include. For reference, please provide a similar table to that summarizing the current Tote Road traffic (2016-2017).

4. The Proponent should clarify whether the daily pattern of flow for traffic on the road will be characterized by a constant 24-hour flow or by distinct peaks and troughs.

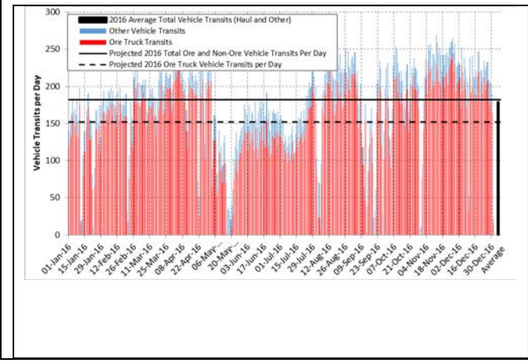
5. The Proponent should clarify whether traffic flow will exhibit any planned or potential seasonal variation, describing and estimating any variation that exceeds the estimated average traffic rates by greater than “>” 20%.

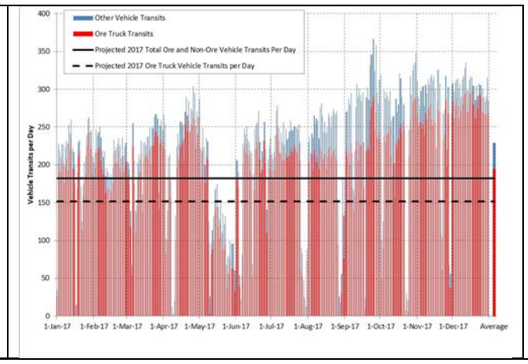
6. The Proponent should revise all relevant Project documents to present a consistent description of the proposed ore transportation by the North Railway and trucking to ore transfer facility at km 57.

7. The Proponent should describe in detail the proposed ore transfer facility at km 57.</td>
<td>should be 280 and 560 total trips per day for production rates of 6 and 12 Mtpa, respectively. This is equivalent to the haul traffic rate presented in TSD 2 Table 1-1 for 12 Mtpa (280 round trips per day which is 560 total trips per day)

3. Minimum daily rates of 0 Tote Road trips per day are possible during inclement weather or maintenance works. Estimated average trips per day during the Phase 2 construction and operation periods are presented in the Phase 2 Proposal Key Facts Table, Appendix C of TSD 2 (Project Description). The estimated traffic rate for other vehicle transits (not including ore trucks) is 250 trips/week as shown in the Phase 2 Proposal Key Facts Table, which corresponds to an average daily rate of 36 trips/day. Maximum trips/day for these periods have been estimated based on the ratio of maximum trips/day to average trips/day recorded for the current operation in 2017.
Average and maximum trips/day for the current operation are presented in the Baffinland Iron Mines 2017 Annual Report to the Nunavut Impact Review Board, March 2018.

<table>
<tr><th></th><th>Current Operations (2017)</th><th>Phase 2 Construction Pre-Rail Operation 2019-2020 (2 years)</th><th>Phase 2 Construction with Rail Operation 2021 (1 year)</th><th>Phase 2 Operation 2022-2035 (14 years)</th></tr>
<tr><td>Ore Haul Trucks</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Minimum Trips/Day</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Average Trips/Day</td><td>196</td><td>280</td><td>560</td><td>0</td></tr>
<tr><td>Maximum Trips/Day</td><td>244</td><td>349</td><td>697</td><td>0</td></tr>
<tr><td>Other Vehicle Transits (Operations, Maintenance, Freight, Fuel, Personnel)</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Minimum Trips/Day</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Average Trips/Day</td><td>32.3</td><td>36</td><td>36</td><td>36</td></tr>
<tr><td>Maximum Trips/Day</td><td>43</td><td>50</td><td>50</td><td>50</td></tr>
<tr><td>Phase 2 Railway Construction</td><td colspan="4">Use of Tote Road localized around construction points for railway from 2019-2021</td></tr>
</table>

4. Traffic flow on the Tote Road in 2016 and 2017 was provided in the Baffinland Iron Mines Annual Reports to the Nunavut Impact Review Board for 2016 and 2017 and are reproduced below as Figure 1 and 2, respectively. The main seasonal variation that has been observed is a reduction in traffic of approximately 25-50% during the freshet period. During this time, freshet and warmer weather have a significant negative effect on the condition of the Tote Road which necessitates extra maintenance and reduces the amount of traffic that can transit along the Tote Road.
 


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<tr><th>ID1</th><th>Info Request</th><th>Response</th><th>Attachment</th></tr>
<tr><td></td><td></td><td>5. Based on operational experience potential seasonal variation is expected for Tote Road traffic as per described in 4 above.

6. The proposed layout of the temporary ore transfer facility at km 57 is presented in TSD 2 (Project Description) Appendix D, Attachment 6.8. The ore storage capacity at the facility was sized to match what will be constructed at the rail loading facility at the mine site, as the loading operations will be similar at the mine site and temporary ore transfer facility.

7. The proposed layout of the temporary ore transfer facility at km 57 is presented in TSD 2 (Project Description) Appendix D, Attachment 6.8.</td><td></td></tr>
<tr><td>GN 05</td><td>Provide the following information:
1. Please address the issues highlighted in the “Importance to Review and Supporting Rationale” section of this Information Request #5 regarding train traffic rates presented in Table 1-1 and Appendix C including any inconsistencies.

2. Please provide a definitive table summarizing rail traffic rates for each phase of the Phase 2 Project with the duration of each phase identified (in years). Traffic rates should be presented as the estimated average number of train transits (i.e. one-way trips) per day as well as the minimum and maximum daily rates that are planned or conceivably possible. Please include separate or pooled rates for ore shipment, inspection/maintenance, snow management, freight/fuel hauling and construction activities. Where pooled rates are provided please indicate the type of traffic they include.

3. Please clarify whether the daily pattern of flow for traffic on the north railway will be characterized by a constant 24-hour flow or by distinct peaks and troughs.

4. Please clarify whether train traffic flow will exhibit any planned or potential seasonal variation (for example, increase traffic prior to marine shipping season); describing and estimating any variation that exceeds the estimated average traffic rates by >20%.</td><td>1. The 8 trips per day for ore shipments by rail are round trips, and are the total number of trips inclusive of all ore trains. The estimated 4 trips per week for track inspection are also round trips. No haulage of freight or fuel will occur along the rail line.

2. Railway ore shipment rates will depend on which rail operation scenario is selected as described in Section 3.2.19 of TSD 2 (Project Description). The minimum number of trips/day is 0 which may occur during inclement weather or maintenance periods. Track inspections are required at least twice weekly as per Transport Canada rail safety regulations. The number of trips required for track maintenance is difficult to predict as it will depend on the results of track inspections.

<table>
<tr><th></th><th>Phase 2 Construction with Rail Operation
2021 (1 year)</th><th>Phase 2 Operation
2022-2035 (14 years)</th></tr>
<tr><td>Railway Ore Shipment</td><td></td><td></td></tr>
<tr><td>Minimum Trips/Day</td><td>0</td><td>0</td></tr>
<tr><td>Average Trips/Day</td><td>5 - 8</td><td>5 - 8</td></tr>
<tr><td>Maximum Trips/Day</td><td>8</td><td>8</td></tr>
<tr><td>Track Inspection</td><td></td><td></td></tr>
<tr><td>Minimum Trips/Day</td><td>0</td><td>0</td></tr>
<tr><td>Average Trips/Day</td><td>0 - 1</td><td>0 - 1</td></tr>
<tr><td>Maximum Trips/Day</td><td>1</td><td>1</td></tr>
<tr><td>Track Maintenance</td><td>2</td><td>2</td></tr>
<tr><td>Minimum Trips/Day</td><td>0</td><td>0</td></tr>
<tr><td>Average Trips/Day</td><td>1</td><td>1</td></tr>
<tr><td>Maximum Trips/Day</td><td>2</td><td>2</td></tr>
</table>

3. Traffic on the North Railway will be characterized by a constant 24-hour flow. Trains will run regularly on the railway with no peaks or troughs expected.

4. No planned or potential seasonal variation is expected for train traffic on the North Railway. Shipment of ore will occur at a relatively constant rate throughout the year.</td><td></td></tr>
<tr><td>GN 06</td><td>Provide the following information:
1. With respect to the Project Description:
a. As discussed above, please clarify (with reference to document name, section and page number) where in the design plans for the north railway, slopes of 3H:1V and 1V:5H are presented and what proportion of</td><td>1. Section 3.2.13 pg. 3.20 of TSD 2 (Project Description) is entitled Safe Crossing of the Railway by Other Users. The embankment slopes of 3H:1V and 5H:1V are intended for dedicated crossing locations for land users. These dedicated crossing locations will be determined through consultation with local community members and elders. A typical cross</td><td>GN 06 Attachment 1: Typical Cross Section for Caribou Crossing</td></tr>
</table>

ID1	Info Request	Response	Attachment
	the 110 km railway will have these gentler slopes. 2. With respect to slope and height data for the north railway embankments that was used in the caribou movement analysis (TSD 10; Section 3.3.2): a. The GN reviewer was unable to locate the Draft Line Plan and Longitudinal Section drawings in Appendix D that illustrate cut depth and fill heights for 20 m segments. Appendix D, attachment 6.7, contains line profile drawings that provide cut and fill data for 250 m segments of the railway. Clarify if attachment 6.7 was the source of data used for the caribou permeability analysis. b. The cut and fill data presented in Appendix D does not appear to include data on embankment slope. Clarify if the slope was estimated "visually"? Please provide further explanation of this methodology. c. With the exception of caribou crossings at up to 11 locations, all the embankment cross section designs to be employed for construction of the north railway (Appendix D, Attachment 6.3) have slopes ratios greater than 1 in 2 (e.g., 1:2, 50%, 26.6° slope). This observation, alongside summary data presented in table 7-1 (Appendix D, attachment 6.3), seemingly suggests that almost the entire 110 km railway alignment will exceed the slope threshold used to identify sections of the rail line that could reduce movement of caribou. Please clarify whether this assertion is correct. d. The criteria used in the analysis to identify steep slopes that may pose barriers to caribou is stated as a slope ratio "greater than 1 in 2 (e.g., 1:2, 50%, 26.6° slope)". However, figure 1 (TSD 10; Section 3.3.2) indicates that a slope ratio of 2:1 was used as the threshold above which movement of caribou is reduced. Please clarify this discrepancy. e. Clarify if the fill heights data used in the caribou analysis are a measure of the height of embankments from grade (i.e. surrounding land) to the top of the rails themselves or something less. 3. To provide a quantitative overview of the railway's structure please provide 2 histograms summarizing the fill and cut data for all rail segments, respectively, that were used in caribou analysis. These should be presented using bins of 0-50 cm, 51-100cm, 101-150, 151-200cm, 201-250cm. Please provide similar histograms for the slope data derived from these railway plans using appropriate bins one of which should be 0-26.6. These histograms are also requested to support GN IR #51; allowing reviewers to understand how variation in the selection of height and slope criteria, within justifiable ranges, might influence the outcome of the analysis conducted in TSD 10; Section3.3.2. 4. With respect to the grain size of quarry material used for covering embankment slopes: a. Please provide some discussion regarding the potential for grain size to influence the movement of caribou across the railway. Provide evidence that the proposed grain size (150 mm) is effective in facilitating caribou movements. Please reference any studies that have quantified variation in the permeability of roads or rails to caribou, dependent on grain size. 5. With respect to snow management: a. For snow management on the Tote Road, accumulated snow can be pushed off the road to flatten drifts and prevent formation of snow banks. Presumably, locomotives confined to rails will not be able to perform this activity. Explain how snow banks formed when locomotives plough snow will be graded flat. 6. Please provide predictions regarding expected snow banks heights along the railway, substantiating these with available evidence, accounting for the noted limitation of locomotives in managing snow and the level of success that has been achieved in maintaining snow bank heights below 100cm along the Tote Road.	section for caribou (and snowmobile) crossings is shown in TSD 2 (Project Description) Appendix D (Attachment 6.9 - Rail Site Standard Drawing Typical Cross Section - Sheet 4 of 4), and is also Attached to this document (Appendix 1). 2. a. The draft plan and longitudinal sections of the railway that were reviewed for the permeability analysis were not included in the Phase 2 Project Proposal materials. The longitudinal drawings presented in TSD 2 (Project Description), Appendix D, Attachment 6.7 are smaller scale versions (i.e., 1:50,000H, 1:5,000V) of the more detailed and larger scale (i.e., 1:5,000H, 1:500V) alignment sheets reviewed as part of the methods of TSD 10 Wildlife Baseline and Impact Assessment, Section 3.3.2. Section 3.2.1.3 of TSD 2 Project Description is entitled Safe Crossing of the Railway by Other Users. The embankment slopes of 1H:3V and 1H:5V are intended for dedicated crossing locations for land users. These dedicated crossing locations will be determined through consultation with local community members and elders. A typical cross section for caribou (and snowmobile) crossings is shown in TSD 2 Project Description Appendix D (Attachment 6.9 - Rail Site Standard Drawing Typical Cross Section - Sheet 4 of 4. a. The draft plan and longitudinal sections of the railway that were reviewed for the permeability analysis were not included in the Phase 2 Proposal materials. The longitudinal drawings presented in TSD 2 Project Description, Appendix D, Attachment 6.7 are smaller scale versions (i.e., 1:50,000H, 1:5,000V) of the more detailed and larger scale (i.e., 1:5,000H, 1:500V) alignment sheets reviewed as part of the methods of TSD 10 Wildlife Baseline and Impact Assessment, Section 3.3.2. b. As indicated at the end of the second paragraph of Section 3.3.2 (Movement) of TSD 10 Wildlife Baseline and Impact Assessment, the alignment sheets were visually inspected for sections of embankment that were >2 m high. There is no detailed information on embankment slope within the 20 m sections, and as noted in the methods, slope was not specifically considered at this level of assessment. Considering the low number of caribou trails and to accommodate the uncertainty presented by not having detailed embankment slope information at a fine scale, the following mitigation by design was noted in the assessment: "During or after construction, the alignment can be reviewed at documented caribou trails to determine if embankment adjustments need to be made to allow for caribou crossing using best design practices indicated in the FEIS." (TSD-10 Wildlife Baseline and Impact Assessment, Section 3.4.1.2, page 62). c. As shown on the Typical Railway Embankment Cross Sections (Section 6.3 of Attachment 6.3 in Appendix D of TSD 2 (Project Description), the typical embankment slope is 1:1.5. While detailed site-specific information on embankment slope is not available, slopes are expected to generally match those presented on the Typical Cross Sections. The mitigation by design provided in the response to GN 06 2b allows for review of railway embankments to support crossing of the alignment by caribou. d. The pitch ratio presented in Figure 1 (TSD 10 Wildlife Baseline and Impact Assessment; Section 3.3.2) is incorrect and should read Steep (> 1:2), or Shallow (< 1:2). e. The fill height data used in the caribou analysis are a measure of the height of embankments from grade to the top of the rails. 3. The level of detail regarding cut and fill data requested by the GN was not used for the analysis of potential barrier to caribou movement. The categories being requested by the GN seemingly do not relate to the criteria used — the same criteria used in the FEIS for the Approved Project. The criteria for height was 2 m. Anything greater than 2 m would then require further analysis of embankment slope, and site-specific mitigation has been suggested. 4. With respect to the grain size of quarry material used for covering embankment slopes: There is one study known to Baffinland that investigated the grain size as a potential correlate to caribou road crossing — a study from the Ekati Diamond Mine (ERM 2016). That study used camera monitoring data to correlated caribou group size, composition, behaviour and road crossing events as they correlate to several road features, including grain size with rocks categorized in three size categories (<100 mm, 100–300 mm, and >300 mm). Of an observed 144 caribou crossing the Misery Road during 69 events over 3,853 days of camera effort, male, female and all age groups were observed crossing over a range of road features. On only 1% of the observations (3 occasions) were caribou observed	

ID1	Info Request	Response	Attachment
		not crossing the road. Groups of up to 27 caribou were observed crossing the road at locations where 100–300 mm grain size was predominant. There was no clear relationship between the number of road crossing events and road feature data. There were no significant relationships between the number of caribou road crossings and deflections and road features. "The results of [that] study suggest the use of [100–300 mm] rock material… does not deter caribou from crossing roads, relative to smaller grain sizes [100 mm]" (ERM 2016). A recent example of the use of similar crossing structures by caribou was provided in TMAC's Madrid-Boston Project, recently awarded a Project Certificate by the Nunavut Impact Review Board: *"The road ramps were constructed in locations identified by Inuit Elders, with a general slope of 4:1 and a length of approximately 6 to 8 m (Plate 9.8-9). The ramps have a core of rock material and a surface of approximately 2 to 4 cm [200–400 mm] gravel. Caribou workshop participants visited these sites in August 2017 and noted that there was a caribou trail leading directly to the crossing ramp with evidence of recent use (Plate 9.8-10) and there were caribou tracks leading up the ramp and across the road. In addition to that observation, the motion-triggered cameras placed at road ramps recorded caribou crossing the road at these locations." TMAC — FEIS Volume 4, Section 09, 9.8.3.3 (Disruption to Movement, pp. 360).* The caribou "ramps" as mitigation to crossing originated in the diamond mines in the Northwest Territories. Design criteria for two ramps to facilitate crossing over a mine access road included a top surface of 300 mm cap of clean 6" minus crushed rock (Dominion Diamond 2015). Kim Poole (Aurora Wildlife Research, Director, Independent Environmental Monitoring Agency, Ekati Diamond Mine) provided the following notes on crossing structures at the Ekati Diamond Mine (K. Poole, pers. comm, December 2018): The Ekati Jay Road: "Caribou crossings will be constructed using crushed rock (6 inches [152 mm] or less in size) so that the side slopes of the road are flatter and provide easier walking for caribou than the large roadfill rock". Ekati Misery Road: There are multiple caribou crossing structures which vary from 10 to 30 m in width and 10-35% slopes (average about 20% or 5:1 slope) with 6" [152 mm] minus crush cover. Ekati Lynx Road: Elders agreed that 6" [152 mm] minus crush is adequate. 5. With respect to snow management: Rail-mounted heavy equipment such as excavators and backhoes can be used to grade snow banks along the railway line where required to limit barriers to caribou movement. Grading of snow banks along the entire length of the rail line has not been envisioned as part of the Phase 2 proposal. 6. Modelling to predict expected snow bank heights along the railway has not been conducted. Due to the railway's proximity to the Tote Road, climactic conditions and snowfall rates are expected to be similar. However, unlike the Tote Road, much of the railway will be constructed on a raised embankment where wind will act to remove more snow than would occur on the Tote Road which has a similar grade to the surrounding terrain. The railway embankment may act as a barrier where snow may accumulate, particularly on the windward side of the embankment. <u>References</u> Dominion Diamond. 2015. Lynx Access Road Caribou Crossings Location and Design Plan. Submitted to Wek'eezhii Land and Water Board, Yellowknife, NWT, Canada. (http://reviewboard.ca/upload/project_document/EA1314-01_Ekati_Lynx_-_Caribou_Crossings_Plan_-_Lynx_Access_Road_-_Design_and_Locations.PDF) ERM. 2016. Ekati Diamond Mine: Caribou Crossing Photo and Road Features Analysis — 2011 to 2015. Prepared for Dominion Diamond Ekati Corporation, Yellowknife, NWT, Canada. 26 pp.	

ID1	Info Request	Response	Attachment
GN 07	Provide the following information: 1. Specifications for the proposed new landfill at the Milne port and a summary of planned explosive waste management. 2. Assessment of environmental effects from construction and operation of the new landfill.	1. The Milne Port landfill will be used to dispose of inert non-hazardous wastes that cannot be incinerated, and as such, adverse quality leachate is not expected. Nor is the landfill expected to attract animals and birds. The landfill will be located within the existing project footprint (Quarry Q1) and will be located away from local watercourses. Explosives waste will continue to be incinerated as described in the Explosives Management Plan. 2.The landfill will be designed and operated in a similar manner as the Mine Site landfill, and in accordance with applicable landfill design and operation guidelines. As such, the environmental effects of the landfill are expected to be minimal, and consistent with the assessment in the FEIS Addendum. Construction of the landfill will occur only in the operation phase, once quarrying of Quarry Q1 is completed. A design and operations report will be submitted to the Nunavut Water Board and will undergo review as required under the water licence at that time. Baffinland suggests that the facts stated in this response should be sufficient to determine that a landfill is appropriate at this location as proposed, and subject to final approval under the water licence, that adverse environmental effects are not expected.	
GN 08	Provide the following information: 1. Actual dust deposition monitoring results and their comparison with the modeling to prove there is no underestimation of deposition effects. Dust fall mitigation target/objectives must be clearly stated. 2. Clarification on whether or not the Proponent intends to comply with the new Canada wide NO2 air quality objectives and confirm that NO2 dispersion does not cause significant effects in ambient air quality, based on the effect magnitude threshold set using the new NO2 air quality objectives. 3. Confirmation on if the 32% increase in emissions from the generators at Milne port has been included in the modeling and results provided in Figures D-4 and D-6. 4. Justification for selecting a threshold for Potential Acid Input.	1. Comparisons of monitoring data against modelling predictions are provided through annual reporting (Terrestrial Environment Annual Monitoring Report; Annual Report to the Nunavut Impact Review Board). Modelling undertaken for the Phase 2 Proposal has taken monitoring results into consideration in the interpretation of results. Mitigation related to dustfall is presented in the Air Quality and Noise Abatement Management Plan (TSD 28 Management and Monitoring Plans, Appendix X, Attachment 7). The attached Commitment Register (Appendix 11) includes commitments to update this management plan as required, if additional mitigation is identified through the technical review period. 2. The following response is based on extrapolations from the air quality contour plots for NO2 provided in TSD-07. Modelling results predict maximum values would exceed the current 1-hour NO2 standard of 400 ug/m3 in an area within the PDA for both the mine site and Milne Port. Maximum values would exceed the 2020 CCME 1-hour NO2 guideline (113 ug/m3) beyond the PDA but likely within the LSA at the mine site, and beyond both the PDA and the LSA at Milne Port. Predicted maximum values exceed the current annual standard for NO2 of 60 ug/m3 in an area within the PDA for both the mine site and Milne Port. Maximum values would exceed the 2020 CCME annual NO2 guideline (32 ug/m3) beyond the PDA but likely within the LSA at the mine site, and beyond both the PDA and the LSA at Milne Port. 3. Yes, it is included, and figures reflect this. 4. The selected threshold is from CASA and AENV (1999) https://www.casahome.org/attachments/161116103658.pdf It was selected for a low sensitivity receptor and for a critical deposition load. In general, if the concentration or deposition level of an airborne pollutant can be maintained below its threshold, then either no health effect is observed, or the effect is small enough that it presents an acceptably low risk to the population and the environment.	Appendix 11: Commitment Register
GN 09	Provide an updated Atmospheric Assessment to determine potential impacts to caribou and/or caribou habitat.	An updated atmospheric assessment is presented in TSD 7 Atmospheric Assessments (as referenced by the GN in their IR). With respect to the noise and vibration assessment, as outlined in Section 3.1 of TSD 7 Atmospheric Assessments: "The assessment concentrated on comparisons with guideline limits and effects on human receptors, as effects on other biophysical components such as wildlife, vegetation and human health were addressed separately by the appropriate disciplines." The potential disturbances to caribou related to various stimuli (as reiterated by the GN in this IR, as indicated in the Terrestrial Wildlife Baseline and Impact Assessment (TSD 10) on page 45), was considered and incorporated into potential impacts within a Zone of Influence (ZOI). That approach is described in the Assessment Methods section (Section 3.3) of TSD 10 Wildlife Baseline and Impact Assessment, Table 5, page 52.	

ID1	Info Request	Response	Attachment
		The ZOI method was used to predict the potential for reduced probability of habitat use based on a variety of stimuli, including noise and vibration. The spatial bounds of the ZOI were adjusted to encompass the disturbances related to Phase 2-associated stimuli. Therefore, the effects of various stimuli including noise and vibration from blasting on caribou and caribou habitat are assessed in TSD 10 Wildlife Baseline and Impact Assessment , not in TSD 7 Atmospheric Assessments.	
GN 10	Provide the most recent monitoring data, including dustfall, Nitrogen dioxide (NO2), Sulfur dioxide (SO2) and meteorology.	Annual dustfall monitoring data is presented to regulators and the public annually in the Terrestrial Environment Annual Monitoring Reports. The Annual Reports are uploaded to Baffinland's Document Portal on Baffinland's website. Dustfall monitoring data is also presented in the NIRB Annual Report, under Project Certificate Condition No. 58. NOx and SO2 monitoring results are provided annually as part of the NIRB Annual Report, under Project Certificate Condition No. 7. The most recent Terrestrial Environment Annual Report and NIRB Annual Report can be found at: http://www.baffinland.com/news-reports/sharedocuments/?lang=en The following documents are provided with this response: a summary of ambient air quality monitoring results; the dustfall reporting section from the Terrestrial Environment Annual Report; and a summary of meteorological data (Appendix 1).	GN 10 Attachment 1: Climate and Wind Data Summary GN 10 Attachment 2: Dust Fall Monitoring Program GN 10 Attachment 3: Detailed Summary of 2017 Continuous Ambient Air Quality Monitoring Results at the Mary River Mine Site and the Milne Inlet Port Site
GN 11	Incorporate all available relevant meteorological data in its modelling and updated results should be presented.	The data used in the modelling adequately represent the typical range of weather conditions that can be expected. The assumptions made for the model are considered to be conservative, and capture events that would lead to maximum predicted concentrations. Baffinland will undertake a review of the meteorological data as it compares to modelling assumptions to confirm that a conservative approach was taken and will provide any necessary updates during the technical review period.	
GN 12	Provide the following information: 1. Please update the assessment to incorporate fugitive emissions from the stock piles. 2. Provide a reference or evidence to support using 10m/s as a cutoff for entrainment from stockpiles. 3. A complete assessment incorporating particulate from the stockpiles is required.	1. Fugitive dust from stockpiles was not included in modeling, as it was assumed that any contributions from these sources would not be substantial and would not likely have an effect on modelling results. Baffinland will refine the emission estimates from fugitive dust based on on-site meteorological data to determine if these sources should be included in updated modeling. The results of this review, and any associated modelling, if required, will be presented through the technical review period. 2. The USEPA method for estimating emissions from stockpiles was used. The equation used is: U10= 1/0.4 X Ustar_threshold X ln (10m/zo) where zo = 0.003 m (tundra and/or perennial snow) and Ustar_threshold = 0.478 m/s). This guidance document states that field testing of exposed materials indicates that threshold wind speeds exceed 10 m/s at 7 m above the surface. As meteorological data used in evaluating threshold wind speed is based on measurements at 10 m above surface, the assumption of 10 m/s as a threshold velocity for wind erosion is conservative. 3. Please refer to response No. 1, above.	
GN 14	The GN requests the Proponent updated tables in its response to include the maximum predicted modelled ground level concentrations within the LSA. If modelling is updated during this review (See Information Request #13; Predicted vs. Actual Air Quality conditions), provide the updated maximum predicted ground level concentrations.	As noted by the reviewer, these exceedance values are provided in TSD 7 Atmospheric Assessments (Appendix C - Updated Air Quality Assessment to Address Frequencies of Exceedances). The TSDs will not be updated, therefore this information will remain available in the provided memo. If additional modelling is undertaken during the technical review process, this information will be included in any newly developed summary tables.	
GN 15	Incorporate an exceedance management plan into the Air Quality and Noise Abatement Management Plan detailing the measures that will be undertaken to manage and mitigate a potential threshold exceedance.	Any new mitigation that is developed through the technical review process to address potential exceedance of thresholds will be added to the Air Quality and Noise Abatement Management Plan. This commitment has been reflected in the Commitment Register (Appendix 11).	Appendix 11: Commitment Register

ID1	Info Request	Response	Attachment
GN 16	Provide support for the 66% fugitive emissions reduction factor used in the emissions estimation, particularly for periods during the year where water take locations will be frozen.	Fugitive dust emissions from unpaved haul routes are mitigated as follows: • Natural dust suppression during and for short periods after significant precipitation events; • Natural dust suppression for an extended period during winter months when the roads are snow covered and/or frozen solid; • Dust suppression implemented by the mine operators during the summer months. BIM uses a combination of watering and application of calcium chloride, from mid-June into September. As a practical way to assess residual fugitive dust emissions and dust deposition, considering mitigation, RWDI applied a single average value of percent reduction, relative to unmitigated dust emissions. We considered a variety of sources of information, including the following: • Golder Associates (Determination of Natural Winter Mitigation of Road Dust Emissions from Mining Operations in Northern Canada, September 2012) conducted field studies at two DeBeers mining operations in Northern Canada and estimated wintertime dust mitigation efficiency to be in excess of 90% relative to unmitigated summertime dust emissions. The wintertime field measurements were conducted during January and February. This does not account for late winter and early winter periods when there is much less natural dust suppression, but the temperatures remain unfavorable for the mine operators to apply water and other dust suppressants. • Walker and Everett (Road Dust and its Environmental Impact on Alaskan Taiga and Tundra, Arctic and Alpine Research, Vol. 19, No. 4, 1987, pp. 479-489) conducted field studies of dust deposition along the unpaved Dalton Highway in Alaska, and reported that, along the heavily-travelled roads near Prudhoe Bay, the 9-month winter dust deposition was about the same as 3-month summer deposition load, implying an average reduction in dust emission over the 9-month winter period of about 66% compared to the summertime. This would include the late and early winter periods when there is much less natural dust suppression compared to mid-winter. • Golder Associates (2012) also looked at the efficiency of DeBeers' summertime watering programs and found that a dust control efficiency greater than 80% could be achieved during the summer months by applying water 4 to 6 times per 24-hour period of mine operation. • Rosbury (Handbook of Dust Control at Hazardous Waste Sites, EPA/540/2-85/003, November 1985) summarized results for various field studies of dust control on unpaved haul roads. The dust mitigation efficiency of watering programs is highly dependent on the frequency of watering, but for high frequency watering programs, observed efficiencies ranged from 75 to 98% for total particulate matter. Mitigation efficiencies for chemical dust suppressants were very high immediately after application (80 to 100%) but degraded over time, generally indicating that the chemical suppressants needed to be reapplied more often than once per summer season. This literature review supports a 66% reduction factor as a good average value to apply throughout the year, representing both average natural dust suppression during the winter, and a practical target for summertime dust suppression.	
GN 17	Provide the greenhouse gas emissions predictions and describe the reduction strategies that will be incorporated in Phase 2 development.	An updated GHG emissions forecast for the Phase 2 Proposal is presented in Section 2 of TSD 6 Climate Change Assessment. The transition from road haulage of ore associated with the Early Revenue Phase to rail with the Phase 2 Proposal will meaningfully reduce life of Project GHG emissions. US EPA Tier IV locomotives have been specified for rail transport on the Project. Renewable energy is also being considered by Baffinland, as described in Section 4.7.2 of TSD 2 Project Description. The federal carbon tax to be implemented in 2019 will provide further incentive to Baffinland to identify means to reduce fuel consumption. Aside from the carbon tax acting as an incentive to reduce fuel consumption, the taxes themselves should be considered a mitigation measure as those funds are meant to be collected by the federal government and transferred to the Government of Nunavut to address climate chance concerns in the territory. Baffinland would like to engage the Government of Nunavut further on this subject to understand what plans, if any, are in place to use the anticipated funds, and to what extent there may be opportunities for government and industry to partner on specific initiatives.	
GN 18	Provide the following information: 1. A comparison of the increase in phase 2 NOx predicted ground level concentrations to the 2020 CAAQS. 2. Provide information as to how NOx emissions reduction techniques or alternate power generation	1. The following response is based on extrapolations from the air quality contour plots for NO2 provided in TSD 7 Atmospheric Assessments. Modelling results predict maximum values would exceed the current 1-hour NO2 standard of 400 ug/m3 in an area within the PDA for both the Mine Site and Milne Port. Maximum values would exceed the 2020 CCME 1-hour NO2 guideline (113 ug/m3) beyond the PDA but likely within the LSA at the Mine Site, and beyond both	

ID1	Info Request	Response	Attachment
	methods have been considered to meet the 2020 CAAQS.	the PDA and the LSA at Milne Port. Predicted maximum values exceed the current annual standard for NO2 of 60 ug/m3 in an area within the PDA for both the mine site and Milne Port. Maximum values would exceed the 2020 CCME annual NO2 guideline (32 ug/m3) beyond the PDA but likely within the LSA at the Mine Site, and beyond both the PDA and the LSA at Milne Port. 2. Emissions reductions are an ongoing and iterative process for Baffinland that involves the consideration of best practices, new technologies, and updated guidelines and regulations. As part of the Phase 2 Proposal, Baffinland has included installation of wind turbines, which would reduce overall emissions, including NOx.	
GN 19	Provide the following information: 1. Provide cumulative results of the mine site and travel on the Tote Road; or 2. Provide a justification for why these results should not be provided as a cumulative impact.	2. The modelling undertaken for the Mine Site considered the full production capacity of 30 Mtpa, and also represents a reasonable worst-case scenario. The adjacent use of the Tote Road would not contribute substantially to this scenario, and with the construction of the North Rail, the simultaneous operation of the Tote Road for ore haulage with a production rate of 30 Mtpa is not conceived. Current monitoring results provide real-time information on operations and are considered to be sufficient in informing the management and mitigation of observed environmental effects.	
GN 20	Provide the rational for the use of non-default settings for IKINE and IOBR parameters.	The selection of non-default settings for IKINE and IOBR parameters in the CALMET models, as presented in TSD 7 Atmospheric Assessments, Appendix 1B, Table B1, were defaults for previous versions of CALMET and were selected for consistency with previous modelling. Those settings would not have substantive effects on the modelling results. The IOBR setting forces the vertical velocity to be zero at the top of the modelling domain and only slightly adjusts the wind field near the ground where most of the sources are. The IKINE setting only affects the wind field at the second vertical level and the adjustment of the wind field is only done for steep slopes and very rugged terrain which are not found at either site.	
GN 21	Provide references or data to support the choice of particulate matter densities employed in deposition modelling for the Milne Port, Mine site, and construction railway scenarios.	At the Milne Port and Mine site, dust is mostly made of iron ore concentrate with the predominant iron ore minerals of hematite and magnetite. The particulate matter density for iron ore concentrate was assumed to be 5 g/cm^3, as proposed in the Newfoundland and Labrador modelling guideline. This value is supported by site specific information based on metallurgical drill core samples from Deposit No. 1 used to derive a grade-based regression formula for estimating dry bulk density. For material within the iron formation domains, dry bulk density was calculated as: 2.65 t/m3 + (0.0288 * Fe%). Based on this calculation the bulk density is generalized at 4.5t/m3 using 65% Fe content. Note that t/m3 and g/cm^3 are equivalent. The 4.5g/cm^3 calculated is a bulk density. The use of the 5 g/cm^3 value proposed in the modelling guideline is a reasonable estimate consider crushed particulate have less pore space than the drill core samples used for the above calculation. For the Northern Transportation Corridor assessment, the dust was assumed to be mostly made of sandstone that has a typical density of 2 g/cm^3. Aggregate materials used on the Tote Road comprise either material from borrow sources or quarried rock materials. Borrow materials along the Tote Road include sand and silty sand with variable quantities of gravel, cobbles and boulders. Rock materials suitable for quarrying along the Tote Road include granitic gneiss, schist, and carbonate rich sedimentary rocks such as sandstones. A density value of 2 g/cm^3 can be considered typical for materials of this nature. Further geological information has been provided in Volume 6 of the FEIS (2012), Section 2.1.4.1.	
GN 22	Provide the following information: 1. Provide an assessment of impacts from long term exposure to elevated airborne contaminants or provide a linkage to these assessments in Table 2.9. 2. Ensure that these assessments incorporate updated predictions if they have changed during the consideration of the IRs.	1. The assessment of impacts from long term exposure to elevated airborne contaminants has been considered in the comparison of predicted air quality impacts to air quality standards and guidelines that are typically protective of human health which considers long-term exposures to these levels for the various contaminants. These standards and guidelines determine concentrations of various contaminants over different averaging times below which no significant health effects are expected, and above which further (e.g., toxicological) investigation may be warranted to determine if the predicted levels could lead to adverse health outcomes. 2. If modelling predictions are updated through the technical review phase, related effects on human health will be reconsidered.	
GN 23	Provide the following information: 1. Describe the additional Quality Assurance/ Quality Control measures being implemented to ensure the testing is completed as planned.	The requested information is provided below:	

ID1	Info Request	Response	Attachment
	2. Confirm each testing sample consists of two 12-hour periods for noise and two 10-hour periods for vibration.	1. In 2018 Baffinland engaged an external noise and vibration expert consultant, RWDI, to perform occupational hygiene testing at the Mine Site and Milne Port. Baffinland Health & Safety representatives accompanied RWDI to ensure the program was being implemented and completed as planned. At the time of submission, Baffinland has completed one of the two scheduled rounds of testing on accommodation complexes at both the Mine Site and Milne Port. Testing for noise was conducted and assessed according to the Mine Health and Safety Act, Consolidation of Mine Health and Safety Regulation, R-125-95, and was assessed on the 8-hour and 12-hour workday thresholds. Since the Mine Health and Safety Act does not provide specific numerical limits, 8-hour equivalent vibration criteria are the taken from the European Physical Agents Vibration Directive - 2002/44/EC. Accommodation complexes tested for impact and steady state noise safety thresholds registered below recommended levels. Accommodation complexes that were tested for vibrational exposure thresholds registered below recommended levels. Results support that there is no risk of noise or vibrational harm to employees while residing in dormitories and accommodations. A Winter testing program is planned for the end of 2018 to compare seasonal differences. Baffinland plans to continue its annual Noise and Vibrational testing in 2019 with two seasonal sample events (winter and summer). 2. Noise and vibration monitoring was conducted at each location for a minimum of four hours, sometimes longer, for a representative portion of the shift. Results were then used to calculate values for 8-hour and 12-hour shifts.	
GN 24	Provide the following information: 1. Indicate whether construction and closure activities will be limited to the hours of 07:00 and 22:00 (daytime). 2. If activities will not be limited to the daytime period, please explain why.	Baffinland operates and constructs on a 24-hour basis, although efforts are made to reduce noise around the accommodation complexes (e.g. establishing quiet hours around accommodation complexes and restricting operation of heavy equipment and helicopters). As described in Section 3.4.1.1 of TSD 7 Atmospheric Assessments, it is noted however that noise from construction activities are exempt from AER Directive 038. Baffinland will continue to conduct noise and vibration testing on accommodation complexes at both the Mine and Milne Port sites during the construction phase proposed for Phase 2 Proposal to confirm that the health and safety of employees and contractors is not impacted by site activities. Monitoring from 2018 demonstrates that there is currently no issue with noise exposure around the accommodation complexes.	
GN 25	Provide the following information: 1. Clarify how a predicted sound level of 50 dBA occurs 1,000 m from the transfer site, yet a lower sound level of 45 dBA occurs closer (630 m) to the site. 2. Clarify how a predicted sound level of 50 dBA occurs 350 m from the center of the road, yet a lower sound level of 45 dBA occurs closer (305 m) to the center of the road.	1. The numbers presented in the identified sentence (TSD 7 Atmospheric Assessments, Appendix E) were reversed. The text should indicate that sound levels are 50 dBA approximately 630 m from the site, and 45 dBA 1000 m from the site. 2. The distance of 305 m for 45 dBA impacts is correct; however, 50 dBA impacts are predicted at approximately 140 m, not 350 m.	
GN 26	Provide the following information: 1. Please provide an explanation of why the requirement to meet 40 dBA Leq at 1.5 km in all directions from the Mine Site PDA, the Milne Port PDA and the HTO Cabin is not anticipated to be met. 2. Provide additional information or commentary as to the likelihood of a dwelling being constructed closer than the current HTO cabin. Provide information regarding the status of discussions with the Mittimatalik HTO members regarding relocating the HTO cabin outside the area of disturbance. 3. In the event that a dwelling is constructed within 1.5 km of any PDA or if the HTO cabin cannot be relocated, provide contingency measures that the Proponent would take to address these scenarios.	1. The requirement to meet a PSL of 40 dBA in all directions is based on an interpretation of Alberta guideline D38, consistent with other northern mining projects of similar complexity. Section 3.2.1.4 of Appendix D of TSD 7 Atmospheric Assessments discusses the applicability of this limit. Since the limit is intended to be protective of humans, and there are not typically humans along this boundary, the limit does not strictly apply. The PSL would be strictly applicable at the HTO Cabins where humans are expected to spend some time, and which is considered a “dwelling” according to the definition of the AER Directive. As indicated in Section 3.2.1.4 of Appendix D of TSD 7 Atmospheric Assessments, the PSL is not exceeded at the HTO cabin. 2. At this time Baffinland cannot speak to the likelihood of a dwelling being constructed closer than the current HTO cabin because a number of factors would play into this decision including but not limited to safety considerations, need, use etc. Conversations are continuing with the MHTO members – possible designs and positioning of the cabin have been discussed. The new location being discussed is approximately 200m further away from the PDA of the current location. For clarification, the re-positioning of the cabin is due to a request directly from the HTO related to accessibility of the current location rather than due to any potential noise impacts. These discussions will continue throughout the winter with the intention of re-locating and positioning the cabin in early spring. 3. Mitigation if required could involve the selection of more robust building materials for walls and windows, noise barriers, or source-specific noise mitigation.	

ID1	Info Request	Response	Attachment
GN 27	Provide the following information: 1. Supporting rationale for why a ground factor G=1.0 is appropriate for winter modeling conditions. 2. A sensitivity analysis to demonstrate that assessment conclusions would not change if a different ground attenuation factor was used for bodies of water such as Milne Inlet, Camp Lake or Sheardown Lake.	1. The ground factor of 1.0 was chosen as this is the appropriate selection to represent noise propagation in winter with snow cover. It was assumed the area around the site would mostly be snow covered with high porosity. As per ISO 9613-2 for outdoor sound propagation, ground factor of 1 is appropriate for porous surfaces while 0 is appropriate for hard surfaces such as pavement, water and ice. In consideration of this, a more conservative approach would be to apply a factor between 0 and 1 to represent the mixed surface characteristics. This would alter the predicted results by extending the noise contours somewhat further out, similar to but not as far out as for the results shown for summer months, which represents the worst-case scenario. A revised figure will be provided to illustrate this. 2. Using a ground absorption factor of 0 for bodies of water would increase the sound levels at areas across the water compared to the results presented. This would result in a small increase in sound level at select locations along the evaluation boundary at 1.5km from the PDA. A revised figure will be provided to illustrate this during the technical review phase.	
GN 28	Confirm that the noise effects listed in Section 3.1.2.2 refer to the Milne Port and not the Mine Site.	Yes, the noise effects listed in Section 3.1.2.2 of Appendix D of TSD 7 Atmospheric Assessments pg. 13 should say "at Milne Port during construction" and not "at the Mine Site".	
GN 29	Provide revised Figures 3 and 4 to present the 3 insets described in Section 3.1.3.2.	The correct figures which show the insets are Figures 10 and 11. Figures 10 and 11 should have been Figures 3 and 4 (and vice-versa). [See also GN 33]	
GN 30	Provide the following information: 1. Provide the combined sound levels (facility contributions + assumed ambient) at the receptors shown in Table 5 for the Mine Site operations and at the receptors shown in Table 7 for the Milne Port operations. 2. Provide a comparison of the combined sound levels for each operation to the PSL and provide any required revisions to the conclusions shown in Sections 3.2.1.4 (Mine Site) and 3.2.2.4 (Milne Port).	1. Minimum background noise levels were found to be in the 20-dB range. Adding them to the predicted noise impacts would not change the upper bounds of estimated sound only the lower bound of the range. As the effects assessment is most concerned with the upper bound, no updates are required. 2. See above. No revisions are required to the conclusions shown in the mentioned sections.	
GN 31	Provide the following information: 1. Explain why a range of predicted sound levels is presented for the worker accommodation buildings at the Mine Site and Milne Port. 2. Confirm that the predicted sound levels for each worker accommodation building represent exterior sound levels or interior sound levels.	1. Different sides of the building were considered. 2. Noise levels presented in Table 5 are for exterior sound impacts. Interior levels are presented as NCB in Table 6.	
GN 32	Explain why a more robust worker accommodation building is planned for the Milne Port compared to the Mine Site and why upgrades to the worker accommodation building at the Mine Site to provide an equivalent NCB level are not planned.	While the specifications of the Milne Port accommodations building differ from the Mine Site accommodations, they were not selected on the basis of soundproofing. The predicted worst-case Balanced Noise Criterion (NCB) rating for the existing worker accommodation building at the Mine Site is below the recommended level of NCB 40, and therefore, there are no plans for additional noise mitigation.	
GN 33	Provide the following information: 1. Indicate whether the noise contours presented in Figures 5 to 8 include an assumed ambient noise level. 2. If the noise contours presented in Figures 5 to 8 do include an assumed ambient noise level, indicate what that assumed noise level is on each Figure. 3. Revise Figures 10 and 11 to present the operations phase of the northern transportation corridor.	1. They do not, but they would not change if ambient levels were included. See response to GN 30 2. See above #1. 3. Figures 10 and 11 should have been Figures 3 and 4 (and vice-versa). [See also GN 29]	
GN 34	Provide a figure similar to Figure 9 that presents predicted short-term sound levels during a train passby event versus the distance from the rail line.	This figure will be provided as part of the technical review process.	
GN 35	Provide the following information: 1. Provide the assumptions used for the train noise modeling. Are train horns included? 2. Confirm the assumptions represent a worst-case scenario (i.e. the construction and/or production period at which the highest frequency of locomotives are travelling between the Mine Site to Milne Port).	1. Horns, whistles, and bells were not included in the train noise modelling because these sound events will be infrequent and short in duration and are not expected to have a substantial effect on modelling results. Trains were assumed to be moving at 45 km/h, with 6 trains per 24-hour period modelled. 2. The train noise modeling assumptions represent expected frequency of operational train traffic between the Mine Site and Milne Port, which was 6 trains per day. Update information confirms there will be up to 8 trains per day. This would lead to higher predicted sound levels in areas where rail noise is dominant, i.e., between the Mine Site and Milne	

ID1	Info Request	Response	Attachment
		Port. Noise contours would be expected to extend about 25% further than previously modelled. At the Mine Site and Milne Port, however, predicted sound levels would not change significantly since rail noise does not dominate the sound environment. As part of the response to GN 39 a revised figure will be produced to show predicted noise levels from rail operation alone; additional figures will be provided to show how predicted noise levels would change based on an assumption of 8 trains per day instead of 6 per day.	
GN 36	Provide the following information: 1. Several sound sources in Tables B1 and B2 do not have 1/1 octave band sound power level data, but just an overall sound power value. Clarify whether a generic spectrum shape was assumed for these sound sources. If so, provide the generic spectrum shape used for all sound sources. If these sound sources were modeled as single band sources, indicate which single octave band was used to represent each sound source. 2. Explain why sound source "Mary River Steensby Train Knuckle Thump" is 1 decibel (dB) higher than sound source "Mary River Milne Train Knuckle Thump". 3. Clarify whether the sound power level of 151 A-Weighted Decibel (dBA) for each "Mary River Powerhouse Generator – Exhaust" represent a silenced or unsilenced sound power level. 4. Explain why sound source "Milne – Lump Reclaimer/Stacker" has the same 1/1 octave band sound power level data as the "Milne Dozer (Caterpillar (CAT) D9) – Lump stockpile". This implies the Lump Reclaimer/Stacker is modeled as a dozer. If so, provide supporting rationale. 5. Explain why sound sources "Milne – Fines Stacker 1" to "Milne – Fines Stacker 4" have the same 1/1 octave band sound power level data as the "Milne Dozer (CAT D9) – Lump stockpile", This implies the Fines Stackers are modeled as a dozer. If so, provide supporting rationale. 6. All the conveyors at the Mine Site have the same overall sound power level of 96 dBA. Indicate if all the conveyors at the Mine Site are the same length. If they are not all the same length, indicate why the overall sound power level is identical. 7. All the conveyors at the Milne Port are the same length. If they are not all the same length, indicate why the overall sound power level is identical.	1. For these sources, no spectral shaping was used, and sources were modelled as a single band at 500 Hz, consistent with the recommendations in ISO9613 part 2. 2. The knuckle thumps are modelled as a line source, and the power level given in Table B1 is the total power level for the source. The length of the line differs for these two sources, and thus the power level differs as well to produce a consistent power level per unit length of the source. 3. The PWL of 151 dBA represents the unsilenced combustion exhaust power level. A silencer having 1/1 octave band insertion losses of (14/22/36/38/42/44/45/40/33) from 31.5 to 8khz is applied in the modelling to reduce this level to 111.4 dBA. 4. At the time of the analysis it was assumed that dozers were involved in stockpile operations and were modelled as a conservative assumption. Subsequently it has been confirmed that dozers are not involved. Predicted noise impacts would not be expected to change significantly; the original results would be somewhat overconservative in the vicinity of these particular sources. 5. See item # 4 above. 6. Sound power levels for conveyors were estimated based on sound power level of the prime mover and since detailed capacity information was not available a typical sound level was assumed. 7. See item # 6 above.	
GN 37	Provide the following information: 1. Explain how truck traffic on the Tote Road was modeled, including the scenarios considered. 2. Provide the sound power level used for the Tote Road haul trucks. 3. Provide the volume of haul trucks modeled for each scenario.	1. During the operation phase, with the transfer point complete, truck traffic on the Tote Road was modelled as a line source, with 40 trucks per hour moving at a speed of 65 km/h, and an average height of 3.5 m above local grade. This is representative of 12 Mtpa. During construction, 20 trucks per hour were modelled with all other parameters the same, accounting for 6.3 Mtpa. 2. Haul trucks were modelled with the following 1/1 octave band sound power level (PWL), from 31.5 hz to 8 kHz: 104.5 / 100.5 / 106.5 / 108.5 / 107.5 / 107.5 / 106.5 / 99.5 / 94.5 3. The volume of haul trucks modeled is presented in response #1 above.	
GN 38	Provide the following information: 1. Provide the sound source level used for the mine haul trucks in the Milne Port noise model. 2. Revise Figures 7 and 8 to include the effects of mine haul trucks and revise Section 3.2.2.4.	1. Haul trucks were modelled with the following 1/1 octave band PWL, from 31.5 hz to 8khz. 104.5 / 100.5 / 106.5 / 108.5 / 107.5 / 107.5 / 106.5 / 99.5 / 94.5	

ID1	Info Request	Response	Attachment
		2. Figures 7 and 8 (pages 245 and 246) do not need to be revised. They show only a small portion of the road because it was not deemed necessary to include the entire road in the Milne Port model. Generalized road contours beyond the PDA are shown in the road modelling figures.	
GN 39	Provide the following information: 1. The Proponent should explain why the noise contours drop off at this location along the roadway. 2. If necessary, the Proponent should revise any figures that are affected (e.g., Figures 1 and 2 in Appendix E).	1. The drop off in predicted sound levels at this location is a result of insufficient vertical spatial resolution in the model at this location (where the rail line encounters a fairly sudden hill) to represent the course of the railroad along ground contours. The rail line is effectively modelled as being below ground here, hence the much-reduced noise predictions. This will be corrected through the technical review period. 2. Figure revisions will be provided through the technical review period.	
GN 40	Provide the following information: 1. Clarify whether impacted PDA soil conditions will be revegetated to baseline conditions; 2. Clarify the existing soil and vegetation conditions within the PDA 3. Clarify the existing soil and vegetation conditions within the area of the highest TSP deposition (adjacent the PDA) after the mine closure. This should include an estimate of the total area of affected soils and vegetation that will not be returned to baseline conditions. 4. Discussion regarding vegetation reclamation experienced at older mines sites (e.g. Polaris).	1. Soils within the PDA are expected to be impacted from Project-related construction and clearing activities. Revegetation of these soils to baseline conditions is unlikely, and there are no detailed plans for revegetation identified in the Interim Closure and Reclamation Plan (TSD 28 Management and Monitoring Plans, Appendix C, ICRP, Baffinland Iron Mines Corporation 2016); however, Baffinland is beginning to conduct reclamation research to provide guidance for reclamation plans that will include activities for revegetation of disturbed sites in the Project area. 2. Clarification on existing soil and vegetation conditions within the PDA can be found in the Technical Support Document (TSD) 9, Vegetation Baseline and Impact Assessment, Effects Assessment Summary of Phase 2 Proposal Residual Effects on Vegetation, Results and Discussion, Section 2.4.3.3 (EDI Environmental Dynamics Inc. 2018). 3. The existing soil and vegetation conditions are characterized in TSD 9 Vegetation Baseline and Impact Assessment, Section 2.0. The areas affected by TSP deposition are assessed in TSD 9, Section 3.4.2. The PDA is not expected to be returned to baseline conditions. The summary of predicted loss of terrestrial habitat within the PDA is in TSD 9, Table 14. 4. A discussion regarding vegetation reclamation experienced at older mine sites across northern Canada (e.g., Polaris Mine) and Alaska, USA will be included in a desktop review of reclamation research and submitted as part of Baffinland's 2018 Annual Report to the NIRB. Polaris Mine will be one of many mines that is reviewed for the successes and failures of reclamation practices. <u>References</u> Baffinland Iron Mines Corporation. 2016. Interim Closure and Reclamation Plan BAF-PH1-830-P16-0012 Rev 4. Oakville, Ontario. 233 pp. (http://www.baffinland.com/downloadocs/interim-closure-and-reclamation-plan_2017-14-21-07.pdf)TSD 28 Appendix C EDI Environmental Dynamics Inc. 2018. Mary River Project — Phase 2 Proposal Technical Supporting Document No. 9: Vegetation Baseline and Impact Assessment. Prepared for Baffinland Iron Mines Corporation, Oakville, Ontario. 189 pp	
GN 41	Provide the following information: 1. The Proponent should conduct an analysis that incorporates the quantitative data from 2012- 2018 monitoring activities that assesses how the Approved Project effects are ranked based on the criteria in TSD 10; Table 7, page 59. For example, clarification as to whether or not the Approved Project has a level 1, 2, or 3 effect on caribou habitat. 2. The Proponent should provide rationale as to why the two additional parameters, (1) habitat loss and (2) health and mortality, mentioned above are no longer a concern for caribou.	1. The analysis of existing data, including that from 2012 to present monitoring, was considered when predicting the potential effects of the Phase 2 Project on caribou. The data considered in the analysis are summarized in the Wildlife and Wildlife Habitat Characteristics (Section 2) and analyzed in Impacts on Wildlife and Wildlife Habitat (Section 3) of TSD 10 Wildlife Baseline and Impact Assessment. At the time of submission, the data included that collected up to the end of 2017. There are no data collected so far in 2018 that would change those predictions. Clarification on the Level of Project Effect on habitat, movement, mortality and Health is summarized, with Levels I, II and III identified, in Table 10 (Effects Assessment Summary of Phase 2 Proposal Residual Effects on Caribou), TSD 10 Wildlife Baseline and Impact Assessment. Supplemental Information:	

ID1	Info Request	Response	Attachment
		The GN suggests in the IR pre-amble that "Without including an assessment of the effectiveness or accuracy of the original predictions the effectiveness of using this method to assess Phase 2 Proposal is unknown and based on opinion." Annual monitoring reports prepared for the terrestrial environment (e.g., EDI 2013–2018) and accompanying annual reports submitted to the Nunavut Impact Review Board, have shown that observed effects are within the predicted Levels of impact predicted for the Approved Project. 2.Habitat loss and health and mortality remain a concern and were assessed specifically in TSD 10 Wildlife Baseline and Impact Assessment, Section 3.4.1.1 (Habitat), and Section 3.4.1.3 (Mortality) and Section 3.4.1.4 (Health). <u>References</u> EDI Environmental Dynamics Inc. 2013. 2012 Annual Terrestrial Monitoring Report. Prepared for Baffinland Iron Mines Corporation, Toronto, Ontario. 50 pp. EDI Environmental Dynamics Inc. 2014. 2013 Terrestrial Environment Annual Monitoring Report. Prepared for Baffinland Iron Mines Corporation, Toronto, Ontario. 152 pp. EDI Environmental Dynamics Inc. 2015. 2014 Terrestrial Environment Annual Monitoring Report. Prepared for Baffinland Iron Mines Corporation, Toronto, Ontario. 134 pp. EDI Environmental Dynamics Inc. 2016. 2015 Terrestrial Environment Annual Monitoring Report. Prepared for Baffinland Iron Mines Corporation, Oakville, Ontario. 79 pp. EDI Environmental Dynamics Inc. 2017. 2016 Terrestrial Environment Annual Monitoring Report. Prepared for Baffinland Iron Mines Corporation, Oakville, Ontario. 102 pp. EDI Environmental Dynamics Inc. 2018. 2017 Terrestrial Environment Annual Monitoring Report. Prepared for Baffinland Iron Mines Corporation, Oakville, Ontario. 114 pp.	
GN 42	Provide the following information: 1. An updated TEMMP that identifies the expected monitoring and mitigation updates for Phase 2. 2. If no additions are made, then Section 3.6 should identify specific reasons why the current monitoring and mitigation is sufficient for additional effects identified in this proposal.	1. Rev 1 of the Terrestrial Environment Mitigation and Monitoring Plan (TEMMP, March 2016) was provided as TSD 28 Management and Monitoring Plans, Appendix U of the Phase 2 Project Proposal. As indicated in Section 3.6 (Mitigation and Monitoring Plan Updates) of TSD 10 Wildlife Baseline and Impact Assessment, no material changes are required to the TEMMP. That plan identifies the expected monitoring and mitigation for the Mary River Project. Updated draft plans will be provided for review following the technical meeting, scheduled for March 12-15, 2019. In the interim, proposed changes to the management plans presented in TSD 28 Management and Monitoring Plans will be tracked in detailed tables for review and document control purposes. 2. The current monitoring program sufficiently addresses Phase 2 Proposal effects because "There is no new information, survey methods, or material changes in Project interactions associated with the Phase 2 Proposal that suggest the need for any substantial changes to the current monitoring program for wildlife and wildlife habitat." (Section 3.6, TSD 10 Wildlife Baseline and Impact Assessment). The TEMMP in use at the Mary River Project has been through several revisions in response to feedback from the Terrestrial Environment Working Group (TEWG), the Nunavut Impact Review Board (NIRB) comments, comments received on results to date, and changes to sampling methods based on robust statistical analysis. The practice of revising monitoring plans as the Mary River Project progresses will continue through the life of the Project. As noted above, at this time there is no new information or interactions, including the existence of a railway (Steensby), associated with the Phase 2 Proposal requiring material changes to the TEMMP — it is sufficiently broad in scope and methodology to capture potential effects of the Phase 2 Proposal activities. The accuracy of the monitoring methods has been scrutinized by the TEWG since the first annual report was drafted in 2012, and mitigation has not changed. It is unclear to Baffinland what missing information is limiting the GN's completion of a full review.	

ID1	Info Request	Response	Attachment
GN 43	Provide an analysis of North Baffin Caribou baseline distribution and habitat use using available distribution data from pre 2009 and 2011-2018.	Baffinland's wildlife baseline report describes caribou distribution and habitat use prior to 2009 using primarily Inuit Qaujimajatuqangit (IQ). The information gathered during numerous IQ workshops provided a long-term, multi-generation understanding of caribou use on north Baffin Island, and that information is well described in the baseline report (TSD 10 Wildlife Baseline Impact Assessment, Section 2), and in the baseline prepared for the FEIS (EDI Environmental Dynamics Inc. 2012). In addition to the baseline information, Baffinland gathered more information post-2009 on contemporary knowledge of caribou distribution and habitat use (Prno 2017, TSD 3 Phase 2 Workshop Report) — information that was also summarized in the baseline characteristics portion of TSD 10. The short-term collar data is used as supplemental information to the IQ regarding caribou distribution and habitat use Supplemental Information: The preamble to the Government of Nunavut's (GN) information request suggests there are data deficiencies in the baseline characterization and impact assessment that limits their ability to assess the effects related to the Project (noted in IMPORTANCE TO REVIEW AND SUPPORTING RATIONALE). 1. "Without knowing the current distribution and habitat use of the caribou in North Baffin…" The Government of Nunavut has conducted several surveys since 2011 to determine the distribution of caribou on North Baffin Island (e.g., (Jenkins et al. 2012, Campbell et al. 2015, Pretzlaw 2016, Anderson 2016, Ringrose 2018). Those surveys were supported in-kind by Baffinland, and the results of those surveys are summarized in Section 2.4.4 of TSD 10. It is unclear to Baffinland why the GN considers the current distribution an unknown when they have been conducting the surveys to determine so. 2. "Knowledge of habitat loss since the original baseline prediction is essential…" Refer to Baffinland's response to GN 41, Part 2, identifying where habitat loss has been evaluated. 3. "If the original baseline predictions have not been accurate…" Refer to Baffinland's response to GN 41, Part 1, Additional Notes, indicating that observed impacts to date have been within predicted impact levels. <u>References</u> Anderson, M. 2016. North Baffin caribou fall demographic composition survey, September 2016. Status Report 2016-XX. Government of Nunavut, Department of Environment, Wildlife Research Section, Igloolik, Nunavut, Canada. 9 pp. Campbell, M., Goorts, J., Lee, D.S., Boulanger, J., and Pretzlaw, T. 2015. Aerial Abundance Estimates, Seasonal Range Use, and Spatial Affiliations of the Barren-Ground Caribou (Rangifer tarandus groenlandicus) on Baffin Island—March 2014. Technical Report Series —No. 01-2015. Government of Nunavut Department of Environment, Iqaluit, Nunavut. 179 pp. EDI Environmental Dynamics Inc. 2012. Mary River Project Wildlife Baseline 2006–2011: Appendix 6F, Volume 6 — Terrestrial Environment, Final Environmental Impact Statement. Prepared for Baffinland Iron Mines Corporation, Toronto, Ontario. 103 pp. Jenkins, D., Goorts, J., and Lecomte, N. 2012. Estimating the abundance of South Baffin caribou. Summary Report 2012. Government of Nunavut, Department of Environment. 33 pp. Pretzlaw, T. 2016. 2015 Government of Nunavut north Baffin Island caribou fall composition/ demographic survey. BIM Final Report. 5 pp. Ringrose, J. 2018. Baffin Island Caribou Composition Summary Report 2015 – 2018. Government of Nunavut Department of Environment, Pond Inlet, Nunavut.	

<table>
<tr><th>ID1</th><th>Info Request</th><th>Response</th><th>Attachment</th></tr>
<tr><td>GN 44</td><td>Provide the following information:
1. The Proponent should revise the analysis on the effects related to caribou movement seasonally, including effects based on sex, and incorporate maximum movement rates of caribou to identify all possible effects on caribou movement.

2. The Proponent should revise modelling of the barrier effect on caribou movement quantifying the barrier effect of a train speeding up, maintain required speed, maintaining speed limits identified in 3.4.1.3, slowing down, and seasonal variation in speeds.</td><td>1. The collar data from 2008–2011 showed very little variation in seasonal movement patterns. This lack of seasonal variability was described in the FEIS wildlife baseline (EDI Environmental Dynamics Inc. 2012). The analysis was based on collar data provided by the Government of Nunavut. The 4 km daily movement was based on a seasonal analysis of data. Section 3.3 of the FEIS baseline summarized movement as follows:

Data from 32 collared caribou cows indicated that caribou were generally sedentary. The average caribou cow movement for all months collar data were available was less than 2 km within an 11-hour interval. Caribou movement increased during the spring and summer months by an average of about 0.5 km/day except in June, which was more consistent with the winter months (Figure 14 [reproduced in Appendix 1]). … These results suggest that the local caribou are fairly sedentary and non-migratory, in agreement with IQ regarding current caribou movement and the non-migratory nature of caribou currently found on north Baffin Island.

Supplemental Information:

Caribou movement average was not used as a covariate in the RSPF model as the GN suggests in the IR preamble.

2. As the GN suggests, train speed is variable and is related to load, incline, decline, accelerating or reducing speed as the train enters yard areas. There are points along the line, particularly at the end points, and on grades where the trains are moving either slower or faster than average speed. For inclines or declines, the speed will partially depend on whether the train is loaded or empty, and whether it is either ascending or descending. Speed profiles are presented in the attached Figure 1 (Loaded) and Figure 2 (Empty) (Appendix 1). The overall average speed is ~50 km/hr. Based on the variability in the speed profile along the length of the railway, it is seemingly enough to use the average speed to characterize this potential impact that is not significant.

Regardless, the reviewers can calculate a predicted barrier of any speed based on a proportion of the calculated value at 50 km/hr for the proposed train set length (79.25 sec, described in Table 6, TSD 10 Wildlife Baseline and Impact Assessment). A sample of barrier time in seconds is provide in Table 1.

Table 1 – Barrier Time in Seconds

<table>
<tr><th>Train set speed</th><th>Max. barrier time (per transit) in seconds</th></tr>
<tr><td>10</td><td>396.25</td></tr>
<tr><td>20</td><td>198.13</td></tr>
<tr><td>30</td><td>132.08</td></tr>
<tr><td>40</td><td>99.06</td></tr>
<tr><td>50</td><td>79.25</td></tr>
</table></td><td>GN 44 Attachment 1: Figures</td></tr>
<tr><td>GN 45</td><td>Provide the following information:
1. Provide quantitative data for the surveying of the railway proposed route that identifies the likelihood of encountering caribou along the Northern Railway route.

2. Provide supporting documentation for the effectiveness of seasonal shutdowns of roads and railways for mitigation caribou mortality.

3. Identify effects and proposed mitigation measures regarding all possible scenarios of caribou mortality, in addition to seasonal migration, including but not limited to caribou unwilling to leave the railway, or approaching a railway.

4. Provide clarification for the statement:
“Additionally, the temporary increase in traffic in the Northern Transportation Corridor and the concomitant increase in mortality risk will be partially mitigated by the shorter-term transition to rail for transport of ore to Milne Inlet.” (TSD 10; Section 3.4.1.3)</td><td>1. The likelihood of encountering caribou along the North Railway route is best quantified by the seasonal Resource Selection Probability Function (RSPF) habitat model values that were calculated (summarized in Section 2.3.2.2, TSD 10 Wildlife Baseline and Impact Assessment). Depending on season, the RSPF model shows the likelihood of caribou selecting various areas as habitat based on a combination of several landscape characteristics including aspect, slope, and proximity to rivers, and a "greenness" score.

The RSPF model quantifies the likelihood of encountering caribou within habitats. An RSPF describes the probability that an animal will choose an area (habitat) based on its abiotic (e.g., topography, adjacency to lakes) and biotic (e.g., vegetation) features. Technically, an RSPF describes the probability that an animal will use a resource as described by a series of environmental covariates. The RSPF values represent actual probabilities of caribou selecting a given location in a landscape based on quantified behaviour of observed (i.e., collared) animals (excerpt from Section 4,2, FEIS Terrestrial Wildlife Baseline Report, EDI Environmental Dynamics Inc. 2012).

2. There is no documented evidence of the effectiveness of seasonal shutdowns of roads and railways for mitigating mortality (i.e., collision) risk. This mitigation is intuitive as the presumption is that stopped vehicles and locomotives will</td><td></td></tr>
</table>

ID1	Info Request	Response	Attachment
		not collide with and kill caribou. It is unclear what evidence the GN expects of Baffinland to provide as supporting documentation of non-events or no measurable impact. 3.Baffinland addressed the potential scenarios of caribou interaction with a railway in the Approved Project (Baffinland Iron Mines Corporation 2012). Baffinland and reviewers recognized that an exact solution to every scenario of caribou interaction could not be determined and that adaptive management would be implemented. Baffinland reiterates the statements made in the Approved Project (Section 5.2.3) and the Phase 2 Proposal TSD 10 Wildlife Baseline and Impact Assessment, Section 3.4.1.3 It is generally an unknown among the knowledge holders involved in workshops whether caribou will be aware of moving locomotives and be capable of getting off the rail tracks. However, regardless of that uncertainty, mitigation is possible because 1) caribou currently are in very low numbers and are seldom expected to be encountered along the rail routes, and 2) when the large numbers of caribou return, seasonal shut downs are possible to allow caribou to pass during migratory movements, should they occur. Those potential impacts and suggested adaptive approach to mitigation were previously reviewed and adopted within the Project Terms and Conditions of the Approved Project that includes railway operations. The Phase 2 Proposal does not introduce new interactions. 4. The combined disturbance over a two to three-year time period of frequent traffic on the Tote Road with rail operations is temporary as the operation transitions to all ore being hauled by rail to Milne Port. The transition of ore haul to rail is a mitigation to the potential effect of Tote Road traffic on caribou movement and mortality because 1) the total number of vehicle transits (physical barrier to movement) is substantially reduced, and 2) the reduced frequency of vehicles reduces the potential for collisions.	
GN 46	Provide the following information: 1. The Proponent should provide an itemized list of the assumptions of the energetics and demographic models identified in TSD Attachment 1. This list must include an indication if the assumption is guided by information specific to North Baffin Caribou, caribou literature and subsequent data or personal opinion. 2. The Proponent should provide a list of all data inputs and whether they are based on data for North Baffin Caribou, caribou literature and subsequent data or personal opinion.	1. Several assumptions had to be made when applying the models to assess potential effects of development in the north Baffin caribou. Assumptions are made and clearly stated when specific data does not exist for the region and/or if even outside of the region, data is equivocal. Throughout the modelling exercise however we tried to err on the side of caution (i.e., exaggerating potential negative effects) when stating our assumption. In several cases assumptions are made to set up scenarios to be tested for the purpose of quantifying potential effects; often a worst-case scenario. The attached list of assumption (Appendix 1) provides a list of assumptions as they appear in the two energetic model reports completed for the Approved Project (Russell 2012 and Russell 2014). Appendix 1 provides a list of assumptions as they appear in the two energetic model reports completed for the Approved Project (Russell 2012 and Russell 2014). 2. Lists of all data inputs and citations are provided in Tables 1 and 2 in Appendix 1.	GN 46 Attachment 1: List of Assumptions GN 46 Attachment 2: Tables
GN 47	Provide the following information: 1. The Proponent should explain how studies of semi-domesticated reindeer are relevant to an assessment of wild, free-ranging Baffin Island caribou. Please also discuss the limitations of these studies for the purposes of assessing the Project. 2. The Proponent should provide, if available, references to literature containing studies of the responses of wild, free-ranging caribou to wind turbines and power lines. 3. The Proponent should explain how a conclusion of “no conceivable effect” is arrived at given the noted gaps in Project design information, limited Project-specific caribou data and lack of relevant literature.	1. Studies on the potential disturbance of wind turbines to semi-domesticated reindeer are relevant for assessing the Project because Eurasian reindeer are of the same species as North American caribou, and some occupy similar barren-ground habitats as north Baffin Island caribou, as stated in Section 3.2.1 of TSD 10 Wildlife Baseline and Impact Assessment. Though comparisons between semi-domesticated and wild, free-ranging herds may be limited, there are enough similarities that they are worth discussing, especially since there has been limited opportunity to observe "wild" caribou response to wind turbines. The limitations of these studies for the purposes of assessing the Project was already acknowledged in section 3.2.1 of TSD 10 Wildlife Baseline and Impact Assessment, as follows: *"There have been only a few studies about wind turbine impacts on caribou, and those studies have been on reindeer in Scandinavia (discussed below where relevant). The conclusions from the studies are varied, and the differences are likely due to factors which are herd or even location specific. Consequently, while using general study results to predict effects of new disturbances on other caribou herds is possible, the ecosystem the caribou herds have adapted within are unique among herds so the utility of using detailed results from studies in one location to predict responses in another location may be limited".*	

ID1	Info Request	Response	Attachment
		2. No additional literature containing studies of the responses of wild, free-ranging caribou to wind turbines and power lines will be provided, because these studies do not currently exist. All relevant, available literature on this subject has been discussed in Section 3.2.1 of TSD 10 Wildlife Baseline and Impact Assessment. 3. Section 3.2.1 in TSD 10 Wildlife Baseline and Impact Assessment states: "There are no conceivable effects of single, isolated operating wind turbines on caribou". This not a generalized conclusion on Project effects to caribou, but rather a specific statement related to the operation of single, isolated wind turbines, which is based on the best available science and consideration of single turbines operating on a small footprint within the range of the north Baffin Island caribou herd. The potential effects of wind farms on caribou are stated (within the same paragraph) as follows: "Currently there is no clear evidence of shadow flicker impact on caribou grazing patterns based on the results of wind farm projects in reindeer habitats in Scandinavia. In general, potential effects from wind farms on caribou are an increase in mortality risks due to the potential for collision with vehicles during construction." These statements are also based on the best available science, which the Proponent has acknowledged to be limited (see Response #1 above).	
GN 48	Provide the following information: 1. With respect to the use of data on railway design to assess potential as a barrier to caribou movements the GN requests the following information: a. Explain how the different railway design cross-sections were considered in the caribou movement analysis (as noted above). Clarify if it was assumed that a 2 meter high, 83 degree rock face in a railway cut reduces caribou movement to the same degree as a 34 degree embankment (the slope indicated for virtually all the north railway embankment designs in the FEIS addendum). Also clarify what evidence exists that caribou will readily scale a 2m high near-vertical rock face. Explain how the analysis considered the double obstacles presented by railway segments where cuts in rock of 83 degree angle run alongside embankments typically 34 degree angle (i.e. type I and II cross-sections). b. Clarify if and how the caribou movement assessment considered the potential barrier presented by the Tote Road in-order to provide a complete assessment of the Northern Transportation Corridor's total (combined/cumulative) effect on caribou movement. c. Clarify if and how the caribou movement assessment considered the 7 combinations of potential barrier presented by embankments, cut rock faces and roads (i.e. embankment, cut, road, embankment + cut, embankment + cut + road, embankment + road, cut + road). 2. With respect to the stratification of the railway for scoring permeability to caribou, the GN requests that the Proponent: a. Provide a rationale for the idea that the presence of suitable crossing locations within 1 day's movement for the average caribou makes the rail permeable to movement. b. Explain the apparent inconsistency between the statement that 4 km "was approximately the average distance travelled by caribou in one day" and the estimates of daily movement rates reported in section 2.4.4 of the report (ranging from 1.3 to 2.8 km/day). c. Clarify what point of origin was used to divide the railway into 4 km segments and if this started with the Milne terminus representing kilometre zero. d. Clarify if the permeability criteria for scoring 4 km rail line segment considered both slope and height/depth. 3. Given the semi-qualitative nature of the assessment methods and reliance on professional judgement, the effects of applying alternate, plausible scoring systems and criteria should be explored. This 'sensitivity' analysis is particularly important where underlying assumptions in the assessment have a notable degree of uncertainty due to variance in available data or reliance on professional opinion. Confidence in the impact predictions would be improved by clearly understanding how uncertainty surrounding selection of appropriate scoring systems and criteria does or does not affect impact significance. The outcome of this analysis may also identify needs for effects monitoring programs should the Project proceed. Accordingly, the GN requests that the Proponent: a. Present assessment results obtained when the following range of alternative scoring thresholds and	1. a. i) The generalized railway cross sections were not considered in the caribou crossing analysis because they were not associated with specific points on the landscape. ii) Yes, based on the presented criteria (TSD 10 Wildlife Baseline and Impact Assessment, Figure 1), that assumption was made. iii) All evidence regarding caribou ability to cross embankments of various heights is presented in TSD 10 Wildlife Baseline and Impact Assessment, Section 3.2.2, pg. 49. Describing the embankment as "…a 2m high near-vertical rock face" is an exaggeration of embankment characteristics. iv) Either one of the "double obstacle" suggested by the GN acts as a potential barrier to caribou movement. b. The potential for the Tote Road, in combination with the railway, to act as a barrier was assessed as part of the Phase 2 Proposal. There is no evidence or IQ provided to Baffinland suggesting that the presence of the road in combination with the rail will necessarily compound a potential barrier effect. There is little to suggest that caribou will respond any differently to the physical features of a road embankment, a rail embankment, or combined embankments. This is uncertainty that is addressed by Project monitoring and adaptive management. c. The caribou movement analysis was not conducted at as fine a scale or project component combinations as the GN is requesting. The GN is suggesting an extremely fine scale of assessment of potential effects on caribou movement (a combination of 7 potential barriers) that published evidence or IQ is unlikely to sufficiently address. It is unclear what that level of analysis will add to Project effects mitigation. This is uncertainty that is addressed by Project monitoring and adaptive management. 2. a. The rationale that potential crossing locations can be found within a caribou's one day movement is a seemingly reasonable perspective to present to reviewers. It acknowledges that the Northern Transportation Corridor will create barriers and that the assessment considered physical barriers that could delay caribou movement by more than a conservative 0.27% (1 day) of annual movement. b. The movement rates summarized in TSD 10 Wildlife Baseline and Impact Assessment, Section 2.4.4 are average movement rates during 11-hour intervals (the collars' reporting cycle), and not daily rates (as incorrectly reported). Those data are summarized in Figure 14 of the FEIS baseline report (EDI 2012). See also the response to GN 44 (1). c. Milne Port is Km 0 of the proposed railway. The assessment looked for any continuous section up to 4 km long that may act as a barrier to caribou movement. d. See response to GN 06 (2b).	

ID1	Info Request	Response	Attachment
	criteria are applied to the available data following the same methodology used in the FEIS addendum: (i) Embankment and cut heights of greater than ">"1, 1.5, 2, 2.5 and 3 meters are used to classify 20m rail segments that may pose a barrier to caribou (per figure 1); (ii) Permeability to caribou is scored on the basis of 1.5, 3 and 4 km segments of the rail alignment; and (iii) Alternative permeability rating criteria are applied to these rail alignment segments. For example, where high permeability is less than or equal to "≤" 33% of rail alignment within 1.5km is estimated as likely not physical barrier threshold; medium is >33% and <67%; low is greater than or equal to "≥" 67%. b. Present assessment results obtained when an alternate methodology and scoring criteria are applied. Specifically, assuming the required data exist, the Proponent should redo the analysis to identify 20 m segments of the Northern Transportation Corridor that may pose a barrier to caribou using the following classification system: Where an obstacle with a slope of 83 degrees and height of >1.5 m, or a slope of 26.6 and > 2 m is created by a railway cut, rail embankment or road embankment, present a table summarizing the frequency and percentage of segments classified as potential barriers, based on this system. Provide separate results for the frequencies and percentage of segments where multiple potential barriers are presented by rail embankment only, rail cut wall only, road embankment only, rail embankment and cut wall, rail embankment and road embankment, rail cut wall and road embankment, rail embankment-cut wall-road embankment. c. Using the alternate methodology described above in item 2) apply alternative permeability rating criteria to these rail alignment segments. For example, where high permeability is less than or equal to "≤" 33% of rail alignment within 1.5km is estimated as likely not physical barrier threshold; medium is >33% and <67%; low is greater than or equal to "≥" 67%. NOTE: This information request should be addressed in conjunction with GN IRs # 6 (North Railway Design and Physical Structure), 49 (Railway as a barrier to known caribou trails) and 50 (Road and rail traffic as a barrier to the movement of caribou).	3. a. The GN's suggestion for re-analysis based on alternative scoring thresholds and criteria will not be presented by Baffinland. Baffinland stands by the criteria that were used for assessment permeability of the Northern Transportation Corridor for the Phase 2 Proposal. The GN does not provide any more justification for their suggested criteria than what has been presented in the Project proposal. Those criteria were used in the FEIS for the Approved Project. The criteria were developed in reference to information gathered in the IQ workshops when caribou movement was discussed with knowledge holders familiar with the local landscape when considering a railway and road embankment relative to the surrounding rugged landscape. These criteria were previously reviewed by the GN and all parties in reference to the southern railway for the Approved Project. b. As noted above in response to GN 49 (3a), the GN provides no additional justification for their suggested criteria beyond what was presented in the Phase 2 Proposal, and to what had already been reviewed for the Approved Project. c. As noted above in response to GN 49 (3a) and GN 49 (3b), the GN is suggesting alternative analyses that are no more justified than what has already been presented. <u>References</u> EDI Environmental Dynamics Inc. 2012. Mary River Project Wildlife Baseline 2006–2011: Appendix 6F, Volume 6 — Terrestrial Environment, Final Environmental Impact Statement. Prepared for Baffinland Iron Mines Corporation, Toronto, Ontario. 103 pp.	
GN 49	Provide the following information: 1. With respect to the selection of caribou trails for the assessment: a. Please explain why trail survey data from 2006 to 2008 were not used in the analysis. b. If trails were found on the railway alignment during the 2006 to 2008 surveys, please include these in the analyses and present the results. c. In an attempt to examine the effect of, and/or account for, potential bias in detecting trails during surveys, the GN recommends using 2 alternate sources of data. The GN requests the Proponent comply with the following in its response: (i) If the tracks of satellite collared caribou cross the rail alignment, these crossing locations (although potentially somewhat imprecise) should be included as trails in the assessment and the result presented. (ii) Please use a set of 100 randomly generated crossing locations along the rail alignment to simulate the impact on movements if caribou are not selective of crossing location. The Proponent should present the assessment results for these simulated trails. The GN recognizes that these simulated trails do not necessarily model caribou behavior. However, the results would provide important context for interpreting results obtained from use of the trail survey data which at present may be biased. 2. With respect to the criteria for determining the significant rating of the caribou trail assessment: a. Please provide justification for the criteria used, citing relevant studies or other evidence where available. Clarify if these criteria are based on professional judgement only. Please note that this information request should be addressed in conjunction with GN IRs # 6 (North Railway Design and Physical Structure), 48 (Railway as a barrier to movement of caribou) and 50 (Road and rail traffic as a barrier to the movement of caribou).	1. a. The 2006 and 2008 trail surveys were conducted by air over 100 km² blocks to characterize movement patterns within portions of the regional study area. The 2010 survey was specific to the Tote Road and included both an aerial overview, and a ground-based survey to confirm the exact location of the trails and to characterize their current use. A more thorough description of the surveys with mapped results is provided in the FEIS baseline report, Section 3.4 and Figure 18 (EDI Environmental Dynamics Inc. 2012). The trail surveys have been comprehensive and includes of empirical evidence collected during both Baffinland-led surveys and by the experience of IQ knowledge holders. b. See response to GN 49 1a c. i) The potential use of caribou collar data to map trails was noted in Section 3.4 of the Approved Project baseline report (EDI Environmental Dynamics Inc. 2012): *"Collar data from 2008–2011 displaying locations of female caribou was correlated with the identified major crossing sites; however, the collar data were collected at 11-hour intervals, so they are not detailed enough to delineate any additional trails near or crossing the Railway alignment."* The locations are imprecise and likely misinform the more precise trail surveys and information provided by IQ knowledge holders (i.e., as illustrated in TSD 10 Wildlife Baseline and Impact Assessment, Map 6 and Map 7). Regardless, the caribou "walk paths (lines joining successive collar point locations) are illustrated in Figure 1 in Appendix 1, with reference to the data provided in TSD 10 Maps 6 (mapped caribou trails) and 7 (IQ on caribou movement). Figure 1 (Appendix 1) shows the area of the PDA encompassed by the extent of walk paths that intersect the PDA. There are already several identified caribou trails, and the area was identified as a movement area by IQ. Based on a visual analysis of the information provided in those maps, Baffinland feels the analysis based on empirical observations of trials and those identified by traditional knowledge is adequate for assessment.	GN 49 Attachment 1: Figure 1. The extent of the PDA encompassed by caribou walk paths (lines joining consecutive collar locations that are ≥ 11 hours apart) showing the PDA, mapped trails and movement identified by Inuit Qaujimajatuqangit

ID1	Info Request	Response	Attachment
		ii) It is unclear to Baffinland why the GN is suggesting that the trail data may be biased. Using a set of 100 randomly generated points seemingly would ignore the crossing evidence provided by both the trail surveys and mapped information provided during the IQ workshops that specifically addressed caribou road crossings (that information is illustrated in Map 6 and Map 7 of TSD 10 Wildlife Baseline and Impact Assessment). It is unclear how an additional 100 random points would reflect known previous caribou use of the area of the Northern Transportation Corridor. 2. a. Supporting evidence for assertions that the criteria used to evaluate the railway as a potential barrier to caribou movement are largely based on Inuit Qaujimajatuqangit (IQ) and is provided in Section 3.3.2 of TSD 10 (Wildlife Baseline and Impact Assessment). "Based on professional opinion informed by discussions in the IQ workshops, it was determined that steep and tall embankments may act as the greatest barrier to caribou movement (although participants in the IQ workshops noted that caribou movement in this region are not deterred by steep terrain). Criteria for determining if a segment of rail will be a barrier to caribou movement was to visually estimate cuts or fills that have embankments slope ratios that are greater than 1 in 2 (e.g., 1:2, 50%, 26.6° slope) and the height or depth of the embankment is greater than 2 m (Figure 1). Two metres was chosen because it seemed like a reasonable height that 1) is close to the height of caribou (caribou are about 1.5 m tall when vigilant), 2) caribou are likely to be able to see habitat on the other side of the railway embankments that are less than 2 m high so they will have more information on the potential benefits of crossing the Railway, and 3) caribou are more able to climb small (<2 m) heights." The criteria for slope were based on what has become acceptable practice for grading crossings for caribou at the Ekati Diamond mine (e.g., Dominion Diamond 2015). For relevant studies on the response of caribou to those crossings, refer to Baffinland's response to GN 06 (4). <u>References</u> Dominion Diamond. 2015. Lynx Access Road Caribou Crossings Location and Design Plan. Submitted to Wek'eezhii Land and Water Board, Yellowknife, NWT, Canada. (http://reviewboard.ca/upload/project_document/EA1314-01_Ekati_Lynx_-_Caribou_Crossings_Plan_-_Lynx_Access_Road_-_Design_and_Locations.PDF) EDI Environmental Dynamics Inc. 2012. Mary River Project Wildlife Baseline 2006–2011: Appendix 6F, Volume 6 — Terrestrial Environment, Final Environmental Impact Statement. Prepared for Baffinland Iron Mines Corporation, Toronto, Ontario. 103 pp.	
GN 50	Provide the following information: 1. Please provide evidence to support the use of a 100 m buffer in the above noted analysis. If available, this should include reference to systematic studies of the behavioral and distributional responses of barren-ground caribou, in open tundra, to haul trucks or trains. 2. Please explain the rationale for applying the same buffer to trains, ore trucks and other vehicles, providing evidence to support this rationale such as published, systematic studies. 3. Please provide summary information in the form of tables and figures, similar to those presented in table 6 (TSD 10; Section 3.3.2) and figures 2 and 3 (TSD 10; Section 3.4.1.2), illustrating the outcome of analysis when a range of alternate buffers are applied to vehicles. For this sensitivity analysis please use a series of buffers ranging from 100 m up to several kilometers. Please apply different buffers to trains, versus ore trucks versus other traffic. 4. Moving trains generate sound and vibration that is propagated along rails to varying distances depending on factors such as train type and speed, track type and condition, sleeper type, ballast type and underlying ground type. There is a large body of published material on this topic. Clarify how far noise and vibration is predicted to be propagated along rails for the northern railway. Please provide reference to a section of the FEIS addendum where this has been presented and reference to relevant literature. Clarify	1. There is no evidence to support the 100 m buffer approximation when a caribou would not safely be able to cross a transportation corridor as a vehicle/trainset approaches and passes. The buffer was used to show the time that moving vehicles/trainsets presented a physical barrier to movement. The 100 m buffer approximates the distance within which, should a caribou decide to cross a road or rail, it could exit the road/railbed before collision. 2. The GN's request for evidence to support the 100 m buffer could be based on a misunderstanding of what that buffer is intended to quantify — an additional distance before or after vehicle passes as a conservative (i.e., over-estimate) of distance and time that a physical barrier due to vehicle passes. 3. In reference to response to GN 50 (1 and 2), the requested re-analysis is irrelevant to vehicle passes as a physical barrier. The GN is seemingly alluding to a behavioural response barrier that is addressed with other methods (e.g., reduced habitat effectiveness with variable Zones of Influence). 4. All studies known to Baffinland relevant to caribou response to noise from rail operations, plus Inuit perspectives on that type of disturbance, are summarized in the FEIS (Baffinland 2012) for the approved project and in the Phase 2 Proposal. The noise associated with rail was considered by all parties, including the GN, involved in the review of the Approved Project.	

ID1	Info Request	Response	Attachment
	how far noise and vibration is predicted to be propagated along rail lines ahead or behind moving trains, at a level detectable by caribou. Provide a list of studies, if any, that have been conducted on this topic and clarify if this was considered in the assessment.	References: Baffinland Iron Mines Corporation. 2012. Mary River Project Final Environmental Impact Statement: Volume 6 — Terrestrial Environment. 200 pp. (http://ftp.nirb.ca/02-REVIEWS/COMPLETED%20REVIEWS/08MN053-BAFFINLAND%20MARY%20RIVER/2-REVIEW/08-FINAL%20EIS/FEIS/Vol%2006/)	
GN 51	Provide the following information: 1. Please explain what is meant by: “should prove equally effective.” (TSD 10; Section 3.4.1.2) Clarify What the current proof of effectiveness is. Clarify how effectiveness will be proven through subsequent monitoring. In this regard, please note that simply documenting cases of caribou crossing the rail line is proof that some individuals will cross but does not by itself quantify the overall permeability of this structure to the north Baffin caribou herd. 2. It is noted that railway design criteria presented in section TSD 02; Appendix D; Section 9.11.2 provide for a total of 11 caribou crossing structure along the railway; an average of 1 every 10 km. Please provide, if available, references to published studies demonstrating that engineered wildlife crossing structures at points along roads or railways serve to increase the permeability of these structures to barren-ground caribou. Again, please note that documenting use of these structures by caribou is proof that some individuals will cross them but does not, by itself, quantify permeability of a road or railway. 3. Please clarify what is meant by: “The Northern Transportation Corridor will have modified embankments (if necessary).” (TSD 10; Section 3.4.1.2) Clarify if all embankments along the corridor will be engineered to heights of less than 2 m and a side slope of < 1V:2H. 4. Provide evidence to support the notion that an embankment height of < 2 m and a slope of < 1V:2H is permeable to caribou and how this has been quantified. Please provide, if available, references to published studies demonstrating that these design criteria enhance the overall permeability of a road or railway to caribou.	1. The statement "should prove equally effective." (TSD 10 Wildlife Baseline and Impact Assessment; Section 3.4.1.2) means that the proposed North Railway and the previously approved South Railway are sufficiently similar that the mitigation measures proposed for the South Railway (the Approved Project) are also applicable to the North Railway. Proof of effectiveness for mitigation measures for the North Railway is not currently practical nor possible. Some uncertainty exists for mitigation measures related to the proposed North Railway, as railways are currently unprecedented in the high Arctic. The proposed mitigation measures were developed based on best practices and extensive IQ input, and their effectiveness will be determined through monitoring results from the programs outlined in the Terrestrial Environment Mitigation and Monitoring Plan (TEMMP; Appendix U of TSD 28 Management and Monitoring Plans of the Phase 2 Proposal). 2. No references to published studies demonstrating that engineered wildlife crossing structures at points along roads or railways serve to increase permeability of these structures to barren-ground caribou will be provided, because these studies do not currently exist. All relevant available literature on this subject has been discussed in Section 3.4.1.2 of TSD 10 Wildlife Baseline and Impact Assessment. 3. The statement "The Northern Transportation Corridor will have modified embankments (if necessary)." (TSD 10 Wildlife Baseline and Impact Assessment; Section 3.4.1.2) means that special crossings will be constructed in areas identified by community members and/or elders in sections where known crossings may be impeded by the rail embankment design. Modifications to the embankments could include widening and/or decreasing the grade of the embankment slope. Not all embankments along the Northern Transportation Corridor will be engineered to heights of less than 2m and a side slope of <1V:2H . See answer to GN 06 for more information. 4. The GN had a similar request for published studies in GN 06 (4). The study cited in that response (ERM 2016) investigated physical characteristics of road crossings that included slope and height. These criteria are the same as in the FEIS for the Approved Project and are based on guidelines that were established for caribou ramps at the Ekati Mine Project roads (e.g., Dominion Diamond 2015). The criteria were also developed in reference to information gathered in the IQ workshops when caribou movement was discussed with knowledge holders familiar with the local landscape when considering a railway and road embankment relative to the surrounding rugged landscape. These criteria were previously reviewed by the GN and all parties in reference to the South Railway for the Approved Project. In particular, the GN is referred to pg. 54 of TSD 10 Wildlife Baseline and Impact Assessment "participants in the IQ workshops noted that caribou movement in this region are not deterred by steep terrain." References Dominion Diamond. 2015. Lynx Access Road Caribou Crossings Location and Design Plan. Submitted to Wek'eezhii Land and Water Board, Yellowknife, NWT, Canada. (http://reviewboard.ca/upload/project_document/EA1314-01_Ekati_Lynx_-_Caribou_Crossings_Plan_-_Lynx_Access_Road_-_Design_and_Locations.PDF) ERM. 2016. Ekati Diamond Mine: Caribou Crossing Photo and Road Features Analysis — 2011 to 2015. Prepared for Dominion Diamond Ekati Corporation, Yellowknife, NWT, Canada. 26 pp.	

ID1	Info Request	Response	Attachment
GN 52	Provide the following information: 1. Please indicate where in the FEIS addendum, details of the modelling methods and results for the 5 scenarios presented in section 3.4.1.5 (TSD 10) can be found. If not provided in the FEIS addendum, please provide these methods and results in full. 2. With respect to the modelling exercise presented in attachment 1 (TSD 10), please clarify whether the caribou collar data used to estimate caribou use of the area around the Project were collected during a period when there was no development activity in the RSA (e.g. exploration activities, camps, roads etc.). If development activities were taking place, please provide a summary of those activities and discuss the potential effect on the accuracy of the model results. 3. With respect to the modelling exercise presented in attachment 1 (TSD 10), please explain how use of a fixed harvest rate of 75 caribou realistically demonstrates the impact of development on the ability of the north Baffin caribou to sustain a harvest that will likely increase to meet the basic needs of Inuit as the population recovers. Please repeat this modelling exercise using the scenario described in the previous section of this information request.	1. Details of modelling methods are not included in the Phase 2 Proposal. The full details are in the first energetics submission for the Approved Project (Russell 2012). Also see response to GN 46. 2. The caribou collar data used to estimate caribou use of the area around the Project were collected between 2008 and 2011 (Jenkins and Goorts 2011). At this time, Baffinland exploration activities were taking place in the RSA that included activities mostly on Deposit 1. For modelling purposes, the collar data represents pre-mine conditions. Exploration activities that occurred during that time were considered negligible and were not expected to affect the accuracy of the model results in any meaningful way. 3. We agree, as was stated, that a harvest of 75 throughout the cycle of abundance is not realistic. Our objective was to provide another quantification of how large an effect the project could potentially have on north Baffin caribou. We felt that the simplest approach was to provide, under current conditions, an assessment of how much of a reduction in harvest and/or a shift from cows to bulls in the harvest could offset development. We did not intend to assume that harvest offsetting development was necessarily a recommended mitigation tool throughout the cycle of abundance. In fact, we would agree that at high population levels, harvest as a mitigation tool would be less effective given harvests' contribution to overall herd productivity. We think that the more detailed analysis of the interaction among population size, productivity, harvest and development (with the aim of evaluating harvest management as a mitigation tool), although a valuable exercise, and requiring the involvement of harvesters and managers, was beyond the scope of our analysis. <u>References</u> Jenkins, D. and Goorts, J. 2011. Space use and movement patterns of north Baffin caribou: Field summary and progress report. NWMB Project No. 03-09-01. Government of Nunavut Department of Environment. 13 pp. Russell, D. 2012. Energy-Protein Modeling of North Baffin Caribou in Relation to the Mary River Mine Project: Appendix 6H, Volume 6 - Terrestrial Environment, Mary River Project, Final Environmental Impact Statement. Prepared for Baffinland Iron Mines Corporation, Toronto, Ontario. 42 pp.	
GN 53	Conduct an assessment of cumulative exposure to Chemicals of Potential Concern through all complete and significant exposure pathways.	A cumulative assessment of exposure from all pathways was not included in the EIS guidelines for the Phase 2 Proposal. In response to IRs from Health Canada, as well as Government of Nunavut, the proponent will undertake a screening of exposures via the drinking water pathway (as per Health Canada (HC) 02), air inhalation pathway (as per HC 04), and country foods ingestion pathways (as per HC 03). Soil ingestion was assessed in TSD 11 Evaluation of Exposure Potential From Ore Dusting Events in Selected VECs, as all soil quality guidelines used in TSD 11 include soil contact and/or ingestion and screening against the guidelines used in TSD 11 is standard practice. Elements found to be elevated in these screening assessments, relative to guidelines and baseline, will be considered further relative to potential for cumulative risks.	
GN 54	Complete further quantitative assessment regarding risks due to blueberry consumption to support its conclusion that ingestion risks are not present. In particular, the assessment should answer whether this conclusion remains valid if blueberries are consumed if this pathway is found to be complete and significant (i.e. if blueberries or other available country foods are available and regularly consumed).	Blueberries were selected as a VEC in the FEIS which was completed in 2012. The selection of this VEC was due to the community's identification of blueberry picking areas near the overall Project, particularly in the Steensby area. Maps 1.5 and 1.6 of the Inuit Mapbook for the project show there is no berry picking in the immediate area of the Mine Site, and limited berry picking near the Port site. Blueberries were kept as a country food of interest for this assessment, because when people travel across the land and find berries, they will pick them, and hence, the Proponent felt it was important to provide an assessment of berries. As indicated in response to GN 53, a technical response is being prepared to Health Canada (HC) 03 (Country foods), and in that technical response, berry consumption will be considered. The response to HC 03 will therefore address this IR.	
GN 55	Provide additional information to support the assumption of reduced bioavailability for metals in ore dust. The Proponent should complete a quantitative assessment of the magnitude at which the reduced bioavailability will reduce risks if consumption of blueberries is a complete and significant exposure pathway.	The consumption of blueberries will be addressed as part of the Technical Response to HC 03 (country foods). Therefore, blueberry consumption will be considered a complete exposure pathway in the pending Technical Response, regardless of whether berries are found in the area. People ingesting berries could be exposed to ore dust through either dust depositing on to the berries, or via metals dust deposition onto soil and root uptake. Therefore, the	GN 55 Attachment 1: Table 1 - Soil and Chemical Characteristics Affecting Oral

ID1	Info Request	Response	Attachment
		bioavailability of metals in ore will have an influence on possible exposure levels. Refer to the attached table for more information (Appendix 1). With respect to bioavailability of ore dust in soils near the Project area, Health Canada provides guidance on the consideration of oral bioavailability in the risk assessment process through the Federal Contaminated Sites Action Plan (FCSAP) Supplemental Guidance on Human Health Risk Assessment for Oral Bioavailability of Substances in Soil and Soil-Like Media (HC 2017). Additional information to support the assumption of reduced bioavailability will be included in the Technical Response to HC 03 (country foods). References Health Canada (HC). 2017. Federal Contaminated Site Risk Assessment in Canada. Supplemental Guidance on Human Health Risk Assessment for Oral Bioavailability of Substances in Soil and Soil-Like Media. Contaminated Sites Division. Safe Environments Directorate. June 2017. ISBN: 978-0-660-09285-0.	Bioavailability of Metals
GN 56	Provide clarity on the areas where increased deposition is expected and whether human receptors will have access to these areas. In its response, the Proponent should describe how consideration was given to both workers and others utilizing the lands and waters in the area.	TSD 11 Evaluation of Exposure Potential from Ore Dusting Events in Selected VECs provided an assessment of areas with deposition rates of 55 g/m2/year (Mine, Milne Port and Tote Road), 144 g/m^2/year (Mine); and 110 g/m^2/year (Tote Road). There are only small differences in the geochemical characterization between these three areas (see Tables 2-1a; b, in TSD 11), and hence, the 144 g/m2/year scenario assessed for the Mine Site can be considered representative of an upper bound scenario. To answer this question, new isopleth figures were developed by RWDI to illustrate the size of areas at Milne Port, the Mine and Tote Road with deposition rates higher than 144 g/m2/year (see Appendix 1; Figure D-14, Milne Port; Figure E-14; Mine; and Figure F-18, Tote Road, and Figure 13, Tote Road, temporary transfer facility scenario). As indicated in the attached Figure D-14 (Milne Port area) (Appendix 1), the size of area with deposition rates > 144 g/m^2/year is small and restricted to areas within the active workings of the industrial port facility. Local land users would not be expected to spend any significant time in this area, as it is an industrial site. There are strict protocols limiting access of non-employees to active industrial areas of the Mine Site, Milne Port and Tote Road that must be adhered to. Hence, exposure potential for local land users to dust deposition rates of this magnitude would be limited. Any exposure, if it were to occur, would be transient and short in duration. Note that the HTO cabin has dustfall rates of 2-5 g/m^2/year, which would be a location where local land users could spend time. Over half of the area within the PDA has dust deposition rates < 55 g/m^2/year (Figure D-14). With respect to workers, they could be exposed to areas with dust deposition rates of > 144 g/m^2/year during their workplace activities. Baffinland Iron Mines is expected to adhere to Territorial occupational health and safety legislation, and hence exposures are expected to be kept within occupational health and safety allowable levels. For the Mine Site, the attached Figure E-14 (Appendix 1) illustrates the size of areas with deposition rates higher than 144 g/m2/year. As per the Milne Port area, areas which are predicted to exceed this level of dust deposition are within the active industrial areas of the site, and hence the likelihood of local land users spending any significant time in this area of the mine is considered to be low, and all non-employees must follow the Hunter and Visitor Site Access Procedures. There are hazards related to high voltage power line and pipeline, which restrict access to many parts of the site. Therefore, exposure potential for local land users to these more elevated dust deposition areas is considered to be low. Note that the HTO cabin has predicted dustfall rates of between 5 and 10 g/m^2/year, and a large proportion of the PDA areas has dustfall rates < 55 g/m2/year (Figure E-14). As per Milne Port area, workers could experience exposure to dust deposition rates > 144 g/m2/year in active parts of the mine site area. Workers are protected by Territorial occupational health and safety limits, which are expected to be adhered to by the proponent. For Tote Road, the attached Figure F-18 (Appendix 1) provides an example of areas which are predicted to exceed 144 g/m^2/year. These areas are limited in size and are generally immediately adjacent to the road. While local land users could be present in these areas, it is anticipated that they would not spend significant periods of time on the road, or adjacent to the road. Therefore, exposures would be expected to be limited and transient. The Tote Road scenario involving the temporary transfer facility is presented in Figure 13 (Appendix 1). This scenario results in higher dust deposition rates in areas south of the transfer facility, and lower dustfall rates in areas north of the facility (due to the transfer of ore to rail, rather than the use of trucks). This scenario is only anticipated to last for a single year, while the southern part of the rail is constructed. Exposure to areas with dust deposition rates > 144 g/m2/year could occur in the instance that local land users spend time in areas near Tote Road, but as indicated above, exposure would be expected to be transient and limited in duration.	GN 56 Attachment 1: Figures

ID1	Info Request	Response	Attachment
GN 57	Provide rationale respecting how dust suppression measures were factored into prediction of dustfall rates for the Tote Road (e.g. type of mitigation measure and the duration of mitigation).	Fugitive dust emissions from unpaved haul routes are mitigated as follows: • Natural dust suppression during and for short periods after significant precipitation events; • Natural dust suppression for an extended period during winter months when the roads are snow covered and/or frozen sold; • Dust suppression implemented by the mine operators during the summer months. BIM uses a combination of watering and application of calcium chloride, from mid-June into September. As a practical way to assess residual fugitive dust emissions and dust deposition, considering these mitigating factors, RWDI decided to estimate and apply a single average value of percent reduction, relative to unmitigated dust emissions. We considered a variety of sources on information, including the following key ones: • Golder Associates (Determination of Natural Winter Mitigation of Road Dust Emissions from Mining Operations in Northern Canada, September 2012) conducted field studies at two DeBeers mining operations in Northern Canada and estimated wintertime dust mitigation efficiency to be in excess of 90% relative to unmitigated summertime dust emissions. The wintertime field measurements were conducted during January and February. This does not account for late winter and early winter periods when there is much less natural dust suppression, but the temperatures remain unfavorable for the mine operators to apply water and other dust suppressants. • Walker and Everett (Road Dust and its Environmental Impact on Alaskan Taiga and Tundra, Arctic and Alpine Research, Vol. 19, No. 4, 1987, pp. 479-489) conducted field studies of dust deposition along the unpaved Dalton Highway in Alaska, and reported that, along the heavily travelled roads near Prudhoe Bay, the 9-month winter dust deposition was about the same as 3-month summer deposition load, implying an average reduction in dust emission over the 9-month winter period of about 66% compared to the summertime. This would include the late and early winter periods when there is much less natural dust suppression compared to mid-winter. • Golder Associates (2012) also looked at the efficiency of DeBeers summertime watering programs and found that a dust control efficiency greater than 80% could be achieved during the summer months by applying water 4 to 6 times per 24-hour period of mine operation. • Rosbury (Handbook of Dust Control at Hazardous Waste Sites, EPA/540/2-85/003, November 1985) summarized results for various field studies of dust control on unpaved haul roads. The dust mitigation efficiency of watering programs is highly dependent on the frequency of watering, but for high frequency watering programs, observed efficiencies ranged from 75 to 98% for total particulate matter. Mitigation efficiencies for chemical dust suppressants were very high immediately after application (80 to 100%) but degraded over time, generally indicating that the chemical suppressants needed to be reapplied more often than once per summer season. This literature review supported the use of a 66% fugitive emissions reduction factor in the dustfall modelling predictions.	
GN 58	Provide the relevant stakeholder feedback as outlined in TSD 13 – Surface Water Assessment.	TSD 13 Surface Water Assessment, Section 1.3 provides an accurate summary of the feedback received. The comments received which were categorized as relating to Surface Water addressed the following issues: • Question about PAG disposal • Question about surface water drainage • Questions about water potability • Support for movement of secondary crushers • Comment about dust observation near brooks • Question about sewage disposal As presented in TSD 13, section 1.3 - “A very small proportion of stakeholder concerns recorded during engagement on the Phase 2 Proposal were related to surface water. Comments were received from community members of Arctic Bay, Clyde River, and Pond Inlet. Approximately half the comments raised were related to effluent discharges and Baffinland’s wastewater treatment facility; two comments were related to the quality of traditional drinking water locations; and the remaining comments were related to acid rock drainage, surface water quality and quantity monitoring and sediment quality. Minimal feedback was received regarding water quantity (changes in flow).”	

ID1	Info Request	Response	Attachment
GN 59	Provide a description of how the construction materials, operation of the rail line, maintenance of the rail line, and accidents may affect groundwater and surface water quality.	Construction of the railway has the potential to result in sedimentation of surface waters if not mitigated (TSD 13 Surface Water Assessment, Section 3.5.2). The potential for quarries, rock cuts and aggregate used to construct the rail embankment to result in acid rock drainage (ARD) and/or metal leaching (ML) is assessed in Section 3.5.3. Railway ties will be made of untreated wood. There is limited potential to impact groundwater (Section 3.1).	
GN 60	Provide confirmation that no dewatering is required for the new quarries associated with the Phase 2 Proposal. If dewatering is required, provide an assessment of the potential effects to groundwater quantity, surface water quantity (groundwater fed watercourses) and quality (i.e., temperature).	Continuous permafrost means that groundwater is limited to seepage through the upper 1 to 2 m of active layer. Hence quarries will not receive meaningful inflows of groundwater that will require management. Limited seepage through the active layer, plus precipitation and any surface runoff that is not diverted away from the quarries will report to the quarries. Occasional discharges may be required but the volumes will be relatively small.	
GN 61	Provide an outline on how an increase in the baseflow could affect the surface water quality (including temperature).	The diverted streams drain terrain similar to the receiving waters, so there is no reason to expect that the increased baseflow from the combined streams will meaningfully affect surface water temperature or other water quality parameters.	
GN 62	Provide an assessment of how increased dust generation at the Milne Port may affect the water quality (metals in particular) of Philips Creek.	A simple model was used to calculate potential metals concentrations in Phillips Creek, based upon conservative estimates of potential TSS in Phillips Creek of 1 to 9 mg/L (Section 3.5.2.6 of TSD 13 Surface Water Assessment), dustfall chemistry presented in Tables 2-1a and 2-1b of TSD 11 (Evaluation of Exposure Potential From Ore Dusting Events in Selected VECs), and 90th percentile of baseline water quality at baseline station N1-020 from the water quality baseline report (FEIS Appendix 7b). Results were compared to CCME criteria for the protection of freshwater aquatic life. Baseline aluminum concentrations of 1.66 mg/L exceed the CCME criterion, and will increase to 1.79 mg/L assuming a TSS level of 9 mg/L. A baseline iron concentration of 0.07 mg/L increases to 0.47 mg/L, above the CCME criterion for iron of 0.3 mg/L. All other parameters are below the corresponding CCME criterion.	
GN 63	Explain how alternative dust suppression methods could potentially affect surface water quality. If no alternatives are identified, please explain if dust generation is expected to increase seasonally due to the reduction of available surface water for suppression.	The reviewer appears to be asking about mitigating dust generated during winter conditions. Dust generation does begin as the Tote Road becomes clear of snow/ice cover in May and June and decreases during the winter months when water would be unavailable for suppression activities and/or would not be considered for such. Following construction of the Phase 2 Proposal, the level of traffic on the Tote Road will be substantially reduced. All alternative non-water based dust suppressants considered for use by Baffinland will be implemented in accordance with the GN's Environmental Guideline for Dust Suppression.	
GN 64	Clarify if this is a typographical error or provide an explanation as to why additional water taking is required beyond that of the approved Water License.	The referenced section and text is a typographical error. The lakes already approved under the licence will not be sufficient to provide water for dust suppression during construction of the Phase 2 Proposal. In addition to seeking a higher volume of water (which the existing approved lakes could provide), Baffinland is seeking to establish more stations, so that water trucks can be more efficient in applying water to the road and less time will be required in transit to and from water sources.	
GN 65	Provide the following information: 1. Explain why the moderate to high risk diversions are not prescribed a multi-year monitoring program. 2. Provide a more thorough monitoring and mitigation program for all water diversions.	The referenced text is clarified here. The low risk diversions will be monitored for 1-2 years but no mitigation is proposed. The moderate to high risk diversions will require mitigation, and though not explicitly stated, will be monitored as well to ensure the mitigation that has been applied will be effective.	
GN 66 (1 of 4)	Ice Conditions: The Ice Conditions Report (TSD 16) indicates that the nominal open water period along the Project's shipping route is August 5 to October 15, resulting in an open-water shipping window of 71 days. However, the Project Description (section 5.1) states that: "[T]he originating ice conditions and ship access study is presented as TSD 16. Shipping routes are generally open water during the period of July 25 to October 15." (TSD 16; Section 5.1) The same open water period (July 25 to Oct 15) is also referenced elsewhere in the FEIS addendum (e.g. TSD 27; Section 1.3.4.4). The Proponent should: 1. Explain the difference in the dates of the open water period as estimated from the ice conditions study commissioned for the Project versus those referred to in other parts of the FEIS addendum. Based on results of the Ice Conditions Report (TSD 16) and assuming a shipping season of July 1 to Nov 15th, there is potential for ice breaking by Project shipping to occur for up to a month during the break-up and freeze-up respectively. The Ice Conditions Report also indicates that:	Please refer to the Overview of Marine Operations Attachment for further information (Appendix 12). Details are also provided in the Overview of Marine Operations Appendix. 1. The shipping window constraints related to sea ice were assessed in TSD 16. Section 3.2.2 of TSD 16 presents shipping windows for different vessel classes and considered data related to thaw and freeze-up from 1997 to 2016 along the Northern Shipping Route. The different ship types considered vary in their ability to engage ice. Open water was defined as the area of free navigable water in which ice can be seen in trace concentrations (less than 1/10). The average open water season from 1997 to 2016 along the Northern Shipping Route was August 5 to October 15 (71 days). Table 2 in TSD 16 indicates the earliest break-up and open water conditions occurred as July 8 (2011) and July 23 (2016), respectively. The latest freeze-up conditions occurred on October 23, in 2016 and 2014. Section 7 of TSD 16 includes the conclusion that Type A and PC 6 vessels have a slightly longer high confidence shipping	Appendix 12: Overview of Marine Operations

ID1	Info Request	Response	Attachment
	"[I]n the channels close to Milne Inlet (Pond Inlet, Milne Inlet, Navy Board Inlet and Eclipse Sound), the sequence of clearing events during break-up is quite rapid. Break-up generally starts in mid-July and lasts 3-4 weeks." (TSD16; Section 2.1) This information suggests that once the process of ice break-up is initiated it proceeds rapidly. 2. Noting that ice-breaking by ships is a form of anthropogenic break-up, what potential is there for the proposed shipping (in particular that occurring during early July) to advance break-up in this area? Was this assessed? If available, provide evidence in the form of studies or other materials demonstrating that Project shipping will not advance break-up and clearing of ice. In providing a response, please take into account estimated levels of shipping during break-up and the likelihood that Project shipping will make multiple tracks through sea-ice rather than all ships following the same track. Please provide evidence to substantiate assumptions and predictions regarding ship tracks (e.g. a map of the area showing Global Positioning System tracks for all ships that have broken ice while servicing the currently Approved Project) (see also GN IR 73 - Marine Shipping Routes). 3. The Ice Conditions Report also indicates that the typical timeframe for freeze-up in this area is short, occurring from mid-October, with the first signs of ice formation, and mid-November, with the consolidation into land fast ice over 30 cm thick. What potential is there for the proposed shipping to delay freeze-up in this area? Was this assessed?	window, from July 25 to October 15 (82 days) and the shoulder window can extend the season by up to 25 days. Extending the season might require an icebreaker escort given the variability in the timing of ice break up and ice formation. 2. Baffinland acknowledges that the operational period from July 1 to November 15 may include limited periods when ice will be present and we recognize that a number of IRs have requested additional information considering ice conditions during this time period. Therefore, Baffinland has elected to undertake an additional stand-alone assessment of icebreaking effects during the shoulder seasons that addresses this concern and which will include underwater noise modelling of icebreaker transits along the Northern Shipping Route. The acoustic modelling will be based on a conservative scenario for icebreaking noise based on thickest seasonal ice conditions in the RSA and maximum acoustic propagation potential. The stand-alone acoustic modelling report and icebreaking assessment will be submitted to the NIRB in 2019 once reporting is completed. 3. Baffinland acknowledges that the operational period from July 1 to November 15 may include limited periods when ice will be present and we recognize that a number of IRs have requested additional information considering ice conditions during this time period. Therefore, Baffinland has elected to undertake an additional stand-alone assessment of icebreaking effects during the shoulder seasons that addresses this concern and which will include underwater noise modelling of icebreaker transits along the Northern Shipping Route. The acoustic modelling will be based on a conservative scenario for icebreaking noise based on thickest seasonal ice conditions in the RSA and maximum acoustic propagation potential. The stand-alone acoustic modelling report and icebreaking assessment will be submitted to the NIRB in 2019 once reporting is completed.	
GN 66 (2 of 4)	Shipping Window: There are differences in the dates of the commencement of the proposed shipping season amongst sections of the FEIS addendum. A season from July 1 to Nov 15 is indicated in some sections (e.g. TSD 02; Appendix C, TSD 02; Section 4.2.4, and TSD 24; Section 2.5.2.2) while in others a season of July 15 to Nov 15 is referenced (e.g. TSD 02; Section 4.1.4, 5.1, & 5.2). 4. Clarify the dates of the proposed shipping season for the Phase 2 project.	July 1 to November 15 is the proposed shipping season. Please refer to the Overview of Marine Operations (Appendix 12) for further information	Appendix 12: Overview of Marine Operations
GN 66 (3 of 4)	Overall Shipping Rates: Reported rates of marine shipping for the Project are inconsistent throughout the FEIS addendum documents. For example, section 1.3.4.4 (TSD 27) indicates there will be an estimated 176 vessel trips over the shipping season. This figure is inclusive of ore carriers, sealift vessels and tankers. In contrast Table 1-1 of the Project Description which indicates shipping for Phase 2 will be 134-164 for ore carriers plus 18 freight deliveries and12 fuel deliveries for a total of up to 194. Additionally, as noted in the Ice Conditions Report (TSD 16), and in the Project Description, the proposed shipping window will require ice management vessels at the beginning and the end of the season some of which will need to escort ore ships for 400 to 500 nautical miles (NM) in Baffin Bay all the way to Milne Inlet. These ice management vessels do not appear to be included in estimates of ship traffic provided. Finally, it is unclear from the tables presented in the FEIS addendum whether the term 'trip' refers to a round trip or a one-way vessel transit. 5. Although the GN appreciates that only estimates of ship traffic can be provided at the present time, it is important to have a clear understanding of the rates considered in the assessment. The Proponent should provide a definitive table of estimated marine ship traffic for the Phase 2 Project. This table should summarize separately the different types of shipping including ore ships, fuel tankers, freight ships and ice management vessels (that will escort ore ships). Please express shipping rates as the mean estimated number of one-way vessel transits to or from the Milne Port site. Please also provide within this table estimates	Please refer to the Overview of Marine Operations Attachment for clarification (Appendix 12)	Appendix 12: Overview of Marine Operations
GN 66 (4 of 4)	Timing of Shipping: It is unclear from the FEIS addendum how much of the Project's marine shipping could involve ice-breaking	6., 8., 9. Please refer to the Overview of Marine Operations Appendix for clarification (Appendix 12)	Appendix 12: Overview of Marine

ID1	Info Request	Response	Attachment
	in the RSA or in Baffin Bay proper. It is noted that: "[M]ost shipping would occur during the open water season, with shipping to occur during the periods of ice break up and ice formation, as required." (TSD 02; Section 4.2.4) The phrase "as required" is not explained further and estimates of shipping that could occur before Aug 5 or after Oct 15 (i.e. outside the nominal open water period identified in the Ice Conditions Report – TSD 16) are not provided. Additionally, the FEIS addendum does not contain information on the handling times of ships visiting the Milne Port site. It is therefore not possible to review whether the proposed 3-fold increase in shipping can be readily accommodated within the nominal 71 day 'open water period' through the addition of a second dock facility or if it will require extensive shipping through ice. 6. The Proponent should further explain what is meant by "as required". What factor or factors will be used to determine when shipping is to occur during the periods of ice break up and ice formation? What criteria or decision tools will be implemented? 7. For all types of marine shipping that have occurred for the currently Approved Project, provide summary information on frequency of shipping in the form of a histogram showing times of arrival and departure at the Milne Inlet port in weekly bins from July 1 to Nov 15. This information is requested in-order to understand the existing shipping pattern in relation to the nominal open water period (Aug 5 to October 15) identified in the Ice Conditions Report (TSD 16). 8. For all types of marine shipping that will be associated with the Phase 2 Project, provide a table of estimated marine ship traffic for the Phase 2 Project in the following intervals that approximate break-up, open water and freeze-up based on the Ice Conditions Report (TSD 16): July 1 to August 4, Aug 5 to Oct 15, Oct 16 to Nov 15. Where possible this should summarize separately the different types of shipping including ore ships, fuel tankers, freight ships and ice management vessels (that will escort ore ships). Where pooled estimates are provided, please indicate the vessel types included. Please express shipping rates as the mean estimated number of one-way vessel transits to or from the Milne Port site. Please provide within this table the estimates of the minimum and maximum conceivable shipping rates for each type of traffic within these time intervals. 9. Using data from the current Approved Project if available, or other referenced sources, provide estimates for the average expected handling time (hour or days) of an ore, freight and fuel vessel using the Milne docking facilities. This should include time required to dock, load or unload and depart. Please note any predicted seasonal variation in handling times.	7. Summary information for marine shipping frequency for the Approved Project, consolidated in weekly bins, is provided in the Attachment (Appendix 1).	Operations GN 66 Attachment 1: Summary of Shipping Frequency
GN 67	Provide the following information: 1. Clarify what the shipping route is outside the RSA and if icebreakers will be operating on this route outside of the dates they will be operating within the RSA. If so, clarify if the period of time the icebreaker(s) will be on hand to operate. Clarify how many ice breakers will be on hand. Clarify if the icebreakers use the same route on every trip. 2. Clarify the estimated speeds the ice breakers will be travelling at, inside and outside the RSA. 3. Clarify the sound levels of ice breakers during various speeds of travel, both while the vessel is actively engaged in breaking ice and when not. 4. Provide a literature review of the potential impacts of icebreaking on the marine mammals that occur in the RSA. Clarify the measures that will be taken to mitigate any impacts on marine mammals and the measures taken to evaluate impacts on marine mammals. 5. Detail the range for marine mammal disturbance from the ice breaking vessels.	In addition to the responses provided below, please also see Appendix 12: Overview of Marine Operations. 1. Shipping routes outside of the RSA is beyond the scope of the current assessment. Please also reference GN 72 and GN 73 2. All Project vessels (including ice management vessels) are required to abide by the maximum speed limit of 9 knots within the RSA. 3. Assessment of acoustic disturbance for Project vessels (tugs and ore carriers) during various scenarios (berthing, transit and mooring) has been included in TSD 24 Marine Mammal Effects Assessment with modelling presented in Appendix B. Baffinland acknowledges that the operational period from July 1 to November 15 may include limited periods when ice will be present and we recognize that a number of IRs have requested additional information considering ice conditions during this time period. Therefore, Baffinland has elected to undertake an additional stand-alone assessment of icebreaking effects during the shoulder seasons that addresses this concern, and which will include underwater noise modelling of icebreaker transits along the Northern Shipping Route. The acoustic modelling will be	Appendix 12: Overview of Marine Operations

ID1	Info Request	Response	Attachment
	6. Explain what was done during the 2018 shipping season to understand the impacts of icebreaking on marine mammals. Clarify how many interactions were documented with marine mammals during ice-breaking activities and what information was collected on marine mammals during ice breaking activities.	based on a conservative scenario for icebreaking noise based on thickest seasonal ice conditions in the RSA and maximum acoustic propagation potential. The stand-alone acoustic modelling report and icebreaking assessment will be submitted to the NIRB in 2019 once reporting is completed. 4. See response to item 3. 5. See response to item 3. 6. The Ship-based Observer (SBO) marine mammal monitoring program ran in 2018 aboard the MSV Botnica during the shoulder seasons. Marine mammal observers (MMO) from Pond Inlet and Golder Associates monitored daily onboard the Botnica from July 28 to August 7 and again from September 28 to October 17. The report is scheduled to be completed in Q1 of 2019 and will be issued to the Marine Environment Working Group (MEWG) members at that time.	
GN 68	Provide the following information: 1. Clarification on the methods used for data collection. Describe how knowledge gathering was conducted, how participants were selected, etc. 2. A list of the questions asked during workshops. 3. Clarification on the number of people that attended the workshops. 4. Clarification on the methods used in data analysis. 5. Clarify whether there was consensus on topics and how many people agreed or disagreed. 6. Robust and complete results from marine mammal survey within the RSA.	The following provides a summary of Baffinland's response. The full response can be found in Appendix 1. The summary of marine mammal IQ from community workshops presented in Appendix A of TSD 24: Marine Mammal Effects Assessment was drawn from the source document TSD 3: Phase 2 Workshop Report. TSD 3 should be consulted for any additional information on the Phase 2 community workshops.	GN 68 Attachment 1: Full Response to GN 68
GN 69	Update its CEA to include the more recent and relevant North Baffin caribou surveys conducted by the Department of Environment Wildlife Division. The Proponent's CEA should accurately describe these surveys and differentiate between which surveys are conducted to determine abundance and which are used to determine herd composition.	Baffinland's summary of the Government of Nunavut caribou surveys was in relation to a description of listing Relevant Projects and Activities (Section 1.3.4) that may physically overlap with the Mary River Project and contribute to cumulative effects. As noted on TSD 27 Cumulative and Transboundary Effects Assessment, page 18, "The disturbances associated with marine mammal and caribou monitoring programs that involve aerial surveys and/or tagging warrant consideration in the CEA." The intent was not to describe the activity as a cumulative effects monitoring program, rather to describe it as a potential cumulative effect due to the disturbance related to aerial surveys. Baffinland acknowledges the clarification provided by the GN, but the further description of the intent of the surveys is, in this context, irrelevant.	
GN 70	Provide a revision of the Proponents CEA to include its plans for any future development.	The GN's IR stated: *"If the Proponent has determined which ore deposits it wishes to develop following the Mary River Phase 2 Amendment; and has conducted enough exploration and planning that they know the amount of ore they will be removing per annum; and the additional area to the PDA will be required as per Table 1.4, then they should include these as reasonably foreseeable projects in the CEA."* Baffinland established a future development scenario for the purposes of the assessment, in accordance with the Guidelines. We attempted, however, to remind readers that the future development scenario does not qualify as a 'reasonably foreseeable project' as per the NIRB's definition and common practice in other jurisdictions. Deposits 2 and 3 have not been sufficiently defined so as to contemplate development. Both deposits will require further study to potentially define a mineable mineral resource. For clarity, no expansions to the PDA or annual production rates are known at this time to justify a revision of the CEA	
GN 71	Provide the following information: 1. An updated standalone section on the assessment scoping and methodology. Describe in detail the proposed revision in the assessment scoping; indicate the updates that are made in the baseline and assessment comparing to the Approved Project. 2. A coherent set of criteria proposed to assess significant effects (i.e. make a clear statement for what	1. The Phase 2 Proposal followed the same methodology that was approved for the FEIS and ERP addendum to provide consistency between applications. The assessment methodology is described in Section 9 of the EIS Main Document of the Phase 2 Addendum. To demonstrate compliance with the Guidelines, Table 9.1 in this Section was developed to describe the scope of the assessment.	

ID1	Info Request	Response	Attachment
	exactly is considered a significant effect and why). 3. Improved methodology of cumulative effects assessment (i.e. describe the criteria of assessing the cumulative effects). 4. Use consistent terminology when discussing “key indicators”.	2. Consistent with previous applications for the Mary River Project, significance determination considered the following criteria. • Direction or nature of an effect (i.e., positive/beneficial versus negative/adverse); • Magnitude and complexity of an effect; • Extent of the effect, including the geographical area that will be affected, the size of the affected human populations, and/ or the size of the affected wildlife populations and habitat; • Frequency and/or duration of an effect; • Reversibility or irreversibility of an effect; • Probability or likelihood of occurrence of the effect; and • The level of confidence in the effects prediction. • Further, determination of significance considered the factors outlined in Section 90 of the Nunavut Planning and Project Assessment Act. • Definitions and descriptions for these criteria were included in the FEIS, Volume 2, Section 3.8 (see Appendix I of the EIS Main Document Phase 2 Proposal), and those same definitions were used in the Phase 2 Proposal. 3. The methodology that was used, and approved, in the Approved Project to assess cumulative effects was also used in the Phase 2 Proposal. This approach provides consistency between assessments. 4. The term "key indicators" is used to describe specific parameters that are measured as part of the assessment and provide specific focus to the assessment.	
GN 72	Little is known about the impact of shipping on polar bears. However, the assumption that there is no important interaction between Project shipping and polar bears (and their sea-ice habitat) is unsubstantiated. This interaction should have been assessed. Baseline information on polar bears exists to support an assessment or an update to a previous assessment. Several gaps in information regarding the rates, timing and routes of shipping, as well as ice management measures are apparent within the FEIS addendum. These gaps limit reviewers in properly understanding the potential for ice-breaking through important polar bear habitat and must be addressed in-order to conduct an accurate, or at least robust, assessment. The GN has attempted to address these gaps through other information requests in this submission (GN IRs 66 (Marine Shipping Rates and Schedule and 73 (Marine Shipping Routes). Subject to review of the responses to those requests, the GN may recommend that additional assessment work be conducted by the Proponent. Provide the following information: 1. Explain how the RSA used in the FEIS addendum for the assessment of polar bears complies with NIRB guidelines. 2. Explain how this RSA represents an “ecologically relevant scale” for polar bears. 3. Explain why the assessment did not consider the Baffin Bay polar bear sub-population as a unit for assessment of Project, cumulative or transboundary effects. 4. Explain why the assessment of the shipping effects on wildlife excluded the route(s) through Baffin Bay and what information about shipping makes this a reasonable approach. 5. Given the potential for marine shipping associated with the Project to break sea-ice for up to a month during break-up and freeze-up respectively, explain why the assessment did not consider the interaction between marine shipping and polar bears (on ice) or their sea-ice habitat.	1. The NIRB guidelines (PR ID# 317362) for the Phase 2 Proposal identify the following criteria for assessment spatial boundaries: • The physical extent of project activities; • The extent of ecosystems potentially affected by the Project; • The extent to which traditional land use and Inuit harvesting could potentially be affected by the Project; and • The size, nature and location of past, present, and reasonably foreseeable projects and activities which could interact with the items listed above. The EIS shall define the spatial boundaries of the maximum area potentially affected by the Project, based on the boundaries for each individual type of impact, taking in to account other relevant factors such as the migratory and/or lifecycle of some wildlife species and showing clearly and in detail, how the seasonal distribution and movements of potential impacted wildlife species (VECs) were considered when defining boundaries. Regional Study Area (RSA): the Regional Study Area shall be defined as the area within which there exists the potential for direct, indirect, and/or cumulative biophysical and socio-economic effects. This area includes lands, communities, and portions of Nunavut and other regions of Canada that may be relevant to the assessment of wider-spread effects of the Project. The RSA used to assess the Northern Shipping Route for marine mammals (including polar bear) includes the physical location of the Project and captures the area of ecosystems potentially affected by the Project. The RSA was selected to include the area of Inuit traditional land use and harvesting, as well as past, present and reasonably foreseeable future developments that could interact with the Project. The RSA is large enough to capture the maximum extent of potential effects (including direct, indirect and cumulative with other past, present and future projects) on marine mammal populations. NIRB's review (PR ID#320082) indicated the Approved Project conformed to NIRB guidelines for spatial boundaries, this incorporates the marine mammal (including polar bear) RSA.	

ID1	Info Request	Response	Attachment
		2. The RSA was selected based on the required NIRB guidelines (PR ID# 317362) noted in item #1. NIRB's review (PR ID#320082) indicated the Approved Project conformed to the NIRB guidelines for spatial boundaries, this incorporates the marine mammals (including polar bear) RSA. 3. As described in #1 and #2, the marine mammal RSA encompasses the area where there is potential for direct and indirect effects from Project shipping on marine mammals (including polar bear), in addition to potential cumulative effects from the Project in conjunction with existing, past, and reasonably foreseeable developments. Use of a larger study area such as the Baffin Bay Management Unit (BBMA) is anticipated to reduce the magnitude, frequency and likelihood of Project-related effects. For example, the BBMA represents approximately a 1,000,000 km2 area (SWG 2016), whereas the marine mammal RSA is 15,934 km2. Focusing the assessment on the RSA maximizes the predicted Project-related effects and the past, present and reasonably foreseeable future projects that the Project is likely to interact with. While additional development may be present in the BBMA the amount of undisturbed area will also increase by orders of magnitude. 4. As described in #3, the selection of the assessment RSA has important implications to characterizing and assessing Project-related incremental and cumulative effects. The Northern Shipping Route represents the area of greatest potential for incremental and cumulative effects (i.e., magnitude, likelihood and frequency) to marine mammals. 5. The Project includes mitigation requiring Project vessels to avoid polar bears on sea-ice by 300 metres (TSD 24 Marine Mammal Effects Assessment). Baffinland acknowledges that the operational period from July 1 to November 15 may include limited periods when ice will be present, and we recognize that a number of IRs have requested additional information considering ice conditions during this time period. Therefore, Baffinland has elected to undertake an additional stand-alone assessment of icebreaking effects during the shoulder seasons that addresses will address this concern. The stand-alone acoustic modelling report and icebreaking assessment will be submitted to the NIRB in 2019 once reporting is completed. <u>References</u> SWG (Scientific Working Group to the Canada-Greenland Joint Commission on Polar Bear). 2016. Re-Assessment of the Baffin Bay and Kane Basin Polar Bear Subpopulations: Final Report to the Canada-Greenland Joint Commission on Polar Bear. 31 July 2016: x + 636 pp.	
GN 73	Provide the following Information: 1. Explain why the description of marine shipping routes and the assessment of effects of shipping on wildlife was limited spatially to the segment running from Milne Inlet, through Eclipse Sound up to the boundary of the NSA east of Pond Inlet and how this complies with EIS guidelines. 2. The Ice Conditions Report indicates that the proposed extension of the shipping season will:"[R]equire the participation of DNV ICE-17 (equivalent to PC 3 for the calculation of AIRSS accessibility) ice management vessels at the beginning and the end of the season. ...In fall, the extension of the season until mid-November would require an escort for 400 to 500 NM in Baffin Bay all the way to Milne Inlet." (TSD 16; Section 4.3) a. Clarify if any of the ore carriers used by the Project will be PC 3 vessels. b. Clarify whether the Project will use ice management vessels to escort Project related shipping through Baffin Bay. If so, please specify the estimated number of transits of these escort vessels. 3. The Ice Conditions Report (TSD 16) indicates that a model was used to generate simulated routes from the regional ice charts. The generated routes were: "[M]eant to avoid or minimize the distance spent in the harshest ice regimes." (TSD 16; Section 3.1.2) Figure 28 shows an example of a voyage simulated by the model from a Canadian Ice Service regional chart, where the route seeks to avoid difficult ice regimes, even though it ends up elongating the distance	1. The rationale for the spatial boundaries of the marine mammal effects assessment is provided in Section 1.2.2 of TSD-24. Two spatial boundaries were used for the assessment of effects on marine mammals in the Project area: a Local Study Area (LSA) and a Regional Study Area (RSA). The LSA allows an assessment of Project-related effects at a local, operational scale and the RSA represents marine mammals and their habitats at a regional, ecologically relevant scale on northern Baffin Island. This regional area is considered sufficient to encompass the full range of direct and indirect effects (incremental and cumulative) resulting from routine Project shipping activities, including those related to shipping noise. The RSA encompasses all waters of Milne Inlet, Navy Board Inlet, Tremblay Sound, Eclipse Sound and Pond Inlet extending to the entrance of Baffin Bay, consistent with the Nunavut Settlement Boundary and the NIRBs administrative boundary. Please also see GN 72. The above approach is consistent with what has been submitted and assessed in the original FEIS and FEIS Addendum for the Early Revenue Phase, and was again confirmed to comply with the Guidelines for the Phase 2 FEIS Addendum by the NIRB on October 12, 2018. 2. a. Current list of proposed / available vessels does not include PC 3 design. b. Yes – Ice Breakers will be used. Please note response to GN 73 (1).	GN 73 Attachment 1: Summary of Ship Track Data 2017-2018

ID1	Info Request	Response	Attachment
	traveled. a. Clarify whether the model generated the routes based on criteria intended to avoid or minimize distance in ice or if the model used an inputted route and, based on this route, calculated the Ice Numerals (INs). b. Based on the modelling work done and the simulations of shipping routes, clarify if it is possible to delineate (via an appropriate analytical method) for each of the different vessel types (classes) that will be used to support the Project: (a) the shipping route(s) or corridor(s) through Baffin Bay that are most likely to "minimize or avoid transit in the harshest ice regimes"; and (ii) for comparison, those route(s) or corridor(s) representing the most direct route possible based on the vessels capabilities and INs. If so, please provide these as route/corridor maps overlain on examples of worst and best-case ice years for the period 1980-2016. This request is specific to the 'shoulder seasons' July 1 to Aug 5 and Oct 15 to Nov 15 (or for the periods early July, later July, late Oct, early Nov). Please provide separate maps for each season/period. c. For each of the 2 requested route scenarios, please provide a table summarizing estimated/predicted mean (and variance in) transit time in sea-ice, by vessel type, for a voyage to or from Milne Inlet. If data are available, please also summarize transit time by ice cover type. d. Clarify to what extent the Proponent can or will manage the selection of routes used by ships transiting through Baffin Bay during the shoulder seasons and what factors the Proponent can or will consider. e. Clarify to what extent the Proponent can or will manage shipping according to route scenario 3(a) above. It is noted that application of the route selection criteria ("avoid or minimize distance spent in harshest ice") will result in longer travel distances than could be achieved through the use of vessels with ice capabilities that permitted ice breaking along a more direct route to and from Milne Inlet. Clarify if these same criteria be applied to the management of Project shipping. See for example the route illustrated in figure 4 which illustrates ice conditions on July 12, 2004 (TSD 16). Clarify how the Project shipping route will be determined in this scenario. If vessels capable of transiting the areas of 3/10th, 5/10th or 10/10th ice cover shown in this map were available clarify if they would take the indirect, open water route shown on the maps or a more direct route through the ice. f. The Shipping and Marine Wildlife Management Plan specifies that with respect to charter vessels: "An Ice Information Contractor will be engaged to forecast ice conditions at the time of the vessel's planned loading and will advise what, if any, ice class is required." (TSD 28; Appendix V; Section 3.1). Presumably, there is a two-way component to making this determination, with the Proponent able to provide route specifications and criteria to the contractor which in turn affects the class of vessel required. Clarify what decision tools, if any, will be employed to manage the effects of shipping on sea-ice. If a choice is possible, clarify if the Proponent will select for the shortest routes, using the most capable ice vessels available and if certain types or areas of ice will be avoided despite ships being capable of transiting through them. Clarify what policies or procedures, if any, will be employed to avoid or minimize shipping effects (i.e. ice breaking) on polar bear sea-ice habitat. g. From modelling work done and based on other factors, please delineate areas or zones in Baffin Bay where transit will not occur during the shoulder season due to vessel-related regulatory restrictions (e.g. such as negative INs). Clarify if there are areas or zones where the Proponent will not transit as a matter of Proponent company policy. If so, please provide a map to illustrate this. 4. Assuming track data are available, please provide a map showing the routes through Milne Inlet, Eclipse Sound, and Baffin Bay used by each vessel that has transited to or from Milne Inlet between July 1 – Aug 5 or Oct 15 – Nov 15 for the currently Approved Project. 5. The FEIS addendum suggests that the disruption of sea-ice by marine shipping will be minimized because ships will follow the same tracks through on transit to and from the Milne Inlet port (TSD 24; Section 2.5.2.2). a. If available, please provide evidence to substantiate the practicality of this mitigation measure. If available, please provide maps showing the tracks of all ships that have transited through sea-ice ice to and from the Milne Inlet port site during operation of the currently Approved Project. Please also provide	3. a) The model generated routes to avoid or reduce the distance spent in the harshest ice regimes, based on what is feasible in various shipping windows for vessels with various ice classes (this is determined by calculating the Ice Numeral). b) A shipping route between Milne Port and Baffin Bay (the Northern Transportation Corridor) was established for the Approved Early Revenue Phased of the Project, and this is the route provided to Captains through the Shipping Instructions to Masters (SITM). There is no intention to vary routes for different classes of ships, therefore this exercise has not been undertaken. Vessel captains are provided with instructions to navigate along waypoints, with flexibility to make adjustments of the shipping route, where needed to maintain safe passage of the vessel. Please see response to e and f for more information. The shipping route outside (east) of Baffin Bay is beyond the scope of this assessment and navigation is at the discretion of the vessel captains to determine safe passage. c) See response to b). d) Baffin Bay is beyond the scope of the assessment. Please see response to e and f for route management through the Northern Transportation Corridor. e) and f) The Shipping Instructions to Masters (SITM) provides all vessels with the waypoints for the approved ship track from the entrance of Eclipse Sound to Milne Inlet. Vessels are requested to maintain that track when feasible. The only times when the track is not followed is when the Master of a vessels determines a navigational hazard exists (ice berg, another vessel, etc.) or during the period of ice infested waters. During ice breaker operations, the vessel track is normally performed and dictated by the ice concentration. Ice breaker(s) and the following vessels will normally take a track through the least amount of ice as is possible to ensure the safety of the vessels. This track may or may not be the shortest route, but rather the safest path. To be clear, the ice breakers will only be used after the land fast ice has begun to break-up. At that point the ice breaker, individual vessels and Port Operations will communicate to apply safe navigation procedures. Using data from the Ice Information Contractor, along with the knowledge and experience of the vessel crews, the vessels will be led through the least amount of ice concentration to allow for positive ice numerals and a safe transit. This track cannot be predicted ahead of time as the ice conditions vary day to day and even hour to hour. 4. Information is not available between July 1-15 and end October-Nov 15 as this is not currently part of the approved project. Ship track data for the 2017 and 2018 shipping seasons are attached in Appendix 1. The shipping season was Aug 2-October 17 and July 24-October 22 for the 2017 and 2018 season respectively. 5. a. As is consistent with the currently Approved Project, the northern shipping corridor will continue to be used for all project vessels. To the extent possible vessels will follow the way points provided to them in the Shipping Instructions to Masters and maintain a straight course. Subject to prevailing weather conditions, deviations from the nominal shipping route may occur when vessel captains feel that it is necessary to do so to ensure the safety of the vessel. Please see ship track data provided in GN 73 (4). b. Shipping routes outside of the RSA is beyond the scope of the current assessment.	

ID1	Info Request	Response	Attachment
	similar evidence available from other mining projects that ship during ice-covered periods. b. Clarify if this mitigation measure applies to sections of the shipping route that are outside the marine RSA. Please provide evidence, derived from operation of the currently Approved Project or other sources, that this is achievable.		

ID1	Info Request	Response	Attachment
GN 74	Provide the following information: 1. Clarify if new employees will be required to find housing themselves on the private rental market, or whether the Proponent will provide staff housing. 2. Clarify if or when employees will require hotel accommodations instead of housing. 3. Clarify whether the Proponent will include a financial literacy module in the Work Readiness program.	1.Baffinland anticipates the vast majority of Project employees will continue to access employment opportunities through point-of-hire communities in the North Baffin and southern Canada, and through other communities in the Qikiqtaaluk Region, thus limiting the potential for demographic effects on Iqaluit to occur. In 2017, for example, an average of 1,572 employees and contractors worked at the Project; only 55 (3.5%) of these originated from Iqaluit. By comparison, an average of 166 individuals (10.6%) originated from the North Baffin communities and an average of 1,351 individuals (85.9%) originated from outside of Nunavut or had unknown origin (see Table 3-7 in Appendix B of TSD 25 Socio-Economic Assessment). The establishment of point-of-hire communities, and Baffinland's IIBA commitment to pay for transportation for Inuit employees from the Baffin Region to and from the Project at no cost to the employee (QIA and Baffinland 2018), effectively removes the need for individuals to move for direct Project jobs. Direct Baffinland positions in Iqaluit (e.g., at Baffinland's Northern Affairs office) are also very limited in number. Any additional in-migration to Iqaluit that may be indirectly created and/or induced by the Phase 2 Proposal is difficult to predict but would occur within a baseline where significant growth has been constant for well over a decade. Baffinland does not anticipate providing staff housing for the Iqaluit-based Project jobs, or for employees based in Iqaluit. The Company anticipates that any new employees or contractors that choose to make Iqaluit home would be required to find their own housing. 2. Short-term hotel accommodations in Iqaluit may be required for employees in some instances. This could occur while employees are transiting between their home communities and the Project site. As noted in the Draft Human Resource Management Plan (Appendix AB of TSD 28 Management and Monitoring Plans), however, overnighting of employees from non-point-of-hire communities passing through Iqaluit or other locations will be avoided as much as possible. When overnighting is required, Baffinland will work with local accommodation providers to adequately plan for accommodation in Iqaluit and other locations. This will create opportunities for local businesses. 3. Financial literacy training is provided by Baffinland to its employees on a stand-alone basis and not as part of its work readiness program. Baffinland provided financial literacy training at both Project locations (i.e. mine site and port site) in March 2018. There were 18 individuals who attended, the majority of which were Inuit (some non-Inuit individuals also participated as all employees were welcome to attend). The individual providing the training also had several informal discussions related to financial planning with Baffinland employees while at site. Baffinland will continue to offer financial literacy training to its employees, on an as-needed basis, in the future. Per IIBA Article 11.9, Baffinland has also committed to provide Inuit employees with advice on personal financial management, when requested by an employee. The Baffinland Inuit Employment and Training Specialist and QIA Inuit Engagement Specialist shall be the points of contact for access to these services. Likewise, the IIBA's Ilagiiktunut Nunalinnullu Pivalliajutisait Kiinaujat (INPK) Fund (Article 12.2) supports projects that demonstrate positive impacts for Inuit in the North Baffin communities, aiming towards resilient communities, strong families, and job readiness. Activities supported by the Fund may include individual and family financial planning. For additional reference, the Inuit Human Resources Strategy (IHRS; Appendix AG of TSD 28 Management and Monitoring Plans) also commits Baffinland to establishing literacy and numeracy upgrade programs on-site. Baffinland recently added a new question to its Inuit Employee Survey on financial literacy training, at the request of Nunavut Housing Corporation (NHC) staff. This question asks survey participants if they would be interested in attending an informational course about managing their personal finances, setting up monthly bill payments, and establishing savings goals if it was offered through their employer or local housing association. Results from the Inuit Employee Survey are typically provided in the Project's socio-economic monitoring reports or directly to relevant stakeholders. <u>References:</u> Qikiqtani Inuit Association (QIA) and Baffinland Iron Mines Corporation (Baffinland). 2018. The Mary River Project Inuit Impact and Benefit Agreement. Amended and restated agreement made on October 22, 2018.	

ID1	Info Request	Response	Attachment
GN 75	Clarify training partners include both the GN Department of Family Services and the Department of Education.	Baffinland will include both the GN Department of Family Services and the GN Department of Education in Section 5.3 of a revised future version of the Human Resource Management Plan. The planned updates to mitigation and monitoring plans will be reflected in the Commitment Register (Appendix 11).	Appendix 11: Commitment Register
GN 76	Provide information on current and planned training programs offered onsite that provide recognized transferable certification or credentials.	Baffinland has provided a total of 122,950 hours of training between 2013 and 2017, of which 15,867 hours (or 12.9%) were provided to Inuit. In 2017, 43,397 hours of training were completed at the Project site, of which 4,024 hours (or 9.3%) were provided to Inuit. In 2017, over 50 different types of training were completed on-site, some of which may result in a recognized transferable certification or credential being obtained. A summary of training delivered to Inuit and non-Inuit in 2017 is provided in Table 1 (Appendix 1). This annual snapshot provides a useful indication of recognized transferable certifications and credentials currently offered by Baffinland. Additional training information is available for Q1-Q3 2018 and is presented in the attached Table 2 (Appendix). In Q1-Q3 2018, 51,261 hours of training were completed at the Project site, of which 23,904 hours (or 46.6%) were provided to Inuit. Even without Q4 2018 data included, this already represents a significant increase in Inuit training hours over previous years. Many of these new training hours can be attributed to Baffinland's Apprenticeship Program and Morrisburg Heavy Equipment Operator Program, which can also result in recognized transferable certifications and credentials being obtained. Annual data pertaining to these programs will be presented in future socio-economic monitoring reports to the NIRB and in IIBA implementation reports to QIA. Baffinland and the GN Department of Economic Development and Transportation are presently negotiating a Memorandum of Understanding (MOU) to allow for enhanced collaboration and cooperation between the two Parties. Once complete, it's anticipated this MOU will allow for further cooperation on enhanced training-to-employment initiatives as well as training programming geared towards the attainment of recognized transferable certifications or credentials. In accordance with the IIBA (Article 8.6.7), QIA and the Company will also collaborate to ensure that training opportunities for Inuit are filled to the greatest degree possible, with priority to Inuit from point-of-hire communities. QIA and Baffinland will also work together to direct all decisions on the use and expenditure of funding for training (Article 8.6.10). It's anticipated that conversations on training as stipulated in the amended IIBA will lead to the development of training programs geared towards the attainment of recognized transferable certifications or credentials Baffinland is committed to ensuring that its training programs meet operational needs, enhance employee job satisfaction, and lead to even greater positive socio-economic outcomes for the point-of-hire communities. Further, Baffinland looks forward to continuing its cooperation with training partners such as the GN to develop innovative programs that benefit Nunavummiut.	GN 76 Attachment 1: Table 1: Project Training Programs Offered in 2017 GN 76 Attachment 2: Table 2: Project Training Programs Offered in Q1-Q3 2018
GN 77	Provide following information: 1. Current measures that specifically encourage female employment and retention. 2. Current practices aimed at attracting women to training programs or initiatives (such as the Heavy Equipment Operators training program, the Apprenticeship training program, and the Supervisory training program) or in skill development or career advancement. 3. Current practices aimed at reducing gender-based barriers to employment and that may attract female employees. 4. Any harassment policies or measures currently in force. 5. Clarify the timeline for completing the 'zero tolerance harassment policy' and whether it will be publicly available.	<u>1, 2 and 3</u> Employment candidate interest levels and skillsets are key in the employment and training selection process. In order to increase female employment and retention, Baffinland reviews candidacy as an equal opportunity to encourage female employment for all employment placements, training programs, and initiatives. Retention of female employees is an ongoing effort and Baffinland encourages involvement in available opportunities and training programs (e.g. Heavy Equipment Operator Program in Morrisburg, Work Ready Program in the North Baffin communities, Apprenticeship Program). If interest is expressed in entry-level housekeeping or kitchen staff positions, the candidate's profile is shared with appropriate contractors for consideration for immediate employment placement. Limited options for childcare in the communities can be a hindrance to retaining female workers and Baffinland and QIA continue to explore available resources through IIBA Employment Committee meetings to help overcome this barrier. In September 2018, Baffinland held an Employment and Training Information Tour in the north Baffin communities and collected Expression of Interest (EOI) forms from attendees. A total of 51 EOI forms were collected, out of which 20 were from female participants. Of the 20 female participants that submitted an EOI form during the Employment and Training Information Tour, 17 were shortlisted for selection into the Work Ready Program, Heavy Equipment Operator Program, Apprenticeship Program, and direct employment for 2019. Women remain under-represented in the Canadian mining industry. The Mining Industry Human Resources Council (2016) notes women comprise only 17% of the total Canadian mining workforce, which is significantly lower than the	

ID1	Info Request	Response	Attachment
		total participation of women in the general Canadian workforce, at 48%. Indigenous women are also less likely than non-Indigenous women to be employed in Canada (Arriagada 2016). Baffinland has developed, or has committed to developing, several measures that further encourage Inuit female employment and retention at the Project. Goals and priorities in this area were recently finalized with the QIA in the Inuit Human Resources Strategy (IHRS; Appendix AG of TSD 28 Management and Monitoring Plans) and through renegotiation of the amended IIBA (QIA and Baffinland 2018). For greater clarity, the Company has established a series of priorities focused on providing ongoing opportunities to women through the IHRS (Appendix AG of TSD 28). Some of these include: • Policy review and revision to support the principle of equal access to employment opportunities and to eliminate gender biases. • Engagement with governmental and non-governmental stakeholders: o To identify and eliminate barriers to the participation of Inuit women in the labour market (both gender and cultural). o Incorporate gender-based analysis information into policy and workplace design decisions. o Ensure that the assistance that the Company provides employees complements community services available to Inuit women. o Development of recruitment and selection processes and methods to encourage applications for employment by Inuit women. o Link with Inuit women's networks to support employment of Inuit women. o The development of training programs specifically targeted to Inuit women which prepare Inuit women for non-traditional occupations. o Consideration of giving temporary priority to the hiring of Inuit women to increase workforce participation. o Development of a gender equity policy and implementation of a zero-tolerance harassment policy. o Include gender sensitivity training as part of employee orientation. o Gender-based approach to the development, analysis and implementation of workplace conditions to create a supportive work environment for Inuit women employees. o Annual engagement on a regional basis to review existing and prospective women's employment programs, initiatives and strategies. o Work with other industry players and Inuit women's organizations to develop information kits to promote interest in careers in mining. o Include direction to provide equal employment opportunities for Inuit women in all instructions to contractors. o Use gender sensitivity language in all advertisements, written and verbal assessment tools and other materials utilized in the hiring process. o Participate in career fairs, school visits and other community events, utilizing Inuit women employees in such events. o Ensure that apprenticeship programs have, as a goal, the increase in number of female apprenticeships in non-traditional occupations. o Hire qualified Inuit women to be developed as trainers and supervisors, where possible. o Develop and support a women's mentoring network. Article 7.17 of the amended IIBA also obligates Baffinland to implement human resources policies that ensure equal access to employment for Inuit men and women. To promote Inuit women's access to employment in the Project workforce, the IIBA notes the IHRS will have an Inuit women's employment component that will provide for the following: • An analysis of the Project workforce, which will assess any potential differential impact on women and men of policies, strategies, procedures, practices and conditions applicable to the Project workforce. Where appropriate	

ID1	Info Request	Response	Attachment
		the Company will use the result of this analysis to develop revised employment and training policies, strategies, procedures and practices in relation to the Project workforce. • A process to be developed by the Company to work with the QIA, Nunavut and federal government agencies and Inuit women's groups to assist Inuit women prepare for jobs with the Company and its contractors. • A workplace environment that is welcoming to Inuit women and workplace policies that assist Inuit women employees to retain their positions. Likewise, Article 11.5 of the amended IIBA addresses affirmative steps Baffinland will take for attracting female employees. These include: • Developing an affirmative action plan that sets out measurable goals and procedures to monitor compliance with government employment equity legislation and any harassment policies. • Developing and locating training programs developed specifically to attract women who may want to work at the Project (in cooperation with a designated Inuit organization). • Developing and implementing gender sensitivity training programs (in cooperation with a designated Inuit organization). • Providing for appropriate accommodations and facilities for female Inuit employees. The development and success of IHRS and IIBA initiatives on Inuit female employment and retention will continue to be tracked internally and thorough IIBA implementation reporting to QIA. As part of the Annual IIBA Implementation Report Baffinland completes for QIA, the Company will also prepare a report on progress with workplace initiatives, including: affirmative steps for attracting female employees, the Anti-Harassment/Discrimination Policy, Inuit preparedness for the workplace, cross-cultural recognition, and other topics. Likewise, Baffinland solicited opinions on workplace conditions from female staff during a January 2018 workplace survey. The results of this survey were reviewed internally by Baffinland and QIA for potential improvements in this area. Baffinland also prepares an annual socio-economic monitoring report that it submits to the NIRB, which includes data on female employment at the Project. It has been acknowledged that securing access to adequate childcare remains an issue in some parts of Nunavut and can act as a barrier to employment for women. Baffinland supports two funds established under the IIBA which could potentially be accessed to provide additional supports to community daycares or childcare services in the North Baffin. While Baffinland makes significant financial contributions to these funds, they are administered solely and exclusively by the QIA. The funds include the Ilagiiktunut Nunalinnullu Pivalliajutisait Kiinaujat (INPK) Fund (which provides up to $1.1 million/year for community wellness-focused projects in the North Baffin) and the Business Capacity and Start-Up Fund (which provides up to $275,000/year to Designated Baffin Inuit Firms to help with start-up capital and financing, management development, ongoing business management, financial management, contracts and procurement or human resources management). <u>4 and 5</u> As noted in the Draft Human Resource Management Plan (Appendix AB, TSD 28 Management and Monitoring Plans), Baffinland is committed to providing a work environment in which all Project employees are treated with respect and dignity. It is the policy of Baffinland to prohibit any form of violence and unlawful harassment including harassment based on race, ancestry, place of origin, colour, ethnic origin, citizenship, creed, sex, sexual orientation, gender identity, gender expression, age, record of offences, marital status, family status or, any other prohibited ground of discrimination. Baffinland already has in place a zero-tolerance policy for all types of harassment. Recently, Baffinland has also developed several new policies and programs on harassment and violence in the workplace and training and awareness workshops for all employees. Improvements to its cultural awareness training are also ongoing. Baffinland held several on-site presentations in fall 2018 on respectful workplace practices to raise awareness of the zero-tolerance policy and process for raising concerns on any issues related to harassment and/or disrespectful behaviour in the workplace.	

ID1	Info Request	Response	Attachment
		References: Arriagada, P. 2016. First Nation, Métis and Inuit Women. Women in Canada: A Gender-Based Statistical Report. Statistics Canada Catalogue no. 89-503-X. Released February 23, 2016. Mining Industry Human Resources Council. 2016. Exploring Gender Inclusion. Accessed January 4, 2017. https://www.mihr.ca/pdf/MiHR_Gender_Report_EN_WEB.pdf Qikiqtani Inuit Association and Baffinland Iron Mines Corporation (QIA and Baffinland). 2018. The Mary River Project Inuit Impact and Benefit Agreement. Amended and restated agreement made on October 22, 2018.	
GN 78	Provide the following information: 1. Whether the Rules of the Road (or some variation) in Attachment B are shared with community residents. 2. How often and through what methods are these rules shared?	1. The health and safety of employees, contractors, and Project site visitors is the number one priority of Baffinland. The Company employs a risk-based approach to managing health and safety which is focused on identifying risks and implementing effective controls for all activities. A strong health and safety culture, built on Baffinland's "Safety First, Always" philosophy is about having the right controls in place that will foster and build a risk sensitive safety culture that will lead to improved safety outcomes in all areas of the Project. Baffinland has been engaging Inuit, Communities, and Inuit organizations and associations to ensure the safety of land users in the Project area is maintained at all times. The specific rules of the road contained in Attachment B "Tote Road Travel Procedure" are not expressly shared with community residents as they are designed and created to mitigate the extreme risk associated with operating mine related equipment on the Tote Road. However, through regular community engagement and engagement with Hunter and Trapper Organizations, the Company explains the risks associated with travelling near project activities and the procedure which should be followed as outlined in the "Hunter and Visitor Site Access Procedure" (Attachment F) for safe travel through the Project area. 2. Baffinland also employs Community Liaison Officers (BCLOs) in Arctic Bay, Pond Inlet, Clyde River, Igloolik, and Hall Beach. BCLOs are in regular communication with staff at Project sites and the corporate office and are able to communicate with the public in real time about company policies and procedures such as measures that are in place to protect the health and safety of land users in and around the Project.	
GN 79	Provide the planned rail safety communication practices for the public and/or land users, including frequency of communication or engagement.	The health and safety of employees, contractors, and Project site visitors is the number one priority of Baffinland. The Company employs a risk-based approach to managing health and safety which is focused on identifying risks and implementing effective controls for all activities. A strong health and safety culture, built on Baffinland's "Safety First, Always" philosophy is about having the right controls in place that will foster and build a risk sensitive safety culture that will lead to improved safety outcomes in all areas of the Project. Baffinland has been engaging Inuit, Communities, and Inuit organizations and associations to ensure the safety of land users in the Project area is maintained at all times. On August 30-31, 2018, Baffinland hosted representatives of the Hamlet of Pond Inlet, QIA, and Mittimatalik Hunters & Trappers Organization (MHTO) at site to discuss land user/operation interactions. Part of the conversation focused on the Phase 2 Proposal and how the company can incorporate the feedback of the MHTO into the design of safe rail crossings. Actions and results of this meeting have been communicated between the Parties present and are being actively followed up by Baffinland. Baffinland also employs Community Liaison Officers (BCLOs) in Arctic Bay, Pond Inlet, Clyde River, Igloolik, and Hall Beach. BCLOs are in regular communication with staff at Project sites and the executive office and are able to communicate with the public in real time about company policies and procedures such as measures that are in place to protect the health and safety of land users in and around the Project. This includes transmitting information about the existing Hunter and Visitor Site Access Policy. Further to the above, Baffinland plans to engage "Operation Lifesaver" (Operation Lifesaver Canada 2017). Funded by the Railway Association of Canada and Transport Canada, Operation Lifesaver works with the rail industry, governments, law enforcement, labour groups, the media, and other organizations and communities to increase awareness about rail safety. Baffinland believes that this organization has the experience and knowledge that can help the Company ensure Nunavummiut are educated about rail safety through rail safety presentations to schools, and community groups such as Hunter and Trapper Organizations.	

ID1	Info Request	Response	Attachment
		This type of ongoing and proactive engagement with the public and/or land users in north Baffin is what Baffinland believes is necessary to provide north Baffin residents with the information they need to stay safe when interacting with project facilitates (existing and planned). <u>References</u> Operation Lifesaver Canada. 2017. Operation Lifesaver Canada Rail Safety - Railway and Train Safety for Canadians. https://www.operationlifesaver.ca/	
GN 80	Clarify the following information: 1. "No Expiry" should instead indicate "December 31st or annually". 2. "No Amendment to Permit likely required" should instead indicate that "Yearly Permits are likely required".	Baffinland acknowledges that Class 2 Permits require renewal annually, as permits expire on December 31 of the year issued. Table 3-1 of Addendum to the Final Environmental Impact Statement (FEIS), Section 3 - Regulatory and Fiscal Regime, and FEIS Appendix F – Current and Required Approvals, should both indicate an expiry for Class 2 Permits (Archaeology) as December 31, and that new permits would be obtained as needed, on an annual basis.	
GN 81	Provide a copy of the paleontological desktop study to the Territorial Archaeology Office in order to assist in providing adequate recommendations for the Assessment and Mitigation of Adverse Impacts to Paleontological Resources.	The Paleontological Desktop Study referred to on page 17, section 2.5.4 of TSD 8 Landforms, Soils, and Permafrost Assessment, was presented as Appendix 6A of the Approved Project. It has been appended to this IR response as Appendix 1.	GN 81 Attachment 1: FEIS Appendix 6A
GN 82	Provide clarification and additional information concerning: 1. Detail of the criteria used to assess site significance; 2. Reconciliation of the inconsistency between Section 9.1 ("An expanded terrestrial footprint with the addition of the North Railway, which will affect archaeological sites of low cultural significance… [TSD 25, Section 9.1]) with Table 9.3 (TSD 25, Section 9.7.1), where 4 of 12 sites listed in the table are rated a high level of significance.	1. Site significance was described in the Preliminary Archaeological Mitigation Plan (FEIS (2012) Appendix 4D), as follows: *"In a broad sense, archaeological significance is based on the potential for information. For archaeologists, potential for information is the chief criterion for assessing importance. The potential information from a site depends on many factors, including;* • *The scale of a site and its state of preservation/condition;* • *The context of the site, or the degree to which the discovery is undisturbed and found in a reliable situation, which will affect the dependability of the evidence; and* • *The potential contribution to broadening understanding of human past."* 2. The statement in Section 9.1 was not accurate; the Phase 2 Proposal will affect archaeological sites of moderate to high significance, as identified in Table 9.3.	
GN 83	Provide clarification and additional information concerning: 1. Who is providing the training to employees? 2. How is the training scheduled to ensure adequate coverage (i.e. all employees trained?) 3. The scope of the training program (i.e. what does the training consist of?)	1&2. Cultural Heritage Resource Employee Training is provided to all employees and contractors coming to work on site as part of the Site Orientation process and is delivered by Baffinland's Training Department. Environmental Protection Plan training is also provided on regular intervals to Supervisors and Managers, by the Environmental Superintendents to ensure they are frequently reminded of protocols and protection measures for Cultural heritage and archaeological resources. 3. Cultural Heritage Resource Training consists of describing how land disturbance activities are to be managed on site. This includes providing a background of what types of activities can create ground disturbance, a comprehensive list of all environmental concerns related to ground disturbance, including archaeological and cultural resources, environmental protection measures that must be taken prior to and during ground disturbance activities, procedure for ensuring that the Environment Department on site completes a pre-disturbance survey of the land, and requirements for records keeping.	
GN 84	Provide detailed information about the measures put in place to protect the archaeologically rich zone located east of the Milne camp. For example, is this Exclusion Zone visually defined? How are the on-site staff and visitors informed of the Exclusion Zone being restricted access?	In accordance with Section 2.1 of Baffinland's Environmental Protection Plan, the following measures to minimize interaction with the archeological zone east of Milne camp have been implemented: • Project personnel shall not deviate from already disturbed areas or established routes • Known sites near Project activities will be marked by stakes, flagging and/or yellow rope at approximately 30 metres away from each site. • Additionally, Baffinland notes that there are no roads out to the sites that have been built by Baffinland, and workers are not allowed off the freight dock zone located west of the archaeological sites.	

ID1	Info Request	Response	Attachment
GN 85	Clarify whether archaeological work took place in 2018 and give details regarding the nature of any work performed.	Yes, an archaeological program was carried out in 2018 and involved systematic data recovery at six previously-identified archaeological sites within the North Railway right-of-way. This work was carried out under a Class 2 archaeological permit (No. 2018-17A).	
GN 86	Provide additional information on: 1. How the corporate income tax revenues were: a. calculated to be $681 M in total in the four years 2034-2037 b. excluded from other jurisdictions 2. How the GN portion from the total corporate income taxes ($321.0 M of which is 50% of all projected GN revenues) was allocated.	1. As noted on pages 38 and 40 of TSD 25 Socio-Economic Assessment (Appendix A – Economic Impact Model: Assessment of Economic Benefits Generated by the Mary River Project's Phase 2 Proposal), the Corporate Income Tax (CIT) dollar amounts apply solely to Baffinland's expected revenues. The amounts shown in both Table II-5 and Table II-6 under the CIT columns were calculated in the Financial Model developed by HATCH for this project. The timeframe for these fiscal revenues (2034-2037) could change but were the best available estimates when the document was produced. It is possible that the exact timeframe for those CIT revenues will change over time as the project gets underway and production actually starts. 2. With respect to the allocation between the government of Nunavut and the federal government, this was also calculated by the Financial Model developed by HATCH and based on known corporate income tax rates.	

THE QIKIQTANI INUIT ASSOCIATION

ID1	Info Request	Response	Attachment
QIA 01	A. Baffinland is requested to provide further detail on anticipated monitoring to be undertaken and mitigation measures to be implemented for the three-year combined Railway construction and Tote Road operations period. B. Baffinland is requested to provide further detail on anticipated monitoring to be undertaken and mitigation measures to be implemented for the first 5 years of combined North Railway and Tote Road operations.	Further details on anticipated monitoring and mitigation measures are not required for the Mary River Project Phase 2 Proposal, as they are adequately described in the Terrestrial Environment Mitigation and Monitoring Plan (TEMMP), which is relevant to both the three-year combined North Railway construction/Tote Road operations period and the combined North Railway/Tote Road operations for the life of the Project. The current mitigation and monitoring program sufficiently addresses all Phase 2 Proposal effects, including effects to caribou calving and mortality for the following reasons: "There is no new information, survey methods, or material changes in Project interactions associated with the Phase 2 Proposal that suggest the need for any substantial changes to the current monitoring program for wildlife and wildlife habitat." (Section 3.6, TSD 10 Wildlife Baseline and Impact Assessment). "The Phase 2 Proposal does not interact with any additional sites known to have been used for calving, determined by either collar data or identified by IQ that were considered for the Approved Project." (Section 3.4.1.1, TSD 10). "Project related caribou mortality may increase, but that risk is readily mitigated" [via the existing TEMMP]. (Section 3.4.1.3, TSD 10). Section 3.3 of the TEMMP outlines all mitigation and monitoring measures related to terrestrial wildlife for the Mary River Project. The TEMMP has been used on site since 2012 and is considered a living document. Since its inception, it has been through several revisions in response to feedback from the Terrestrial Environment Working Group (TEWG), the Nunavut Impact Review Board (NIRB) comments, comments received on results to date, and changes to sampling methods based on robust statistical analysis. The practice of revising monitoring plans as the Mary River Project progresses will continue through the life of the Project. As noted above, at this time there is no new information or interactions associated with the Phase 2 Proposal requiring material changes to the TEMMP — it is sufficiently broad in scope and methodology to capture potential effects of the Phase 2 Proposal activities, including potential effects to caribou calving and mortality.	
QIA 02	A. Baffinland is requested to provide further detail on anticipated monitoring to be undertaken and mitigation measures to be implemented for the three-year combined North Railway construction/Tote Road operations period to protect caribou calving if occurring in the Project area. B. Baffinland is requested to provide further detail on anticipated monitoring to be undertaken and mitigation measures to be implemented in relation to possible caribou calving activities in the Project Area for the first 5 years of combined North Railway and Tote Road operations.	Refer to QIA 01	
QIA 03	Baffinland is requested to provide further detail on anticipated monitoring to be undertaken and mitigation measures to be implemented to minimize the risk of caribou mortality for the first 5 years of combined North Railway and Tote Road operations.	Refer to QIA 01	
QIA 05	Baffinland to provide an assessment of the potential impacts to avian species, particularly species at risk, resulting from the proposed wind turbines. This is to include measures that will be taken to avoid or lessen potential effects and monitoring measures.	An assessment of the potential impacts to avian species, including species at risk resulting from the proposed wind turbines are described in Sections 3.5.2.1 and 3.5.4 of TSD 12 (Birds Baseline and Impact Assessment); however, this assessment is general in nature and does not describe specific effects to each key indicator species (particularly species at risk) with respect to the proposed turbines. The specific sites for the individual wind turbines have not been finalized. After selection of the site(s), Baffinland commits to conducting a risk assessment including any surveys required for informing site sensitivity, consistent with Environment and Climate Change Canada's Environmental Assessment Guidance Document on Wind Turbines and Birds (Environment Canada, Canadian Wildlife Service 2007a). Based on the outcome of this assessment, mitigation and monitoring measures will be developed to avoid or lessen potential effects to avian species, including species at risk, consistent with Environment and Climate Change Canada's Guidance Document on Recommended Protocols for Monitoring Impacts of Wind Turbines and Birds (Environment Canada, Canadian Wildlife Service 2007b). See the response for ECCC 01 for more details. <u>References</u> Environment Canada, Canadian Wildlife Service. 2007a. Wind Turbines and Birds: A Guidance Document for	

ID1	Info Request	Response	Attachment
		Environmental Assessment. 46 pp. Environment Canada, Canadian Wildlife Service. 2007b. Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds. 33 pp.	
QIA 08	It is requested that the Proponent: A. Confirm whether all ancillary facilities and activities locations are finalized and located within the PDA and if so provide further details on their location and required physical works and activities at these locations. B. Provide a detailed assessment of potential impacts to Cultural Heritage resources and Inuit land and resource use from all ancillary facilities and activities associated with the project. C. Identify all commitments to engaging Inuit in final siting and management planning and monitoring at any yet to be determined ancillary facilities and activity locations, and how IQ will be used to inform final siting decisions.	A. Details on the Project not found in the main part of TSD 2 Project Description can be found in the appendices. This includes 33 detailed 11x17 figures in Appendix B (Figure B.4) that show proposed modifications to the current Commercial Lease Boundaries, and the Water Licence Amendment Application presented in Appendix D. The final footprint of additional project infrastructure is well defined.	
QIA 09	It is requested that the Proponent work with QIA and the affected Inuit communities to address gaps in the assessment of Culture, Resources and Land Use by: A. Include consideration of the potential for psycho-social and stigma impacts alienating Inuit use within the PDA and Local Study Area B. Providing more information on return per unit of harvesting effort by Inuit and how this has changed over time since major development activities started on Mary River Mine. C. Re-assessment of effects on Inuit land and resource use to include identification of preferred Inuit future use and potential long-term effects of the Project on those uses.	A. Please see Section 9 of TSD 25 Socio-Economic Assessment, where these issues have been considered, described and assessed. Further, and in accordance with Article 13.3.1 of the IIBA (2018) the Company has committed to offsetting potential impacts to Inuit travel and access rights by implementing the following mitigation measures: • providing fuel at the Project facilities needed for detouring around Project infrastructure • providing food and shelter at Project facilities • support Inuit in identifying and communicating the use of safe travel routes around Project infrastructure • any other proposed Inuit travel mitigation measures including those that arise from the Annual Project Review Forum and agreed to by the Parties. Further, Baffinland under Article 13.4 of the IIBA and in accordance with Section 5.7.16 of the NLCA will allow for Inuit to access the Project area and engage in traditional activities on all lands, waters and marine areas used for the Project, except where Project activity is undertaken, provided land access and uses do not conflict with the Company's health and safety policies outlined in Article 13.5 of the IIBA.	
QIA 10	It is requested that the Proponent provide more information on the assessment of effects on vegetation, including: A. Identification of IQ based monitoring indicators and thresholds. B. Identification of culturally valued plant species and communities of importance. C. Provision of any data the Proponent has gathered related to willingness of Inuit to use vegetation in the PDA/LSA. D. Provision of evidence of the integration of IQ in the selection of sampling locations. E. Results of any TEK/IQ field studies F. Collection and meaningful consideration of IQ related to natural revegetation/regeneration.	A. Inuit Qaujimajatuqangit (IQ)-based monitoring indicators and thresholds were not identified for the various vegetation surveys completed in the Project area as part of baseline and existing project monitoring including inventory of vegetation species, communities, abundance, composition and rare plants; vegetation and soil trace metals; revegetation by native plant species; exotic invasive vegetation (Baffinland Iron Mines Corporation 2018) and aquatic vegetation as part of habitat assessments for freshwater biota (North/South Consultants Inc. 2010). These surveys were designed using scientific guidelines and methods provided in the literature. Baffinland's vegetation baseline and impact assessment (TSD 9 Vegetation Baseline and Impact Assessment; Section 2.3.5) presents the extent of information shared by Inuit elders during IQ based traditional plant use studies in 2007 at Pond Inlet, Nunavut as part of baseline studies (EDI Environmental Dynamics Inc. 2018). No indicators or thresholds were identified or relevant to IQ-based traditional plant use studies. B. Baffinland identified culturally valued plant species and communities of importance in the vegetation baseline and impact assessment as part of baseline studies (EDI Environmental Dynamics Inc. 2018). Refer to Section 2.3.5 for details regarding IQ traditional knowledge as part of the study to determine what plant species are used by Inuit in Pond Inlet, north Baffin Island and which of these species occur in the Project area. A total of 20 plants were identified as part of the study, 17 of which are found in the Project area. These plants were identified as being used for tea, berry picking, or as a trail snack and are mainly collected while out on the land hunting (Burt 2010, EDI Environmental Dynamics Inc. 2018). C. No data are available regarding the willingness of Inuit to use vegetation in the PDA/LSA. Vegetation within the PDA is expected to be impacted from clearing activities and construction; therefore, vegetation use within this area is not expected. D. Baseline traditional plant use study survey sites were selected with Inuit elders (Burt 2010, EDI Environmental Dynamics Inc. 2018).	

ID1	Info Request	Response	Attachment
		Like the response to QIA-IR-10a, IQ was not considered in the selection of vegetation sampling locations for monitoring work. These surveys were designed using scientific guidelines and methods provided in the literature as requested in part by the Terrestrial Environment Working Group (TEWG). E. Results of IQ studies for vegetation are presented in the vegetation baseline and impact assessment (EDI Environmental Dynamics Inc. 2018). Refer to Section 2.3.5 for details regarding IQ as part of the study to determine what plant species are used by Inuit in Pond Inlet, North Baffin Island and which of these species occur in the Project area. F. Baffinland is in the early stages of reclamation research. Research plans are expected to be developed in consultation with IQ. Where practical, IQ will be incorporated into research plans for revegetation. <u>References</u> Baffinland Iron Mines Corporation. 2018. Mary River Project — Phase 2 Proposal, Addendum to the Final Environmental Impact Statement. NIRB File No. 08MN053. 512 pp. Burt, P. 2010. Vegetation Baseline Study Report: Appendix 6C, Volume 6 - Terrestrial Environment, Mary River Project, Final Environmental Impact Statement. Prepared for Baffinland Iron Mines Corporation. 23 pp. EDI Environmental Dynamics Inc. 2018. Mary River Project — Phase 2 Proposal Technical Supporting Document No. 09: Vegetation Baseline and Impact Assessment. Prepared for Baffinland Iron Mines Corporation, Oakville, Ontario. 189 pp. North/South Consultants Inc. 2010. Mary River Project: Marine baseline synthesis, physical, chemical, and biological oceanography. Appendix 8A-1: Oceanography in Mary River Project Environmental Impact Statement, Volume 8: Marine Environment.	
QIA 11	It is requested that the Proponent provide more detail on how IQ was integrated in every step of the assessment conducted in the development of the FEIS Addendum. This should include some form of tabular description of how, specifically, IQ informed each step of the assessment methodology outlined in Section 9 of the FEIS Addendum.	Baffinland used the same assessment methodology for the Phase 2 Proposal as was used for the original FEIS and ERP FEIS Addendum. As described in Section 6.0 of the FEIS (2012), the methods used include, but are not limited to: • Identification of potential environmental and socio-economic concerns • Environmental and socio-economic baseline and Inuit knowledge studies • Consultation with north Baffin communities, Inuit organizations and government agencies. • Baseline studies for the Project were conducting using, though not limited to: • Site investigations • Stakeholder, Inuit and government consultation • Inuit knowledge studies. Inuit knowledge studies were carried out specific to the Mary River Project from 2006 to 2016, with the sole focus of supporting Project design and the environmental assessment process. IQ information played a central role in developing an understanding of baseline conditions and historical trends, especially where limited historical scientific data was collected prior to Project studies. IQ was also used to identify and substantiate the VECs and VSECs to help focus the effects assessment on the issues identified by local communities and knowledge-holders, and in developing mitigations and monitoring plans. For each impact assessment volume in the FEIS (2012) there is a description of how Inuit knowledge was used in the assessment. Where additional IQ has been collected and/or utilized to assess Phase 2 Proposal components, is recognized in the respective Technical Supporting Document.	

ID1	Info Request	Response	Attachment
QIA 12	Baffinland acknowledges additional community engagement will be necessary to fully satisfy public consultation requirements on the Phase 2 project proposal. When is this consultation scheduled to occur, and how will the results of this and additional data collection (e.g. Inuit land and marine use) be integrated into a reassessment of effects from what is currently described in the FEIS Addendum?	Please refer to the Attachment (Appendix 2) for a summary of planned engagement activities for 2018 and 2019 related to the Phase 2 Proposal. Generally, the planned engagements are meant to either 1) identify and address issues of concern with the project overall, or 2) develop mutually agreeable mitigation measures for specific components of the Phase 2 Proposal. Through the EA process, it is Baffinland's intention to reflect the outcomes of these engagements in the updated management plans to be submitted for review following the technical meeting. For those engagements that are part of a series that extend past the deadline to submit updated management plans, additional updates may be required, as reflected in current operational practice.	QIA 12 Attachment 1: Summary of Planned Engagement Activities for 2018 and 2019 Related to the Phase 2 Proposal
QIA 21	Please provide more information on what caribou crossings will look like, where they will be located, and provide supporting evidence for assertions that the railway will not prove a substantial barrier to caribou movement.	A typical design for caribou crossings over the rail alignment is provided in the attached typical cross section (Appendix 2). Locations of caribou crossings have not been finalized and will be determined through engagement with Inuit community members and elders. Approximately 49% of the proposed North Railway route has embankments or cuts <2 m that will not create a barrier to caribou movement. Supporting evidence for assertions that the criteria used to evaluate the railway as a potential barrier to caribou movement are largely based on Inuit Qaujimajatuqangit and is provided in Section 3.4.1.2 of TSD 10 (Wildlife Baseline and Impact Assessment). As mentioned above, special crossings will be constructed in areas identified by community members and/or elders in sections where known crossings may be impeded by the rail design.	QIA 21 Attachment 1: Typical Cross Section for Caribou Crossing
QIA 23	Are the wind turbines discussed at several places in the FEIS Addendum part of the scope of the proposed Project or outside of it? If they are part of the scope of the Project, provide further information on how IQ has been integrated into the siting process for the wind turbines.	Siting of the wind turbines, which are included in the scope of the proposed Project, has not been finalized. Before final placement is confirmed, Baffinland will carry out specific engagements with local land users to identify optimal and/or preferable locations.	
QIA 24	What does IQ have to say about the relative abundance of carnivore populations?	Baffinland's Wildlife Baseline and Impact Assessment (TSD 10; Section 2.3.1.2) presents the extent of information shared during workshops on carnivores. The baseline describes the relative abundance of Baffin Island wolf and other carnivores using primarily Inuit Qaujimajatuqangit (IQ) as follows: Wolves generally occur around the Project area but are believed to be rare on north Baffin Island by Inuit hunters. Their abundance, density, distribution and movement patterns are tied to that of caribou, which can partly account for their low abundance. All IQ interview participants had heard of wolverines occurring in the Project area but did not recall ever actually seeing one. Wolverines are suspected to be rare in the Project area. Fox and ermine abundance are also mentioned in Section 2.3.1.2, but no IQ is referenced. IQ related to carnivore densities in the RSA was also documented in the wildlife baseline prepared for the FEIS (Volume 6, Section 5.3.2 Carnivores, Baffinland Iron Mines Corporation 2012). There was no new information provided on carnivores when contemporary knowledge was collected for the Phase 2 project (Prno 2017) <u>References</u> Baffinland Iron Mines Corporation. 2012. Mary River Project Final Environmental Impact Statement: Volume 6 — Terrestrial Environment. 200 pp. (http://ftp.nirb.ca/02-REVIEWS/COMPLETED%20REVIEWS/08MN053-BAFFINLAND%20MARY%20RIVER/2-REVIEW/08-FINAL%20EIS/FEIS/Vol%2006/) Prno, J. 2017. Mary River Project, Phase 2 Proposal TSD 03 Results of Community Workshops conducted for Baffinland Iron Mines Corporation's Phase 2 Proposal. Prepared for Baffinland Iron Mines Corporation by Jason Prno Consulting Services Ltd., Peterborough, Ontario.	
QIA 25	How was IQ integrated or used to determined VEC's?	The VECs and VSECs for the Mary River Project are set out in the NIRB's Guidelines for the Preparation on an Environmental Impact Statement for Baffinland Iron Mines Corporation's Mary River Project (2015). Guideline development is an iterative process administered by the NIRB and designed to incorporate IQ through written correspondence, community scoping tours, and if necessary, in-person workshops. For the Mary River Project Guidelines specifically, the NIRB solicited feedback from Hunters' and Trappers' Organizations (HTO) and Hamlet offices of 11 communities in Nunavut, relevant Federal and Territorial Agencies, Inuit Organizations and interested parties regarding the issues to be included in the environmental review. The NIRB also conducted public scoping	

ID1	Info Request	Response	Attachment
		sessions in the following potentially-affected communities in the Nunavut Settlement Area (NSA): Pond Inlet, Arctic Bay, Resolute, Grise Fiord, Igloolik, Hall Beach, Coral Harbour, Cape Dorset, Kimmirut, Clyde River and Iqaluit. The objective of these meetings was to allow NIRB staff to effectively engage the public and interested parties on the proposed scope of the assessment, while soliciting their advice on VEC's and VSEC's that should be addressed in the EIS. For a full understanding of the EIS Guideline Development process for the Mary River Project please see Section 1.2 of the NIRB Guidelines.	
QIA 26	How was IQ used to inform ice conditions assessment including open water timing?	Baffinland has previously conducted extensive IQ data collection throughout the development and various phases of the Mary River Project, with the results of historic Phase 2 specific IQ Workshops summarized in TSD 3 Phase 2 Community Workshops. Three out of the five IQ Workshops that were held between March 2016 and May 2016 were focused on ice conditions and contemporary uses of Milne Inlet, including a specific focus on: contemporary Inuit land use in the Eclipse Sound and Navy Board Inlet areas, shipping through ice; and open water shipping. As a result of these workshops, and several other consultation activities conducted by Baffinland on Phase 2 (see TSD 4 Public Consultation), Baffinland set a nominal shipping window for Phase 2, with a commitment to confirm that land fast ice would not be engaged and that prior consultation with the MHTO would occur at the start of each shipping season to confirm that Inuit were no longer using the floe edge for traditional harvesting purposes. Baffinland is also planning a series of workshops that will be held in January, February and March of 2019, which will include discussions around seasonal ice conditions, timing of the open water and shoulder seasons and more generally how the Project interacts with components of the environment that are understood to be of importance to Inuit. How IQ can enhance Baffinland's Project mitigations, monitoring and environmental management for both the current Project and additional activities proposed for the Phase 2 Proposal is a key objective of the sessions.	
QIA 27	How was IQ used to assess the impacts of noise (from shipping and aircraft overflights) and traffic on marine mammals?	Reactions to aircraft overflights were evaluated in the previous assessment (Baffinland 2012). The Project Description for the Phase 2 Proposal indicates no change in aircraft flights (TSD 2 Project Description) that would warrant additional assessment. A mitigation measure carried forward from the previous assessment is that all aircraft will respect a minimum flight altitude of 450 m. The potential effects of noise from Project-related vessels on marine mammals has been discussed during several consultation sessions (see TSD 4 Public Consultation) and during the IQ Workshops for Phase 2 (see TSD 3 Phase 2 Community Workshops) with representatives from the QIA and north Baffin Island communities. Most notably, IQ has informed Baffinland's understanding of how levels of noise produced from Project-vessels operating at increased speeds could have the potential to negatively impact marine mammals in the area. As a result, Baffinland has committed to establishing speed restrictions for all Project-related vessels travelling in the Northern Shipping Corridor. Further, beginning in the summer of 2019, Baffinland has committed to employ 2 Inuit Shipping Monitors to be based in Pond Inlet so that members from the community can conduct live monitoring of vessel traffic management throughout the shipping season. Inuit from Pond Inlet have also been involved in Baffinland's marine monitoring programs each year since the start of the Project. Information collected via these participants has helped to inform the design of Baffinland's marine mammal monitoring programs and established recommendations for mitigations or additional adaptive management to ensure the noise from Project-related vessels is being sufficiently monitored and mitigated throughout the life of the Project. Baffinland is also planning a series of workshops that will be held in January, February and March of 2019, which will include discussing perceptions of how marine mammals may be affected by vessel noise and more generally how the Project interacts with components of the environment that are understood to be of importance to Inuit. How IQ could enhance Baffinland's Project mitigations, monitoring and environmental management for both the current Project and additional activities proposed for the Phase 2 Proposal is a key objective of the sessions.	
QIA 32	QIA requests that the Proponent clarify how many wind turbines it proposes to install.	Assessing technical and financial feasibility is ongoing. Specific design parameters will be developed at the preliminary engineering phase. Specific numbers of turbines at each study location will depend on site-specific factors but more than two at any single location is not being considered.	
QIA 34	When and where will the airstrip at Milne be constructed? A map that shows the proposed airstrip location at Milne should be provided.	The Milne Port airstrip is clearly identified in Figure 1.4 of the Main EIS, as well as Figure 1.4 of TSD 2 (Project Description). Appendix B of TSD 2 also includes a figure of the proposed Milne Port layout for the Phase 2 Proposal, with the airstrip outlined just west of the ore stockpile. The relocation of the existing airstrip at Milne Port is part of	

ID1	Info Request	Response	Attachment
		the Approved Project (Baffinland 2013a); however, its construction has been deferred to 2020 or later.	
QIA 35	Provide a description of the closure and reclamation approach for the norther rail components (e.g., embankment, culverts, bridges, access roads, quarries, etc.), as well as, any adjustments completed to the Tote Road that are Phase 2 specific. Additionally, for each component, identify the residual landform and aesthetic condition that will remain at closure.	Subject to further discussion and subsequent approval of the reclamation approach by QIA, the closure and reclamation for the North Railway components will involve the removal of rail infrastructure (rail and ties) at closure, grading to restore natural drainage pathways, and scarification to promote natural re-vegetation. Embankments will be left in place, provided they are safe for humans and wildlife, and geotechnically stable. Culverts, bridges, access roads and quarries will adhere to the established closure principals in the ICRP for these activities. Future closure options for the rail, embankments and water crossings will consist of evaluating which structures will remain, and which will be removed/graded, based on long term stability considerations. Consistent with the Site wide closure objective in the ICRP, aesthetic conditions should be similar to the surrounding natural conditions. It is understood that aesthetic conditions are subjective, and the closure criteria developed in the ICRP are subject to change based feedback from the future Mine Closure Working Group, which will endeavor to incorporate IQ into closure objectives and criteria such as this condition. Final closure may only be achieved upon final inspection by a representative of the Designated Inuit Organization.	
QIA 39	Provide the exact time for updates to management, mitigation and management plan, as this is currently uncertain.	Baffinland will distribute updated management plans, reflecting all changes identified through the review process to date, following the technical meetings. This process is further outlined in TSD 28 Management and Monitoring Plans, Section 1.1.3.	
QIA 42	A. When will the final design of the rail embankment and associated geotechnical/thermal analysis be completed? B. Will thermal modelling be completed for each bridge abutment and major water crossing?	A: The anticipated completion date for the additional studies listed in responses to QIA 42 (Geotechnical Bridge Design Memo), QIA 43 (Long Term Embankment Settlement Report) and QIA 40 (Cut Slope Stability Analysis) is February 2019 B: 1-D thermal modeling has been completed for the railway bridge abutments. A geotechnical bridge design memo in this regard is being prepared which will describe the results of the thermal modeling and will be made available once completed. No thermal modeling has been completed at any other water crossings.	
QIA 43	Describe the adaptive management program that will be applied to the northern rail to address settlement concerns for the northern rail.	The Project is currently completing long-term embankment settlement calculations for areas in fill and the recommendations from these studies will be incorporated into the design where required. The results of these studies will be made available once completed. However, post-construction track alignment is monitored as part of normal railway maintenance practices and as such settlement will be monitored over time. The proposed ballasted track design provides the ability to manage vertical settlements in the range of 0-200 mm through the addition of ballast and providing re-alignment interventions through the process of track tamping interventions where the track alignment is adjusted both vertically and horizontally to maintain the initial design and keep the rail alignment within normal safe operating limits as set out by the AREMA standards.	
QIA 44	Provide on a map of the locations of the borrows identified in Table 2.3	Quarry locations are presented as Figure 9.1 in Attachment 9 of the Application to Amend the Type A Water Licence (TSD 2 Project Description, Appendix D). Quarry locations are also shown in detail in Figure B.4 in TSD 2, Appendix B.	
QIA 48	Describe why pit water quality and waste rock drainage are not considered in the effects assessment for water quality.	The Phase 2 Proposal does not introduce any changes to the Mine Site presented in the FEIS. As such, there are no changes to waste rock management or the open pit that would require revisiting potential impacts of these project components on surface water. TSD 13 Surface Water Assessment makes brief mention of non-compliant discharges from the WRF pond in 2017 that has necessitated corrective action including the installation of a water treatment plant in 2018. This is an operational issue that is being addressed by Baffinland independent of the Phase 2 Proposal.	
QIA 52	Provide a summary of proposed SNP locations associated with Phase 2 infrastructure.	Proposed additional SNP stations to address the Phase 2 Proposal are presented in Table 6.1 of the Application to Amend the Type A Water Licence (TSD 2 Project Description, Appendix D). Exact coordinates for the additional SNP stations will be provided to the NWB for approval prior to the commissioning of the associated Phase 2 infrastructure.	
QIA 53	What is the maximum quantity of ore that would be trucked along the Tote Road in a given year?	Truck trips along Tote Road will peak during rail commissioning at 560 truck trips/day. A total of 12 Mtpa of iron ore was used to calculate the figure based on current haul truck load capacities, estimated downtime, and operational experience. The actual amount of ore hauled will vary on a number of factors, including operational efficiencies and established environmental limits.	
QIA 54	Clarify the number and location of landfill and landfarms that are currently approved and sought as part of the Phase 2 Proposal.	Under the current water licence 2AM-MRY1325, landfills for solid waste can be constructed at the Mine Site and Steensby Port. Currently there is one landfill present at the Mine Site only. As part of the Phase 2 Proposal, Baffinland is proposing to construct a landfill at the Milne Port. Under the current water licence 2AM-MRY1325, landfarm facilities for the deposition and treatment of hydrocarbon	

ID1	Info Request	Response	Attachment
		contaminated snow and soil can be constructed at the Milne Port , Mine Site, and Steensby Port. Currently there is one landfarm facility present at Milne Port only. No further landfarm facilities are proposed as part of the Phase 2 Proposal.	
QIA 55	If an access road or haul road is not constructed to the design criteria presented in Appendix D and/or G, will the road be used in operation?	Roads used in operation will be constructed to appropriate design criteria, as presented in TSD 2 Project Description.	
QIA 56	QIA requests that the Proponent clarify terminology used to describe flights and trips.	The term "flight", as used in the Phase 2 Proposal, refers to a single round-trip flight in and out of the airstrip located on site. The term "trip" is generally used to speak of the movement of vehicles along the Tote Road, between Milne Port facilities and the Mine Site. "Round trip" is often used to include movement both ways to and from a destination. In Appendix C (Phase 2 Key Facts Table) of TSD 2 (Project Description), all mentions of trips (Tote Road, North Railway and shipping) refer to rounds trips, to and from destinations.	
QIA 57	QIA request that the Proponent clarify where the Tote Road Earthworks Execution Plan (TREEP; Golder 2017) is available.	The TREEP is provided in Appendix 14.	Appendix 15 Memo: Truck transportation of Ore (6 Mtpa)
QIA 58	QIA requests that the Proponent clarify whether modelling dust inputs to Phillips Creek from the Milne Port area considered dust inputs from the tote road and railway construction upstream and, if so, where in the EIS?	No, the modelling of dust inputs to Phillips Creek did not consider dust inputs from the Tote Road and railway construction upstream. Section 3.5.2.5 of TSD 13 Surface Water Assessment noted the following: Dust generation is considered to be the least likely mechanism to lead to inappropriate levels of TSS within water bodies, however, and the primary sources of TSS include sediment entrainment in snowbanks and mass wasting at crossings (Golder, 2016a,b).	
QIA 64	QIA requests clarification as to whether all Project vessels are required to reduce speed to a maximum of 9 knots beginning at the entrance to Pond Inlet through Eclipse Sound and Milne Inlet.	Vessel speed (regardless of vessel type) has been assessed at max of 9 knots through Eclipse Sound and 5 knots through Milne Inlet. Please refer to Overview of Marine Operations, provided in Appendix 12.	Appendix 12 Overview of Marine Operations
QIA 65	QIA requests clarification on autumn shoulder season shipping dates and mitigation of impacts on Inuit travel.	Please refer to Overview of Marine Operations, provided in Appendix 12.	Appendix 12 Overview of Marine Operations
QIA 66	QIA seeks information on the relative availability of ore carriers of different sizes and ice classes for charter.	The type of vessel required is driven by a function of ice conditions (please refer to Table 10, TSD 16 Ice Conditions Report for the classifications of vessels as related to seasonal ice conditions). Ice class designs for ore carriers include (not an exhaustive list, but based on current knowledge of market availability): i) Non Ice Class (Type E) ii) Ice Class 1C (Type D) iii) Ice Class 1B (Type C) iv) Ice Class 1A (Type B) v) Ice Class 1A Super (PC 7) Types of ore carriers include (not an exhaustive list, but based on current knowledge of market availability): vi) Supramax vii) Panamax viii) Kamsarmax ix) Capesize	
QIA 67	QIA requests clarification as to the status of the freight dock that was to be constructed in 2018.	The freight dock has not yet been constructed. It is Baffinland's intention to begin construction on the freight dock in the winter/spring of 2019 following authorization by Fisheries and Oceans Canada.	
QIA 69	QIA requests that the Proponent clarify where fish salvage operations related to construction of Ore Dock 2 are described or provide details on how these operations will be conducted.	Fish salvage operations will be required in the two isolated waterbodies formed by the Phase 2 Proposal ore dock design (TSD 24 Marine Mammal Assessment, Figure 1.2). A detailed fish salvage plan will be developed and included in an Environmental Management Plan (EMP), which will form part of the application for the Fisheries Act Authorization (FAA). This commitment is reflected in the Commitment Register (Appendix 11).	Appendix 11: Commitment Register

ID1	Info Request	Response	Attachment
QIA 77	QIA requests clarification as to why shipping interactions with seabirds are scored as a Subject of Note and not a Key Interaction.	Marine birds were assessed as a Key Interaction in the EIS, as per TSD 12 (Migratory Birds Baseline and Impact Assessment). The scores of 1 given to marine birds in Table G4 (Effects Interaction Matrix – Shipping) in Appendix G (Interaction Summary Table) are incorrect. Marine birds should have been given an impact rating score of 2 for all items assessed in the FEIS that are related to shipping in Table G4. An impact rating score of 2 is defined as "an interaction to be considered further in the EIS".	
QIA 78	QIA requests clarification as to why marine mammals were not included in the sustainability analysis of the Phase 2 Proposal.	Marine mammals were considered in the sustainability analysis for the Phase 2 Proposal. In Table 11.1 of the Phase 2 Proposal EIS, the row that references Marine Habitat and Biota includes marine mammals. The references for this row are TSD 17 Marine Environmental Effects Assessment, and TSD 24 Marine Mammal Effects Assessment. The term "marine habitat and biota" includes marine mammals and their habitat.	
QIA 80	QIA requests that the Proponent clarify where bearded seal, one of the Key Indicators for the Marine Mammal VEC, has been assessed, or if it has not, provide information to support exclusion.	The assessment used ringed seal as a surrogate for bearded and harp seal. This was a reasonable approach because both potential Project-related effects and mitigation are equally applicable to ringed seal, bearded seal and harp seal. Baseline monitoring and scientific data and Inuit Qaujimajatuqnagit (IQ) indicate that ringed seal are the most common seal species in the RSA and that bearded seal are relatively uncommon in the RSA (TSD 24 Marine Mammal Effects Assessment, Appendix A).	
QIA 81	QIA requests additional information and clarity on the marine mammal effects assessment for Atlantic walrus.	Atlantic walrus was assessed in TSD 24 Marine Mammal Effects Assessment in Section 2.4.1. The preliminary screening completed in Section 2.4.1 indicated that the only potential interactions between the Project and Atlantic walrus would occur during shipping. Potential interactions included vessel wake, disturbance or impairment from underwater noise, and vessel strikes associated with shipping. These interactions were assessed as minor after the application of mitigation. Based on extensive aerial survey records, very few walruses occur along the Northern Shipping Route during the open-water season and no walrus haul-out sites are present in this area (Thomas et al. 2016). The closest aggregations of walrus occur near Kane Basin in northern Baffin Bay, extending into Lancaster Sound, Barrow Strait, and Jones Sound in the Canadian Arctic Archipelago (Vibe 1967; Davis et al. 1978; DFO 2002; COSEWIC 2006b). This is consistent with local IQ information indicating that small numbers of walrus occur at the northern entrance of Navy Board Inlet and in Lancaster Sound - west of Admiralty Inlet (Baffinland 2013). Only one walrus sighting was made during five consecutive years of shore-based monitoring conducted at Bruce Head from 2013 to 2017 (Thomas et al. 2014; Smith et al. 2015; 2016; 2017; Golder 2018). A total of five walrus sightings were recorded along the Northern Shipping Route during three consecutive years of aerial surveys conducted for Baffinland between 2013 and 2015 (Elliott et al. 2015; Thomas et al. 2015; 2016). Given the low likelihood of interactions between Project vessels and walrus, potential disturbance and hearing impairment effects from ship noise were considered negligible and this pathway was not considered further in the assessment. The minor assessment conclusion for each interaction were provided in Section 2.4.1.1. Effects that are not likely to be of notable environmental importance or consequence were defined as Subject of Note, or Level 1 interactions, and were not carried forward in the assessment; however, are discussed in Section 2.4.1.1. Key Issues, defined as Level 2 interactions (Volume 2, Section 3.5.3; Baffinland 2012) that were identified as being of substantial public interest and/or of potentially high environmental importance or consequence, were carried forward in the assessment.	
QIA 86	Provide additional details on training delivered to date and planned for Phase 2: A. Breakdown of Mandatory vs On-the-job (advancement) training delivered to Inuit and Non-Inuit in hours by year. B. New Inuit hires by year, age and educational attainment. This helps understand the number of Inuit who are accepting the opportunity cost of not finishing secondary school. C. The number of apprenticeships offered to Inuit and Non-Inuit; number of successful vs attempted Trades Entrance Exams; instances of level advancement within an apprenticeship; number of Red Seals earned. D. Additional Inuit employment hours that Baffinland expects to generate from its current Apprenticeship Program and HEO Training (Q-STEP). E. Explanation of how Baffinland confirms “Inuit Ethnicity” if not through NTI number. (p 33). F. How exactly Baffinland will adapt training programs to account for the “small shift in employee level skill requirements” (p 24). G. Identify the precise training programs that will upgrade employees’ skill levels from D to C to B Positions (p 27). Baffinland rather simply refers to the IHRS (not a training program) and Q-STEP generally. This is a critical question	The following provides a summary of Baffinland's response. The full response can is attached in Appendix 2. A. As noted in Section 3.4 of TSD 25 Socio-Economic Assessment a total of 122,950 hours of training have been provided since Project development, of which 15,867 hours were provided to Inuit. In addition, there have been considerable work-related experience and informal on-the-job training opportunities generated by the Project. A breakdown of mandatory vs. advancement-related training delivered to Inuit and non-Inuit in 2017 is provided in the Attachment. This annual snapshot provides a useful indication of mandatory vs. advancement-related training that has been delivered by Baffinland. Additional training information is available for Q1-Q3 2018 and is presented in the Attachment. Many new training hours can be attributed to Baffinland's Apprenticeship Program and Morrisburg Heavy Equipment Operator Program, which can be considered additional types of advancement-related training. B. To-date, Baffinland has not monitored new Inuit hires by year, age, or educational attainment. However, Baffinland can acknowledge that as of Q3 2018, 357 Inuit worked at the Project for Baffinland or a contractor. This	QIA 86 Attachment 01: Full Response

ID1	Info Request	Response	Attachment
	that Baffinland has been asked to consider in the EIS guidelines and it has not done so. H. Additional details on Inuit promotions, such as lateral vs skill level advancement. I. Additional details on Inuit departures, including rehires and those ineligible for rehire. J. Provide career paths for each department that operates in Nunavut, and example career path development plans. This has been a Baffinland commitment for over one year.	represents a 20% increase over the number of Inuit who worked at the Project in Q2 2018. Baffinland and QIA have agreed to conduct a Workplace Conditions Review annually, and both parties could consider adding these type of data requests to the annual review process. Additional Inuit Employee Survey data relevant to this IR is presented in the attachment. C. Since 2015, 11 Inuit have passed their Trades Entrance Exam while employed by Baffinland. Of those 11, 2 withdrew from the program of their own volition. Currently, 2 Inuit apprentices are in their third year and 7 are in the first year of their programs. No Inuit have earned Red Seals to-date. The next cohort of apprentices are currently being selected. D. Baffinland and QIA were recently successful in securing funds through Employment and Social Development Canada's (ESDC) Skills and Partnership Fund for their Qikiqtani Skills and Training for Employment Partnership (Q-STEP) training program. The program is expected to provide wage subsidized training for at least 300 Inuit, and lead to a minimum of 110 permanent jobs. In addition, Q-STEP will provide on-the-job training to new and current Inuit employees with Baffinland. Finally, Q-STEP will also help to reduce barriers to Inuit employment across the Qikiqtaaluk Region by teaching relevant and transferable skills to participants beyond the operational needs of the Mary River Project. E. Most Inuit candidates who apply for employment with Baffinland self-declare their Inuit ethnicity on their resume. In cases where this does not occur, Baffinland employees are asked to self-declare their Inuit ethnicity through the recruitment and hiring process. Contractor employees are asked to self-declare their Inuit ethnicity through the process used to arrange for travel to the Project site. F. Baffinland human resources and training staff will conduct an internal review of training needs for the Phase 2 Proposal and identify any gaps in current training programs. G. Baffinland has outlined how its training programs will upgrade employees' skill levels in Table 3.3 of TSD 25 Socio-Economic Assessment. While some specific training programs have not been created by Baffinland yet, other programs are currently in operation and/or development. For example, Baffinland currently offers an Apprenticeship Program and continues to run the Heavy Equipment Operator Program in Morrisburg, Ontario. As per IIBA Article 7.20 (QIA and Baffinland 2018), Baffinland recently made a new commitment to develop and operate an Inuit Internship Program. To guide current employee progression planning Baffinland also has a 'Lines of Progression Policy'. The purpose of this policy is to ensure that employees and managers/supervisors clearly understand the interrelationship between roles, the pathways for promotion, and accompanying policies and procedures. Article 7.15 of the IIBA further commits Baffinland to developing career path development plans for every Inuit employee and developing career paths for each department. H. Baffinland provides data on Inuit promotions through its annual socio-economic monitoring reports to NIRB and its IIBA implementation reports to QIA. Conversations between Baffinland and QIA are ongoing on the topic of tracking positions by NOC code through the IIBA Employment Committee. I. Some additional details on Inuit departures (and non-Inuit departures) have been presented in Appendix B of TSD 25 (Socio-Economic Assessment) and/or in IIBA implementation reports provided to QIA but are also summarized in the Attachment for convenience. J. Baffinland respectfully notes that this level of information is not a requirement of the EIS Guidelines and is addressed under the IIBA (QIA and Baffinland 2018). Article 7.15 of the IIBA commits Baffinland to developing career path development plans for every Inuit employee and developing career paths for each department. Baffinland is in	

ID1	Info Request	Response	Attachment
		the process of developing these in collaboration with MIHR, which are expected to be completed in late 2019 or early 2020.	
QIA 87	Provide additional details on employment opportunities planned for Phase 2. A. Additional details on Inuit departures, including rehires and those ineligible for rehire. B. Provide career paths for each department that operates in Nunavut, and example career path development plans. This has been a Baffinland commitment for over one year. C. A list of current and anticipated position titles in all phases by Skill level and educational requirements should be added to Appendix D. D. An analysis or at least discussion about how Baffinland will consider skill equivalencies for Inuit who do not meet education requirements. E. Adjust Figure 4.4 to include Inuit who are 18-24. F. Expand analysis of the labour market to consider movement of Inuit into the labour force over the course of Phase 2. G. Provide a list of positions for which English fluency is not required.	A. Please see Baffinland's response to QIA IR #86, Part I. B. Please see Baffinland's response to QIA IR #86, Part J. C. Lists of current and anticipated position titles by skill level and educational requirements by Project phase are not a requirement of the EIS guidelines. Updated lists of current position titles at the Project are provided by Baffinland to QIA in Quarterly IIBA Implementation Reports. Moving forward, Baffinland has also committed to provide National Occupational Classification (NOC) code information for positions at the Project as part of its regular IIBA reporting to QIA. As noted in IIBA Article 7.15.4, career paths for each department will also be developed and will include position title, NOC Code and wage, as well as the number of hours and specific training required to advance from one position to the next. Career paths will be provided to QIA through the IIBA Employment Committee. The current assessment of employment and skill levels presented in Section 3 (Education and Training), Section 4 (Livelihood and Employment), and Appendix D of TSD 25 (Socio-Economic Assessment) presents sufficient detail to support the environmental assessment. Furthermore, workforce projections are forward-looking, based on best estimates, and subject to change based on operational and market realities. Actual annual employment and skill level information will continue to be tracked through the Project's socio-economic monitoring program and/or IIBA implementation reporting process. Baffinland also continues to refine its workforce planning and is committed to making this information available to the QIA through existing IIBA committees prior to the commencement of Phase 2 construction. D. Through the recruitment and hiring process, Baffinland's human resources staff continually assess and consider a candidate's skills for the positions they have applied for. Baffinland recruiters may use their professional judgement to consider skills as equivalent to education, work experience or other areas deemed required for a specific position. The IIBA (QIA and Baffinland 2018) provides overarching guidance on how Baffinland further considers skill equivalencies for Inuit who may not meet education requirements. IIBA Article 7.3 notes that all positions will be open to Inuit with the work habits and skills, experience and qualifications required by the positions. It also notes that Baffinland's recruiters and contractors will consider ability, skills and experience as equivalent to formal qualifications using agreed upon Skills Equivalency Assessment Templates (SEAT) and that Inuit applicants with experience equivalencies will be treated equally with all applicants with formal training. As a result of IIBA renegotiations that recently took place between QIA and Baffinland, the Parties are presently engaged in the drafting of an IIBA Implementation Guide. Part of this guide will provide guidance and direction to the IIBA Employment Committee on the use of the SEAT and further aid the Parties in determining skill equivalences for Inuit seeking employment at the Project. Further to the above, Baffinland is engaging the Mining Industry Human Resources Council (MIHR) to complete a package of work for the Company which includes a Qikiqtaaluk Region specific labour market analysis, assessment of barriers to employment, skills assessment, and employment classification (i.e. NOC Code) undertaking. This work is being regularly discussed with the QIA through the IIBA Employment Committee. E. This figure was sourced from the Labour Market Analysis (LMA) presented in in TSD 26. Please note that a revised LMA has since been prepared by Baffinland and has been attached with its response to Information Requests provided to NIRB. Data limitations prevent Figure 4.4 from including Inuit who are in the 18 to 24 age cohort. The 2016 Census presents population estimates based on 'Highest certificate, diploma, or degree' for two age cohorts – 15 and over (meaning 15 to 99+) and 25 to 64. The 15 and over dataset can be particularly misleading in the context of Figure 4.4 because it includes youth who are still in school and not yet old enough to have graduated and residents over the age of 65 who would not likely work at the Project regardless of their education. The inclusion of these two age groups lowers the educational	

ID1	Info Request	Response	Attachment
		attainment results when compared to the 25 to 64 age cohort. Therefore, the 25 to 64 age cohort is a better representation of the Inuit population being studied. F. A revised Labour Market Analysis (LMA; original version was presented as TSD 26) has been prepared by Baffinland and has been attached with its response to Information Requests provided to NIRB. This revised LMA incorporates new data released through the 2016 Census on population demographics, education levels, and labour force characteristics of the Local Study Area (i.e. Arctic Bay, Clyde River, Hall Beach, Igloolik, Pond Inlet, and Iqaluit). The revised LMA now also includes new data and analysis pertaining to a 'secondary labour market' (i.e. Cape Dorset, Grise Fiord, Kimmirut, Pangnirtung, Qikiqtarjuaq, Resolute, and Sanikiluaq), to reflect Baffinland's commitment to provide air transportation for Inuit employees from the Baffin Region to and from the Project at no cost to the employee (as per IIBA Article 7.6.2). The revised LMA also incorporates population projections for the LSA and secondary labour market based on a 20-year outlook, so that potential movement of Inuit into the labour force through population growth is addressed. The revised LMA uses this information to provide an estimate of the potential workforce in the LSA (i.e. the ready, able, and willing labour supply). This estimate further considers various constraints to Project employment including aptitude, interest, familiarity with wage employment, family responsibilities, language, criminal record, dependencies, and competition for Inuit labour. The LMA also discusses the experience other northern Canadian mines have had with growing their Indigenous workforces. Agnico Eagle Mines Limited's Meadowbank Mine located in the Kivalliq Region of Nunavut and the diamond mines located in the Northwest Territories (i.e. Ekati, Diavik, and Snap Lake) are recent examples of northern mines that have experience in growing their resident Indigenous workforce. These two examples provide evidence of the challenges and opportunities in entering this type of labour market. G. As per Article 11.4 of the IIBA (QIA and Baffinland 2018), Baffinland supports the use of Inuktitut in the workplace and agrees that lack of English will not be a barrier to Inuit for employment at the Project. Furthermore, Article 7.4 of the IIBA notes Inuit who lack fluency in the English language may qualify for positions where fluency does not compromise safety. If required for safety reasons, as determined by the Company, Inuit without fluency in English may be transferred to another position. Baffinland does not have a list of current positions for which English fluency is not required but does assess position and related safety considerations on an as-needed basis for individual Inuit employees who may lack English fluency. In 2018, Baffinland expanded the number of Inuit Cultural Advisors (previously called on-site Elders) that are on staff. Should an Inuit employee require any assistance due to a lack of fluency in English, Inuit Cultural Advisors are engaged to provide the necessary support. <u>References:</u> Qikiqtani Inuit Association (QIA) and Baffinland Iron Mines Corporation (Baffinland). 2018. The Mary River Project Inuit Impact and Benefit Agreement. Amended and restated agreement made on October 22, 2018.	
QIA 88	How and to what extent did alternative options either positively or negatively (adversely) impact the opportunities available to Inuit and Inuit Firms?	As described in Section 1 of TSD 1 Alternatives Analysis, viable alternatives for the Project were evaluated according to 4 key performance indicators: technical feasibility, cost-effectiveness, environmental acceptability and finally community acceptability. An understanding of community acceptability was derived from community engagement activities (see TSD 4 Public Consultation Report) and incorporated into the alternatives assessment. It is notable however, that any alternatives that would make the project economically or technically infeasible could not be carried forward, irrespective of how high community acceptability for a proposed option was ranked. Regardless of the preferred options identified through the alternatives assessment, Baffinland's commitments to Inuit identified in the IIBA (2018) remain unchanged. In other words, all commitments Baffinland has made to ensuring Inuit have access to the benefits of the Project, specifically with respect to the areas of employment, training and business opportunities also remain unchanged.	

ID1	Info Request	Response	Attachment
QIA 89	Can Baffinland expand upon its engagement efforts with Inuit Firms regarding the opportunities of Phase 2?	Recent initiatives Baffinland has undertaken to engage Inuit Firms on the contracting opportunities associated with the Phase 2 Proposal include: Baffinland completed a Contracting and Procurement Information Tour in the five north Baffin communities from October 15-19, 2018. The purpose of this tour was to discuss opportunities associated with the Project for Inuit-owned businesses, provisions of the IIBA that relate to procurement and contracting, and to meet directly with Inuit firms interested in business opportunities with Baffinland or one of its contractors. Members of the Baffinland procurement team attended the 2018 Nunavut Trade Show & Conference in Iqaluit from September 17-20, 2018 and hosted an Information Session. A goal of this session was to help increase Inuit content and Inuit firms engaged in contracts at the Project. Discussions were held to educate attendees on how to become suppliers of Baffinland using the pre-qualification document, as this is the first step prior to becoming an approved bidder. Only companies (Inuit and non-Inuit) that have pre-qualified will be invited to tender as per the IIBA. Members of the procurement team were also available for one-on-one meetings throughout the conference. Ongoing implementation of the Inuit Procurement and Contracting Strategy (IPCS; see TSD 28 Management and Monitoring Plans, Appendix AH), which includes a number of goals and initiatives related to Inuit contracting at the Project. Ongoing implementation of Inuit contracting provisions in the IIBA (QIA and Baffinland 2018), including the delivery of preferential opportunities for Inuit Firms to contract with the Project, and ongoing support of the Business Capacity and Start-Up Fund ($275,000/year). Ongoing membership in the Baffin Region Chamber of Commerce, which helps improve Baffinland's visibility and accessibility to the Baffin Region business community. Article 6 (Contracting Opportunities) of the IIBA (QIA and Baffinland 2018) commits Baffinland to conducting annual workshops and information sessions in Pond Inlet, Arctic Bay, Clyde River, Hall Beach, Igloolik, and Iqaluit for purposes of facilitating Inuit Firm and Inuit entrepreneur participation in the contracting process and increasing their chances of contract award. The IIBA also notes Baffinland will conduct annual outreach to Inuit Firms and Inuit entrepreneurs in the form of a business survey in order to facilitate an understanding of needed training, workshops, and information sessions and other topics as recognized by Baffinland and decided by the IIBA's Contracting Committee. Furthermore, Baffinland's ongoing community engagement efforts will provide Inuit with additional opportunities to learn about the Project and the opportunities it presents (e.g. through community tours, public meetings, open houses, and other forms of outreach). The above initiatives will be conducted by Baffinland in an ongoing manner to support engagement with Inuit and Inuit Firms regarding opportunities associated with the Phase 2 Proposal. <u>References:</u> Qikiqtani Inuit Association (QIA) and Baffinland Iron Mines Corporation (Baffinland). 2018. The Mary River Project Inuit Impact and Benefit Agreement. Amended and restated agreement made on October 22, 2018.	
QIA 90	Can Baffinland expand upon how it intends to improve its engagement efforts with Inuit and Inuit Firms regarding the opportunities of Phase 2?	The following provides a summary of Baffinland's response. The full response can is attached in Appendix 2. Please see QIA IR #89 for a discussion of how the Company intends to engage Inuit Firms, specifically, regarding the opportunities of the Phase 2 Proposal. Baffinland's Stakeholder Engagement Plan is presented in Appendix Z of TSD 28 (Management and Monitoring Plans) and establishes the approach, strategy, and means by which Baffinland communicates with Project stakeholders. In addition, the Company has implemented, or has committed to implementing, several initiatives through the IIBA (QIA and Baffinland 2018) that contribute to engagement with Inuit on the Project. Baffinland has also finalized an Inuit Human Resources Strategy (IHRS; see Appendix AG of TSD 28) with the QIA. It outlines eight pillars of strategic actions, several that are relevant to engagement with Inuit on the Project. Through Article 15.10 of the amended IIBA the Company further supports enhanced engagement efforts with Inuit by paying for QIA's participation, including technical advisory support, in NPC, NIRB, and NWB proceedings as they	QIA 90 Attachment 01: Full Response

ID1	Info Request	Response	Attachment
		relate to the Project. These payments will further the participation of QIA in the regulatory process, ensuring that Inuit are engaged both directly and indirectly through QIA.	
QIA 91	How many new Phase 2 contracts have already been awarded, and to whom?	The value of Phase 2 Proposal contracts which have already been awarded as of November 2018 totals USD 589M. Of this amount, USD 146M has been awarded to Inuit Firms, including Almiq Construction, Nahanni Construction, Nuna East, and Qikiqtaaluk Sana. The value of Phase 2 Proposal contracts which have not yet been awarded as of November 2018 is estimated to total approximately USD 300M-400M. This estimated value includes several major earthworks contracts, a contracting category in which Baffinland has had previous success in contracting Inuit Firms and hiring Inuit employees (through contractors).	
QIA 92	What is the value of new Phase 2 contracts that have already been awarded?	Please see Baffinland's response to QIA 91.	
QIA WL 01	1. An estimate of the total financial/reclamation security for the highest liability over the life of the undertaking should be provided in the application, as required in the NWB's SIG. 2. It is requested that details on the expected overall reclamation cost be provided so that parties can consider the information in the context of the current review process rather than outside of or sperate from the current review process.	An estimate of the total reclamation security for the highest liability over the life of the project will be included in the revised Interim Closure and Reclamation Plan. The planned updates to mitigation and monitoring plans will be reflected in the Commitment Register (Appendix 11). All management plans are expected to be updated following the Technical Meeting, currently planned for March 12-15, 2019. However, it is noted that Baffinland will continue to assess security on an annual basis through the Annual Security Review process outlined in the current Water Licence 2AM-MRY1325 and the Commercial Lease.	Appendix 11: Commitment Register
QIA WL 02	1. In accordance with relevant NWB guidelines, new/updated plans must be submitted for applications related to new activities/undertakings. Baffinland states that the current Interim Closure and Reclamation Plan (ICRP) includes all elements of the Phase II Proposal. However, information contained in the document suggests otherwise. 2. The reference to Part J, item 2 in the application is erroneous, and misleading. The amendment in reference in Item 2 is the approved Amendment 1, not future applications for amendments. As per the NWB guidelines a new plan should be submitted with the application, specific for the new activities 3. Baffinland should clarify the current Project scope in the approved ICRP and what components of the Phase II Proposal are in the current ICRP (if any). To ensure that reviewers are able to access and review the components of the ICRP including those relevant to the Phase II Proposal, an updated version of the ICRP should be provided for the current review process.	1. The ICRP will be updated to include the location and scale of the Phase 2 earthworks and infrastructure, as outlined in TSD 28 Management and Monitoring Plans. The scope of earthworks and infrastructure considered in Phase 2 is consistent with, or a variation on the existing scale of the project as approved under Project Certificate No. 005, for which closure strategies, objectives and criteria have been developed in the ICRP. In discussions with QIA, Baffinland has made clear that an update to the ICRP will be required for Phase 2 Proposal and that QIA approval will be required. Consistent with all management plan updates outlined in TSD 28, the ICRP will be updated. The planned updates to mitigation and monitoring plans will be reflected in the Commitment Register (Appendix 11). 2. Part J, Item 2 states the following: *The Licensee shall to submit to the Board for Approval in writing, within sixty (60) days following approval of this Amendment, a revised version of the Plan entitled Interim Closure and Reclamation Plan (BAF-PH1-830-P16-0012, Rev 3), March 19, 2015, that addresses the relevant comments and recommendations provided by intervening parties during the review period. The Plan under this section will supersede the Plan referred to in Part J, Item 1 once approved and must address all mine related components including the following….* We understand that this clause was written for Amendment 1. If that process was suitable during Amendment 1, it would seem to be applicable to the current amendment application; that an update to the current plan can be submitted to the NWB within 60 days of approval of receiving Amendment 2 that incorporates any comments and recommendations provided by intervening parties during the review period, and the revised plan will be subject to review by the parties and approval by the NWB. 3. The scope of the ICRP considers the current mining operations at Deposit 1, stockpiling, crushing and hauling of ore, the operation of the waste rock facility, transportation of ore by truck on the Tote Road, stockpiling and shiploading of ore (including the Ore Dock), and various support infrastructure at the Mine and Milne port including; transportation (roads, airstrip, helipad), accommodations, utilities (power, water and sewage), warehouses/offices/garages, waste storage (landfills, landfarms, hazardous waste berms), polishing and sedimentation ponds, and quarry and borrow areas. In addition, the ICRP considers the closure strategy for the approved railway execution phase of the project under Project Certificate No. 005, and other associated infrastructure associated with this phase but not yet constructed. Phase 2 will include the addition of the railway in the Northern Transportation Corridor, reconfiguration of and new construction of crushing, screening and stockpiling facilities, and an additional Ore Dock and shiploader at Milne Port. Support infrastructure will remain generally consistent with the Approved Project. With respect to changes required for the ICRP, the description of this infrastructure and earthworks, as well as all figures demonstrating their	Appendix 11: Commitment Register

ID1	Info Request	Response	Attachment
		location will need to be updated. Closure strategies, criteria and objectives remain the same, including for railway infrastructure already considered in the ICRP. Consistent with all management plan updates outlined in TSD 28, the ICRP will be updated. The planned updates to mitigation and monitoring plans will be reflected in the Commitment Register (Appendix 11)	
QIA WL 04	QIA requests that updated versions of these plans (management and/or monitoring plans) or relevant new plans, which addresses Phase II activities and undertakings, be provided to parties for review at the earliest stage under the current review process.	The planned updates to mitigation and monitoring plans will be reflected in the Commitment Register (Appendix 11). All relevant management plans are expected to be updated following the Technical Meeting, currently planned for March 12-15, 2019.	Appendix 11: Commitment Register
QIA WL 05	QIA notes that the current Water Compensation Agreement (WCA) and the Commercial Production Lease (CPL) do not cover the activities and/or undertakings proposed under the Phase II Proposal. Consequently, the CPL and WCA will likely need to be amended/new ones will need to be developed and implemented.	Baffinland recognizes that updates to the WCA and CPL are necessary and has already begun discussions with the QIA and will continue to work with the QIA to develop amended versions prior to the NWB Public Hearing	
QIA-WL 03	It is requested that copies of IFC drawings/designs for water and waste management facilities be provided in time for the current review process.	The NWB's Guide to Completing and Submitting Water Licence Applications states the following: *Generally, the NWB requires final plans to be submitted for review and approval. Submissions may be approved either as part of the water licence application or prior to construction as a condition of an approved water licence. Depending upon the complexity of the technical issues associated with a proposed undertaking, the NWB may request final plans to be submitted as part of the water licensing approval process.* The application contained a mix of drawings labelled, "Issued for Construction," "Approved for Construction," and "Not for Construction". Much of the Phase 2 Proposal is not technically complex, including the in-water and waste disposal aspects of the Phase 2 Proposal, and therefore the drawings presented in the application provide a sufficient level of detail for the impacts of the project and the mitigations proposed to be assessed. Consistent with the NWB guidelines and the conditions of the Type A Water Licence 2AM-MRY1325, Baffinland will submit all IFC drawings for review 60 days prior to construction.	

CROWN-INDIGENOUS RELATIONS AND NORTHERN AFFAIRS CANADA

ID1	Info Request	Response	Attachment
CIRNAC 2	CIRNAC requests that the Proponent provide the following additional information: a) Whether a North Railway alternative capable of transporting 30 Mtpa was ever considered; b) If so, why a North Railway alternative capable of transporting 30 Mtpa was ultimately discounted as not being viable; and c) Include the analysis of no-go alternative for building a North Railway capable of transporting 12 Mtpa to Milne Port.	a) Baffinland confirms that the railway design will be capable of transporting in excess of 12 Mtpa. Although railway transportation modelling has not been carried out for the transportation of up to 30 Mtpa, the constructed infrastructure could be able to accommodate transportation for additional tonnage with additional engines and rolling stock. b) This alternative may be viable. Additional feasibility work is required to establish the adequacy of the Milne Port infrastructure (dock, unloading, stockpiles, etc.) as well as vessel traffic within Milne Port area to determine what is technically feasible and practically achievable. Such studies have not yet been undertaken as Baffinland's development strategy for the Mary River Project is to generate sufficient cash flow to undertake the development of the South Railway and Steensby Port for which Baffinland already holds authorizations. The Southern Shipping Route (Foxe Basin – Hudson Strait) is preferable to the Northern Shipping Route (Milne Inlet – Eclipse Sound) in terms of year-round transportation of ore. c) The No-go analysis for building a North Railway is presented in TSD 2 Project Description, Section 2.1 - Cease, Maintain or Increase Production.	
CIRNAC 3	CIRNAC requests that the Proponent provide, as per the EIS Guidelines, a detailed description of the geology and geomorphology aspects in the project area and consideration of their effects on the major project components including but not limited to: dock facilities, railway embankments, bridges, major watercourse crossings, open pit, and equipment pads.	As noted in TSD-08, Landforms, Soil and Permafrost Assessment, "The descriptions of the surface geology, subsurface geology, topography, geochemistry, hydrogeology, geomechanics, protected areas, special management areas, and conservation areas have not changed from what was presented in the FEIS (Baffinland, 2012)." These descriptions are provided in the FEIS in Volume 6, Terrestrial Environment, Section 2.0 Landforms, Soil and Permafrost. Additional geotechnical investigations and terrain analyses have been completed at areas where new infrastructure is proposed as part of the Phase 2 Proposal, and have been included as attachments to the application to amend the Type A Water Licence, in Appendix D of TSD 2 (Project Description) the Phase 2 Proposal, as follows: • Milne Port Infrastructure: o Preliminary Geotechnical Recommendations for Infrastructure at Milne Inlet (Attachment 12.2) • Second Ore Dock: o Geophysical Seismic Survey for a Proposed Fixed Dock (Attachment 12.4) o 2017 Milne Port Ore Dock No. 2 Geotechnical Factual Data Report (Attachment 12.3) • Railway: o Site Assessment of North Railway Alignment (Attachment 6.1) o 2016-2017-2018 Railway Geotechnical Investigation Factual Data Report (Attachment 6.2) o Preliminary Geotechnical Recommendation for Railway Embankment (Attachment 6.3) • Mine: o 2018 Mine Site Geotechnical Investigation Report (Attachment 12.1) Consideration of the effects of Project components on geology and geomorphology are presented in TSD-08. An evaluation of potential effects to stream morphology and consequently surface water quality due to combining flows of diverted streams is provided in TSD 13 (Surface Water Assessment), Section 2.5.3 and Appendix D. Consideration of the effects of geology and geomorphology on the Project components is presented in the various geotechnical reports prepared for the Project, and consideration of these effects has informed the design of these components. As part of the Phase 2 Project, no changes are proposed to the mining operation at Deposit No. 1, where the open pit will be present as mining of the deposit advances. The assessment for this component presented in the FEIS remains valid.	

ID1	Info Request	Response	Attachment
CIRNAC 4	CIRNAC requests that the Proponent provide the following information, as per the EIS Guidelines: a) Geology and mineralogy of the ore deposit; b) Deposit locations; c) Detailed structural geology map; d) Lithology and mineralogy in the Project area; e) Presence of ice lenses and implications to the Project; f) The nature, depth and thickness of the ore deposit to be mined; g) Estimated volumes and characteristics of waste rock; h) ARD and metal leaching characteristics; i) Ore body delineation; j) Permeability of the open pit; and k) General characterization of the pit water.	The Phase 2 Proposal scope does not include the development of any mineral deposits other than the currently approved Deposit 1.	
CIRNAC 5	CIRNAC requests that the Proponent provide the following information with respect to the WRF: a) Physical characteristics of processed ore, including size and quantities of fines; b) Details of the water drainage, diversion and discharge; c) Chemical stability analysis of the waste rock; and d) Measures to prevent ARD and ML.	The components referenced in this information request (including physical characteristics of processed ore, water drainage and discharge in the ore mining area, chemical stability analysis of waste rock, and ARD/ML control measures) are not changing as a result of the Phase 2 Proposal. For clarification, current information has been provided to CIRNAC in various formats previously, including Modification Request #8 for the waste rock pond expansion submitted to the Nunavut Water Board.	
CIRNAC 6	CIRNAC requests that the Proponent provide: a) An updated version of the EPP and Environmental Management Plans, applicable to Mary River Project Phase 2 considering the North Railway and the expansion of Milne Port; b) A Follow-up and Adaptive Management Plan that indicates the criteria and thresholds to trigger mitigation measures for the evaluation of the efficiency of mitigation measures; c) Quality Assurance and Quality Control measures to be applied to the monitoring program; and d) Updated Management, Mitigation and Monitoring Plans as proposed in TSD-28 for the technical review period.	Management plans will be updated, as committed to in TSD 28 Management and Monitoring Plans. a) The EPP and Environmental Management Plans applicable to Mary River Project Phase 2 considering the North Railway and the expansion of Milne Port will be updated as outlined in the Commitment Register (Appendix 11). b) Follow-up and Adaptive Management Plans are included in relevant management plans as listed in TSD 28 Management and Monitoring Plans and will be updated to indicate the criteria and thresholds to trigger mitigation measures as outlined in the Commitment Register (Appendix 11). c) Quality Assurance and Quality Control measures to be applied to each monitoring program will be included in relevant plans, where warranted, as outlined in the Commitment Register (Appendix 11). d) Management, Mitigation and Monitoring Plans as proposed in TSD 28 Management and Monitoring Plans will be updated as outlined in the Commitment Register (Appendix 11).	Appendix 11: Commitment Register
CIRNAC 7	CIRNAC requests that the Proponent provide the following information: a) Calculations of de-watering volumes to be pumped based on meteorological baseline and other relevant analysis; b) A description of mine de-watering methods; c) Proposed geotechnical works, sediments disposal and disposal methods; and d) Develop contingency strategies should monitored mine water volumes differ from predictions.	No aspect of the mine dewatering plan will change as a result of the Phase 2 Proposal. The previous assessment remains applicable for this component of the Project.	
CIRNAC 8	CIRNAC requests that the Proponent provide: a) Geochemical testing of rock cut areas in the North Railway area; and b) Information available on the risk of encountering ARD/ML material in the North Railway construction materials and how this can be mitigated effectively to avoid unexpected problems in the long term.	a) Appendix B of Baffinland's Borrow Pit and Quarry Management Plan presents a Protocol for the Assessment for the Potential for Acid Rock Drainage. The analytical criteria that are used for classifying material as potentially acid-generating (PAG) are: 1) Neutralization Potential Ratio (NPR) < 2 2) Sulphur concentration > 0.20% b) Documents provided in response to CIRNAC-IR#:10 provide information on ARD/ML testing that has been completed.	
CIRNAC 9	CIRNAC requests the Proponent provide the following: a) Summary of mine site water quality monitoring data; and b) Updated water quality predictions of seepage and run-off incorporating monitoring data.	a) As required by the Project's Type 'A' Water Licence, Baffinland provides water quality monitoring data for Project sites to regulators, including CIRNAC, in monthly and annual monitoring reports. Monthly and annual reports produced for the Project can be found on the NWB's ftp site.	

ID1	Info Request	Response	Attachment
		b) An update to the water quality predictions for the Waste Rock Facility that incorporates data collected will be provided in 2019.	
CIRNAC 10	CIRNAC requests the Proponent provide the following: a) Interim ML/ARD Assessment of Railway Quarry Rock Samples (Baffinland Mary River Project, December 2010); and b) Additional geochemistry reports and data sets that may be relevant to the quarry areas	a) The requested Interim ML/ARD Assessment of Railway Quarry Rock Samples (Baffinland Mary River Project, December 2010) is attached in Appendix 3. Note that the focus of this assessment was on the South Railway from the Mine Site to Steensby Port. b) The following additional documents have also been provided as Attachments to this response (Appendix 3): • Project Memo: Geotechnical Investigations - Acid Rock Drainage Assessment. Hatch, September 2017. • Technical Memorandum: Baffinland Mary River Project - Trucking Feasibility Study, Interim ML/ARD Assessment of Tote Road Quarry and Borrow Pit Samples, December 2010.	CIRNAC 10 Attachment 1: Appendix 6B-3 Geochemical Evaluation of Railway Quarry Materials CIRNAC 10 Attachment 2: Geotechnical Investigations - Acid Rock Drainage Assessment CIRNAC 10 Attachment 3: Trucking Feasibility Study Interim ML/ARD Assessment of Tote Road Quarry and Borrow Pit Samples Rev1 – Issued for DEIS
CIRNAC 11	CIRNAC requests that the Proponent provide the following: a) The proposed areas of snow stockpiles at Milne Port and along the Tote Road; b) Details on the physical delineation of 31 m boundary from water body in the Snow Management Plan; and c) Description of methods used in the field to delineate these areas.	a, b) BIM will update the Snow Management Plan with the requested information, as outlined in the Commitment Register (Appendix 11). The current Snow Management Plan includes snow stockpiles for both Milne Port and Tote Road. Note that snow stockpiles contain only non-contaminated snow. c) To ensure the limits of snow stockpiles are at least 31 metres from the ordinary high-water mark of nearby water bodies, Baffinland will delineate the limits of snow stockpile areas using stakes or similar in-field markers.	Appendix 11: Commitment Register
CIRNAC 12	CIRNAC requests that the Proponent provide the following: a) Details on contaminated snow and ice collected volumes from previous and current operations at site; and b) Details on projected volumes and requirements.	a) Volumes of hydrocarbon contaminated snow and ice are presented in the QIA/NWB Annual Report for Operations which can be found on the NWB's ftp site. b) Projections of additional contaminated quantities of snow requiring storage due to the Phase 2 Project are difficult to quantify objectively as the majority of contaminated snow is sourced from unplanned spills/releases of hazardous substances. If additional contaminated snow storage locations are required, they will be identified and developed in accordance with Baffinland's Type A Water Licence. Baffinland already plans to increase its hazardous material containment capacity in 2019 through the construction of lined containment berms that have been included in the 2019 Work Plan as part of the approved project.	
CIRNAC 13	CIRNAC requests that the Proponent provide the following: a) A summary of the investigation reports mentioned above describing the geological conditions and geotechnical investigations along the Railway alignment; and b) A summary of the feasibility study mentioned above regarding the North Railway embankment designs (Hatch 2017c).	The referenced geotechnical reports are presented as appendices to the Application to Amend the Type A Water Licence (TSD 2 Project Description, Appendix D). Geotechnical reports are presented as Attachments 6.1, 6.2, 6.3, and 12.1 to 12.4. The Project Description (TSD 2) provides a summary level of the feasibility study; the feasibility study is not a public document.	
CIRNAC 14	CIRNAC requests that the Proponent provide the following: a) Thermal modelling or analysis and monitoring plans for the entire service life of the infrastructure and related facilities such as the North Railway, docks, railway embankments, bridges, and other relevant components, as well as for the WRF; b) Incorporate the site-specific meteorological information in its climate change assessment and update the relevant modelling accordingly;	a) Thermal modelling for the North Railway is currently being updated and will be made available with the technical response. Thermal modelling for port infrastructure will be provided after that date. The waste rock facility (WRF) is not part of the Phase 2 Proposal. b) This is being done as part of the current updates to the thermal models.	

ID1	Info Request	Response	Attachment
	c) Clarification as to when the Proponent expects suitable data to become available for updating thermal modelling; and d) Thaw consolidation data or thaw strain predictions for various infrastructures, namely North Railway, docks, railway embankments, bridges, and other relevant components.	c) See response to Part A. d) Settlement was considered in the geotechnical reports for the various project components. See Attachments 5.2, 6.3 and 12.2 of TSD 2 Project Description, Appendix D.	
CIRNAC 16	CIRNAC requests that the Proponent provide the following: a) Clear description of expected changes in quantities and types of waste (including sewage) that would be required to be managed under Phase 2; b) Locations and capacities of key management infrastructure such as landfills, incinerators and sewage treatment plants; and c) Details related to expected changes in quantities and type of hazardous materials associated with Phase 2 and their expected management, particularly those associated with fuel and explosive agents.	The Application to Amend the Type A Water Licence (TSD 2 Project Description, Appendix D) contains these specific details. Table 4.3 presents quantities of solid waste, sewage effluent and hazardous waste expected to be generated from the Phase 2 Proposal. Sewage volumes are summarized in Section 4.7 and site water balances presented as Attachments 11.2 and 11.4 (to the water licence application). The locations of landfills, incinerators and sewage treatment plants are shown on Figures B.1 and B.5.	
CIRNAC 17	CIRNAC requests that the Proponent provide the following: a) The 2014 version of Mine Rock ML/ARD Characterization Report Deposit 1, Mary River Project, as appended to the Life-of-Mine Waste Rock Management Plan; b) Detailed results from the blast hole data completed in 2017, referred to in the Interim Waste Rock Management Plan; c) Detailed results from 2018 Geochemical Evaluation, referred to in the Interim Waste Rock Management Plan; and d) Geochemical reports or data sets from mine sites in comparable climatic conditions.	a) The Life-of-Mine Waste Rock Management Plan and attachments can be found on Baffinland's Document Portal, located on Baffinland's website at http://www.baffinland.com/document-portal-new/?cat=9&archive=0&lang=en. It is also included as Appendix J of TSD 28. b) 2017 blasting hole data and summary tables were provided in Appendix E.6 of the 2017 QIA and NWB Annual Report for Operations, provided to regulators on March 31, 2018 and available on the NWB's ftp site c) Results from the 2018 Geochemical Evaluation are not available at this time and will be provided in 2019. d) Baffinland does not have access to geochemical reports or data sets from industry peers in similar climatic conditions.	

FISHERIES AND OCEANS CANADA

ID1	Info Request	Response	Attachment
DFO 3.1.1	Provide an updated table which contains all information related to watercourse crossings, diversions, and encroachments. The table should include: a) A numbered list of proposed crossings, diversions, and encroachments; b) If the crossing is permanent, temporary, new, replacement, extension, or modification; c) The type of crossing structure (e.g. bridge, culvert). In cases where a single or multi barrel culvert crossing is proposed, please indicate if a box culvert or bridge is a feasible alternative; d) Information regarding locations that will have more than one crossing, diversion, or encroachment on the same waterbody; e) Fish-bearing status and species present. For fish-bearing status, please indicate yes/no. In cases where uncertainty exists (e.g. "possible, "probable", "possible", "unlikely"), DFO will consider these habitats to be fish-bearing; f) Description of fish habitat and waterbody characteristics; and, g) Amount (m2) of fish habitat permanently altered or destroyed at each site.	The inconsistencies in several of the peripheral TSDs is acknowledged. TSD 14 (Freshwater Biota and Habitat Assessment) is the definitive document for this information, and Table A1-1 of that document provides a full listing of these sites. Attachment 8.1 of TSD 2 Project Description, Appendix D (Application to Amend the Type A Water Licence) presents the same information as well as the requested details with regard to the type of structure, number of culverts, and fish-bearing status. The information in the table presented as Attachment 8.1 has been confirmed to be correct. The amount of fish habitat estimated to be either altered or lost at each site is presented in Tables 4-3 to 4-7 in Appendix 1 of TSD 14. All this information has been consolidated into a single table presented as an Attachment to this response (Appendix 4). The exception is the identification of which crossings are best suited for bridges or box culverts. The project proposed to use corrugated steel pipe (CSP) culverts at the vast majority of crossings, since culverts offer substantial benefits in terms of cost, ease of installation, scheduling considerations, and physical properties that are preferable for arctic conditions: Cost: CSP culverts offer cost benefits over other crossing structures. Ease of installation/scheduling considerations: More than 400 crossings need to be installed. CSP culverts can be installed quickly and efficiently. Construction is focused on working during the shoulder seasons while the water is frozen and there is no flow in the streams. Physical properties: The tolerance of CSP culverts to compressive and tensile stresses make them very suitable for use in the Arctic conditions since changes in the rail embankment and long-term settlement remain a risk even if the design includes consideration of this. Therefore, these culverts provide flexibility into the future while some of the other culvert solutions pose risks should excessive settlement and creep be experienced. The culverts are galvanized and with the low corrosion level on site due to the area being classified as an Arctic desert there is little to no risk of corrosion being a problem. Further to this there is not any debris and organic matter in the streams since vegetation levels are so low. Ease of repair: These culverts also offer the ability for easy repair should a total culvert failure occur. Despite these advantages, Baffinland is currently reviewing the crossings to identify a short-list of crossings that are better suited to alternatives to CSP culverts and will be prepared to table this for discussion with DFO in the upcoming weeks.	DFO 3.1.1 Attachment 1: List of Stream Crossings (Culverts), Bridges, Cuts/Diversions, and Lake/Pond Encroachments/Infills Along the North Rail Alignment and Tote Road Realignment and Fish Habitat Summary
DFO 3.1.2	In watercourses where Arctic Char are present, provide the approaches that will be used to provide passage for Arctic Char.	Section 2.5.2 of TSD 13 Surface Water Assessment outlined a number of mitigation measures that may be employed to reduce streamflow velocities to baseline conditions. Baffinland will be undertaking additional engineering work on a crossing by crossing throughout the review process to determine the best approach and complete updated hydrological modelling to confirm that flow velocity exceedances are addressed. Baffinland proposes to then meet with DFO to review these results.	
DF0 3.2.1	Provide an updated/consolidated table which contains all information related to shipping. The table should include information from 2019-2035 regarding: a) Numbers of ships (totals for types and overall total for all vessels); b) Types of ships (e.g. Pananax/Cape Sized); c) Number of round trips for all types of vessels; d) Shipping season schedules in relation to a, b, and c; and, e) Support vessels (number and type) in relation to all the above, this includes tugs and icebreaking vessels.	Please refer to the Overview of Marine Operations (Appendix 12).	Appendix 12: Overview of Marine Operations
DFO 3.2.4	Provide clarification on how acoustic modelling incorporated potential impacts of ice (e.g. ice cover, movement of vessels through ice-covered waters).	Assessment of acoustic disturbance for Project vessels (tugs and ore carriers) during various scenarios (berthing, transit and mooring) has been included in TSD 24 Marine Mammal Effects Assessment with modelling presented in Appendix B. Baffinland acknowledges that the operational period from July 1 to November 15 may include limited periods when ice will be present and we recognize that a number of IRs have requested additional information considering ice conditions during this time period. Therefore, Baffinland has elected to undertake an additional stand-alone assessment of icebreaking effects during the shoulder seasons that addresses this concern, and which	

ID1	Info Request	Response	Attachment
		will include underwater noise modelling of icebreaker transits along the Northern Shipping Route. The acoustic modelling will be based on a conservative scenario for icebreaking noise based on thickest seasonal ice conditions in the RSA and maximum acoustic propagation potential. The stand-alone acoustic modelling report and icebreaking assessment will be submitted to the NIRB in 2019 once reporting is completed.	

NATURAL RESOURCES CANADA

ID1	Info Request	Response	Attachment
NRCAN 1	Please indicate if detailed terrain mapping at a larger scale providing additional information on terrain sensitivity has been conducted. If this mapping has been conducted, please provide the maps. If this mapping has not been done, please indicate if there are plans to complete this mapping to support infrastructure design.	A terrain analysis report has been completed and is presented as Attachment 6.1 of the Water Licence Amendment Application (TSD 2 Project Description, Appendix D).	
NRCAN 2	Please clarify if any ground thermal data have been collected for the Northern Railway Corridor and provide details on these data if they have been collected. If such data have not yet been acquired, please describe any plans to collect these data in the future to support infrastructure design.	Ground thermal data has been collected at the bridge locations along the Northern Railway Corridor; this information will be provided with technical responses.	
NRCAN 3	Please clarify if any thermal analysis/modelling has been conducted to support estimates of settlement to inform embankment design for the Northern Railway and provide details on any analysis completed. If such analysis has not yet been conducted, please describe any future plans for detailed thermal/analysis to support embankment design.	Yes, thermal analysis has been conducted in support of the North Railway design. A thermal analysis report for the North Railway will be provided with technical responses.	
NRCAN 4	Please provide, to the extent currently possible, confirmation that there will not be any significant changes in the proposed explosives plant or storage facilities as described in a 2012 Explosives Management Plan and other Mary River Project documents. Also, please confirm that the construction and operation of new rail infrastructure will not require changes in the location of explosives manufacturing and storage components with respect to Quantity-Distance requirements.	Four new explosives storage areas for the storage of pre-packaged explosives (for use in rail construction) are planned along the Northern Transportation Corridor, as shown on Figure B.2 and in Figure B.2 sheets in Appendix B of TSD 2 (Project Description), and as discussed in TSD 2. Two of these areas are planned for inclusion in the 2019 Work Plan Addendum to support quarrying activities related to the Approved Project. The other two are necessary to support the construction of Phase 2 infrastructure. Expansion of the Mine Site explosives area is also required to accommodate increases in volume of ammonium nitrate and storage of pre-packaged explosives, with an increase in the Mine production rate, as approved for the original 18 Mtpa South Railway operation in the original FEIS. Two heating facilities for emulsion trucks (one south of Milne Port, one at the Mine Site) are also being proposed. Information related to these storage areas will be added to the Explosives Management Plan as reflected in the Commitment Register (Appendix 11). Note that a proposed explosives storage area at km 81 and the emulsion truck heating facility at the Mine Site are not shown on the figures referenced above. Revised figures will be provided. Construction and operation of new rail infrastructure will not require changes in the location of explosives manufacturing and storage components with respect to quantity-distance requirements.	Appendix 11: Commitment Register

ENVIRONMENT AND CLIMATE CHANGE CANADA

ID1	Info Request	Response	Attachment
ECCC 01	ECCC requests that the Baffinland Iron Mines Corporation (the Proponent): 1. Describe the migratory bird and species at risk surveys that were collected to specifically inform the site sensitivity for the wind energy project. 2. Provide details on what specific pre-construction phase surveys for migratory birds and species at risk are planned and when these surveys will be conducted. These surveys should be consistent with ECCC guidance (EC 2007a, 2007b) including the level of effort required given predicted site sensitivity. 3. Describe how mitigation or monitoring requirements identified as a result of pre- construction phase surveys will be incorporated in the project design.	1. Migratory birds and species at risk surveys to inform site sensitivity for the wind energy project have not been conducted. The specific sites for the individual wind turbines have not been finalized. Upon selection of the site(s), Baffinland commits to conducting a risk assessment including any surveys required for informing site sensitivity, consistent with ECCC guidance (EC 2007a). 2. Details on pre-construction phase surveys for migratory birds and species at risk have not been planned yet. Baffinland commits to conducting the required surveys, consistent with ECCC guidance (EC 2007a, 2007b) prior to construction of the wind energy project including the level of effort required given predicted site sensitivity, which will be determined from the risk assessment and associated surveys described in response 1 above. 3. Mitigation and monitoring requirements for the wind energy project derived from pre-construction phase surveys have not yet been identified. Baffinland commits to identifying mitigation and monitoring requirements from the pre-construction phase surveys described in response 2 above, which will be incorporated into the wind energy project design, consistent with ECCC guidance (EC 2007b).	
ECCC 07	ECCC requests that the Proponent: 1. Characterize all dust and total suspended particulate sources broken down into each metal associated with each source (e.g. metal speciation of the dust and total suspended particulate sources). 2. Provide predicted metal depositions associated with Total Suspended Particulate and dust deposition from all dust sources	1. Since the Mine is currently operating, there is extensive dustfall data available for the Mine Site, Milne Port and Tote Road areas. Dustfall monitoring conducted near these sites includes total insoluble dustfall over a monthly sampling period, but also a full ICP metals analysis of the dustfall. These data are presented in the Terrestrial Monitoring reports for the mine, submitted to NIRB. These dustfall data were analyzed as part of TSD 11 (Evaluation of Exposure Potential From Ore Dusting Events in Selected VECs) and are included in Appendix A of TSD 11. Geochemical breakdowns for each of the three operational areas (Milne Port, Mine Site and Tote Road) were developed in TSD 11 based on an analysis of the dustfall monitoring data. The methods used and a map of the dustfall monitoring stations are presented in Section 2.1 and Appendix A of TSD 11, respectively. Average percentages of specific metals on dustfall at the Mine Site, Milne Port, and Tote Road are provided in Tables 2-1a,b of TSD 11. 2. Within TSD 11 (Evaluation of Exposure Potential From Ore Dusting Events in Selected VECs), the geochemistry percentages noted above were applied to selected dust deposition rates based on the annual dust deposition isopleth figures presented in TSD 7 (Atmospheric Assessments), to calculate potential future soils and vegetation concentrations in areas near the Mine Site, Milne Port, and Tote Road. The methods used to select the dust deposition rates are provided in Section 3 of TSD 11, along with the isopleth figures. The methods used to predict future soil and vegetation concentrations are provided in Section 4 of TSD 11, along with tabulated predictions of incremental (Project) and accumulated Project + Baseline soil concentrations, as well as vegetation concentrations. Assessments of the data are provided in Section 5 and 6 of TSD 11.	
ECCC 08	ECCC requests that the Proponent clarify if the amount of waste being incinerated will increase due to increased workers onsite. If the amount of waste incineration is increasing, ECCC recommends the frequency of incineration stack testing be increased from 5 years to every 3 years.	Yes, the amount of waste being incinerated will increase temporarily during construction at the Mine Site and will increase permanently at Milne Port. The incinerators at Milne Port and the Mine site are designed to meet strict environmental standards. Volumes of waste, waste type, date and time of burns are recorded, and a total is reported annually as part of Baffinland's emission calculations. Further, and as described in Section 3.5 of Baffinland's Waste Management Plan, incinerators are operated in accordance with the Government of Nunavut's Environmental Guideline for the Burning and Incineration of Solid Waste (GN, January 2012) and all waste is segregated in compliance with Baffinland's Incinerator Operation Procedure to ensure a complete burn cycle. Monitoring of Project incinerators includes: conducting routine inspections; pre-operation stack testing; stack-testing every five years; continuous monitoring of temperature in the primary and secondary chambers as well as the stack; and recording the quantity, condition and TCLP analysis results of collected bottom ash. Based on comparable workforce numbers from the Approved Project to Phase 2, and the best management practices and monitoring Baffinland currently employs for waste management, it is not expected that there will be a need to increase the frequency of routine stack tests for dioxins, furans and mercury. Baffinland has committed to stack	

ID1	Info Request	Response	Attachment
		testing every 5 years, and maintains that adhering to the best practices outlined in its Incinerator Operation Procedure along with the operational monitoring (record of waste volumes and composition; date and time of burns; monitoring of temperatures in both chambers and the stack to verify complete burning; TCLP analysis of bottom ash) is adequate to ensure that the incinerators are being operated such that CWS should be met.	
ECCC 10	ECCC requests that the Proponent: 1. Provide information on how mitigation has reduced dustfall deposition and sedimentation in waterbodies since the previously documented dust exceedances, and how these methods will be sufficient to mitigate the expected further increases in dust due to the Phase 2 Project. 2. Provide information on how dust deposition and subsequent impacts to water quality will be monitored and mitigated along the transportation corridor and at Milne Port.	1. Dustfall deposition for the ERP was anticipated to be greatest at the Mine Site. Recent monitoring of sediment deposition rates in aquatic environments (Sheardown Lake NW) at the Mine Site in 2018 indicate that deposition rates are significantly less than thresholds associated with potential effects on incubating fish eggs. Key dust mitigation measures implemented to date at the Project include the use of water, CaCl2 and the installation of coverings on Mine Site ore crushers. As part of Phase 2, dust deposition at the Mine Site is anticipated to be reduced further with the relocation of secondary ore crushing to the enclosed facility at Milne Port. Additionally, dust deposition along the Northern Transportation Corridor will be reduced as ore transportation is transitioned to rail. As noted in the original FEIS, dust is anticipated to play a minor role in the overall sediment deposition rates in aquatic environments. 2. Dust deposition will be monitored as detailed in the Project's current Dustfall Monitoring Program (TSD 28 Management and Monitoring Plans, Appendix X-Attachment 6) and expanded to include additional monitoring locations as required for the Northern Transportation Corridor. This commitment is reflected in the Commitment Register (Appendix 11). Other monitoring programs of note include: • Aquatic Effects Monitoring Plan (TSD-28 Management and Monitoring Plans, Appendix T) – governs monitoring of water and sediment quality around the Mine Site • Tote Road Monitoring Program (planned implementation in 2019 after finalization with the QIA) – focused on measuring total suspended solids (TSS) and would capture dustfall runoff into surface water.	Appendix 11: Commitment Register
ECCC 11	ECCC requests that the Proponent identify criteria that would be used to determine whether runoff from the ore transfer area stockpiles is suitable for dust suppression along the North Transportation Corridor.	Runoff retained by surface water management infrastructure and recycled for dust suppression purposes will be compliant with the water quality criteria detailed in the Project's Type 'A' Water Licence.	
ECCC 13	ECCC requests that both missing references be provided and included in further revisions to the Ice Study Updates (TSD 16).	The missing cross-reference on page 2 of Appendix I of TSD 16 (Ice Conditions Report) was intended to refer to Table 3. The text should read as follows: "The form of the ice is an additional indicator of the development and severity of ice conditions (Table 3)." The missing cross-reference on page 11 of Appendix I was intended to refer to Section 3 of the main TSD 16. The text should read as follows: "There were many examples of vessels encountering severe ice conditions within the allowable access windows and other situations where vessels were denied access to areas of light ice conditions. It is to circumvent these limitations in the ZDS that the more flexible AIRSS was created (Section 3)."	
ECCC 14	ECCC requests that the Proponent update the reference to the physical and chemical properties of IFO-180 fuel oil.	The pour point of IFO 180 fuel oil has been documented as ranging from 15°C to 18°C (Emergencies Science and Technology Section, Environment and Climate Change Canada, 2018). <u>References</u>: Emergencies Science and Technology Section, Environment and Climate Change Canada. 2018. Physiochemical properties of petroleum projects. Retrieved from https://open.canada.ca/data/en/dataset/53c38f91-35c8-49a6-a437-b311703db8c5.	
ECCC 15	ECCC requests that the Proponent provide the results on their shoreline classification data surveys so that this data can inform the effects assessment of potential spills of fuel/oil on water.	Shoreline classification data surveys and sensitivity mapping for both the North and South shipping routes were completed and included as Appendix 9C of the FEIS (2012). This information has been integrated and included in Section 3.3.1 of Baffinland's Oil Pollution Emergency Plan (Rev 5, Sept 2018; TSD 28 Management and Monitoring Plans Appendix N), which is updated by Baffinland and approved by Transport Canada annually.	
ECCC 18	ECCC requests that the Proponent identify how additional camp wastewater treatment needs will be met, and if there will be any potential changes to receiving environments due to increased discharges as well as if additional mitigation measures will be required.	The requested information is presented in Section 4.7 of the Water Licence Amendment Application (TSD 2 Project Description, Appendix D) as well as the attachments referenced in that section.	
ECCC 21	ECCC requests that the Proponent update references of the MMER to MDMER.	References to the Metal Mining Effluent Regulations (MMER) under the Fisheries Act will be updated to refer to the current Metal and Diamond Mining Effluent Regulations (MDMER) in all relevant management plans, including the	Appendix 11: Commitment Register

ID1	Info Request	Response	Attachment
		Metal Mining Effluent Regulations Emergency Response Plan, the Interim Closure and Reclamation Plan, the Marine Environmental Effects Monitoring Plan, the Interim Waste Rock Management Plan, the Phase 1 Waste Rock Management Plan, the Life-of-Mine Waste Rock Management Plan, and the Aquatic Effects Monitoring Plan. This commitment is reflected in the Commitment Register (Appendix 11).	
ECCC 22	ECCC requests that the Proponent: 1. Revise Table 1 to include the updates that are required for the Landfill Maintenance and Operations Manual. These updates are identified in Table 11. 2. Update the Landfill Maintenance and Operations Manual accordingly.	1. Table 1 indicates that the Landfill Maintenance and Operations Manual does require an update, which is detailed in Table 11. Table 1 will not be edited through the review process. 2. The proposed updates are reflected in the Commitment Register (Appendix 11).	Appendix 11: Commitment Register
ECCC 24	ECCC requests that the Proponent provide a description of the changes to the Interim Closure and Reclamation Plan that will be required as part of the changes at Milne Port during the Phase 2 Project.	The infrastructure and earthworks at Milne Port associated with the Phase 2 Project will require minimal updates to the ICRP, and generally be restricted to the Project Description, Site Plans, Post Closure Monitoring and Closure Objectives. Updates to the Closure Objectives and Criteria will be required to include the second Ore Dock, but the closure principals for all other infrastructure and earthworks are already considered directly or indirectly in the existing ICRP.	
ECCC WL 01	ECCC requests that Baffinland Iron Mines Corporation (the Proponent): 1. Clarify whether monitoring of collection pond water quality will be done prior to use for dust suppression and how this monitoring would be undertaken. 2. Identify whether it is feasible to consolidate collected runoff for management and water quality testing.	1. Prior to use for dust suppression, water quality monitoring of contact water will be completed to ensure that the water meets the appropriate effluent discharge limits detailed in the Project's Type 'A' Water Licence. Monitoring will be undertaken through sampling of water prior to discharge/use. 2. Effluent collected in the additional ponds at Milne Port will be used for water suppression or will be trucked to one of the existing ponds, or the shore, to be discharged to Milne Inlet via the existing approved discharges. Because an existing discharge will be used, new Surveillance Network Program (SNP) stations were not identified for each of the new ponds. It is conceivable, however, that effluent testing would be conducted at these new ponds, and for this reason, it may be appropriate to establish new SNP stations for each of the new ponds.	
ECCC WL 02	ECCC requests that the Proponent clarify where pond water in the ore processing drainage area will be discharged.	Effluent discharged from the proposed Crushing Feed Stockpile surface water management pond will be pumped to the approved Mary River outfall discharge location, currently used to discharge treated effluent from both the Mine Site Sewage Treatment Plant (MS-01) and the surface water management pond that services the Mine Site Crusher Facility (MS-06). The new final discharge point (FDP) and outfall location for the new surface water management pond will be established in accordance with the Metal and Diamond Mining Effluent Regulations. This commitment is reflected in the Commitment Register (Appendix 11). A figure showing water monitoring location is provided in the Attachment to this response (Appendix 4)	Appendix 11: Commitment Register ECCC WL 02: Attachment 1: Mine Site Layout and MDMER/Water Licence Monitoring Locations
ECCC WL 03	ECCC requests that the Proponent identify how additional camp wastewater treatment needs will be met, and if there will be any potential changes to receiving environments due to increased discharges as well as if additional mitigation measures will be required.	Details on additional wastewater treatment infrastructure will be provided through the technical review period. Additional infrastructure is expected to utilize similar technologies as that currently existing on site. No potential changes to receiving environments due to increased discharges are expected as even with this additional infrastructure, Baffinland's operations will remain within the water taking and discharge volume limits prescribed in the existing water licence. All discharges must also meet the appropriate effluent quality parameters in this water licence.	

HEALTH CANADA

ID1	Info Request	Response	Attachment
HC 01	Health Canada requests: 1. Clarification if the PSL exceeds or does not exceed the PSL at the HTO Cabin – this is currently not clear. 2. Health Canada recommends further evaluation of human health impacts, including vulnerable persons, with regards to noise. Including at locations identified to be places used for camping (TSD-05 Mary River Inuit Knowledge Study Map book: Figures: 1.7; 1.8; 1.9; 1.11; 1.12).	1. Appendix D of TSD 7 (Atmospheric Assessments), Section 3.2.1.4 (Conclusions) indicates that sound levels at the HTO Cabin are predicted to range from 33 to 35 dBA. This is assessed against a PSL of 40 dBA as discussed in section 1.3.1. 2. As directed by the NIRB, a response to #2 is not required at this time.	
HC 08	Health Canada requests the following: 1. Further discussion if the added tonnage would increase the height of the fine ore stockpile and therefore increase the potential for wind erosion. 2. The most recent dust monitoring and management plan inclusive of all sources of dust including those newly identified but not limited to all vehicle traffic, ore dust from locomotive loading and transport, and wind erosion of all stockpiles using winds at the height of stockpile not at ground level was not included and if required update the effects assessment	1. The maximum height of ore stockpiles at Milne Port is 16 m. The maximum height of ore stockpiles will not increase as a result of the Phase 2 Proposal. 2. Dustfall monitoring and management are discussed in Baffinland's Air Quality and Noise Abatement Management Plan. TSD 28 Management and Monitoring Plans lists the updates that will be required to this plan as a result of the Phase 2 Proposal in Table 22. Table 22 includes this required update: "Update dustfall monitoring program to account for new and modified emission sources during construction and operations." A draft version of the updated plan which addresses the updates in TSD 28 will be provided following technical meetings. The proposed updates are reflected in the Commitment Register (Appendix 11)	Appendix 11: Commitment Register

PARKS CANADA AGENCY

ID1	Info Request	Response	Attachment
PCA 1	PCA-1(a): Please define the anticipated total annual sailings for each of ore, freight and fuel vessels. PCA-1(b): For all project shipping (ore, freight, and fuel vessels) please clearly define (1) vessel speed limitations, and drift zone and anchoring locations (2) the time of day that ships will be transiting the project area (3) what criteria/parameters will be used to determine the location and use of anchoring and the drift zone, and the number of ships in the project area at one time, and (4) describe potential effects to the marine ecosystem resulting from the use of additional and current anchoring locations and the use of the drift zone. PCA-1(c): Please explain (1) how masters of all project vessels (ore, freight, and fuel) will consistently be provided with the same instructions/updates related to shipping mitigations (including vessel speed, use of drift zone, and anchoring locations), (2) how this information will be updated and distributed in a timely fashion, and (3) how compliance will be determined and enforced. PCA-1(d): Please provide updated management and monitoring plans to address the increase in project shipping volume and season.	1 (a,b,c) Please refer to the Overview of Marine Operations (Appendix 12). 1 (d): Management plans requiring updates will be updated and circulated for review following the technical meeting, currently planned for March 12-15, 2019. In the interim, proposed changes are being tracked in the attached Commitment Register (Appendix 11). Baffinland encourages reviewers to review TSD 28 Management and Monitoring Plans and the associated management plans in detail through the technical review phase, and to provide thorough recommendations to aid in the updating process.	Appendix 11: Commitment Register Appendix 12: Overview of Marine Operations
PCA 2	PCA-2 (a): Please explain why project-level shipping effects to the marine ecosystem were not considered as a combined effect from all types of project vessels and provide an updated assessment considering this combined effect. PCA-2 (b): Please provide an effects assessment of spills of arctic diesel shipped by fuel tanker. PCA-2 (c): Please describe the potential effects on the marine ecosystem, including ice, resulting from a combined spill of arctic diesel and IFO.	a) TSD 24 Marine Mammal Effects Assessment included an assessment of all Project vessel types including ore carriers (bulk transport), fuel tankers, freight vessels and tugs. The use of the term "ore-carries" in the example provided by the reviewer was intended to be a surrogate for all vessel types used for shipping by the Project. Bulk transport vessels do represent the greatest proportion of Project vessels that interact with marine mammals and the marine environment. b) An effect assessment of a spill of arctic diesel along the Northern Shipping Route was provided in support of the ERP application in 2015 (FEIS Addendum, Appendix 9F, Coastal Ocean Resources - Marine Spill Sensitivity Assessment for Baffinland's Early Revenue Phase). This effect assessment is still valid for the Phase 2 Proposal. c) Potential effects of spills on marine ecosystems, as well as the fate of diesel fuel and IFO are discussed in: • FEIS 2012 Appendix 9C – Coastal Ocean Resources, Spill Sensitivity of Proposed Port and Shipping Routes Mary River Iron Mine Project • FEIS Addendum, Appendix 9F, Coastal Ocean Resources - Marine Spill Sensitivity Assessment for Baffinland's Early Revenue Phase • NIRB – BIMC 2015 Annual Report, AMEC – Fuel Spill Modelling Northern Shipping Route Open Water Season • Phase 2 FEIS – TSD 19 – AMEC, Fuel Spill Modelling: Northern Shipping Route Sea Ice Shoulder Seasons Milne Inlet, Eclipse Sound, Pond Inlet (section 3.1.4 – Weathering (for fate of IFO)	
PCA 4	PCA-4(a): Please define the dates for the proposed Phase 2 shipping season (for all vessel types: ore, freight, and fuel) and identify if these dates include the window for operational flexibility. PCA-4(b): Please provide the criteria that will be used to adjust the shipping season to weather and ice conditions. PCA-4(c): Please provide the approval process that will take place each year in deciding when to open and close the shipping season, including the format of community input.	Please refer to the Overview of Marine Operations (Appendix 12).	Appendix 12: Overview of Marine Operations
PCA 5	PCA-5(a): Please describe “ice management activities”; define when, where, and how these activities will be undertaken and describe if they will be conducted to ensure safe passage of freight and fuel ships in addition to ore carriers. PCA-5(b): Please describe what measures will be implemented to address vessel safety (for ore, freight, and fuel vessels) when ice management activities are being undertaken (e.g.: to reduce the risk of ice entrapment or collision between IMV's and escorted vessels) and how these measures will be relayed to all vessel masters.	Please refer to the Overview of Marine Operations (Appendix 12).	Appendix 12: Overview of Marine Operations
PCA 7	PCA-7 (a): Please describe the specific methods that will be used to ensure that all mammals are detected in the exclusion zone, particularly for ensuring the detection of mammals who enter at depth and may not be visible from the surface, and what steps will be taken once a marine mammal is detected.	During construction of the new ore dock and associated marine infrastructure, the following mitigation measures will be implemented by Baffinland during active pile driving activities to reduce the potential effects of underwater noise on marine mammals:	

ID1	Info Request	Response	Attachment
		• Marine mammal monitoring will be undertaken by qualified and experienced Marine Mammal Observers (MMO) during impact pile driving. MMOs will be responsible for detecting and accurately identifying marine mammals from a distance during pile driving, and to effectively report and communicate to the respective pile driving contractor(s) when marine mammals enter a set safety zone prior to and during pile driving operations. MMOs are responsible for advising the contractor(s) and Project personnel of necessary delays or shut-downs during pile driving, and for documenting marine mammal sightings information including behavioural responses. • Implementation of a 1-km Marine Mammal Exclusion Zone (safety zone) – defined as the zone within which a marine mammal may be potentially exposed to sound levels above established injury thresholds. The occurrence of a marine mammal within the safety zone will trigger specific mitigation actions (e.g., shut-downs) such to avoid potential for physical injury to the marine mammal from impact pile driving or dredging. • Shut-down procedures – impact pile driving will be temporarily suspended when a marine mammal is located within the safety zone until which time it moves outside the safety zone. • Implementation of a 30 minute pre-operational search for marine mammals prior to start-up of active impact pile driving or dredging. This would consist of a visual scan of the water by the MMO to determine that no marine mammals are present within the safety zone. If a marine mammal is spotted within the safety zone during the pre-operational search, the ramp-up procedure will be delayed 20 minutes from the time the marine mammal left the safety zone or was last sighted in the safety zone. • The MMO will periodically verify underwater sound levels in the field using a hydrophone and a real-time sound monitor to confirm that sound levels at the modeled safety zone radius are below the established injury thresholds for marine mammals. If sound levels are shown to exceed the injury thresholds at the safety zone radius, the safety zone distance will be adjusted accordingly. • A ramp-up procedure will be used during initial impact pile driving. The ramp-up procedure consists of activation of the equipment using the lowest energy source/ pulse and gradually increasing the intensity of the sound until it reaches the required intensity. It is anticipated that disturbance during ramp-up will result in marine mammals leaving and avoiding the exclusion zone. • A bubble curtain will be installed around the wetted pile during impact pile driving to assist in the attenuation of underwater noise emitted during pile strikes.	
PCA 8	PCA-8 (a): Please outline the locations and amounts of untreated sewage released from project vessels within, or in the vicinity of, the proposed NMCA. PCA-8 (b): If untreated sewage is disposed of within or near the proposed NMCA, please provide an effects assessment.	8 a. The proponent is not aware of any released untreated sewage from project vessels within, or in the vicinity of, the proposed NMCA. The Shipping Instructions to Masters (STIM) that are sent to all ship owners and individual vessels do not allow for any discharge (other than ballast operations) of any kind while in the Project area. b. Not applicable	

OCEANS NORTH

ID1	Info Request	Response	Attachment
ON 001	Information is requested regarding comprehensive Inuit and non-Inuit employment statistics over the course of the Early Revenue Phase, on a perannum basis. Specifically, the following data: I) Employment, Hours, and Wages • Proportion of Inuit workers in the labor force, with absolute numbers. • Hours worked by Inuit employees out of total hours • Proportion of payroll going to Inuit employees • Inuit employees by type of job and rank, and salary brackets; non- • Inuit employees by type of job and rank, and salary brackets II) Training, Employment Duration, and Promotions • Inuit employee departures and turnover rates; non-Inuit employee departures and turnover rates • Inuit employment duration and turnover rates; Inuit employment duration and turnover rates • Hours of training received by Inuit – as part of normal operations and as part of IIBA • Hours spent assisting Inuit in advancing into higher positions • Number of Inuit Apprentices, and Non-Inuit Apprentices • Inuit promotions – as a % of total promotions III) Contracting • Hours hired to Inuit contractors out of total hours • Money awarded in contracts to Inuit-owned firms out of total money paid in contracts. Separate Inuit from Nunavut. • Number of Inuit registered firms	Baffinland has developed a comprehensive socio-economic monitoring program for the Project (see Appendix Y of TSD 28 Management and Monitoring Plans) and submits annual socio-economic monitoring reports to the NIRB which are made available to the public through the NIRB public registry and the Baffinland website. These reports contain data on employment, training, and contracting at the Project in addition to several other topics. The Project's most recent (2017) socio-economic monitoring report can be found in Appendix B to TSD 25 Socio-Economic Assessment. Sections of this report that provide information of relevance to this Information Request are summarized below. • Section 3.5 Employee and contractor origin • Section 4.1 Participation in pre-employment training • Section 4.3 Hours of training completed by Inuit employees and contractors Types of training provided to Inuit employees and contractors Apprenticeships and other opportunities • Section 5.1 Hours of Project labour performed in Nunavut • Section 5.2 Project hours worked by LSA employees and contractors • Section 5.3 Inuit employee promotions Inuit employee turnover • Section 5.4 Hours worked by female employees and contractors • Section 6.1 Value of procurement with Inuit-owned business and joint ventures • Section 6.2 LSA employee payroll amounts Number of registered Inuit Firms in the LSA Baffinland's response to QIA IR #86 should also be consulted for additional information on current training programs offered at the Project.	
ON 002	Information is requested regarding projected Inuit and non-Inuit employment statistics during the Phase 2 period and at specific output volumes (6MT-30MT). Specifically, the following data: I) Employment, Hours, and Wages (Phase 2) • Proportion of Inuit workers in the labor force, with absolute numbers. • Hours worked by Inuit employees out of total hours • Proportion of payroll going to Inuit employees • Inuit employees by type of job and rank, and salary brackets; non- Inuit employees by type of job and rank, and salary brackets II) Training, Employment Duration, and Promotions (Phase 2) • Inuit employee departures and turnover rates; non-Inuit employee departures and turnover rates • Inuit employment duration and turnover rates; Inuit employment duration and turnover rates • Hours of training received by Inuit – as part of normal operations and as part of IIBA • Hours spent assisting Inuit in advancing into higher positions • Number of Inuit Apprentices, and Non-Inuit Apprentices • Inuit promotions – as a % of total promotions III) Contracting (Phase 2) • Hours hired to Inuit contractors out of total hours • Money awarded in contracts to Inuit-owned firms out of total money paid in contracts. Separate Inuit from Nunavut.	Comprehensive information on the employment, training, and contracting dimensions of the Phase 2 Proposal has been provided by Baffinland and is presented in TSD 25 Socio-Economic Assessment, TSD 26 Labour Market Analysis, and TSD 28 Management and Monitoring Plans. For greater clarity, the documents and sections of those documents that may be relevant to this Information Request are outlined below: • TSD 25: Socio-Economic Assessment o Section 3: Education and Training o Section 4: Livelihood and Employment o Section 8: Contracting and Business Opportunities o Appendix A: Economic Impact Model o Appendix D: Phase 2 Proposal Workforce Projections • TSD 26: Labour Market Analysis o All sections. Please note that Baffinland has submitted a revised Labour Market Analysis document with its IR response submission package to NIRB. • TSD 28: Management and Monitoring Plans o Appendix AG: Inuit Human Resources Strategy Procedure o Appendix AH: Inuit Procurement and Contracting Strategy	

ID1	Info Request	Response	Attachment
	• Number of Inuit registered firms		
ON 003	Information is requested regarding royalties, licensing fees, and other economic rent paid to Inuit (Qikiqtani Inuit Association-- QIA; Nunavut Tunngavik Incorporated-- NTI) and Crown. I) During the Early Revenue Phase: • any advance or one-off payments made to each respective Inuit agency, per annum • amounts paid for the lease of surface and subsurface rights to each respective Inuit agency, per annum • royalties, paid to each respective Inuit agency, per annum • any licensing fees (e.g, water) paid to each respective Inuit agency, per annum • any other economic rent payments made to QIA or NTI II) Projections for Phase 2 (operational): • any advance or one-off payments made to each respective Inuit agency, per annum • amounts paid for the lease of surface and subsurface rights to each respective Inuit agency, per annum • royalties, paid to each respective Inuit agency, per annum • any licensing fees (e.g, water) paid to each respective Inuit agency, per annum • any other economic rent payments made to QIA or NTI III) Projections for Continuing Production 2018 Output Levels (<6MT): • any advance or one-off payments made to each respective Inuit agency, per annum • amounts paid for the lease of surface and subsurface rights to each respective Inuit agency, per annum • royalties, paid to each respective Inuit agency, per annum • any licensing fees (e.g, water) paid to each respective Inuit agency, per annum • any other economic rent payments made to QIA or NTI	Comprehensive information on the benefit, royalty, and taxation dimensions of the Phase 2 Proposal has already been provided by Baffinland and is presented in TSD 25 Socio-Economic Assessment. Appendix A of TSD 25 also contains a detailed Economic Impact Model for the Phase 2 Proposal, which includes information relevant to this information request. Some data for current operations (i.e. payroll and corporate taxes paid by Baffinland to the territorial government) are monitored under the socio-economic monitoring program (Appendix B to TSD 25). The QIA also publishes an annual report on its activities which details non-consolidated revenue received, including revenue through the Mary River IIBA. For greater clarity, the following sections/appendices of TSD 25 (Socio-Economic Assessment) that may be relevant to this Information Request include: • Section 10: Benefits, Royalty, and Taxation • Appendix A: Economic Impact Model (All Sections) • Appendix B: 2017 Socio-Economic Monitoring Report (Section 11.1)	
ON 004	Information is requested in terms of a comprehensive financial forecast for the Mary River Project. The following data and rationale are requested for projections incorporating current output levels, as well as a second forecast for Phase 2. *Each projection should accommodate for a range of ore prices and exchange rates. • Capital costs • Operating costs/tonne • Internal rate of return • Payback period • Cumulative net cash flow	The information that has been requested is not relevant to the scope of the Phase 2 review and is of a commercially-sensitive nature and cannot be shared publicly.	
ON 005	BIMC notes that “There was no significant change in overall narwhal abundance and distribution observed in the area from 2014-2017.” Information is requested surrounding the following: I. Results that show statistical evidence to back up statement II. LGL final report from 2016. Note that we are aware this document exists and we have asked for this multiple times.	All reports, including the referenced LGL report (Smith et al. 2017), have been provided to Marine Environmental Working Group (MEWG) of which Oceans North takes part as an observer. Section 8.3.10 of the Phase 2 Proposal incorrectly references the period in which there was no observed change in narwhal abundance during the Bruce Head monitoring program. The correct period for this conclusion is 2014 to 2016, not 2014 to 2017, which was identified in TSD 24 (Marine Mammal Effects Assessment) as a key finding by Smith et al. (2017). According to Smith et al. (2017), year effects were evaluated (in addition to other independent predictor variables) using generalized linear mixed models, where study year was specified year as a categorical variable. Smith et al. (2017) report that the study year effect was not statistically significant (Type III test, P = 0.52). Smith et al. (2017) also used Tukey adjusted familywise contrasts (comparisons) to test for differences between each pair of study years. Their results indicate no statistical difference in narwhal abundance between 2014 and 2015 (P = 0.88), 2014 and 2016 (P = 0.46) and 2015 and 2016 (P = 0.70). In other words, there was no statistical difference detected among 2014, 2015 or 2016 study years for narwhal abundance and the model effect of "year" was not different than zero. At the time of writing this response an integrated Bruce Head monitoring DRAFT report has been issued to the Marine	

ID1	Info Request	Response	Attachment
		Environment Working Group (MEWG) (Golder 2018), which includes an analysis for the period of 2014 to 2017 for narwhal relative abundance. A generalized linear mixed model analysis completed in this report did not detect a change in narwhal abundance from 2014 to 2017 (Golder 2018). The relative abundance of narwhal in the Bruce Head area has remained relatively constant over the four years of sampling (as shown by a lack of significant year effect on narwhal counts) and fewer occurrences of zero counts in 2017) despite the relative increase in shipping over this period. Please note Oceans North holds observer status in the MEWG. <u>References</u> Smith HR, Moulton VD, Raborn S, Abgrall P, Elliot RE, Fitzgerald M. 2017. Shore-Based Monitoring of Narwhals and Vessels at Bruce Head, Milne Inlet, 2016. Prepared for Baffinland Iron Mines Corporation by LGL Limited, Environmental Research Associates, ON. Golder (Golder Associates Ltd.) 2018. Bruce Head Shore-based Monitoring Program, 2014-2017 Integrated Report. Prepared for Baffinland Iron Mines Corporation by Golder Associates Ltd., Victoria, BC. Report number 1663724-081-R-Rev0-12000 (dated 27 November, 2018). DRAFT	

WORLD WILDLIFE FUND

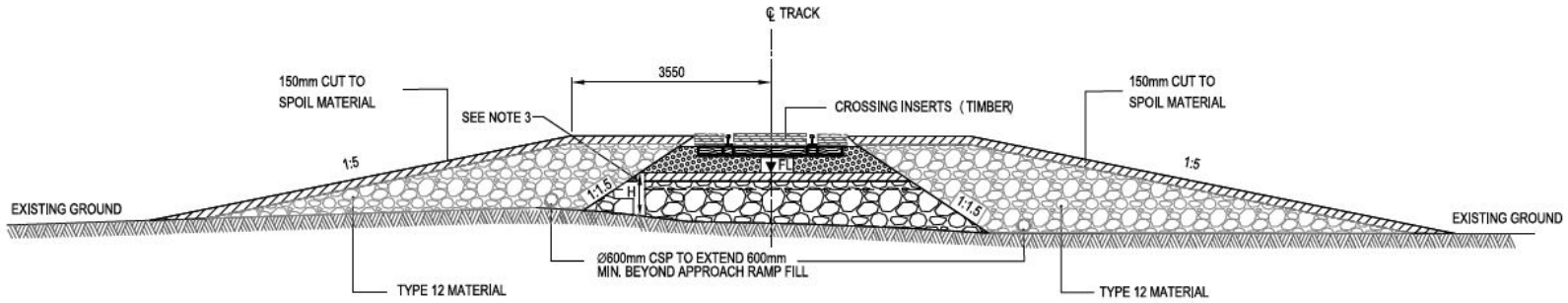
ID1	Info Request	Response	Attachment
WWF 01	Please provide an assessment of the acoustic disturbance for Project vessels (tugs and ore carriers) on marine mammals that are expected to be present during various scenarios (berthing, transit, and mooring), particularly considering ice conditions expected to be present during the extended shipping window (November 1-15). BIMC is requested to review and update all sections of its FEIS Addendum and supporting documents, as well as relevant assessments, to include the proposed extended shipping window July 1 - November 15.	Assessment of acoustic disturbance for Project vessels (tugs and ore carriers) during various scenarios (berthing, transit and mooring) has been included in TSD 24 Marine Mammal Effects Assessment with modelling presented in Appendix B. Baffinland acknowledges that the operational period from July 1 to November 15 may include limited periods when ice will be present and we recognize that a number of IRs have requested additional information considering ice conditions during this time period. Therefore, Baffinland has elected to undertake an additional stand-alone assessment of icebreaking effects during the shoulder seasons that addresses this concern and which will include underwater noise modelling of icebreaker transits along the Northern Shipping Route. The acoustic modelling will be based on a conservative scenario for icebreaking noise based on thickest seasonal ice conditions in the RSA and maximum acoustic propagation potential. The stand-alone acoustic modelling report and icebreaking assessment will be submitted to the NIRB in 2019 once reporting is completed.	
WWF 03	Will ice management and ice breaking be undertaken regardless of Inuit use of ice within Eclipse Sound, Pond Inlet and Milne Inlet? At what threshold of use will Baffinland cease ice breaking/ice management activities? Please clarify what the shipping frequency will be during the shoulder seasons when landfast ice is present and/or when ice management and/or breaking activities are being carried out. Given BIMC's recent concerns with limits on production and transport of ore threatening the economic viability of operations (i.e. Production Increase Proposal), further information is requested to support BIMC's proposal to base its shipping during shoulder seasons on Inuit use. Specifically, a proposed schedule outlining the volume of ore planned for transport throughout the shipping season would be helpful to outline what level of flexibility is built in to allow for cessation of ice management activities in support of Inuit use of ice (and/or poor ice conditions which may prevent transits due to safety concerns). Please define ice management and ice breaking activity in the context of their planned implementation along the Northern Shipping Route, including details regarding the ice management vessels to be used, a description of ice management/breaking support activities that will be employed, and outline plans and schedule for ship transits during shoulder seasons. Please also clarify with greater certainty what class and/or type of ore transit vessels are being proposed for use with the Phase 2 Proposal.	The WWF IR contains a number of questions which have been broken down here. Please also refer to the Appendix 12 Overview of Marine Operations for other relevant information. 2) Will ice management and ice breaking be undertaken regardless of Inuit use of ice within Eclipse Sound, Pond Inlet and Milne Inlet? No. Communication between BIM and relevant personnel will be maintained so as to ensure that such operations do not hinder use of land fast ice. 3) At what threshold of use will Baffinland cease ice breaking/ice management activities? Several factors will determine when operations could come to a close, including: i) Prevailing ice conditions prevent ore carriers from rendering a positive ice numeral; ii) Annual shipping requirements have been achieved; iii) Presence of landfast ice has been identified. 4) Please clarify what the shipping frequency will be during the shoulder seasons when landfast ice is present and/or when ice management and/or breaking activities are being carried out. a) Unless Polar Class 4 or above vessels are procured, operations will not be executed when landfast ice is present and prevents ore carriers from rendering a positive ice numeral. Current operations do not require use of Polar Class 4 vessel or operations in landfast Ice. b) Assuming landfast ice is no longer present, then ore carriers will operate under ice breaker escort. A prerequisite for said operations is the need to submit ice numerals to NORDREG. c) Frequency of shipping will be assessed on a day to day basis, taking into consideration prevailing ice conditions and operational requirements at the two ore docks. 5) Given BIMC's recent concerns with limits on production and transport of ore threatening the economic viability of operations (i.e. Production Increase Proposal), further information is requested to support BIMC's proposal to base its shipping during shoulder seasons on Inuit use. Specifically, a proposed schedule outlining the volume of ore planned for transport throughout the shipping season would be helpful to outline what level of flexibility is built in to allow for cessation of ice management activities in support of Inuit use of ice (and/or poor ice conditions which may prevent transits due to safety concerns). Please refer to the Overview of Marine Operations (Appendix 12). 6) Please define ice management and ice breaking activity in the context of their planned implementation along the Northern Shipping Route, including details regarding the ice management vessels to be used, a description of ice	Appendix 12: Overview of Marine Operations

ID1	Info Request	Response	Attachment
		management/breaking support activities that will be employed, and outline plans and schedule for ship transits during shoulder seasons. a) Ice breakers are used to facilitate the safe passage of vessels through prevailing ice conditions which are predominantly expected during the shoulder seasons. More precisely, ice breaking operations create a safe track for ore carriers to transit. b) Ice management operations are more focused on preventing floes of ice or ice bergs from contacting vessel(s), port infrastructure or other. c) Ice breakers will be deployed from start of the season until ice conditions improve. 7) Please also clarify with greater certainty what class and/or type of ore transit vessels are being proposed for use with the Phase 2 Proposal. a) Ice class designs for ore carriers include (not an exhaustive list, but based on current knowledge of market availability): i) Non Ice Class (Type E) ii) Ice Class 1C (Type D) iii) Ice Class 1B (Type C) iv) Ice Class 1A (Type B) v) Ice Class 1A Super (PC 7) b) Types of ore carriers include (not an exhaustive list, but based on current knowledge of market availability): i) Supramax ii) Panamax iii) Kamsarmax iv) Capesize	
WWF 04	Can BIMC confirm that its accident scenarios and likelihood ratings (low) of ship-related accident ratings in Table 10-2 were updated to reflect the proposed level of ship transits (>200/season)? Please provide criteria considered in risk assessments, including whether the probability of oil/fuel spills is increased with increased number of ship transits, and whether and how probability of a spill influences the calculations for the risk register.	Baffinland confirms that the accident scenarios and likelihood ratings of ship-related accident ratings in Table 10-2 were updated to reflect the proposed level of ship transects. The definitions for consequence and likelihood, and the matrix for assessing overall risk, were the same as presented for the Approved Project, as defined in Table 2 and Table 3, respectively, in FEIS Volume 10 Appendix 10A-2 "Standard for Hazard Identification and Risk Assessment". These tables are provided as Attachments to this response (Appendix 10). Likelihood has been defined relative to the frequency of occurrence of a particular accident being considered. While an increase in ships per year may have influence on the likelihood of an accident, the increase was not considered enough to change likelihood categories of the selected shipping-related accidents, in consideration of the mitigation in place to reduce the potential for such accidents. Note: Baffinland has reviewed "Major diesel spill..." within Table 10-2 (Major Accidents and Malfunctions Risk Summary), and notes that the "Likelihood" of such an event should be "possible" (as previously noted in the FEIS and FEIS Addendum for the Early Revenue Phase), and not "unlikely" as reported in the Phase 2 Proposal. However, using the Consequence/Likelihood Risk Matrix, the Risk Rating of "High" is correct.	WWF 04 Attachment 1: Tables
WWF 05	1) Clarify that the spill trajectory modelling conducted for the Phase 2 proposal included considerations for only intermediate fuel oil, and not diesel fuel or other distillates? If so, clarify that section 10.2.3.1 Diesel Spill Along a Shipping Route is inappropriately titled. If diesel spill modelling was also conducted, BIMC is asked to provide the results of that model. 2) BIMC confirm why TSD 19 was not updated to reflect the proposed shipping window (July 1-November 15)? 3) BIMC clarify how it determined that a mid-October spill scenario, and not an early- to mid-November scenario, was the appropriate timing for the modelling exercise to support the Phase 2 proposal. 4) BIMC provide new modelling output, or extrapolate on existing model results, showing spill behaviour closer to freeze up (i.e. within the November 1-15 window).	1) TSD19 Fuel Spill Modelling, of the Phase 2 proposal considered IFO only. Diesel fuel was considered in the "AMEC – Fuel Spill Modelling Northern Shipping Route Open Water Season" February 2015 report (Attached to this response in Appendix 10). Section 10.2.3.1 does not exist in either TSD 19 or the 2015 AMEC report. Baffinland is unaware of which section WWF is referring to in order to provide clarification. 2) The TSD19 modelling adequately covers spill predictions for as late as mid-November. The shipping window identified in the Phase 2 project description is unlikely to measurably alter the validity or suitability of the produced results or their ultimate use in support of the Spill at Sea Response Plan (SSRP) (e.g., Section 7), which is Appendix Q of TSD 28 Management and Monitoring Plans. The overall conclusion related to ice breakup scenarios - that the effect of ice (if encountered) is to keep the fuel offshore and delay any drift to one of the shorelines – is unlikely to be different. The overall conclusion related to ice freeze-up scenarios - that the effect of ice	WWF 05 Attachment 1: Fuel Spill Modelling: Northern Shipping Route Open Water Season

ID1	Info Request	Response	Attachment
	5) BIMC clarify whether information provided in TSD 19 is explicitly related to IFO, or whether general statements about "fuel" pertain also (or explicitly) to properties of lighter distillates (i.e. diesel). Specifically, BIMC should clarify whether the following statements are true of the IFO considered within its spill trajectory modelling: a) "Upon release in the marine environment, fuel oil is subject to weathering processes, including spreading, evaporation, dissolution, dispersion of fuel droplets into the water column, photochemical oxidation, emulsification, microbial degradation, adsorption onto particulate matter, ingestion by aquatic organisms, sinking and sedimentation (Payne et al., 1991)." (TSD 19, p. 38) b) "Another major weathering process within the first days of a spill is evaporation. According to ITOPF(2010), most of the fuel components with a boiling point under 200°C tend to evaporate within the first few days." (TSD 19, p. 39) c) "The fuel fraction that is not lost to evaporation or dilution in water is eventually broken up into droplets of varying sizes which are subject to dispersion. The process of dispersion, often accelerated by the application of dispersants, contributes towards faster biodegradation, dissolution and sedimentation of the spilled fuel. Dispersion can be hindered by emulsification of the fuel under the action of waves, which is a common cause for the persistence of spilled fuel in the marine environment. On a time scale longer than a week, the dominant weathering processes become biodegradation by microorganisms and sedimentation and sinking processes (ITOPF 2010)." (TSD 19, p. 40)	for the freeze up scenarios is to keep the fuel offshore and delay any drift to one of the shorelines and in practice, effectively trapping the fuel in the ice as it freezes - is unlikely to be different. In practice, the Project's strategic decisions made early in the year with respect to provisional opening and closing dates for vessels of different ice classes should ensure that only safe and prudent timing of shipping is undertaken further reducing risk of an incident. These decisions will be further informed with key technical (e.g., from TC) and community (e.g., HTO) level involvement. 3) and 4) Please see response to 1 and 2 above. New modelling is not required. 5) a) This is true for IFO (and other fuels). b) This is a general statement: evaporation is an important weathering element. Section 3.4.1 and Figure 3-3 shows the expected evaporation loss for IFO using the OILMAP database. c) This is a general statement and is expected to be applicable for IFO.	
WWF 06	Can BIMC confirm whether its consideration and assessment of emissions from shipping activities was based on current levels of sulphur in fuel? What is the current level of sulphur in fuels utilized by project ships? Can BIMC provide further detail on SOx emissions predictions following the 2020 implementation of the MARPOL cap on sulphur in fuels? Did BIMC consider the use of lighter (non-IFO/HFO) fuels for use by Phase 2 project shipping? Please provide details regarding the feasibility assessment of contracting shippers that use non-IFO/HFO fuels for project shipping.	The air quality modelling for the Phase 2 Proposal assumed low sulphur fuel. Carriers are currently using the following grades/specifications for bunkers: IFO 308CST RMG as per ISO 8217:2010(E) SPECS and MGO DMA or RMD80 Equivalent as per ISO 8217:2010 SPECS. The level of sulphur in these bunker specs would reflect current regulations. Baffinland does not have control over the fuel that its carriers use. Baffinland contracts reputable shippers that are leaders in the industry that meet legal requirements with respect to the use of fuel. These shippers will comply with the low sulphur fuel requirement.	
WWF 09	Provide updated versions of all management and response plans pertaining to the North Railway. Specifically, this must include proposed mitigation and response for accidents related to fuel transportation by rail. Provide a clear proposal with regard to the implementation of the transportation of fuel via rail, including the volumes, frequency, and schedule for this transport (i.e. seasonal restrictions/coordination with truck transport, etc.), as well as fuel transfer loading and unloading procedures/activities at rail facilities. Provide specific impact assessment, mitigation, and monitoring details with regard to this project activity.	Management plans requiring updates will be updated and circulated for review following the technical meeting, currently planned for March 12-15, 2019. In the interim, proposed changes are being tracked in the attached Commitment Register (Appendix 11). Baffinland encourages reviewers to review TSD 28 Management and Monitoring Plans and the associated management plans in detail through the technical review phase, and to provide thorough recommendations to aid in the updating process. Baffinland is not planning to transport freight or fuel along the North Railway.	Appendix 11: Commitment Register

APPENDIX 1
GOVERNMENT OF NUNAVUT IR ATTACHMENTS

GN 06 ATTACHMENT 1: TYPICAL CROSS SECTION FOR CARIBOU CROSSING



TYPICAL CROSS SECTION FOR CARIBOU CROSSING

NTS

NOTE

1. TIMBER CROSSING INSERTS SHALL BE 178mm HIGH AND 229mm WIDE INSERTS TO BE FASTENED TO TIMBER TIES USING 305mm LAG SCREWS. MINIMUM OF 76mm SHALL BE MAINTAINED BETWEEN GAUGE FACE OF THE RAIL AND NEAREST CROSSING INSERT.

GN 10 ATTACHMENT 1: CLIMATE AND WIND DATA SUMMARY

Knight Piésold CONSULTING

www.knightpiesold.com

TRANSMITTAL

TO: Baffinland Iron Mines Corporation
#300 - 2275 Upper Middle Road East
Oakville, Ontario
Canada, L6H 0C3

DATE: November 10, 2016

FILE NO.: NB102-00181/39-A.01

ATTENTION: Mr. Matt Weaver

CONT. NO.: NB16-00651

RE: Climate and Wind Data Summary

ITEM NO.	DESCRIPTION
1.	One (1) Adobe .pdf copy of the following:
	Table 1 Rev 0 - Mary River Meteorological Data - Data Summary 2006-2015
	Wind Rose Plot - Mary River Met Station - Open Water Season
	Wind Rose Plot - Mary River Met Station - Non-Open Water Season
	Table 2 Rev 0 - Milne Inlet Port Meteorological Data - Data Summary 2006-2015
	Wind Rose Plot - Milne Inlet Met Station - Open Water Season
	Wind Rose Plot - Milne Inlet Met Station - Non-Open Water Season

REMARKS:

Prepared: Amanda Daigle-Randall

Reviewed: Simon Foster

Copy To: Wayne McPhee, Baffinland Iron Mines Corporation

Knight Piésold CONSULTING

TABLE 1

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

MARY RIVER METEOROLOGICAL DATA
DATA SUMMARY 2006-2015[1]

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Air Temperature (°C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	-30.7	-33.1	-29.3	-19.1	-6.3	3.7	11.4	8.6	-0.8	-9.9	-23.2	-30.4
Median	-31.9	-34.7	-29.8	-18.7	-6.1	3.7	11.1	8.5	-1.6	-10.6	-24.2	-32.5
Min	-46.0	-45.5	-45.5	-41.2	-25.5	-8.1	1.5	-36.8	-14.1	-26.0	-38.7	-43.7
Max	-5.3	-3.9	-6.1	-4.0	21.5	13.5	22.8	20.8	10.6	3.4	-6.4	-11.5
Q1	-36.3	-39.2	-34.6	-23.9	-10.2	1.5	8.5	5.9	-6.6	-15.5	-32.1	-37.5
Q3	-25.2	-28.3	-24.7	-14.4	-1.9	5.8	14.0	11.0	1.3	-4.6	-17.2	-25.7
n	2585	2381	2928	2461	3269	3570	3157	2696	2428	2295	2494	2943
Relative Humidity (%)[2]												
Mean	71.3	67.7	69.6	71.3	75.3	75.8	69.7	77.8	72.5	78.1	71.3	68.6
Median	71.4	67.2	69.3	71.2	75.2	75.5	69.4	77.6	75.9	79.4	74.5	69.3
Min	48.9	27.0	46.5	30.9	33.6	24.3	10.2	23.7	18.8	23.5	10.5	17.2
Max	94.8	95.9	91.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	98.9	99.0
Q1	66.7	64.1	65.1	65.2	66.8	66.0	55.6	63.1	67.2	71.7	70.2	66.1
Q3	75.6	71.2	73.2	78.1	83.5	87.0	83.7	89.5	85.3	85.6	80.3	73.3
n	2585	2381	2928	2458	3254	3556	3114	2479	2691	2373	2710	3082
Sunshine Hours (hours/day)[2]												
Mean	0.0	0.0	5.2	0.7	1.4	6.7	9.5	12.6	14.0	2.9	4.7	2.6
Daylight Hours (hours/day)[3]												
Mean	0.5	6.6	11.8	17.0	23.4	24.0	24.0	19.2	13.4	8.4	1.8	0.0

I:\1\02\00181\39\A\Data\26 Climate Data Summary\[Table 1.0 MARY RIVER - Consolidated Weather Data up to Jun 16 2015.xlsx]TABLE 1 MARY RIVER MET

NOTES:

1. TIME PERIOD OF DATA SUMMARY IS FROM JUNE 3, 2006 TO JUNE 16, 2015.
2. CALCULATED FROM MET STATION, ACCURACY IN QUESTION.
3. CALCULATED FROM THE UNITED STATES NAVAL OBSERVATORY WEBSITE (http://aa.usno.navy.mil/data/docs/Dur_OneYear.php) ACCESSED NOVEMBER 9, 2016.

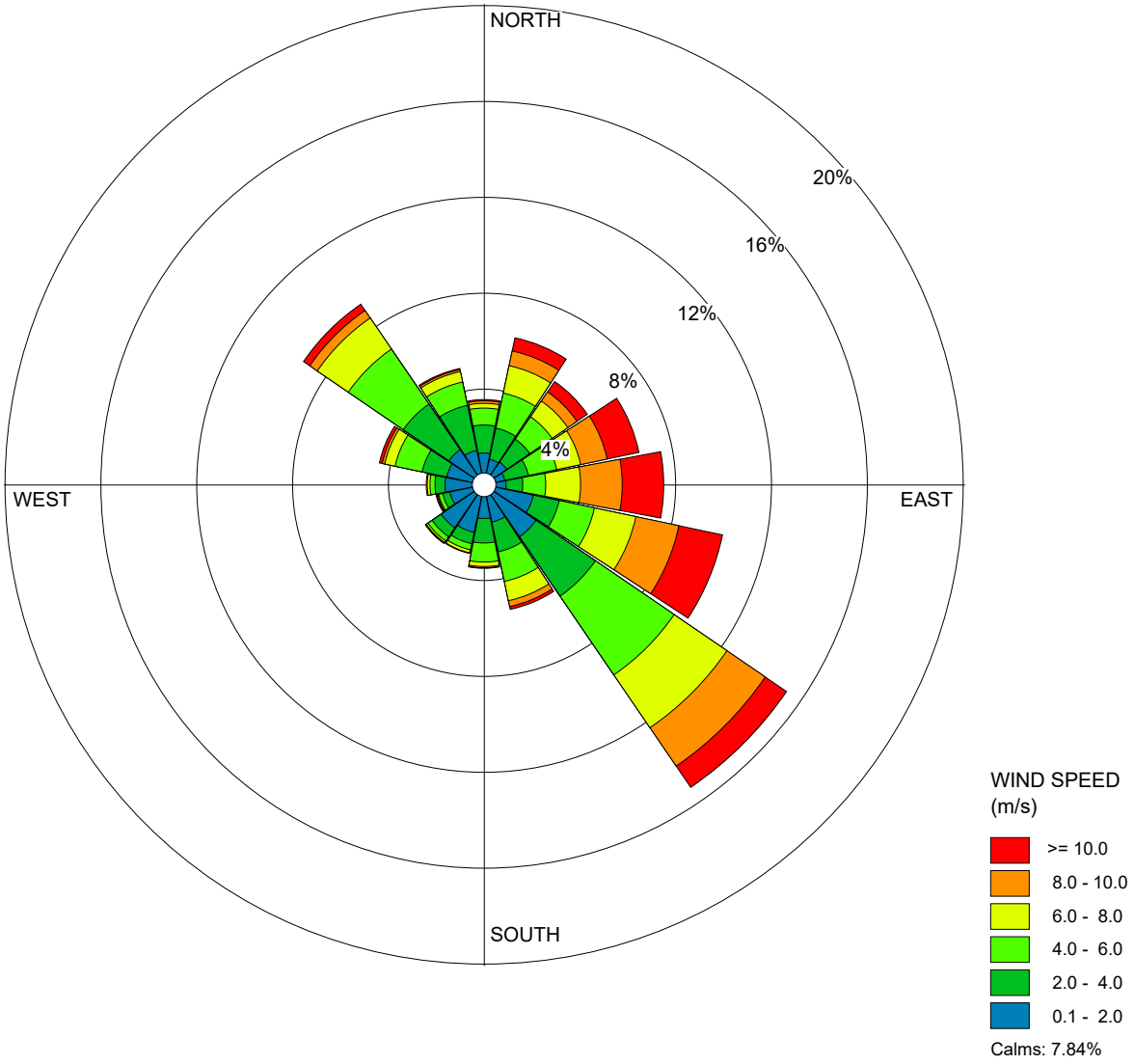
REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	10NOV'16	ISSUED FOR INFORMATION NB16-00651	SBF	RAC

WIND ROSE PLOT:

MARY RIVER MET STATION
OPEN WATER SEASON

DISPLAY:

Wind Speed
Direction (blowing from)



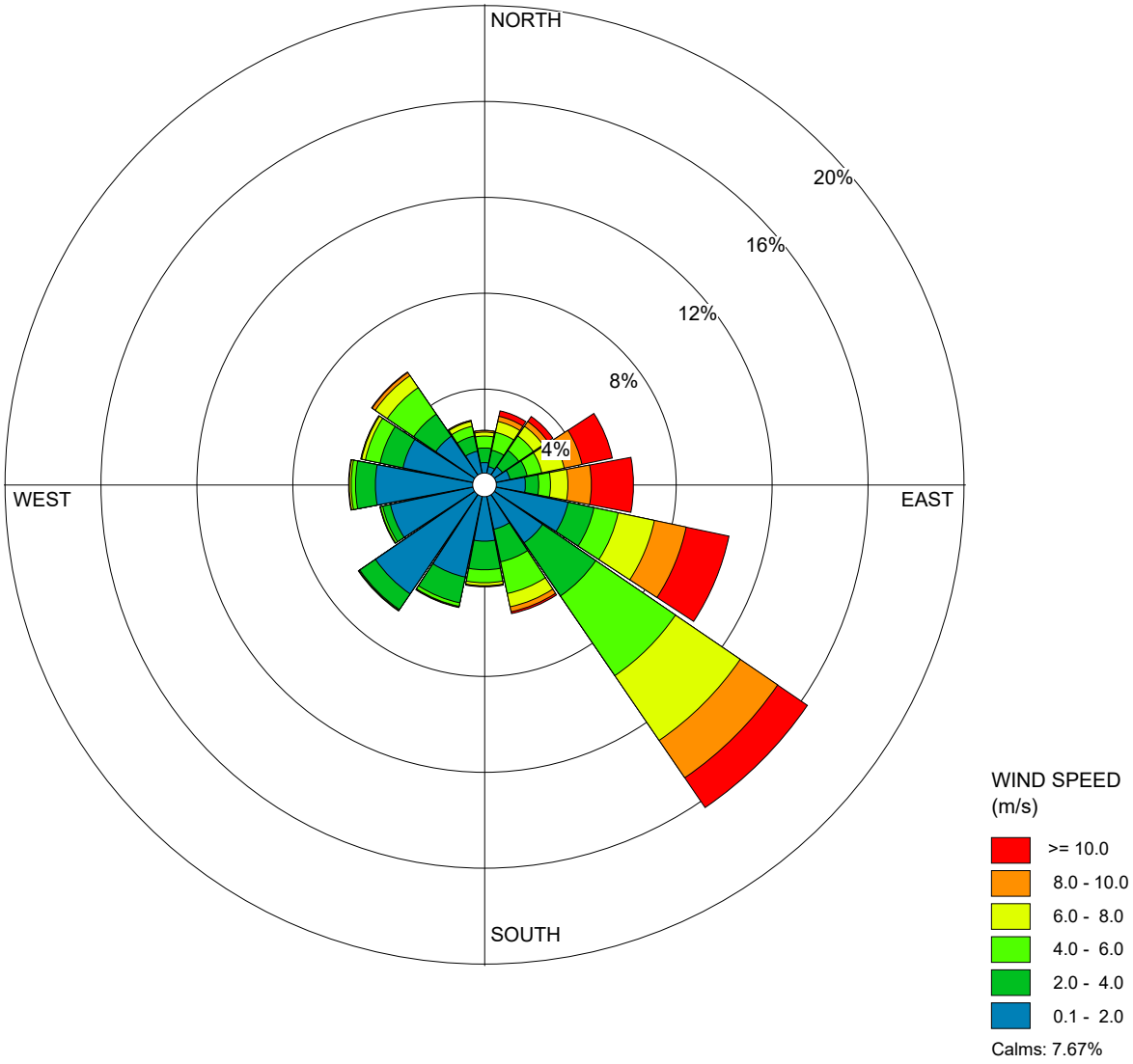
COMMENTS: Open Water Wind Conditions - August 1st through to October 31.	DATA PERIOD: **Start Date: 8/1/2006 - 00:00** **End Date: 10/31/2014 - 23:00**	COMPANY NAME: **Knight Piésold Ltd.**	
		MODELER: **SBF**	Knight Piésold CONSULTING
	CALM WINDS: **7.84%**	TOTAL COUNT: **7656 hrs.**	
	AVG. WIND SPEED: **4.33 m/s**	DATE: **11/9/2016**	PROJECT NO.: **NB102-181/39**

WIND ROSE PLOT:

MARY RIVER MET STATION
NON-OPEN WATER SEASON

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS: Non-Open Water Wind Conditions - November 1st through to July 31.	DATA PERIOD: **Start Date: 6/3/2006 - 00:00** **End Date: 6/16/2015 - 12:00**	COMPANY NAME: **Knight Piésold Ltd.**	
		MODELER: **SBF**	Knight Piésold CONSULTING
	CALM WINDS: **7.67%**	TOTAL COUNT: **23243 hrs.**	
	AVG. WIND SPEED: **3.47 m/s**	DATE: **11/9/2016**	PROJECT NO.: **NB102-181/39**

Knight Piésold CONSULTING

TABLE 2

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

MILNE INLET PORT METEOROLOGICAL DATA
DATA SUMMARY 2006-2015[1]

Print Nov/10/16 14:23:47

Air Temperature (°C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
median	-30.6	-31.9	-29.4	-19.4	-6.3	3.2	9.7	7.5	-1.0	-7.6	-18.9	-27.3
mean	-29.5	-30.8	-28.9	-19.6	-6.9	3.5	10.2	7.4	-0.9	-7.7	-17.9	-25.1
min	-43.8	-44.2	-43.4	-33.7	-23.9	-10.5	2.6	-1.0	-11.1	-24.5	-37.9	-39.9
max	-5.8	-13.6	7.7	-3.9	4.3	16.8	22.3	18.9	10.3	6.2	6.2	6.2
Q1	-34.4	-35.6	-33.7	-24.1	-10.6	1.3	7.7	4.9	-3.4	-12.0	-24.6	-31.9
Q3	-25.5	-26.4	-24.6	-15.3	-3.1	5.6	12.4	9.7	1.7	-3.2	-12.6	-20.5
n	4464	4056	4701	5040	4851	4659	5009	3763	3610	4935	4629	4737
Relative Humidity (%)[2]												
median	73.9	71.7	72.9	76.4	79.9	79.6	71.4	80.3	79.4	85.4	79.5	74.0
mean	74.4	73.2	72.8	76.8	79.4	78.3	71.1	78.7	79.3	84.6	79.6	75.0
min	57.1	52.3	51.2	48.9	47.1	35.1	30.1	38.1	47.1	46.4	56.0	58.1
max	100.0	91.5	97.2	99.3	99.6	100.0	99.2	99.5	100.0	100.0	100.0	95.2
Q1	71.1	69.2	68.5	71.8	73.4	69.6	60.7	70.6	72.9	78.9	75.4	71.4
Q3	77.9	77.5	76.7	82.7	86.0	88.5	82.5	87.9	86.1	91.5	83.5	77.8
n	2976	2688	2998	2880	2623	2499	2794	2172	2170	3447	3189	3249
Sunshine Hours (hours/day)[2]												
Mean	0.0	9.4	23.0	19.4	16.8	18.5	17.6	19.7	22.3	21.0	3.8	3.3
Daylight Hours (hours/day)[3]												
Mean	0.5	6.6	11.8	17.0	23.4	24.0	24.0	19.2	13.4	8.4	1.8	0.0

I:\1\02\00181\39\A\Data\26 Climate Data Summary\[Table 2.0 MILNE PORT - Consolidated Weather Data up to Jun 16 2015.xlsx]TABLE 2 MILNE PORT SUMMARY

NOTES:

1. TIME PERIOD OF DATA SUMMARY IS FROM OCTOBER 2, 2006 TO JUNE 16, 2015.
2. CALCULATED FROM MET STATION, ACCURACY IN QUESTION.
3. CALCULATED FROM THE UNITED STATES NAVAL OBSERVATORY WEBSITE (http://aa.usno.navy.mil/data/docs/Dur_OneYear.php) ACCESSED NOVEMBER 9, 2016.

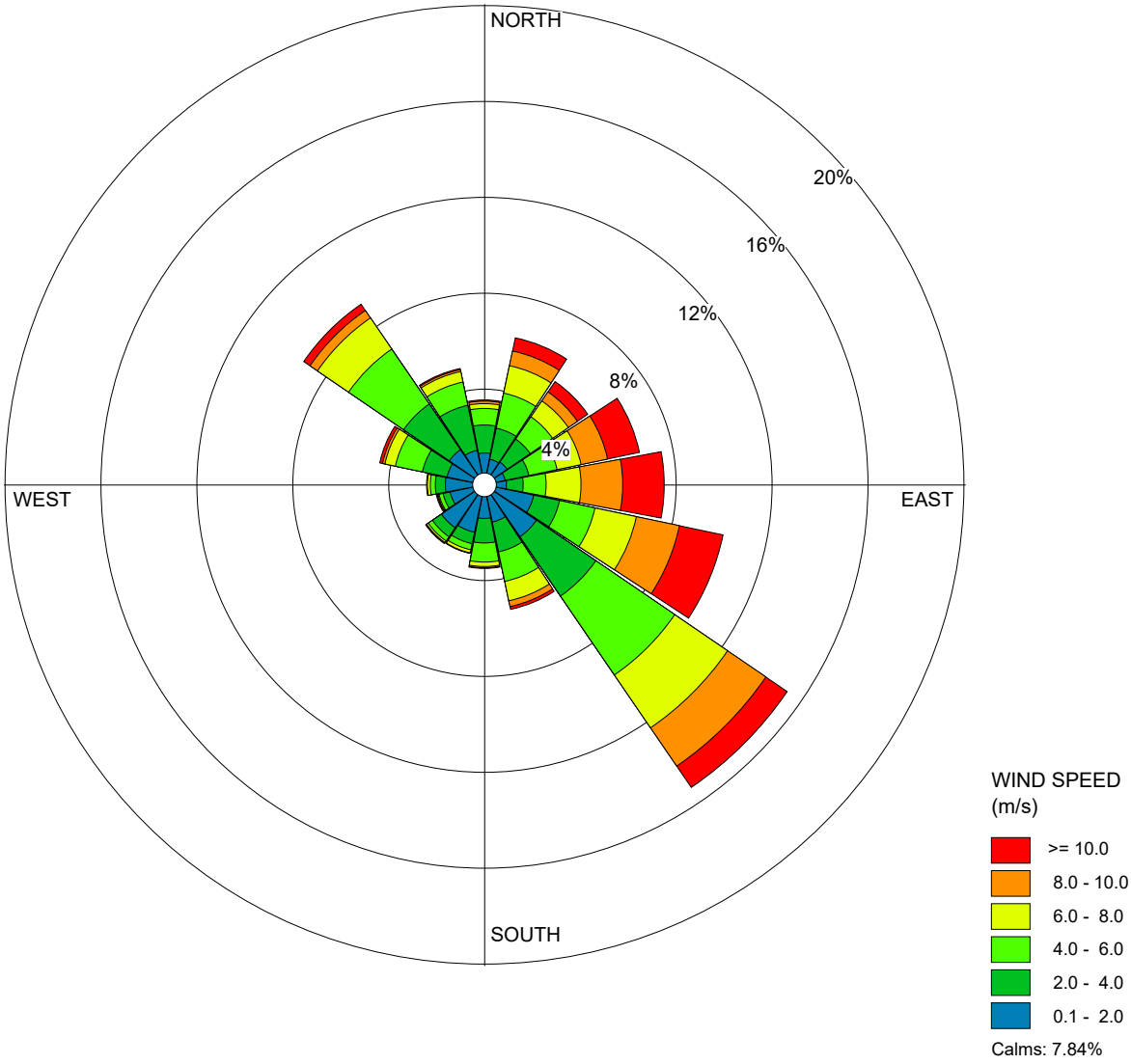
REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	10NOV'16	ISSUED FOR INFORMATION NB16-00651	SBF	RAC

WIND ROSE PLOT:

MILNE INLET MET STATION
OPEN WATER SEASON

DISPLAY:

Wind Speed
Direction (blowing from)



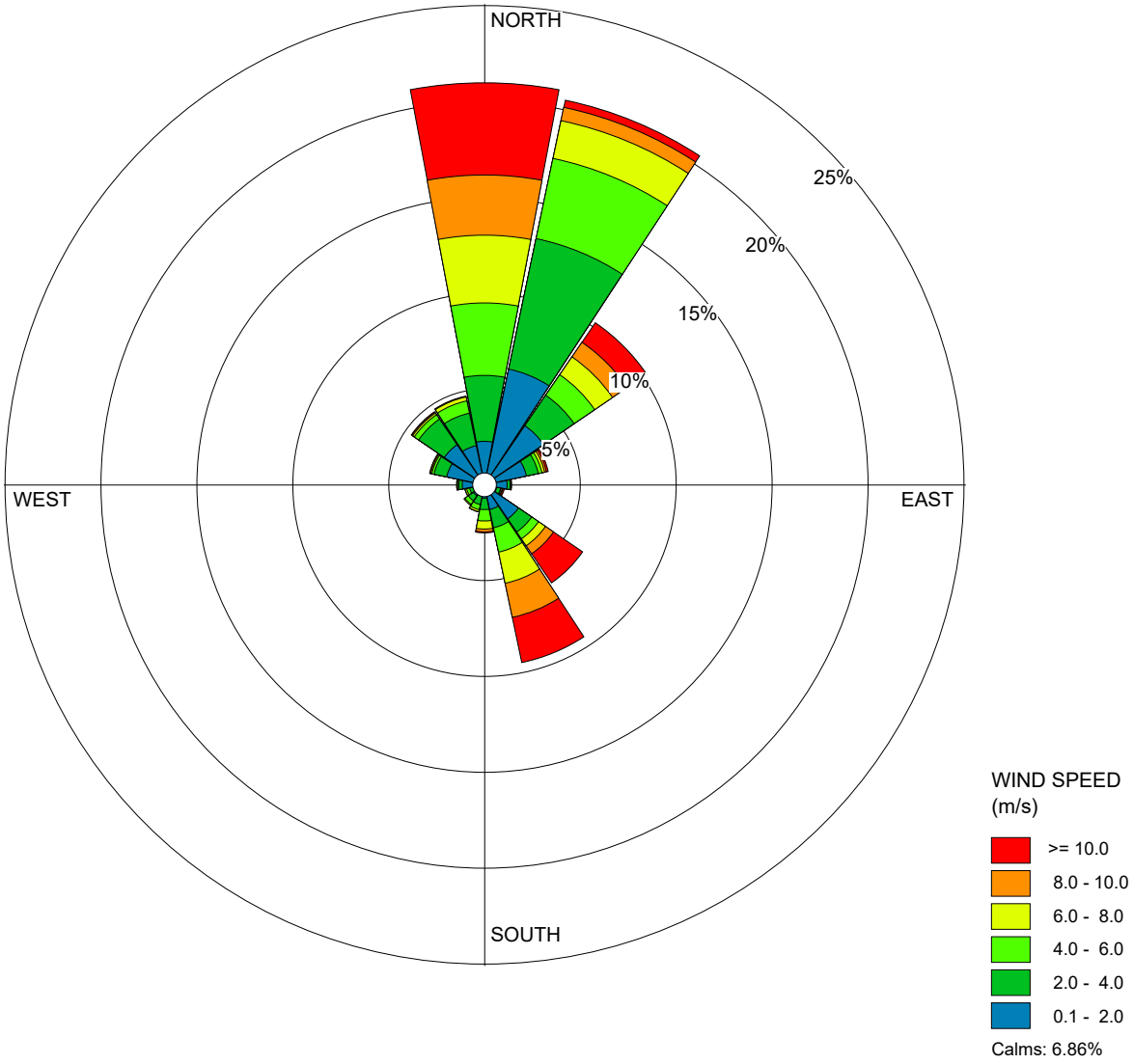
COMMENTS: Open Water Wind Conditions - August 1 to October 31	DATA PERIOD: **Start Date: 8/1/2006 - 00:00** **End Date: 10/31/2014 - 23:00**	COMPANY NAME: **Knight Piésold Ltd.**	
		MODELER: **SBF**	Knight Piésold CONSULTING
	CALM WINDS: **7.84%**	TOTAL COUNT: **7655 hrs.**	
	AVG. WIND SPEED: **4.33 m/s**	DATE: **11/9/2016**	PROJECT NO.: **NB102-181/39**

WIND ROSE PLOT:

MILNE INLET MET STATION
NON-OPEN WATER SEASON

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS: Non-Open Water Wind Conditions - November 1 to July 31	DATA PERIOD: **Start Date: 11/1/2006 - 00:00** **End Date: 6/16/2015 - 12:00**	COMPANY NAME: **Knight Piésold Ltd.**	
		MODELER: **SBF**	Knight Piésold CONSULTING
	CALM WINDS: **6.86%**	TOTAL COUNT: **42144 hrs.**	
	AVG. WIND SPEED: **4.33 m/s**	DATE: **11/9/2016**	PROJECT NO.: **NB102-181/39**

GN 10 ATTACHMENT 2: DUST FALL MONITORING PROGRAM

2 DUST FALL MONITORING PROGRAM

Dust deposition on soil and vegetation can have adverse effects on vegetation health and ultimately on wildlife and humans that consume vegetation. Baffinland is therefore committed to establishing a monitoring program investigating the extent of dust fall generated from Project activities. Several of the Project Conditions (e.g. Project Conditions 36, 50, 54d and 58c) address dust fall concerns or relate to reporting requirements for the dust fall monitoring program.

To meet these requirements, the Mary River dust fall monitoring program was initiated in the summer of 2013. The three main objectives of the dust fall monitoring program are to:

1. Quantify the extent and magnitude of dust fall generated by Project activities;
2. Determine seasonal variations in dust fall; and
3. Determine if annual changes in dust fall exceed identified thresholds associated with the dust fall dispersion models (Volume 6, Section 3; Baffinland Iron Mines Corporation 2013).

To address Project Condition 57g, which refers to assessment and presentation of annual environmental conditions including timing of snowmelt, green-up, as well as standard weather summaries, weather summaries including an overview of the 2017 weather conditions, timing of snow melt, and green–up are provided under Section 2.2.1.1.

2.1 METHODS

In addition to the collection of dust fall data, the monitoring program also reviewed supporting data that may affect the magnitude and extent of dust fall over the 2017 time period. These supporting data includes weather conditions and traffic on the Tote Road.

2.1.1 REVIEW OF SUPPORTING DATA

2.1.1.1 Overview of Weather Conditions

Climate data for 2017 collected from on-site meteorological stations at Mary River and Milne Inlet were compared with baseline data for the area (2005–2010; EDI Environmental Dynamics Inc. 2012). Air temperature, precipitation as rainfall, wind speed, and wind direction were considered in relation to dust fall.

2.1.1.2 Traffic on the Tote Road

Ore hauling began in September 2014 and the number of trucks hauling ore on the Tote Road each day is tracked by Mine Operations Dispatch. All non-haul vehicle traffic on the Tote Road from the Mine Site to Milne Port is recorded by Baffinland security. Data from both sources were collected, reviewed and compiled, and are presented on a 'vehicle transits per day' basis; further, these data are compared with the projected ore haul and non-haul vehicle transits (Volume 3, Appendix 3B, Baffinland Iron Mines Corporation 2013).

While the ore haul truck traffic data provides a clear picture of the number of ore haul trucks travelling the full length of the Tote Road, there are limitations associated with 'other traffic' vehicle transits. These data are collected from the Mary River and Milne Port security staff for purposes of ensuing employee safety while travelling the Tote Road. The data includes date and time of travel, the number of vehicles, road closures, etc. (but not ore haul), and does not include complete data regarding the length of travel of each vehicle along the Tote Road. The non–haul ('other') vehicle transits are generally over-estimated (and thus inflate vehicle transits where this may not be the case) because it is assumed that all vehicles complete the full travel distance from Mary River to Milne Port. Much of the non-ore haul traffic on the Tote Road travels less than 50 km along the road, and then return to camp without completing the full Tote Road distance. This type of vehicle traffic includes road maintenance mobile equipment, mechanical maintenance/fueling trucks, pick-up trucks, etc.

2.1.1.3 Dust Suppression

Dust suppression activities are carried out by Baffinland Mine Operations staff each year throughout the Project footprint at the Mine Site, Milne Port, along the Tote Road, and along the Mine Haul Road using water and calcium chloride. After the 2017 dust suppression program, an excel sheet detailing the completed program, including dates and times of water and calcium chloride application, was provided to EDI staff for analysis.

2.1.2 DUST FALL SAMPLING

The dust fall monitoring program began in July 2013 with 26 dust fall monitoring sites. In August 2014 one site at Milne Port (DF-P-2) was discontinued as it needed to be re-located to allow for port infrastructure, and an additional eight sites were added at the mine and port areas (Map 1; Table 2). Dust fall sampling locations were chosen to represent areas of various expected dust fall deposition rates based on isopleth dispersion models and the direction of prevailing winds within the RSA, excluding areas of future infrastructure development. Since August 2014, there have been no changes in the number of dust fall sampling location; the 33 dust fall sampling locations for 2017 include:

- Nine (9) dust fall samplers located at the Mine Site (three within the Mine Site, four outside the mine footprint within low to moderate isopleth areas and two references sites; one to the northeast, and one to the south) located at least 14 km from any Project infrastructure, outside of the extent of expected dust fall;
- Six (6) dust fall samplers located at Milne Port (five active sites on the port site footprint; DF-P-5 replaced DF-P-2) and one (1) reference site located northeast of the port site outside of the extent of expected dust fall; and
- Sixteen (16) dust fall samplers divided between two sites along the Tote Road (North sites and South sites). These two sites are organized into transects, each composed of eight (8) dust fall samplers distributed perpendicular to the Tote Road centreline at 30 m, 100 m, 1,000 m, and 5,000 m on either side of the road. The prevailing wind direction is variable, often parallel to the Tote Road as opposed to perpendicular; therefore 'upwind' and 'downwind' directions from the

road are not identified. The two (2) reference dust fall samplers are located 14 km southwest of the Tote Road (one at the north site, one at the south site).

Each dust fall sampler comprises one sampling apparatus including a hollow post, approximately two metres in height, and a terminal bowl-shaped holder for the dust collection vessel. The terminal bowl is topped with "bird spikes" to prevent birds perching and contaminating samples with feces. Each sampling apparatus was installed by inserting rebar posts into the ground, placing the post over the rebar, and then stabilizing the apparatus with guy wires. Dust collection canisters were placed in the holder; these containers were pre-charged with 250 mL of algaecide in summer and 250 mL of isopropyl alcohol in winter. Collection vessels were changed out every month and shipped to ALS Environmental Laboratory (ALS) in Waterloo, Ontario, for analysis of total suspended particulates (TSP; units of mg/dm^2·day). In addition to the analysis of TSP, the dust fall samples were analyzed for total metal concentrations to help inform potential trends in soil and vegetation tissues, collected as part of vegetation health monitoring.

Table 2 Dust fall monitoring sites.

Site ID	Location	Sample period	Distance to PDA[1] (m)	Dust isopleth zone	Latitude	Longitude
DF-M-01	Mine Site	year round	Within PDA	High	71.3243	-79.3747
DF-M-02	Mine Site	year round	Within PDA	High	71.3085	-79.2906
DF-M-03	Mine Site	year round	Within PDA	High	71.3072	-79.2433
DF-M-04	Mine Site	variable	9,000	Nil	71.2197	-79.3277
DF-M-05	Mine Site	variable	9,000	Nil	71.3731	-78.9230
DF-M-06	Mine Site	variable	1,000	Moderate	71.3196	-79.1560
DF-M-07	Mine Site	variable	1,000	Moderate	71.3000	-79.1953
DF-M-08	Mine Site	variable	4,000	Moderate	71.2945	-79.1002
DF-M-09	Mine Site	variable	2,500	Low	71.2936	-79.4127
DF-RS-01	Tote Road – south	variable	5,000	Nil	71.3275	-79.8001
DF-RS-02	Tote Road – south	variable	1,000	Low	71.3893	-79.8324
DF-RS-03	Tote Road – south	year round	100	Moderate	71.3967	-79.8228
DF-RS-04	Tote Road – south	year round	30	Moderate	71.3975	-79.8222
DF-RS-05	Tote Road – south	year round	30	Moderate	71.3980	-79.8228
DF-RS-06	Tote Road – south	year round	100	Moderate	71.3986	-79.8234
DF-RS-07	Tote Road – south	variable	1,000	Nil	71.4077	-79.8182
DF-RS-08	Tote Road – south	variable	5,000	Nil	71.4489	-79.7106
DF-RN-01	Tote Road – north	variable	5,000	Nil	71.6883	-80.5363
DF-RN-02	Tote Road – north	variable	1,000	Low	71.7145	-80.4704
DF-RN-03	Tote Road – north	year round	100	Moderate	71.7186	-80.4473
DF-RN-04	Tote Road – north	year round	30	Moderate	71.7189	-80.4456
DF-RN-05	Tote Road – north	year round	30	Moderate	71.7185	-80.4414
DF-RN-06	Tote Road – north	year round	100	Moderate	71.7189	-80.4397
DF-RN-07	Tote Road – north	variable	1,000	Nil	71.7226	-80.4165
DF-RN-08	Tote Road – north	variable	5,000	Nil	71.7435	-80.2898
DF-P-01	Milne Port	year round	Within PDA	Moderate	71.8802	-80.9072
DF-P-02	Milne Port	decommissioned	Within PDA	Moderate	71.8850	-80.8912
DF-P-03	Milne Port	variable	3,000	Nil	71.8996	-80.7884
DF-P-04	Milne Port	year round	Within PDA	Low	71.8710	-80.8828
DF-P-05	Milne Port	year round	Within PDA	Moderate	71.8843	-80.8945
DF-P-06	Milne Port	year round	Within PDA	Low	71.8858	-80.8790
DF-P-07	Milne Port	year round	Within PDA	High	71.8838	-80.9160
DF-RR-01	Reference– Road	summer only	14,000	Nil	71.2805	-80.2450
DF-RR-02	Reference– Road	summer only	14,000	Nil	71.5189	-80.6923

1. PDA = Potential Development Area

Dust fall sampling was conducted year-round; however, the winter sampling program was limited to a subset of the sample sites (16 out of 33 in the 2017 season) because access to remote sites is restricted and unsafe during the winter months (17 by helicopter access when helicopter available on site in summer, and just the 16 truck access locations during winter). Those sites exposed to the highest dust fall, i.e., those samplers located within one kilometre of the Potential Development Area (PDA) were sampled throughout 2017 (Table 3). The sites not visited over the winter months are generally those located at a distance one kilometre or greater from the PDA, and therefore exposed to the least amount of Project-related dust fall.

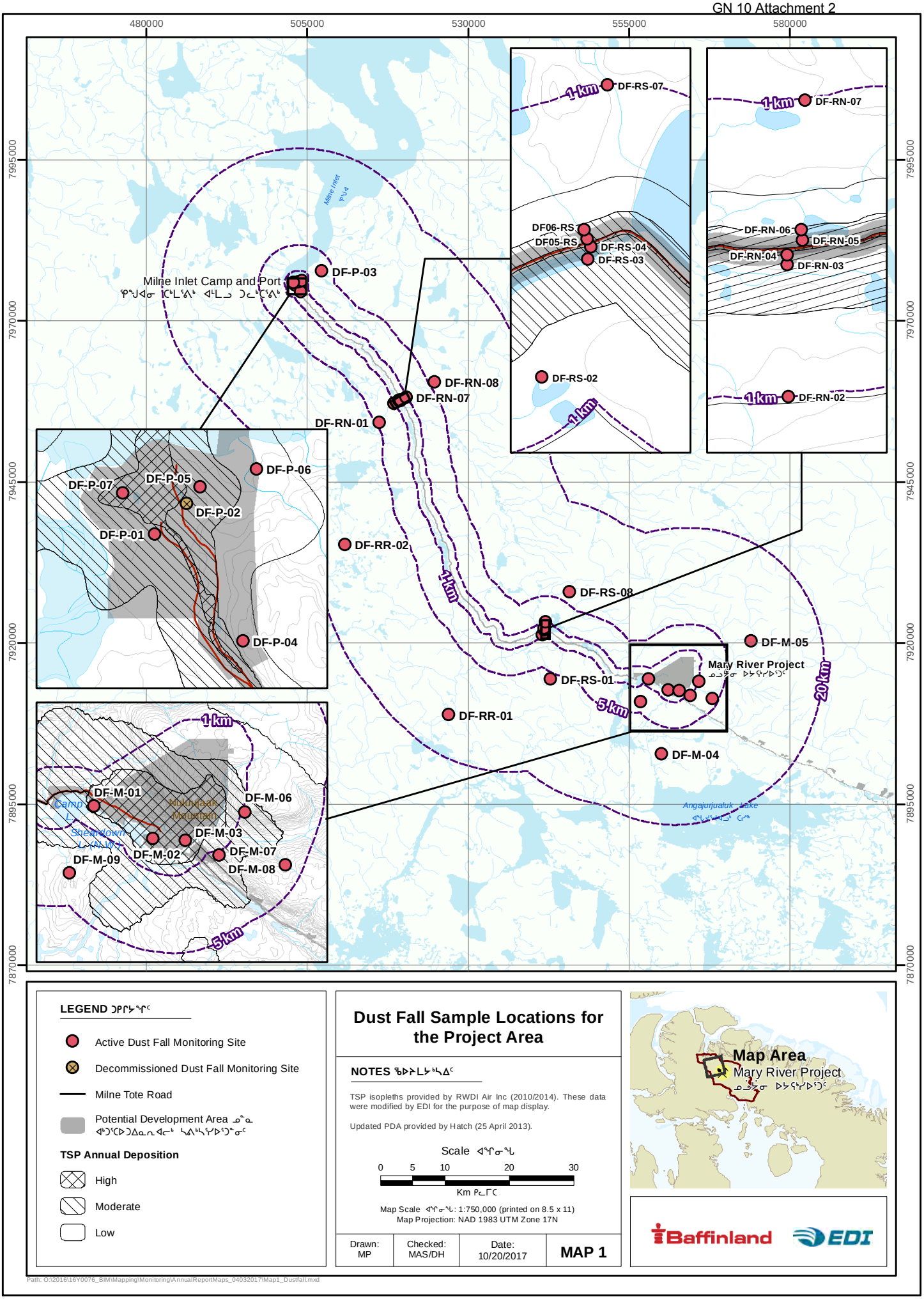
For data analysis and reporting purposes, summer includes sampling data from June, July and August, and winter includes data collected September through May. This seasonal delineation was determined after reviewing site weather data, indicating that in September through May the average daily temperature is below 0°C, and more than 50% of the monthly precipitation falls as snow. It is anticipated that less dust is mobilized under frozen, snow-covered conditions. The 2017 dust fall monitoring program data includes data collected for a full calendar year from mid December 2016 through mid-December 2017.

Table 3 Record of sampling associated with the 2017 dust fall monitoring program.

Sampling session	Start date[1]	End date[1]	Number of days[1]	Number of canisters deployed	Number of canisters analyzed	Sampling solution
1	18,19 Dec-2016	15, 16, 19 Jan-2017	28–31	16	16	Alcohol
2	15, 16, 19 Jan-2017	16, 17, 18 Feb-2017	31–35	16	16	Alcohol
3	16, 17, 18 Feb-2017	19, 20, 22 Mar-2017	28–33	16	16	Alcohol
4	19, 20, 22 Mar-2017	22, 23 Apr-2017	32–34	15	15	Alcohol
5	22, 23 Apr-2017	21, 22, 23 May-2017	28–30, 64[2]	16	16	Alcohol
6	21, 22, 23 May-2017	19, 20 Jun-2017	28,29	16	16	Alcohol
7	19, 20 Jun-2017	21, 22, 23 Jul-2017	31–33	33	33	Algaecide
8	21, 22, 23 Jul-2017	19, 21Aug-2017	27–30	33	33	Algaecide
9	19, 21 Aug-2017	19, 20, 21 Sep-2017	31–34	33	33	Algaecide
10	19, 20, 21 Sep-2017	15 Oct-2017	24-26	16	16	Alcohol
11	15 Oct-2017	13,14 Nov-2017	29-30	16	16	Alcohol
12	13,14 Nov-2017	10, 11 Dec-2018	26-28	16	16	Alcohol

[1] Sample collection and jar change out takes approximately three days when all 33 sites are collected.

[2] DF-RN-04 was buried in snow during April sample collection, collection vessel therefore remained deployed for 64 days until 23-May-17.



LEGEND ↄᑭᑢᖅᑎᑦ

- Active Dust Fall Monitoring Site
- Decommissioned Dust Fall Monitoring Site
- Milne Tote Road
- Potential Development Area ᓄᓐᓄ ᐊᑐᑦᑕᐅᐃᓇᓗᐊᓕᓐᓂᖅ ᖃᐃᑲᓗᓂᐅᑦᑐᓐᓂᓪᓗᒥ

TSP Annual Deposition

- High
- Moderate
- Low

Dust Fall Sample Locations for the Project Area

NOTES ᖃᐅᔨᒪᔨᖏᓚᐅᑦ

TSP isopleths provided by RWDI Air Inc (2010/2014). These data were modified by EDI for the purpose of map display.

Updated PDA provided by Hatch (25 April 2013).

Scale ᐊᖏᔪᓂᖅ

0 5 10 20 30

Km ᑭᓪᓕᑕ

Map Scale ᐊᖏᔪᓂᖅ: 1:750,000 (printed on 8.5 x 11)
Map Projection: NAD 1983 UTM Zone 17N

Drawn: MP	Checked: MAS/DH	Date: 10/20/2017	MAP 1

Baffinland EDI

2.1.3 ANALYTICAL METHODS

The RSA was divided into four areas for the purposes of reviewing dust fall data:

1. The Mine Site;
2. Milne Port;
3. The Tote Road South crossing; and
4. The Tote Road North crossing.

Extent and Magnitude of Dust Fall at Various Sites — Dust fall deposition rates (as Total Suspended Particles — TSP) for each site were compiled for the 2017 season and reviewed to determine which sites in each sampling area are most affected by dust fall, and if any reference sites were recording high deposition rates of dust fall.

Daily dust fall from summer sampling periods (June, July, and August) were used to look at the relationship between dust fall and distance from source for the Mine Site, Tote Road north and Tote Road south crossing sites; dust fall has historically been highest in June/July, and only a subset of the sites are sampled though the winter which renders the data less useful for review of this relationship. Mixed effects models were used to test for a relationship between distance from the road and daily dust fall. Distance from the Mine Site was treated as a categorical variable with three classes — Near (within footprint), Far (1,000 m – 5,000 m), and Reference (>5,000 m). Distance from the Tote Road was treated as a categorical variable with four classes – 30 m, 100 m, 1,000 m, and 5,000 m. Sample site was included as a random effect in all models. Daily dust fall values were log transformed prior to analysis.

Residual plots were examined to confirm assumptions of normality and equality of variance in the residuals. Significance of model terms was tested using F-tests; terms were considered significant at $\alpha < 0.05$. If there was an effect of distance class on dust fall, we used pairwise comparisons of means with a Tukey correction to determine which distance classes were different. Linear combinations of means and t-tests were used to report differences in group means. All estimates were back transformed to the original scale and reported as medians ±95% confidence intervals. Statistical analysis was conducted using R version 3.3.1 (R Core Team 2016).

Seasonal Variation in Dust Fall — We used generalized least squares regression to test for effects of season (summer and winter) and sample site on daily dust fall accumulation for each project area (mine site, Milne Inlet port, north road and south road), for sites that were sampled throughout the year. Each model included main effects of season and sample site, with an interaction term between sample site and season. All dust fall data were log transformed prior to analysis and results were back-transformed to the original scale. Models included a first order autocorrelation structure, based on sampling period within a sample site, to account for the possibility that dust fall in one sampling period was more similar to samples from the preceding period than other samples from the same site (Zuur et al. 2009). Fixed model weights based on

the number of days in each sampling period were used to give more weight to dust samples collected over a longer time (Zuur et al. 2009).

Residual plots were examined to confirm assumptions of normality and equality of variance in the residuals. Significance of model terms was tested using marginal F-tests; terms were considered significant at $\alpha < 0.05$. If there was no evidence that daily dust fall was related to season or site, then median dust fall ± 95% confidence intervals was reported across all sites and seasons. If there was evidence of an effect of season on daily dust fall we used least squared means to estimate the median effect of season after accounting for the effect of sample site (Lenth 2014). Statistical analysis was conducted using R version 3.3.1 (R Core Team 2016).

Annual Dust Fall — Annual total suspended particulates (TSP) thresholds were developed for the Project, see Appendix B. 4-3 of the TEMMP (Baffinland Iron Mines Corporation 2017). These thresholds were developed with input from the results of the dust dispersion models, existing literature related to air quality guidelines and dust deposition, and similar dust monitoring programs in place at other northern mines:

Low: 1–4.5 g/m²/year;

Moderate: 4.6–50 g/m²/year; and

High: ≥50 g/m²/year.

The results of the dust fall 2017 sampling program were converted from units of mg/dm²·day to g/m²/year and were compared with the modelled dust deposition isopleths for the Project to determine if deposition rates exceed the applicable indicator threshold. Each month's data are converted to (g/m²/day), and then summed to add up to one year

Sites in the nil and low isopleth zones were not sampled during winter months, so annual accumulation was not calculated for those sites. Very low dust fall accumulation, often below laboratory detection, was observed at these sites during the summer months.

2.2 RESULTS AND DISCUSSION

2.2.1 SUPPORTING DATA

2.2.1.1 Overview of Weather Conditions

North Baffin Island has a semi-arid climate with relatively little precipitation and few frost-free days (Baffinland Iron Mines Corporation 2012). Generally, snow melt occurs in late June and frost-free conditions last until late August. In 2017, the onset of snow melt was around mid to late June where temperatures were consistently above 0ºC. Following the onset of snow melt, air temperatures rise and the amount of daily sunlight increases, triggering plant growth and green-up. On-site staff reported an abundance of flowering purple saxifrage (*Saxifraga oppositifolia*) across the landscape in late June and early July 2017.

Environment Canada operated a climate station at Mary River from 1963–1965 during the summer months (Baffinland Iron Mines Corporation 2012). This data is included for comparison where relevant. Climate data for 2017 was collected from on-site meteorological stations at Mary River and Milne Inlet and compared to available baseline data (2005–2010; Baffinland Iron Mines Corporation 2012). Baffinland established an on-site meteorological station at Mary River Camp on June 13, 2005 and at Milne Inlet in June 2006. Parameters measured include monthly air temperature, precipitation as rainfall, wind speed, and wind direction. Data included in the following analysis was from January 1, 2017 to December 31, 2018.

Air Temperature — Air temperatures in 2017 were somewhat cooler during the summer and warmer during the winter relative to baseline conditions, 2005–2010. Air temperatures recorded by Environment Canada at the Mary River meteorological station from 1963–1965 were cooler during the summer months than 2017 air temperatures. In general, air temperatures for North Baffin Island tend to be warmest in July and coldest in February.

At Milne Inlet, the lowest air temperature recorded during baseline conditions was -46.9°C in February 2008 compared to -40.2°C in February/March 2017. The highest air temperature recorded during baseline was 22.3°C in July 2009 compared to 16.3°C in July 2017.

At the Mine Site, the lowest air temperature recorded during baseline was -70.0°C in April 2010 compared to -40.2°C in February/March 2017. The highest air temperature recorded during baseline was 22.8°C in July 2009 and 11.0°C in September 1964. In 2017, the highest temperature recorded was 17.9°C in July.

Precipitation (Rainfall) — There were fewer days of rainfall and a lower total amount of rain in 2017 at Milne Inlet relative to baseline conditions, 2005–2010, while the number of rainfall days at Mary River in 2017 was somewhat average. The highest recorded rainfall in 2017 at Milne Inlet was also lower than baseline conditions, while maximum recorded rainfall at Mary River was comparable. Total rainfall recorded annually from 1963–1965 by Environment Canada at the Mary River meteorological station was lower than the 2017 amount at the Mine Site. In general, July and August tend to be the wettest months for North Baffin Island.

At Milne Inlet, the total number of days when rainfall was recorded during baseline conditions was 40 days in 2006, 25 days in 2007, and 26 days in 2008. Baseline rainfall data was not available for Milne Inlet in August 2009 and after March 4, 2010 to provide an accurate estimate for these years. In 2017, there were 21 days when rainfall was recorded. The highest recorded rainfall at Milne Inlet during baseline conditions was 7.4 mm in July 2008. This is somewhat higher than in 2017 where 4.8 mm of rain fell in July 2017. The total amount of rainfall recorded at the Milne Inlet weather station in 2017 was 54 mm.

At Mary River, the total number of days when rainfall was recorded during baseline conditions was 46 days in 2005, 53 days in 2006, 34 days in 2007, 27 days in 2008, and 51 days in 2009. Baseline rainfall data for Mary River was not available after July 7, 2010 to provide an accurate estimate for 2010. In 2017, there were 41 days when rainfall was recorded. The highest recorded rainfall at Mary River during baseline conditions, 2005–2010, was 5.3 mm in July 2007. This is similar to 2017 with 5.7 mm of rain falling in August 2017. The total amount of rainfall recorded at the Mary River weather station in 2017 was 159.5 mm. From 1963–1965

the highest amount of rainfall recorded in a single year at the Mary River meteorological station was 94.4 mm in 1964.

Wind Direction and Speed — Wind direction recorded in 2017 at Milne Inlet and Mary River was mostly consistent with baseline wind direction data, 2005–2010. In both 2017 and baseline conditions, the range in minimum and maximum wind speeds was variable from calm to gusting winds on the upper end of the Beaufort scale. Wind data was not recorded at the Environment Canada Mary River meteorological station, 1963–1965.

At Milne Inlet, wind direction data during baseline conditions is consistent with current wind direction data from the Baffinland weather station where prevailing north/northwest and south/southeast winds occur most frequently. The range in baseline minimum and maximum wind speeds was similar during baseline conditions and in 2017 with 0–29.5 m/s or 90 km/hr, which is considered "calm" to "storm" on the Beaufort scale. In 2017, a maximum wind speed of 24.9 m/s was recorded at Milne Inlet in September, October, and November. This is categorized as "storm" winds on the Beaufort scale, indicating strong, violent winds at Milne Inlet. Wind speed is recorded every hour at Baffinland weather stations and high winds indicating storm conditions are likely a result of gusting winds.

At the Mine Site, baseline wind direction data is mostly consistent with previously reported wind direction data from the Mary River weather station where prevailing south/southeast winds occur most frequently, followed by strong north winds. The range in baseline minimum and maximum wind speed was similar during baseline conditions to 2017.

2.2.1.2 Vehicle Transits on the Tote Road

The numbers of ore haul trucks per day remained relatively steady in 2017, with an average number of 195.9 ore haul transits per day (Figure 1). The only month where the number of ore transits was decreased was May, when the average number of ore haul transits decreased to 116 transits/day (58 ore loads); ore transits began to decrease mid-May and remained depressed until the first week of June. This decrease is noted each year and coincides with spring melt conditions which result in road closures for haul trucks, traffic is restricted to only light vehicles during the warmest hours of the day or closed to all traffic for hours/days based on melt conditions.

The average annual number of ore haul truck transits slightly exceeded the projected maximum haul truck transits (152 ore haul transits per day, as per Volume 3, Appendix 3B, Baffinland Iron Mines Corporation 2013). Other non-haul truck traffic had an annual average of 32.3 vehicle transits per day, with the highest number of transits occurring in September.

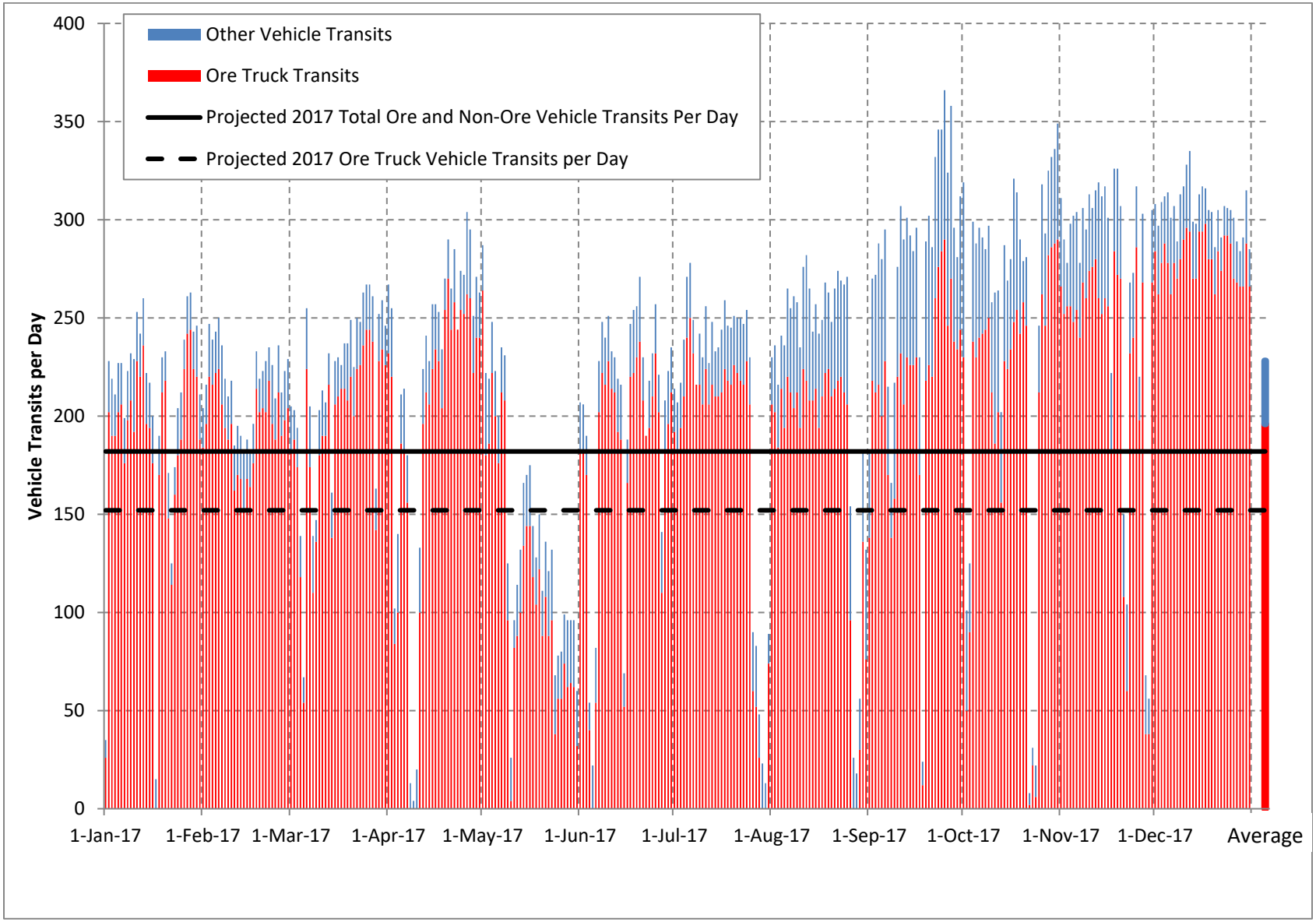


Figure 1 **Vehicle transits per day on the Tote Road, including both full ore trucks (red), and all other traffic (blue) through 2017.** *Also included is the projected maximum number of vehicle passes per day on the Tote Road, and the projected maximum number of Ore Haul Trucks per day on the Tote Road.*

2.2.1.3 Dust Fall Suppression in 2017

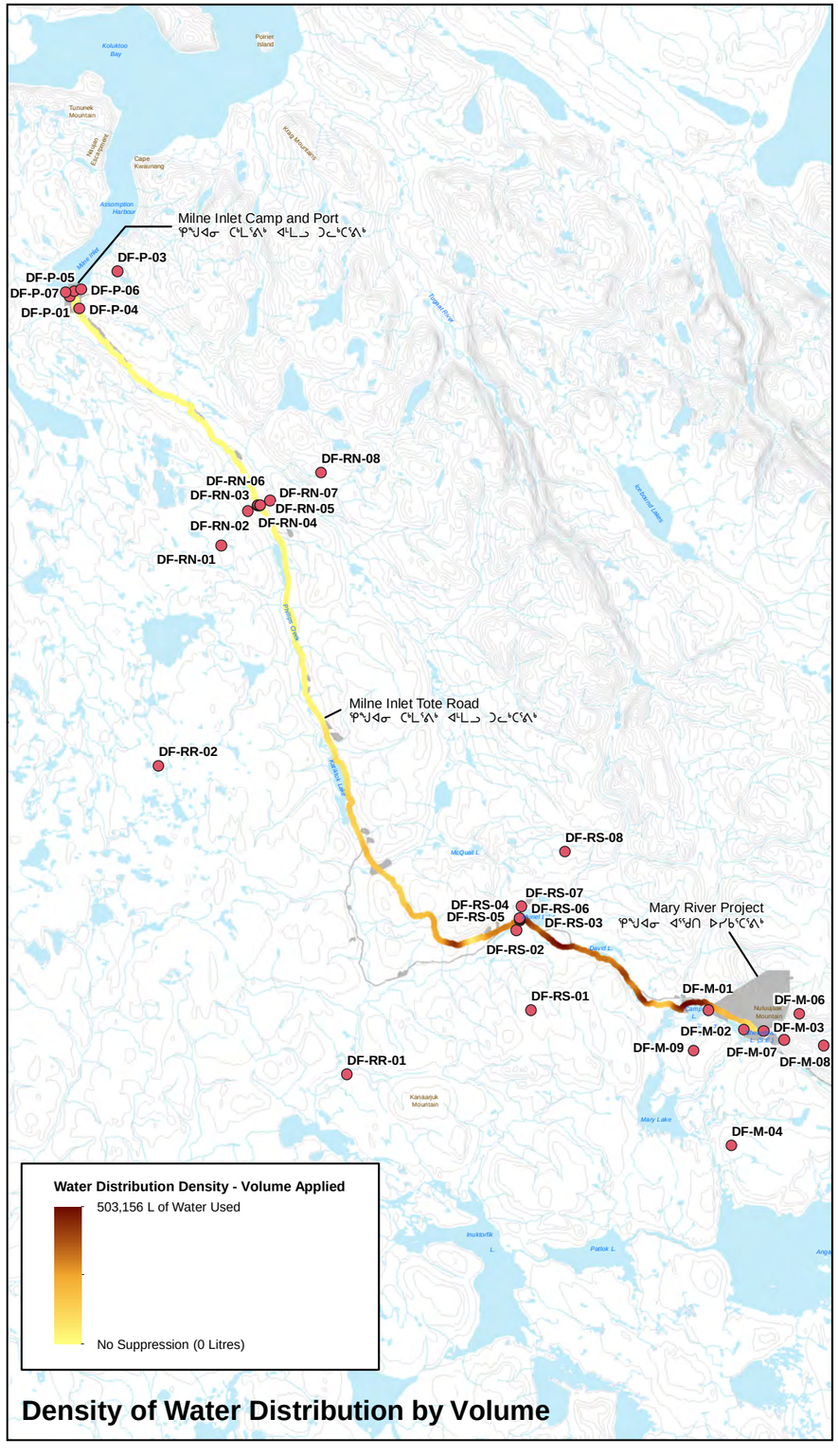
Water and calcium chloride were used for dust suppression throughout the Project area from July 6 through August 25, except for Milne Port, where there was no dust suppression. Water was used to suppress dust fall on Project areas including the Tote Road, the Mine Site and the Mine Haul Road. It was used on 13 events in the Mine Site area, 58 events along the Mine Haul Road, 467 events along the northern half of the Tote Road, and 25 events along the southern half of the Tote Road (Table 4; Map 2). The total amount of water used in each area was 393.7 m^3 in the Mine Site area, 4898.3 m^3 along the Mine Haul Road, 13,728.6 m^3 along the North Tote Road, and 567.8 m^3 along the South Tote Road.

Calcium chloride was used only along the Tote Road. Along the North Tote Road there were 11 events where calcium chloride was spread, with an average of 2,630.9 kg per event, for a total of 28,940 kg used. Along the South Tote Road there were 17 events where calcium chloride was spread with an average of 3,188.2 kg per event, for a total of 54,200 kg used (Table 4; Map 3).

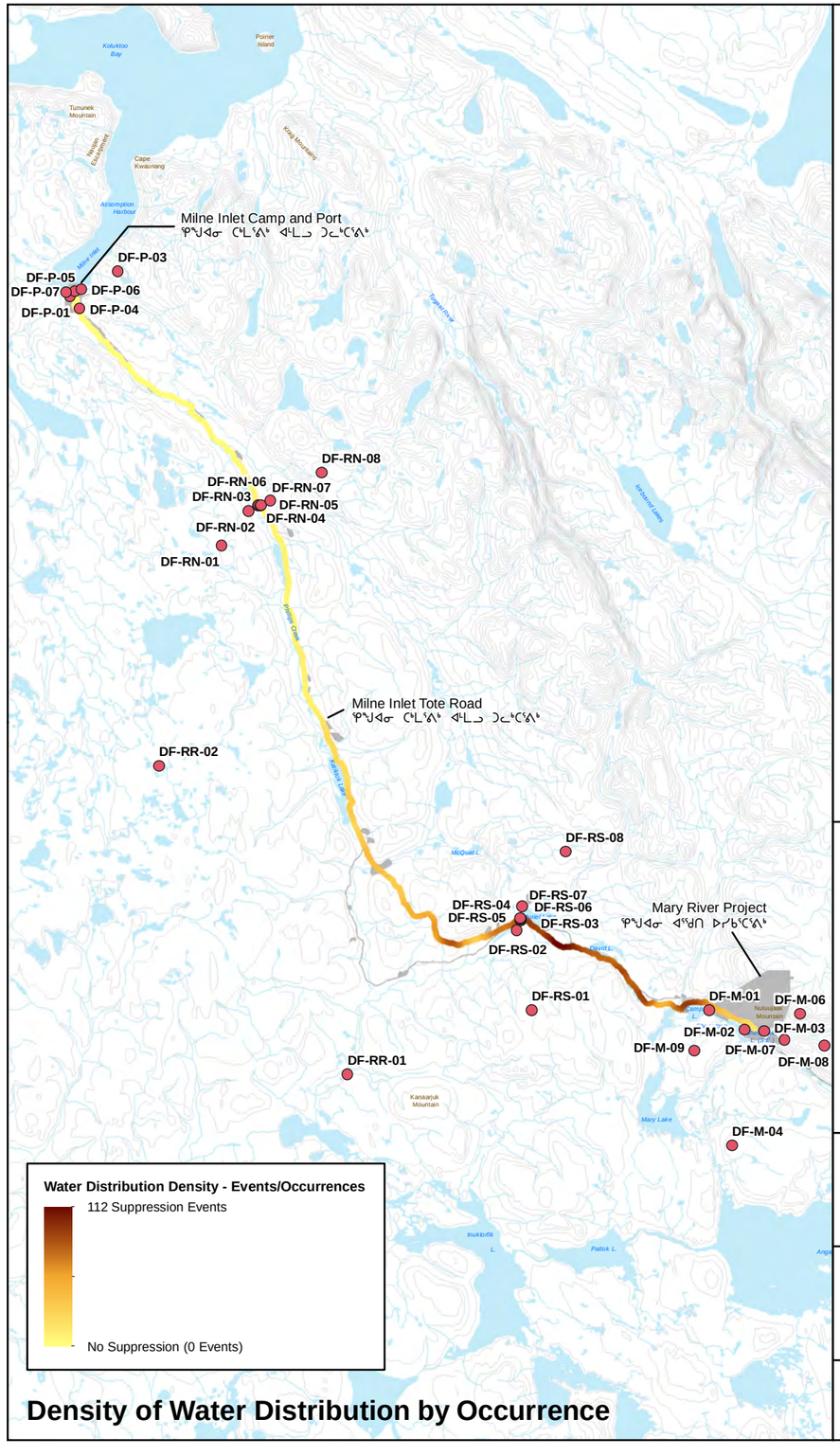
Table 4 Summary of dust fall suppression activities, summer 2017.

Area	Type of Dust Suppression	Number of Application Events[1]	Average Quantity of Suppressant per Event	Total Quantity of Suppressant Used
Mine Site	Calcium Chloride	0	–	–
	Water	13	30.3 m^3	393.7 m^3
Mine Haul Road	Calcium Chloride	0	–	–
	Water	58	84.5 m^3	4898.3 m^3
Milne Port	Calcium Chloride	0	–	–
	Water	0	–	–
North Tote Road	Calcium Chloride	11	2630.9 kg	28,940 kg
	Water	467	29.4 m^3	13,728.6 m^3
South Tote Road	Calcium Chloride	17	3188.2 kg	54,200 kg
	Water	25	22.7 m^3	567.8 m^3

[1] 'Events' refers to each truck carrying either calcium chloride or water for dust suppression activities; there may be more than one event per day.



Density of Water Distribution by Volume



Density of Water Distribution by Occurrence



LEGEND ↄᑭᑘᓴᖓᑦ

- Dust Fall Monitoring Site
- Potential Development Area
- Regional Study Area

NOTES ᖃᐅᔨᒪᓴᕐᕋᔭᐃᓚᐅᑦ

Map Projection: North American Datum UTM Zone 17N.

PDA provided by KP, July 11, 2017.

Suppression data provided by Baffinland Iron Mines (October 2017). Data includes suppression events from June to August, 2017.

This document is not an official land survey and the spatial data presented is subject to change without notice.

Scale ᐊᑭᓕᖅᓴᖅ 0 2.75 5.5 11 16.5 22 27.5 Km ᑭᒪᑐᐃᓐᓇᖅ

Baffinland

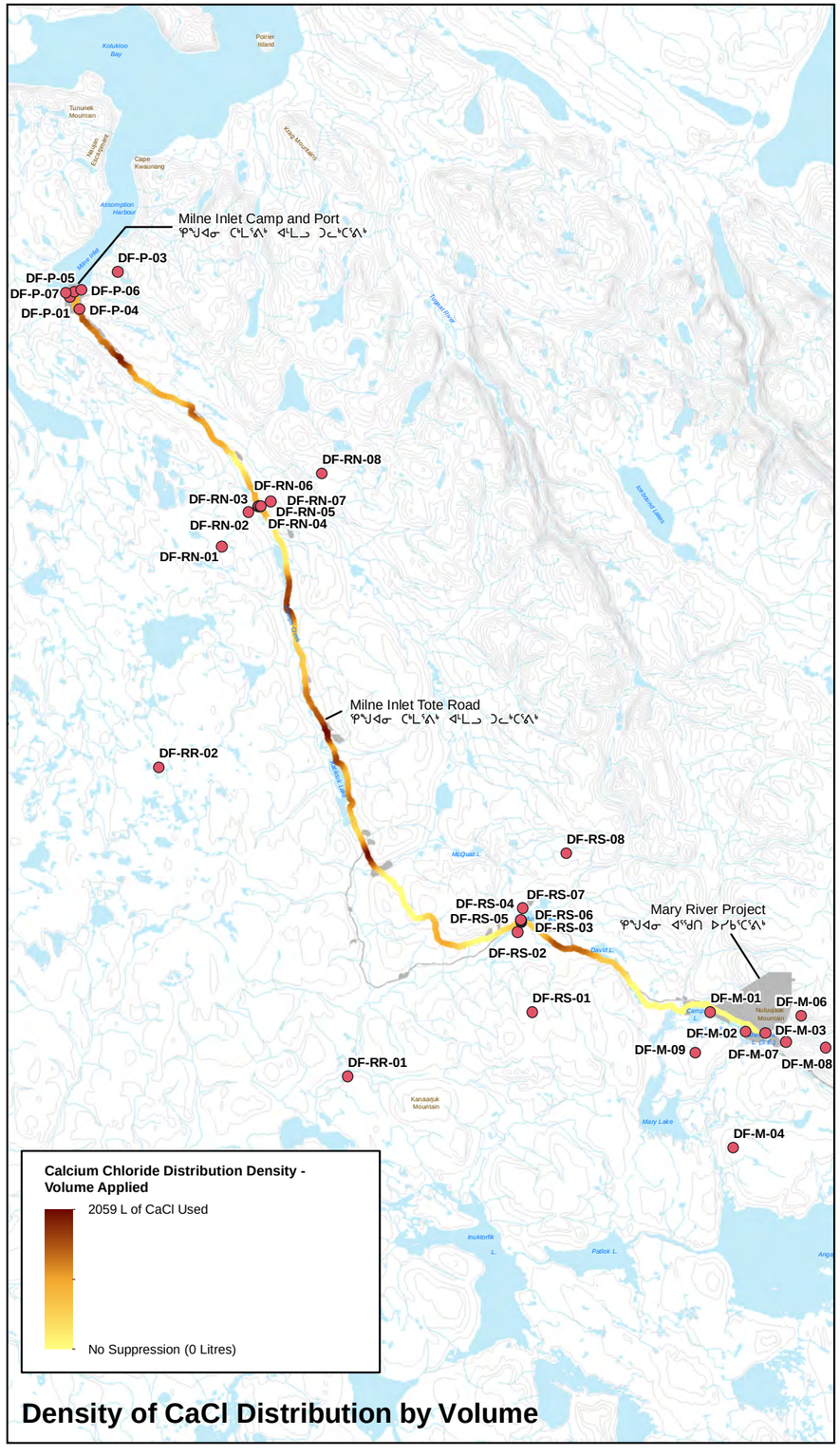
Dust Fall Suppression Using Water Along the Tote Road

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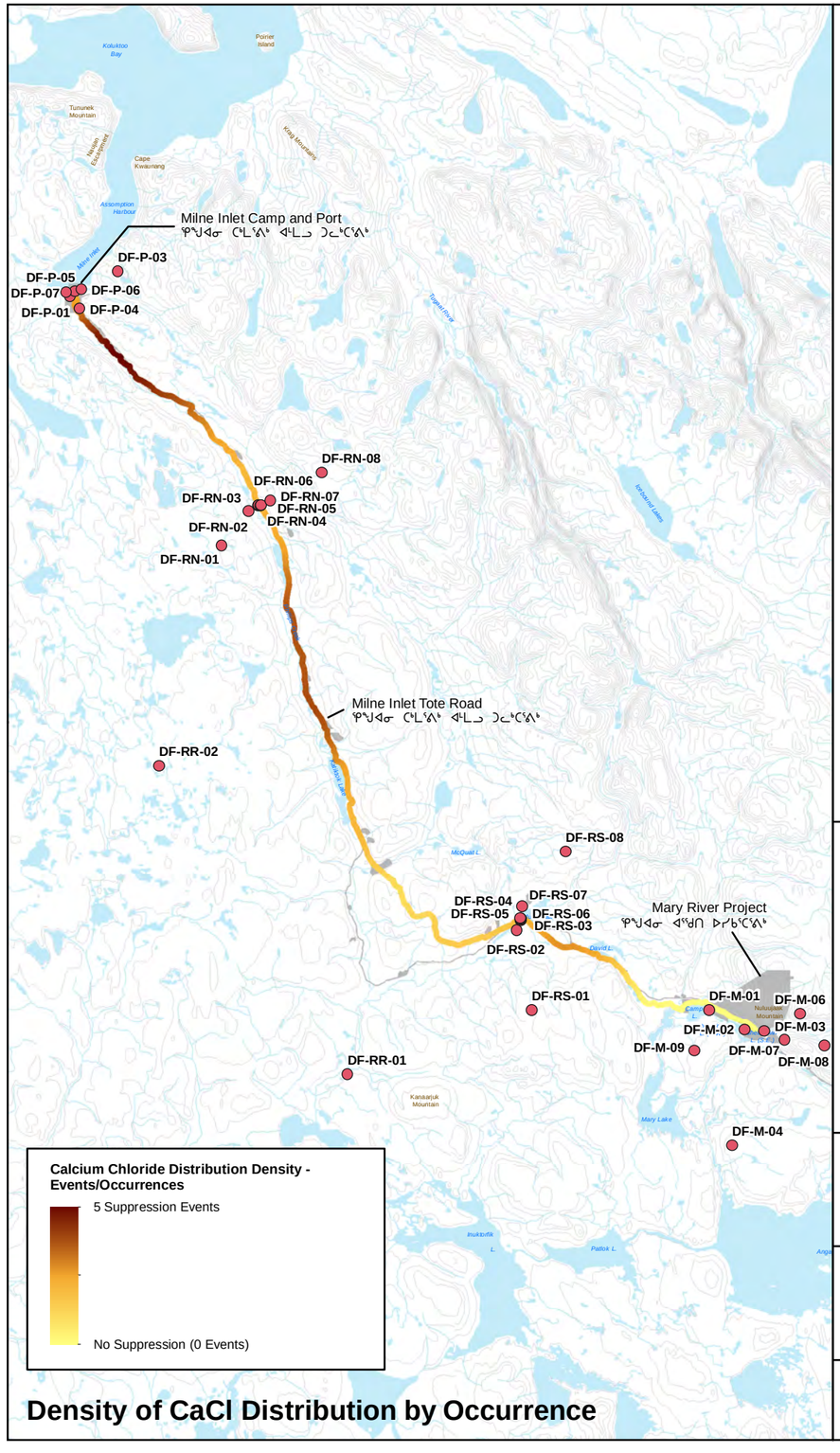
Date: 1/17/2018

Map 2

Path: O:\201711.7Y0152_BIM_Monitoring\GIS\Final\Map2_Water_Supp.mxd



Density of CaCl Distribution by Volume



Density of CaCl Distribution by Occurrence



LEGEND ↄᑭᑘᓴᖓᑦ

- Dust Fall Monitoring Site
- Potential Development Area
- Regional Study Area

NOTES ᖃᐅᔨᒪᓴᕐᓂᐊᕐᑦ

Map Projection: North American Datum UTM Zone 17N.

PDA provided by KP, July 11, 2017.

Suppression data provided by Baffinland Iron Mines (October 2017). Data includes suppression events from June to August, 2017.

This document is not an official land survey and the spatial data presented is subject to change without notice.

0 2.75 5.5 11 16.5 22 27.5
Scale ᐊᑕᓂᖅ Km ᑭᒥᑦ

Baffinland Iron Mines Corporation

Dust Fall Suppression Using Calcium Chloride Along the Tote Road

EDI

Date: 1/17/2018

MAP 3

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2.2.2 MAGNITUDE AND EXTENT OF 2017 DUST FALL

Mine Site — The 2017 monitoring included nine dust fall samplers associated with the Mine Site – three within the mine footprint (Near sites), four outside the mine footprint but within the five kilometre buffer (Far sites), and two reference sites located more than 5 km from the Mine Site (Table 2). The highest recorded dust fall at the Mine Site was at sample site DF-M-01, located near the weather station (Map 1); deposition rates ranged from below detection (<0.10 mg/dm²·day) in February 2017 to a high of 41.50 mg/dm²·day in December 2017 (Table 5). At DF-M-02, located between the airstrip and the land fill site, the dust deposition rates ranged from 0.22 mg/dm²·day to 10.50 mg/dm²·day. At site DF-M-03, located just south of the mine haul road, the dust fall deposition rates ranged from 0.19 mg/dm²·day to a high of 5.04 mg/dm²·day. Elevated dust fall in late November/early December 2017 is believed to be associated with a crusher that was operated in the QMR2 quarry from November 24, 2017 through December 7, 2017; it was observed to create a dust cloud when operating.

Sites DF-M-06, -07, -08, and -09, all located outside the mine footprint but within 5 km radius, are sampled only during the summer months (June, July and August). Dust fall recorded at these stations was generally below detection (Table 5); the only exceptions were in the samples collected at DF-M-07 and DF-M-09, both in July 2017 with dust fall levels of 0.13 and 0.19 mg/dm²·day, respectively. Dust fall deposition rates at both Mine Site reference locations (DF-M-04 and DF-M-05) were below detection in all samples collected (sampled only during summer months).

There was strong evidence of differences in distance class for mine sites, i.e., Near compared with Far sites ($p < 0.001$; Figure 2). Median daily dust fall was highest in the Near distance class at 0.9 (CI = 0.6 – 1.5) mg/dm²·day, this was 8.9 (CI = 4.9 – 16.0) times higher than the other two distances classes ($p < 0.001$). There was no difference in dust fall between the Far and Reference distance classes ($p = 0.97$), where daily dust fall was less than 0.1 (CI = 0.1 – 0.2) and 0.1 (CI = 0.1 – 0.2) mg/dm²·day, respectively.

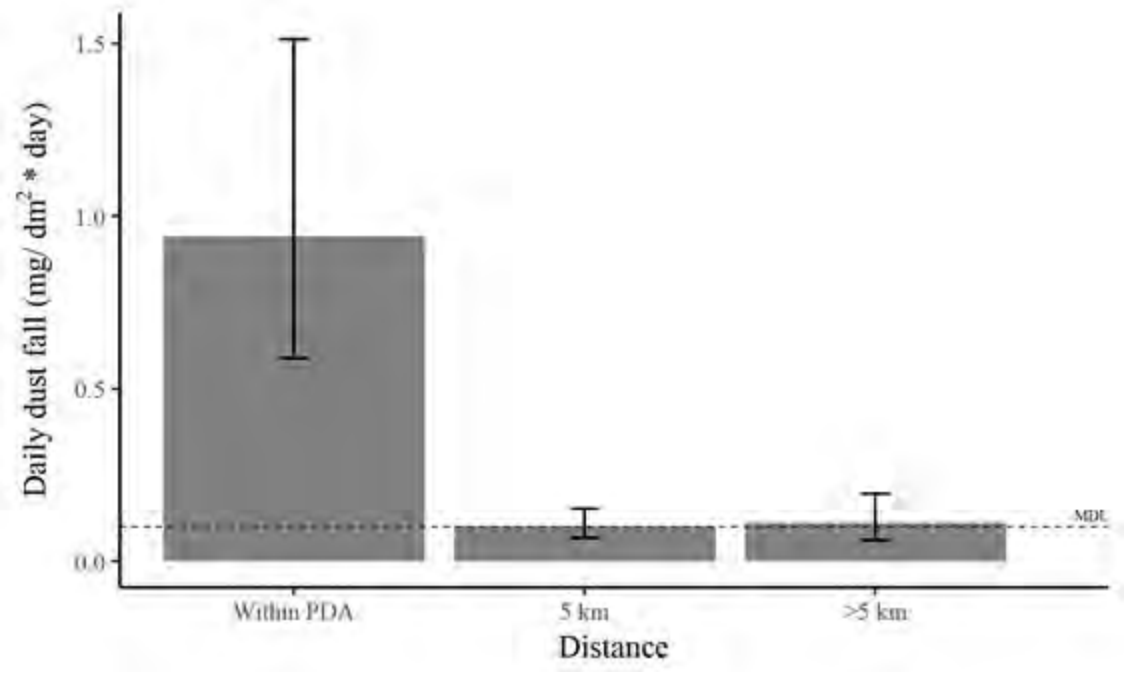


Figure 2 Median daily dust fall (mg/dm²·day) for mine sites by distance class. Bar heights show median daily dust fall with 95% confidence intervals. *The dashed horizontal line indicates the minimum detection limit (MDL) for dust samples.*

Milne Port — Six dust fall samplers were associated with Milne Port in 2017 (Table 2, Map 1); five active sites on the port footprint; DF-P-5 replaced DF-P-2 and one reference site located northeast of the port site. Dust fall deposition rates at Milne Port were highest at DF-P-01, where dust fall ranged from 0.22 mg/dm²·day to 19.60 mg/dm²·day in December. Dust fall at DF-P-05 ranged from 0.36 mg/dm²·day to 4.84 mg/dm²·day (Table 5). Dust fall data collected at sites DF-P-04, -06 and -07 were all low, exceeding 1.0 mg/dm²·day only during the November sampling period when dust fall at DF-P-04 and -06 was 1.64 and 1.82 mg/dm²·day, respectively. Dust fall deposition rates at the Milne Port reference site, DF-03-P, which is sampled only in summer months were below detection in all samples. Elevated dust fall in November and December 2017 at DF-P-01 and -05 is believed to be associated with ore stackers on the Milne Port ore pad, which were producing dust clouds that were depositing on snow over a distance of one kilometre coupled with wind speed gusts between 10 and 25 m/s.



Photo 1 Dust cloud blowing off the ore stacker at Milne Inlet Port, November 21, 2017 (photo courtesy of BIM).

Tote Road Crossings — Eighteen dust fall samplers were associated with the Tote Road; eight at each of two sample sites consisting of transects perpendicular to the road (the North crossing site and South crossing site), and two reference samplers are located approximately 14 km from the road.

North Crossing — As at the North Crossing, dust fall was highest at the sample station nearest the centerline on the south side of the Tote Road (DF-RN-04) with dust fall that ranged from 1.24 mg/dm²·day to 51.10 mg/dm²·day. On the north side of the road (DF-RN-05) the dust fall ranged from 0.28 mg/dm²·day to 8.79 mg/dm²·day. Dust fall decreased with distance from the centerline, and dust fall at DF-RN-03 and DF-RN-06 ranged from below detection (<0.10 mg/dm²·day) to 5.05 mg/dm²·day, and from below detection to 2.96 mg/dm²·day, respectively. Dust fall in samples collect during the summer season at the farthest sites (DF-RN-01, -02, -07 and -08) were all low, below 0.20 mg/dm²·day (Table 5).

There was strong evidence of an effect of distance from the north road on daily dust fall ($p < 0.005$; Figure 3). Median daily dust fall was highest in the 30 m distance class at 4.5 (CI = 2.2 – 9.5) mg/dm²·day, this was 42.4 times higher than the 1,000 m and 5,000 m distance classes ($p < 0.001$). There was suggestive evidence ($p = 0.07$) that dust fall in the 30 m distance class was 3.6 (CI = 1.3 – 10.1) times higher than the 100 m distance class. Daily dust fall in the 100 m distance class was 1.3 (CI = 0.6 – 2.6) mg/dm²·day, which was also higher than the two farther distance classes ($p < 0.001$). There was no difference in dust fall between the 1,000 m and 5,000 m distance classes ($p = 0.99$), where daily dust fall was than 0.1 (CI = 0.1 – 0.2) and 0.1 (CI = 0.1 – 0.2) mg/dm²·day, respectively.

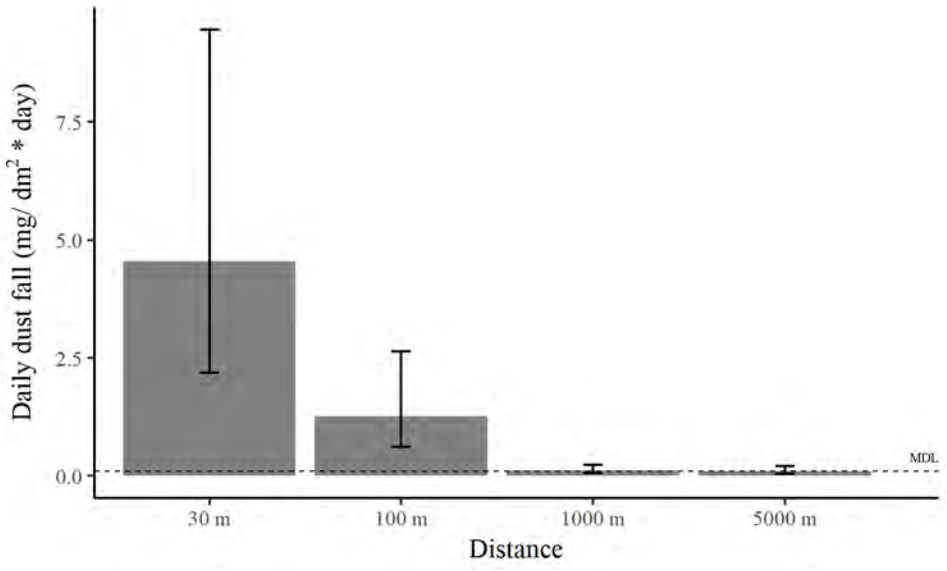


Figure 3. Median daily dust fall (mg/dm²·day) for north road sites as a function of distance from the tote road. Bar heights show median daily dust fall with 95% confidence intervals. *The dashed horizontal line indicates the minimum detection limit (MDL) for dust samples.*

South Crossing — Dust fall was highest at the sample station nearest the centerline on the south side of the Tote Road (DF-RS-04) with dust fall that ranged from 0.12 mg/dm²·day to 41.50 mg/dm²·day. On the north side of the road (DF-RS-05) the dust fall ranged from below detection (<0.10 mg/dm²·day) to 33.00 mg/dm²·day Dust fall decreased with distance from the centerline, and dust fall at DF-RS-03 and DF-RS-06 ranged from below detection to 6.91 mg/dm²·day and from below detection to 3.46 mg/dm²·day, respectively. Dust fall in samples collected during the summer season at the farthest sites (DF-RS-01, -02, -07 and -08) were all low, below 1.0 mg/dm²·day (Table 5).

There was strong evidence of an effect of distance from the south road on daily dust fall ($p = 0.001$; Figure 4). Median daily dust fall was highest in the 30 m distance class at 10.1 (CI = 5.5 – 18.7) mg/dm²·day, this was significantly higher than all other distances classes ($p < 0.001$). Dust fall in the 30 m distance class was 5.5 (CI = 2.3 – 13.0) times higher than the 100 m distance class. Daily dust fall in the 100 m distance class was 1.8 (CI = 1.0 – 3.4) mg/dm²·day, which was 13.6 (CI = 6.5 – 28.6) times higher than the two farther distance classes ($p < 0.001$). There was no difference in dust fall between the 1000 m and 5000 m distance classes ($p = 0.49$), where daily dust fall was less than 0.2 (CI = 0.1 – 0.4) and 0.1 (CI = 0.1 – 0.2) mg/dm²·day, respectively.

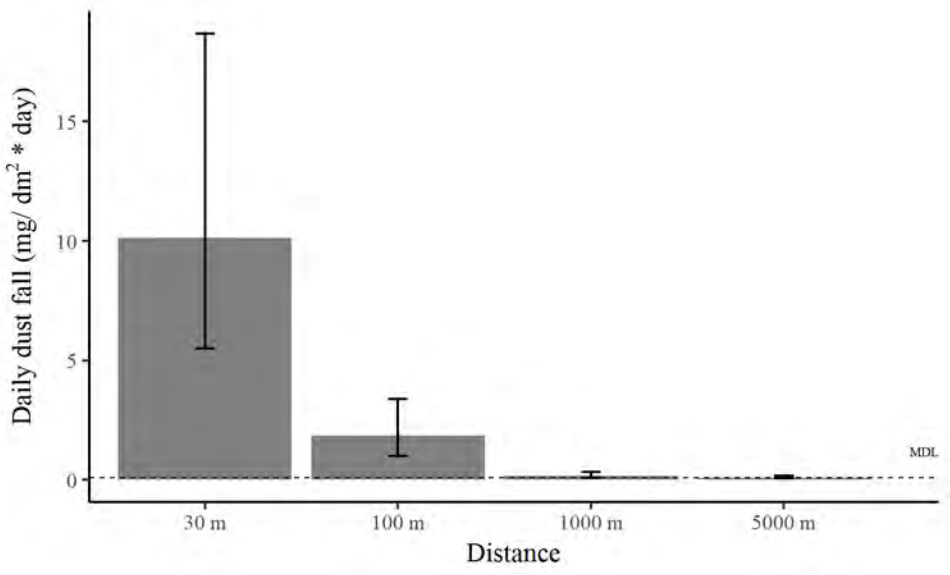


Figure 4. Median daily dust fall (mg/dm²·day) for south road sites as a function of distance from the tote road. Bar heights show median daily dust fall with 95% confidence intervals. *The dashed horizontal line indicates the minimum detection limit (MDL) for dust samples.*

Reference sites — Dust fall deposition rates at the two Tote Road reference sites (DF-RR-01 and DF-RR-02), which are sampled only in summer months were below lab detection in all samples (Table 5) and are not included in graphs such as Figure 4.

Table 5 Dust fall, as total suspended particulate matter (mg/dm²·day), collected at all sample sites during the 2017 monitoring year.

Site Name	Sample Collection Timing											
	January	February	March	April	May	June	July	August	September	October	November	December
DF-M-01	6.01	<0.10	0.89	1.53	9.89	2.46	5.48	0.40	0.20	2.84	0.87	41.50
DF-M-02	3.28	0.26	2.33	1.09	4.18	0.88	2.50	0.22	0.56	1.70	1.58	10.50
DF-M-03	0.89	0.19	1.51	1.02	3.86	1.74	5.04	0.95	1.21	2.65	0.81	2.87
DF-M-04	–	–	–	–	–	–	<0.10	<0.10	<0.10	–	–	–
DF-M-05	–	–	–	–	–	–	<0.10	<0.10	<0.10	–	–	–
DF-M-06	–	–	–	–	–	–	<0.10	<0.10	<0.10	–	–	–
DF-M-07	–	–	–	–	–	–	0.13	<0.10	<0.10	–	–	–
DF-M-08	–	–	–	–	–	–	<0.10	<0.10	<0.10	–	–	–
DF-M-09	–	–	–	–	–	–	0.19	<0.10	<0.10	–	–	–
DF-P-01	4.80	0.22	1.97	3.80	7.15	2.09	7.46	2.96	1.11	3.91	9.37	19.60
DF-P-03	–	–	–	–	–	–	<0.10	<0.10	<0.10	–	–	–
DF-P-04	<0.10	<0.10	<0.10	0.24	0.63	0.24	0.26	0.22	0.13	0.46	1.64	0.31
DF-P-05	1.70	0.36	1.95	1.15	3.25	1.77	1.70	1.31	0.94	3.37	2.59	4.84
DF-P-06	0.16	<0.10	0.19	0.26	0.39	0.21	0.11	<0.10	0.13	0.76	1.82	0.46
DF-P-07	0.48	<0.10	0.50	0.40	0.46	<0.10	0.84	0.24	0.16	0.81	0.68	7.40
DF-RN-01	–	–	–	–	–	–	<0.10	<0.10	<0.10	–	–	–
DF-RN-02	–	–	–	–	–	–	0.17	<0.10	<0.10	–	–	–
DF-RN-03	0.65	<0.10	0.34	0.80	2.82	1.24	5.05	2.03	0.23	1.39	0.46	1.01
DF-RN-04	10.40	1.33	14.30	–	5.88	13.8	51.10	6.85	1.24	8.48	3.58	8.53
DF-RN-05	2.70	0.28	1.09	2.87	6.47	7.60	8.79	2.70	1.05	4.24	1.80	1.00
DF-RN-06	1.12	<0.10	0.50	1.10	2.89	1.98	2.96	1.40	0.45	1.83	0.95	0.47
DF-RN-07	–	–	–	–	–	–	0.14	<0.10	<0.10	–	–	–
DF-RN-08	–	–	–	–	–	–	<0.10	<0.10	<0.10	–	–	–
DF-RS-01	–	–	–	–	–	–	<0.10	<0.10	<0.10	–	–	–
DF-RS-02	–	–	–	–	–	–	0.67	0.22	0.18	–	–	–
DF-RS-03	0.25	<0.10	0.11	0.38	2.75	3.85	6.91	1.08	1.37	2.88	0.22	0.31
DF–RS-04	1.05	0.12	0.34	1.37	11.90	41.50	40.60	9.06	9.15	22.10	1.02	0.57
DF-RS-05	1.04	<0.10	0.30	1.33	12.00	33.00	17.40	7.42	2.39	5.27	0.73	0.81
DF-RS-06	0.27	<0.10	0.13	0.51	4.14	5.36	3.46	1.73	0.67	1.37	0.25	0.40
DF-RS-07	–	–	–	–	–	–	0.13	0.12	<0.10	–	–	–
DF-RS-08	–	–	–	–	–	–	<0.10	<0.10	<0.10	–	–	–
DF-RR-01	–	–	–	–	–	–	<0.10	<0.10	<0.10	–	–	–
DF-RR-02	–	–	–	–	–	–	<0.10	<0.10	<0.10	–	–	–

2.2.3 SEASONAL COMPARISONS OF 2017 DUST FALL

Seasonal variations in dust fall in all Project areas were investigated as per the dust fall monitoring objectives.

Mine Site — The effect of season on dust fall differed among Mine site sample stations during the 2017 summer season, but not the winter. There was significant evidence of an interaction between season and sample site for the mine sites during the summer season ($p = 0.006$) (Figure 5). Dust fall at DF-M-03 in summer was 3.4 (CI = 1.4 – 8.3) times higher than DF-M-02 in summer. There were no significant differences among sites in winter.

Milne Inlet Port — There was no support for a seasonal effect ($p = 0.95$) or an interaction between season and sample site in the Milne Port area ($p = 0.24$). There was, however strong evidence of a difference in dust fall among sample sites for the Milne Port ($p < 0.001$; Figure 6). DF-P-01 and DF-P0-5 had significantly higher median daily dust fall than the other three sites ($p < 0.001$), a trend that was present in both summer and winter sampling periods.

North Crossing — There was no evidence of an interaction between sample site and season for the north road sampling area ($p = 0.45$). There was evidence of seasonal differences in dust fall for the north road sites ($p = 0.50$; Figure 7). There was a significant difference among sample sites ($p < 0.001$). After accounting for seasonal effects, median daily dust fall at DF-RN-04 was 3.4 (CI = 2.6 – 4.5) times higher than DF-RN-05 ($p < 0.001$), and DF-RN-05 was 2.3 (CI = 1.9 – 2.9) higher than the other two north road sites ($p < 0.001$).

South Crossing —There was suggestive evidence of an interaction between sample site and season for the south road sampling area ($p = 0.08$; Figure 8); dust fall in summer was significantly greater than dust fall in winter ($p < 0.001$). Dust fall at site DF-RS-04 was 7.4 (CI = 1.1 – 47.9) times higher in summer than in winter ($p = 0.04$). After accounting for season, DF-RS-04 was 1.7 (CI = 1.1 – 2.6) times higher than DF-RS-05 ($p = 0.07$), and DF-RS-05 was 3.2 (CI = 2.2 – 4.7) times higher than the other two sites ($p < 0.001$).

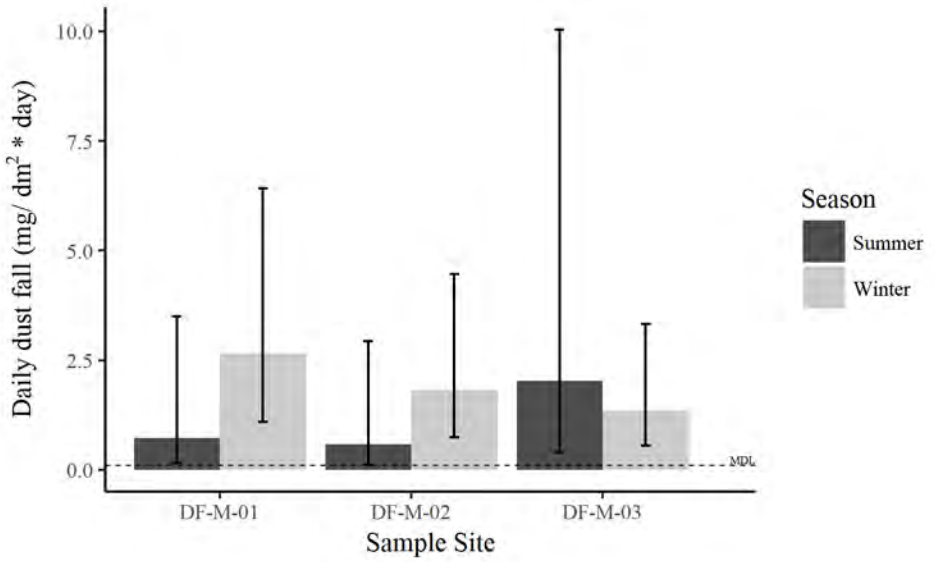


Figure 5 **Median daily dust fall by site and season for the mine site sampling sites. Bar heights show median daily dust fall with 95% confidence intervals.** *The dashed horizontal line indicates the minimum detection limit (MDL) for dust samples.*

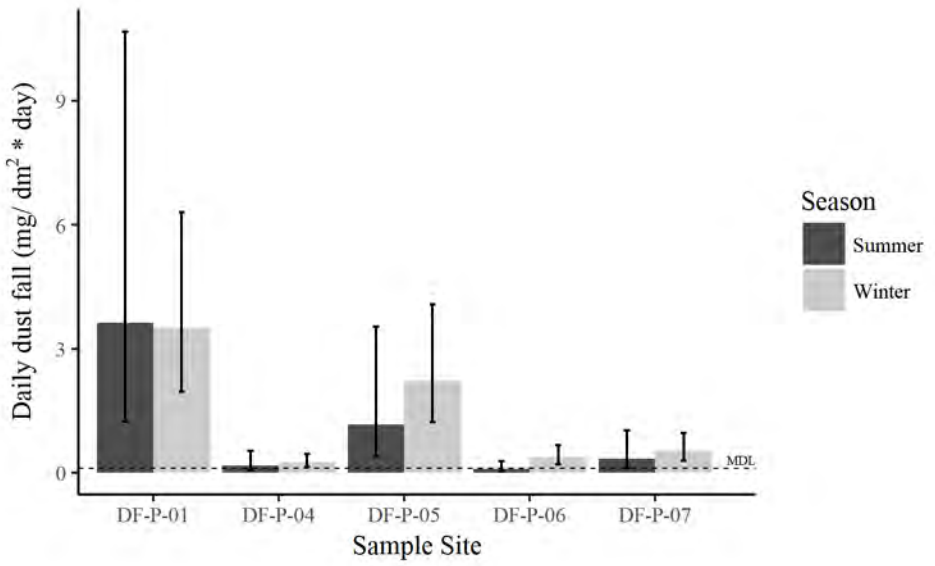


Figure 6 **Median daily dust fall by site and season for the Milne Inlet Port sampling sites. Bar heights show median daily dust fall with 95% confidence intervals.** *The dashed horizontal line indicates the minimum detection limit (MDL) for dust samples.*

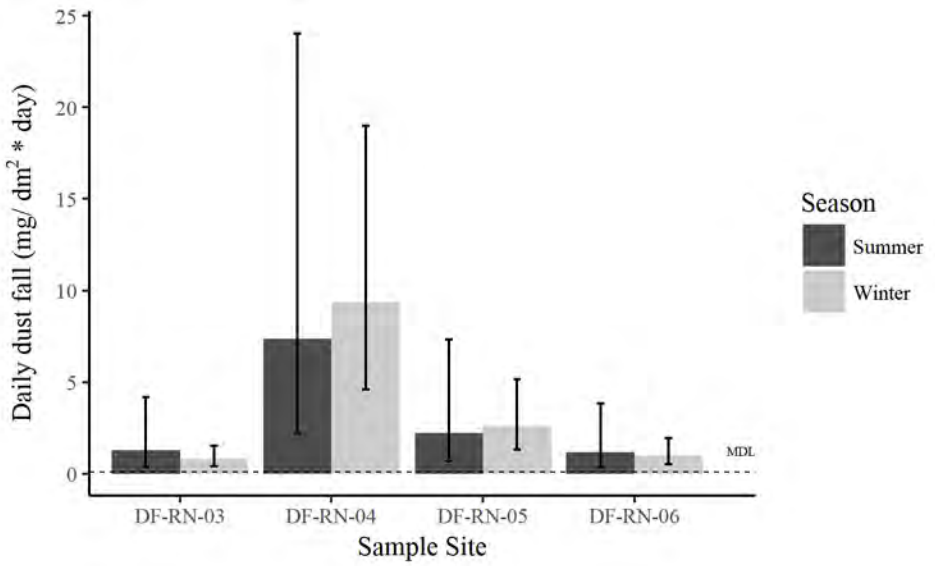


Figure 7 **Median daily dust fall by site and season for the Road North sampling sites. Bar heights show median daily dust fall with 95% confidence intervals.** *The dashed horizontal line indicates the minimum detection limit (MDL) for dust samples.*

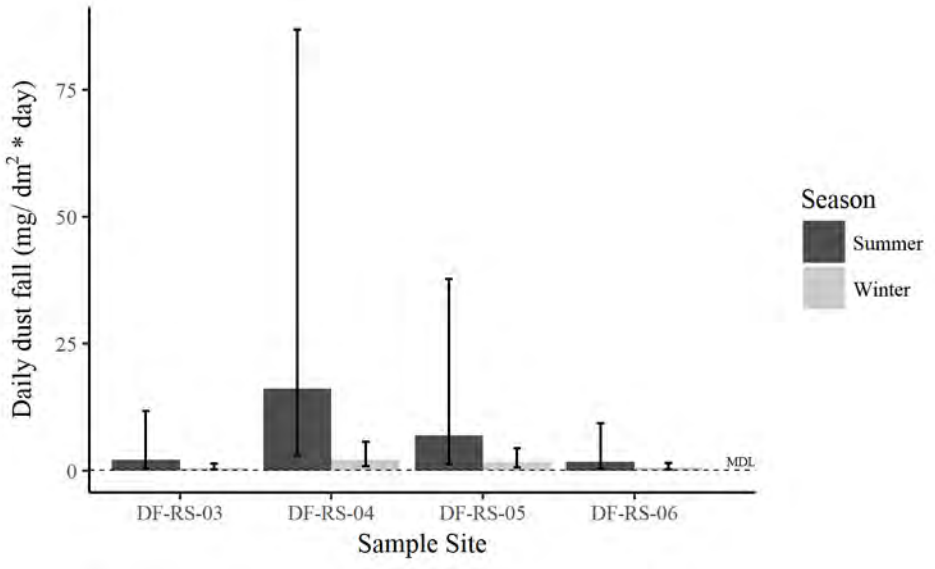


Figure 8 **Median daily dust fall by site and season for the Road South sampling sites. Bar heights show median daily dust fall with 95% confidence intervals.** *The dashed horizontal line indicates the minimum detection limit (MDL) for dust samples.*

2.2.4 ANNUAL DUST FALL

Total annual dust fall was reviewed at all sites that were sampled year-round for the 2017 calendar year; data presented here is from December 20, 2016 through December 10, 2017. Sites in the nil and low isopleth zones were not sampled during winter months when helicopter access was unavailable; therefore, annual accumulation was not estimated for these sites. However, very low dust fall accumulation, generally below laboratory detection, was observed at these sites during the summer months.

Annual dust fall in samplers at the Mine Site were all predicted to be in the 'high' isopleth (≥ 50 g/m²/year). Dust fall from sample locations DF-M-01, -02, and -03 all indicated annual dust fall that was greater than 50 g/m²/year, with the highest dust fall at site DF-M-01 (198.37 g/m²/year). Dust fall was less than 100 g/m²/year at sites DF-M-02 and -03 (Figure 9).

Year-round dust fall samplers at Milne Inlet Port sites DF-P-01 and -05 had annual dust fall deposition rates that were greater than 50 g/m²/year, though it is modelled to be in the moderate threshold. The total annual deposition rate at DF-P-01 and -05 were 186.68 g/m²/year and 71.70 g/m²/year, respectively (Table 6). Milne Port sites DF-P-04, -06 and -07 all fell into the moderate isopleth threshold with annual dust fall rates of 13.02, 13.58 and 34.03 g/m²/year, respectively; however, DF-P-04 and -06 were modelled to be in the low threshold (Figure 10).

Annual dust fall at the north and south Tote Road crossing locations within 100 m of the road centreline fell within the high isopleth, though they were modelled to fall into the moderate isopleth (Table 6). Dust fall at the sites located closest to the Tote Road centreline at both the north and south crossing transects was higher than observed at any sampling locations at Mine Site and Milne Inlet Port (Figure 11 and Figure 12).

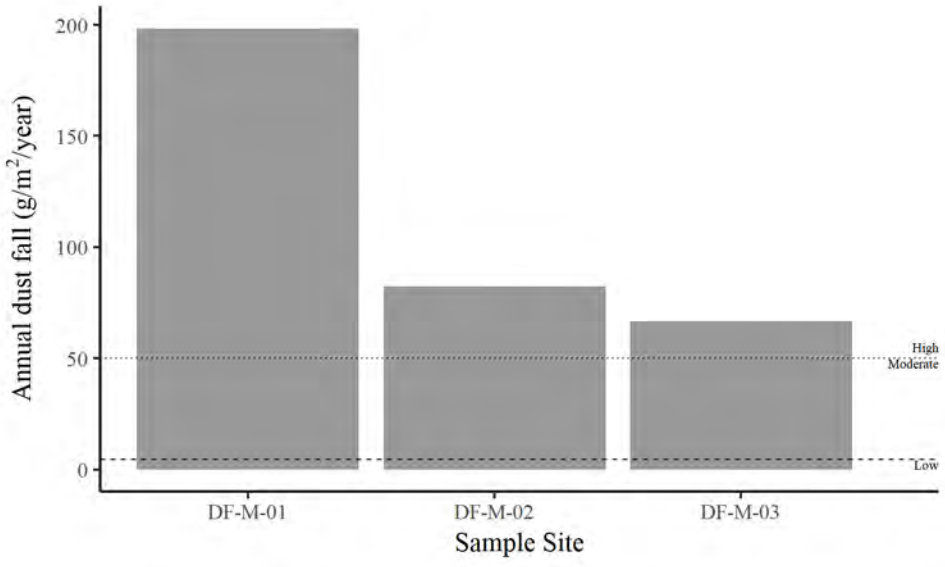


Figure 9 Mine Site annual dust fall for high isopleth sampling stations that were sampled year-round. *Dashed horizontal lines show low, moderate, and high dust isopleth threshold upper limits.*

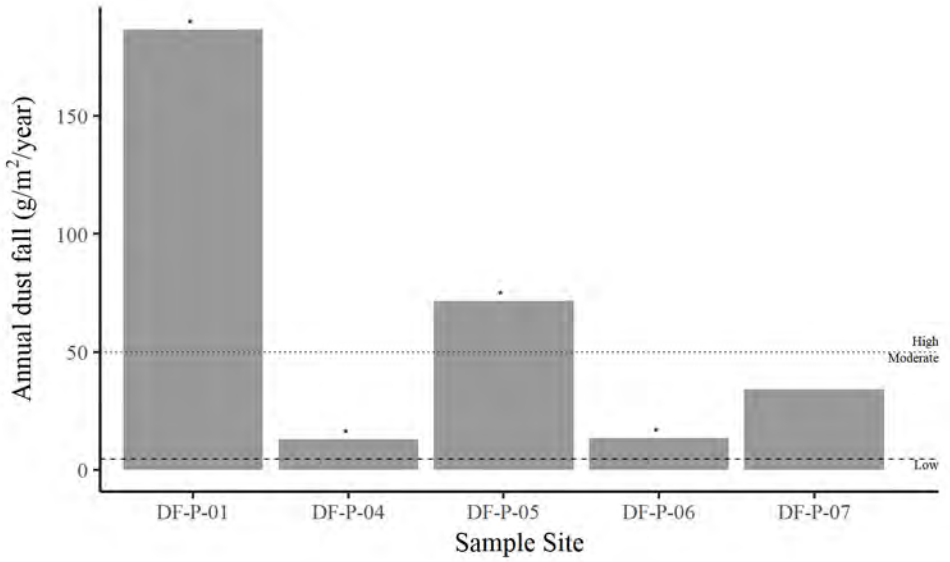


Figure 10 Milne Port annual dust fall for sampling stations that were sampled year-round. *Dashed horizontal lines show low, moderate, and high dust isopleth threshold upper limits. The asterisk (*) denotes that the annual dust fall was greater than projected by the predicted isopleth.*

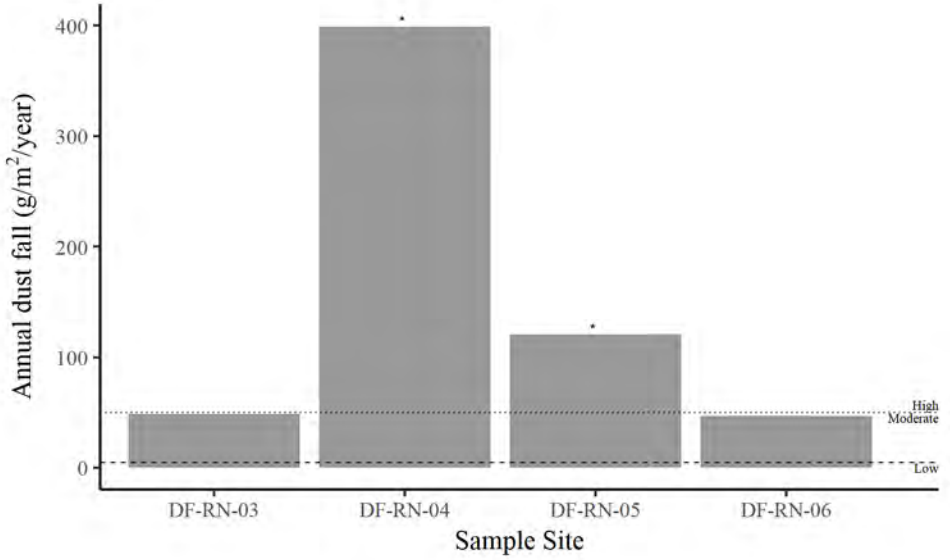


Figure 11 Tote Road north crossing annual dust fall for sampling stations that were sampled year-round. *Dashed horizontal lines show low, moderate, and high dust isopleth threshold upper limits. The asterisk (*) denotes that the annual dust fall was greater than projected by the predicted isopleth.*

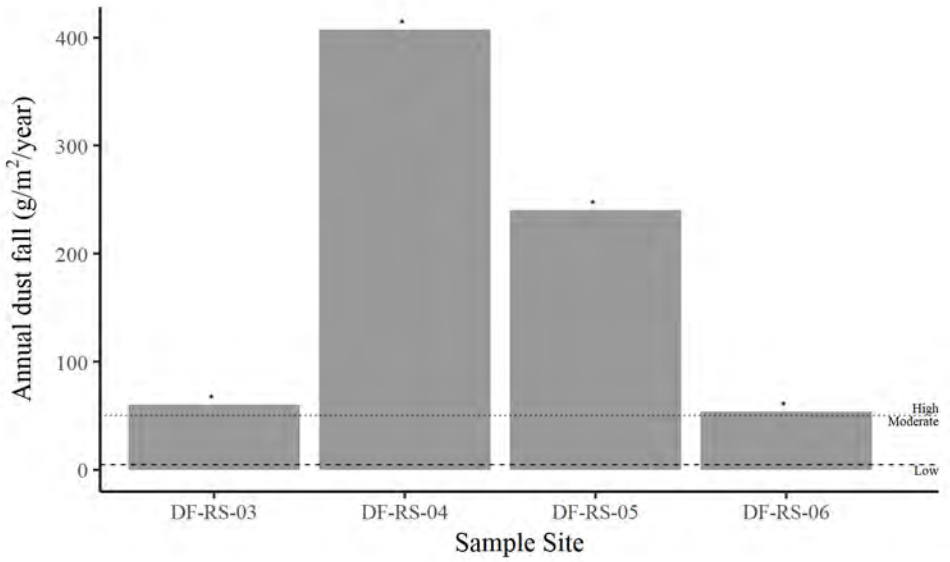


Figure 12 **Tote Road south crossing annual dust fall for sampling stations that were sampled year-round.**
Dashed horizontal lines show low, moderate, and high dust isopleth threshold upper limits. The asterisk (*) denotes that the annual dust fall was greater than projected by the predicted isopleth.

Table 6 **Annual dust fall accumulation for sites sampled throughout the year. Annual accumulations are reported for the period 20 Dec 2016 to 10 Dec 2017. Sample sites that exceeded the predicted annual dust fall are shaded.**

Site	Area	Distance	Threshold	Threshold Upper Limit	Annual Dust Fall [1] (g/m²/year)
DF-M-01	Mine Site	0	High	N/A[2]	198.37
DF-M-02	Mine Site	0	High	N/A	82.32
DF-M-03	Mine Site	0	High	N/A	66.83
DF-P-01	Milne Inlet Port	0	Moderate	50	186.68
DF-P-04	Milne Inlet Port	0	Low	4.5	13.02
DF-P-05	Milne Inlet Port	0	Moderate	50	71.70
DF-P-06	Milne Inlet Port	0	Low	4.5	13.58
DF-P-07	Milne Inlet Port	0	High	N/A	34.03
DF-RS-03	Road South	100	Moderate	50	60.29
DF-RS-04	Road South	30	Moderate	50	407.64
DF-RS-05	Road South	30	Moderate	50	240.38
DF-RS-06	Road South	100	Moderate	50	53.80
DF-RN-03	Road North	100	Moderate	50	48.43
DF-RN-04 [3]	Road North	30	Moderate	50	399.24
DF-RN-05	Road North	30	Moderate	50	120.73
DF-RN-06	Road North	100	Moderate	50	46.67

Notes:
[1] Total to date; figures will be updated for final report once all 2017 data has been collected.
[2] The 'high' threshold does not have an upper limit; sites modelled in the high threshold are predicted to have >50 g/m²/year of total suspended particulate matter (dust fall).
[3] one sample not collected for one month because collector was buried in snow.

Annual Dust Fall Trends

Year over year trends can be reviewed for all year-round monitoring stations. In general, dust fall across the Project area increased from 2014 through 2016 as mine production increased, however, 2016 and 2017 showed a levelling off in most sites, except DF-M-01, which was affected by crusher activities in late November/early December 2017 resulting in higher than expected dust fall.

Mine Site dust fall monitoring sites DF-M-02 and DF-M-03 saw a decrease in dust fall in 2017 compared with 2016, however, dust fall at site DF-M-01 indicated an steep increase over 2016 (Figure 13).

Milne Port dust fall monitoring sites DF-P-01 and DF-P-05 indicated a decrease in dust fall in 2017 when compared with 2016. Very slight increases or no change was noted at DF-P-04, -06 and -07 (Figure 13).

The Tote Road North dust fall monitoring station DF-RS-04 indicated an increase in dust fall in 2017 compared with 2016. All other sites at the Tote Road North crossing transect indicated a negligible change in dust fall in 2017 compared with 2016 (Figure 13). Dust fall suppression, particularly with water, was less in the area around the north crossing sampling locations when compared to the south (Map 2), which may be associated with the increase over 2016.

Tote Road South dust fall monitoring sites all indicated a decrease in dust fall in 2017 compared with 2016, particularly at sites DF-RS-04 and -05, which are closest to the road centreline (Figure 13). This decrease may be associated with effective dust suppression activities along this section of the Tote Road.

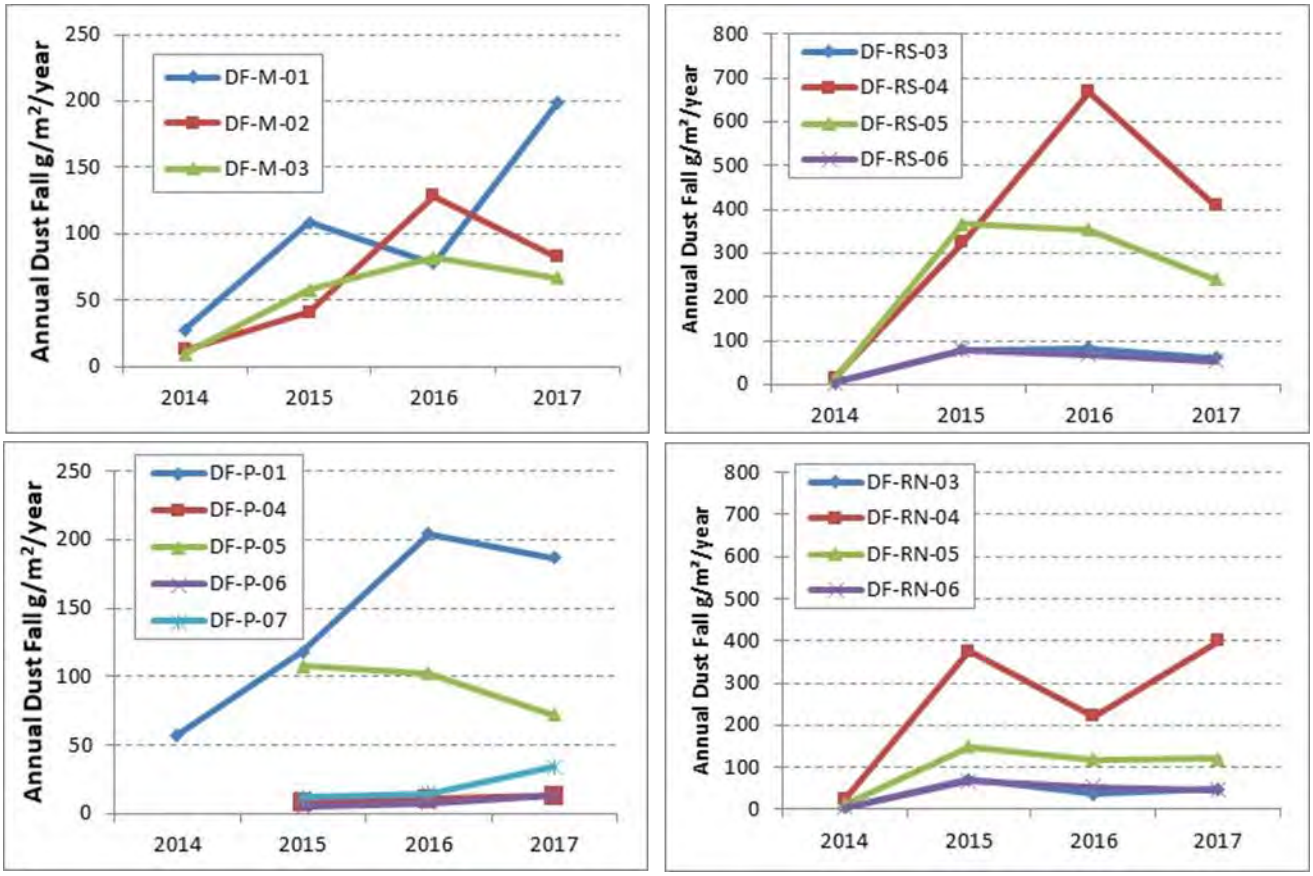


Figure 13 Annual dust fall trends throughout the Project area.

2.3 SUMMARY AND TRENDS

- Dust fall monitoring data is compared to predictions that were made in the FEIS and is valuable in the context of effects to other indicators including potential changes to vegetation and soil.
- Climate data collected in 2017 was compared with climate data collected as part of the project baseline data collection (2005–2010). Conditions were similar with regard to air temperature, but considerably drier in 2017 when compared to baseline data.
- The average number of vehicle passes on the Tote Road in all months regularly exceeded the projected maximum traffic volume; this vehicle activity is a contributor to dust fall as measured at both the south and north Tote Road crossing sample locations.
- Annual dust fall at the Mine Site sample locations currently falls within predicted levels and 2017 annual dust is less than was observed in 2016, except DF-M-01, which was affected by crusher activities in late November/early December 2017 resulting in higher than anticipated dust fall in those months given the dust fall in early winter in previous monitoring years.

GN 10 ATTACHMENT 3: DETAILED SUMMARY OF 2017 CONTINUOUS AMBIENT AIR QUALITY MONITORING RESULTS AT THE MARY RIVER MINE SITE AND THE MILNE INLET PORT SITE

Detailed Summary of 2017 Continuous Ambient Air Quality Monitoring Results at the Mary River Mine Site and the Milne Inlet Port Site

Notes

- Ambient monitoring shows “non-detect” at the Mary River site until November 3, 2017, when monitoring resumed at this location. Similarly, monitoring at the Milne location resumed on March 11, 2017. The maximum, minimum, and average concentrations of SO2 and NO2 for each month are presented and include all hours with numerical data.
- The highest average SO2 concentration occurred in November 2017. The hourly SO2 concentrations were plotted for November; the plot shows higher concentrations at the beginning of the month and decreasing after November 5.
- The highest average NO2 concentration occurred in December 2017. The hourly NO2 concentrations were plotted for December; the plot shows increasing NO2 concentrations as the month progresses.

Monthly Maximum, Minimum, and Average Concentrations of SO2 and NO2

SO2 - ppb - maximum

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mary	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.9	3.5
Milne	ND	ND	2.5	3.6	1.3	0.9	2.5	2.7	ND	2.3	3.5	2.2

NO2 - ppb - maximum

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mary	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	77.8	123.3
Milne	ND	ND	67.5	54.8	36.8	15.7	28.1	19.3	ND	65.7	77.8	105.8

SO2 - ppb - minimum

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mary	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Milne	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

NO2 - ppb - minimum

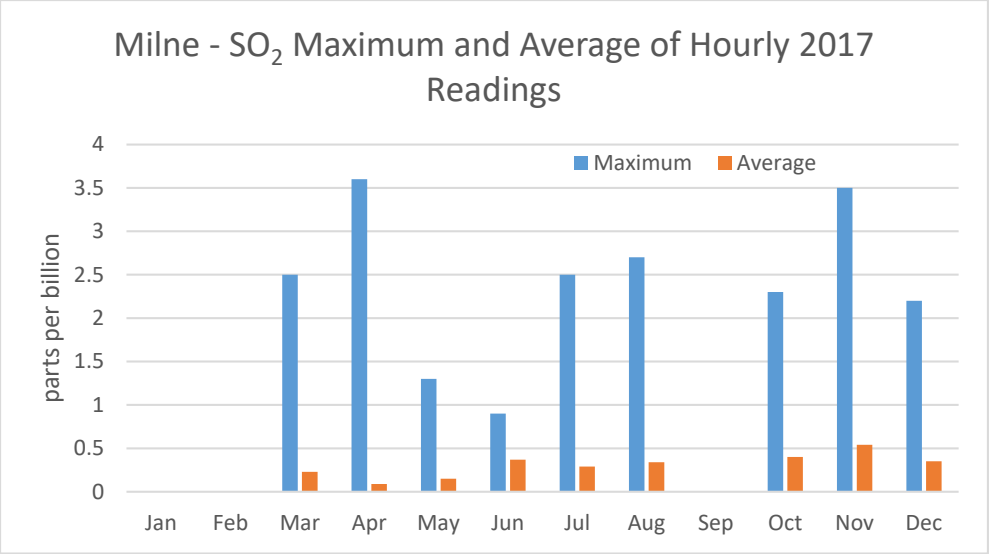
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mary	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.5
Milne	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.1	ND	ND

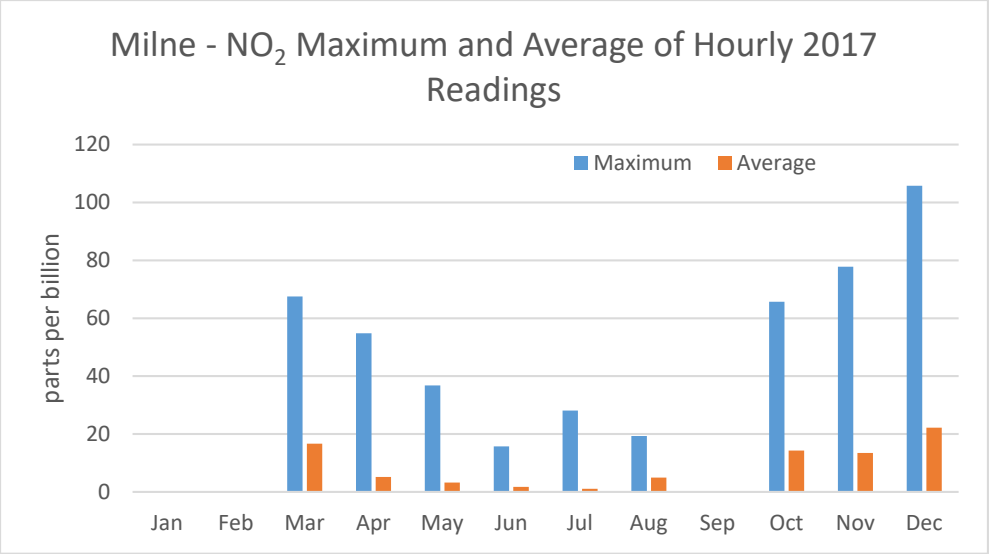
SO2 - ppb - average

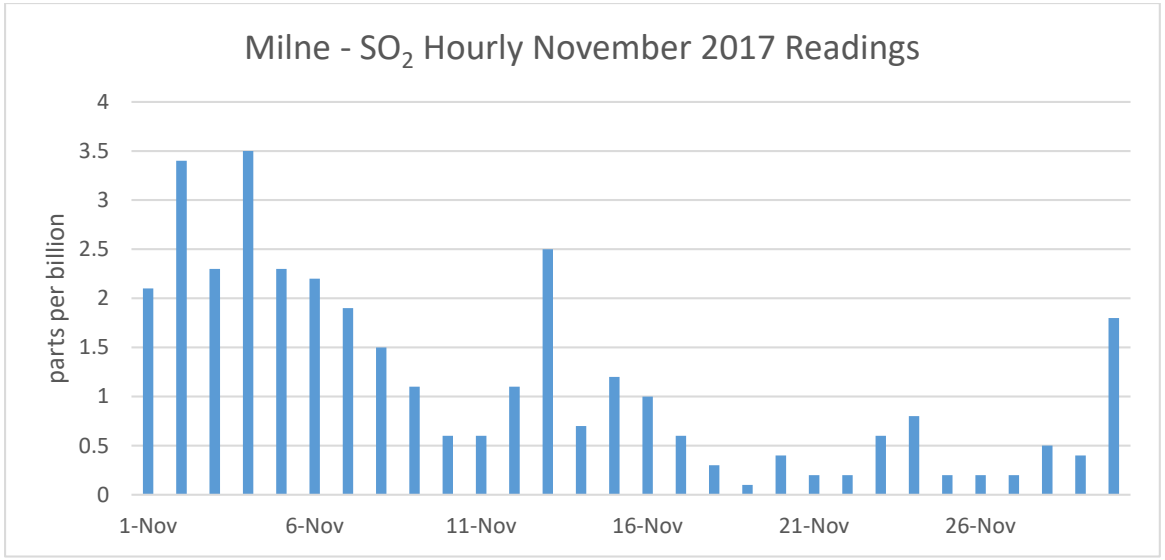
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mary	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.22	0.57
Milne	ND	ND	0.23	0.09	0.15	0.37	0.29	0.34	ND	0.4	0.54	0.35

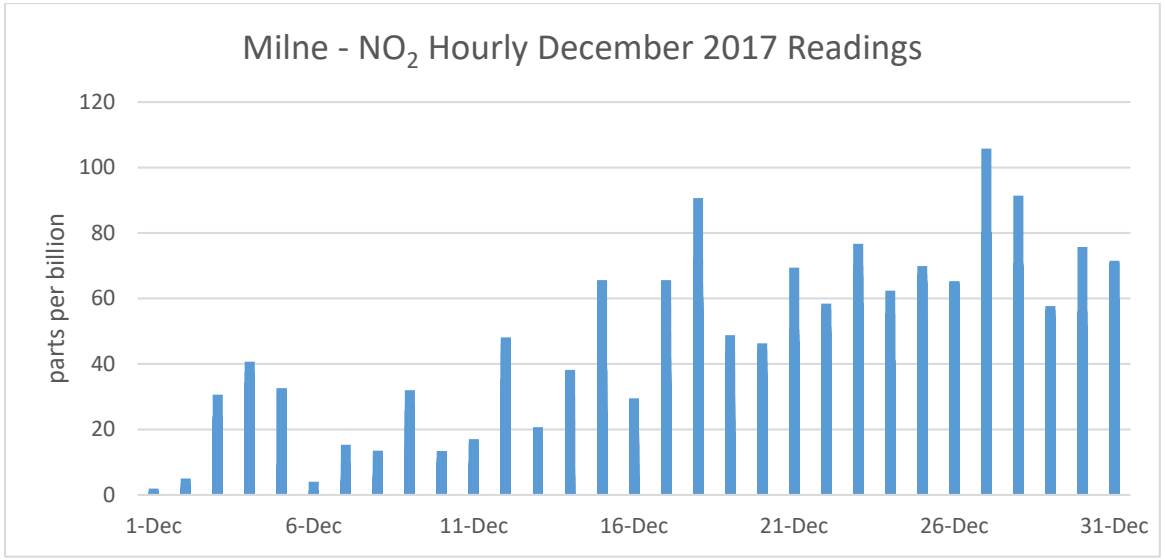
NO2 - ppb - average

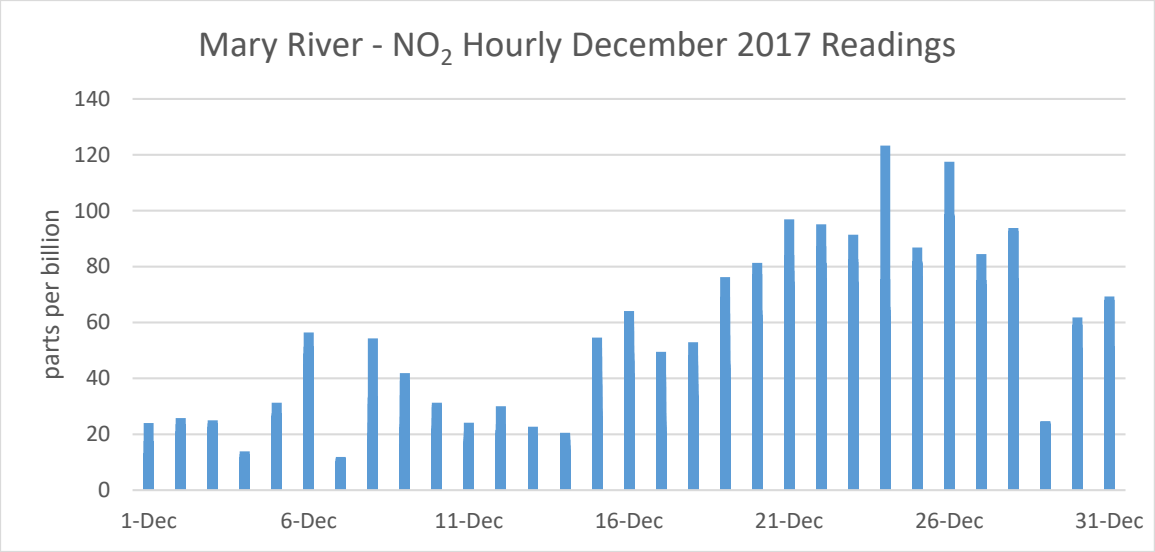
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mary	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	15.62	31.55
Milne	ND	ND	16.63	5.13	3.23	1.74	1.09	4.94	ND	14.27	13.47	22.18

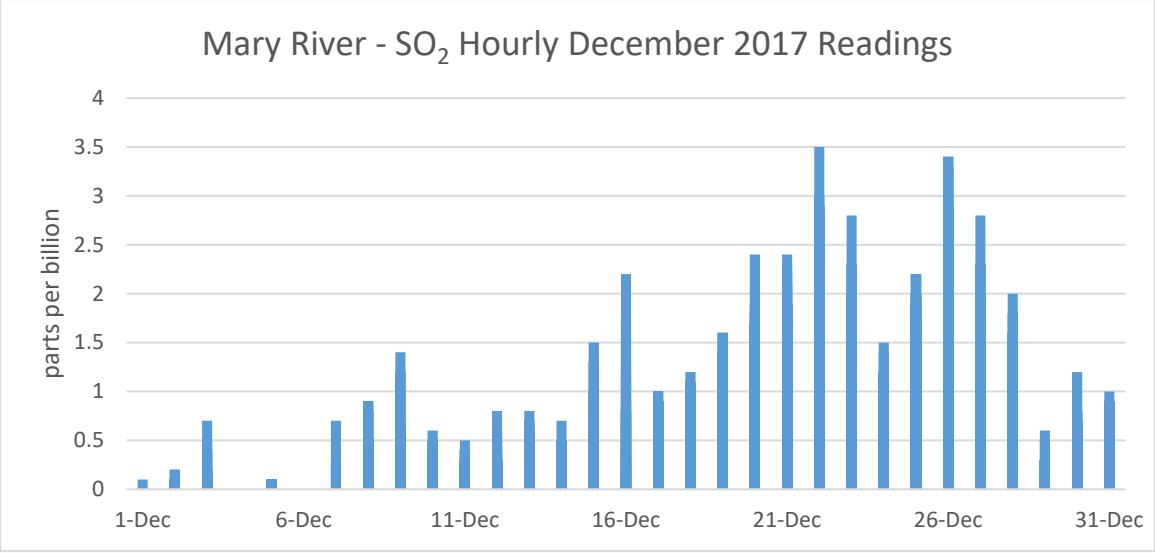

Milne - SO_2 Maximum and Average of Hourly 2017 Readings
parts per billion
Maximum
Average
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec


Milne - NO_2 Maximum and Average of Hourly 2017 Readings
parts per billion
Maximum
Average
120
100
80
60
40
20
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec


Milne - SO_2 Hourly November 2017 Readings
parts per billion
4
3.5
3
2.5
2
1.5
1
0.5
0
1-Nov
6-Nov
11-Nov
16-Nov
21-Nov
26-Nov


Milne - NO_2 Hourly December 2017 Readings
parts per billion
120
100
80
60
40
20
0
1-Dec
6-Dec
11-Dec
16-Dec
21-Dec
26-Dec
31-Dec


Mary River - NO_2 Hourly December 2017 Readings
parts per billion
140
120
100
80
60
40
20
0
1-Dec
6-Dec
11-Dec
16-Dec
21-Dec
26-Dec
31-Dec


Mary River - SO_2 Hourly December 2017 Readings
parts per billion
4
3.5
3
2.5
2
1.5
1
0.5
0
1-Dec
6-Dec
11-Dec
16-Dec
21-Dec
26-Dec
31-Dec

GN 44 ATTACHMENT 1: FIGURES

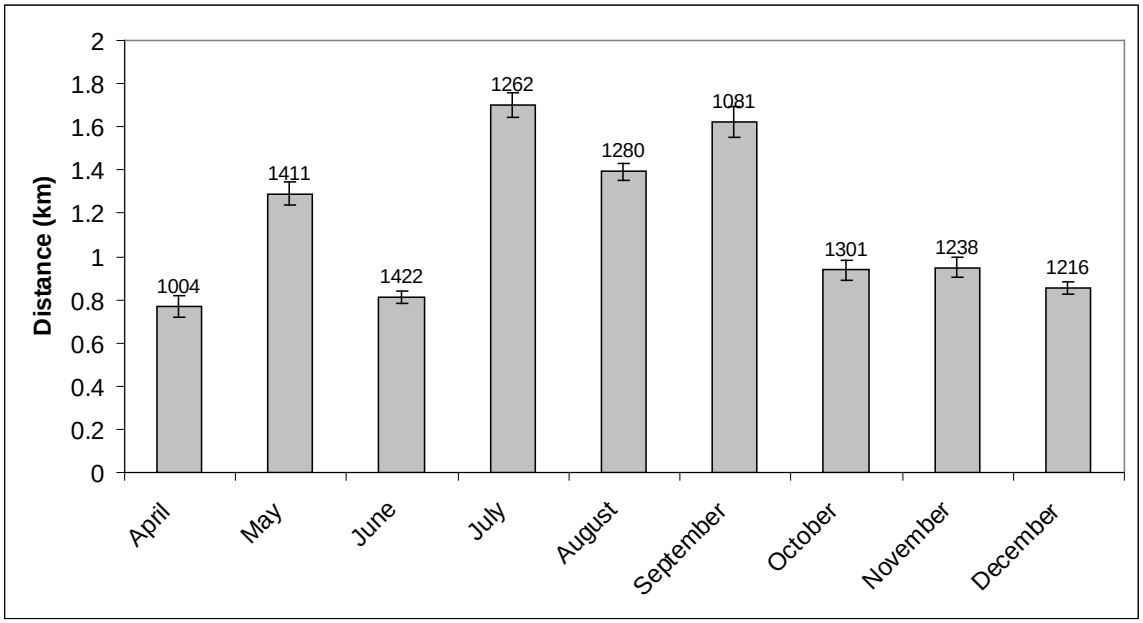


Figure 14. Mean distance travelled (with standard error) by caribou on north Baffin Island during 11-hour intervals.

Note: Values associated with individual bars represent sample sizes of travel bouts.
Data source: GNDoE unpublished.

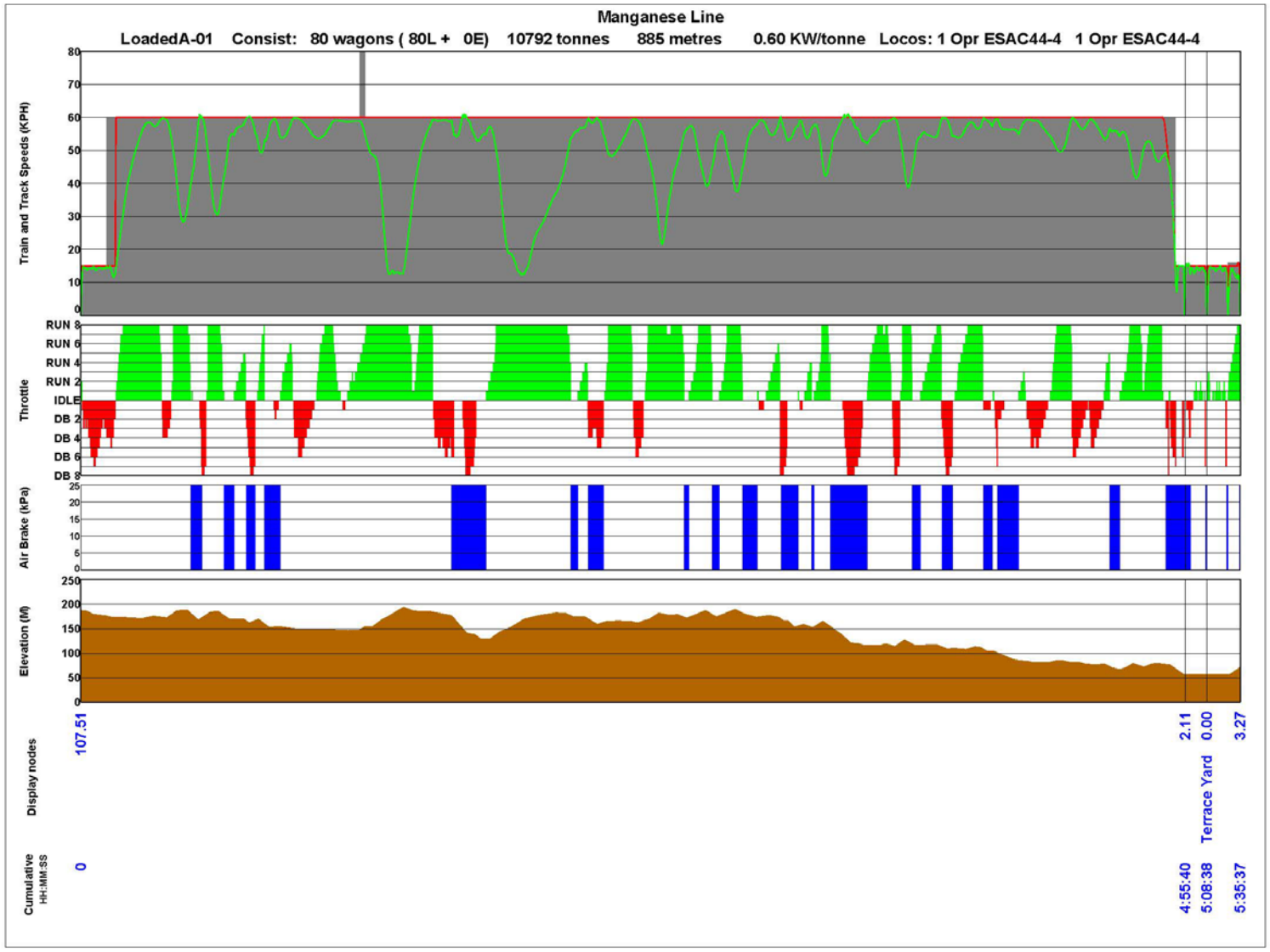


Figure 1. Loaded trainset speed profile, northern railway, Mary River Project Phase 2 Proposal

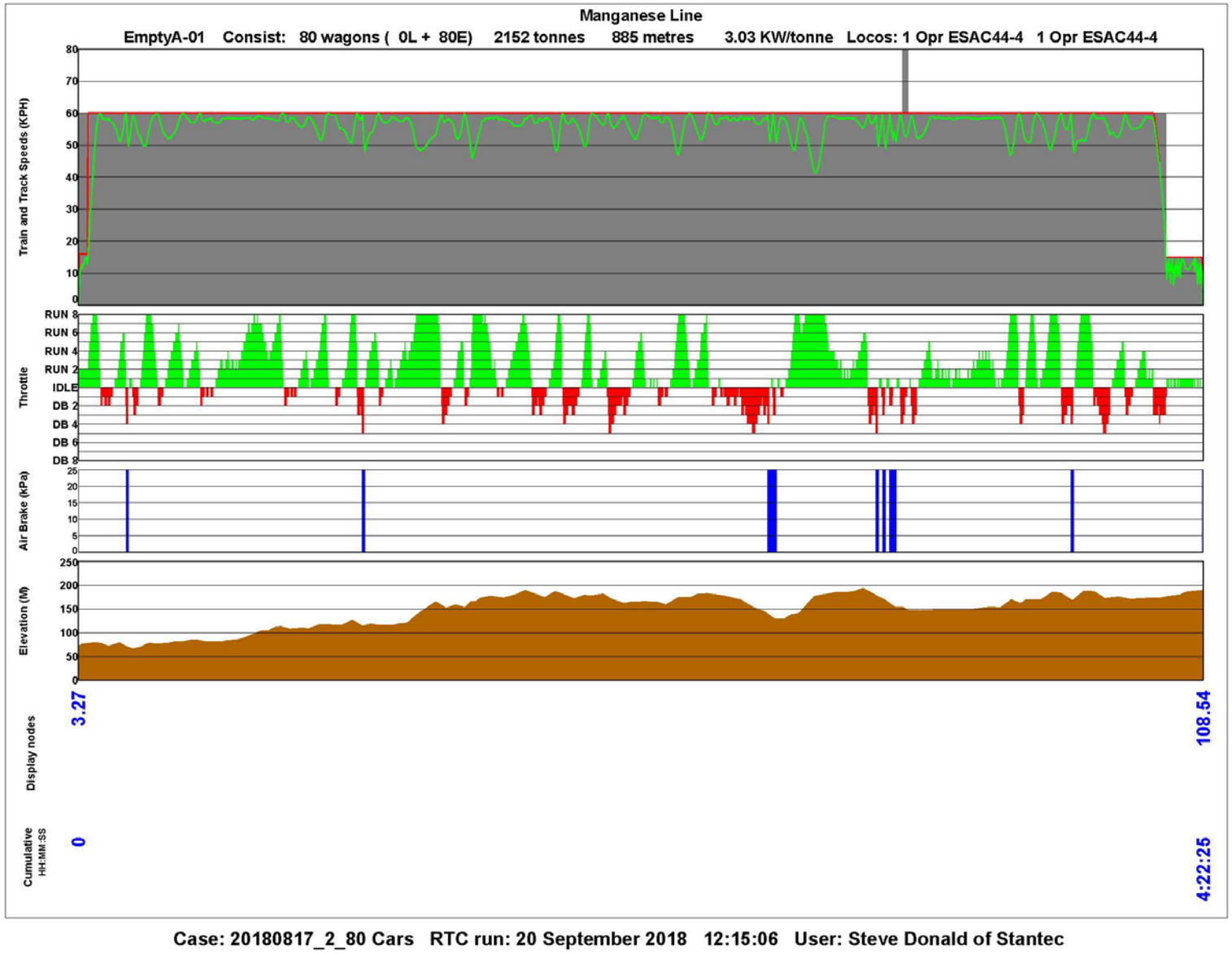


Figure 2. Empty trainset speed profile, northern railway, Mary River Project Phase 2 proposal.

GN 46 ATTACHMENT 1: LIST OF ASSUMPTIONS

From Russell 2012 report

- *For the purposes of our modelling, we assume the total green biomass in the graminoid prostrate shrub type was similar to the tussock tundra graminoid type.*
    - We needed to make this assumption because biomass data came from Sirmilik Park and the prostate shrub type was not available — as well prostrate shrub type was rare in the regional study area.
- *From this process we then determined the above ground green biomass and used the relative difference in community biomass in the Baffin region compared to Bathurst caribou range and assumed similar scaled values for non-green biomass of lichens, some moss, mushrooms, and standing dead graminoids.*
    - We needed to disassociate the cover type biomass into specific plant groups. Descriptions of plant groups within these cover types were determined from a study of diamond mine impacts on the Bathurst caribou range (Gunn et al 2010). Therefore, we used the relative abundance of plant groups from that study and scaled to the lower community biomasses in the North Baffin region.
- *We assumed that the herd initially was small, that the area acted as a center of habitation, and that the herd was rapidly increasing between each time step.*
    - Caribou currently exist in the study area in low densities following population highs in the late 1990s. As the population recovers and densities increase there is ample historic information that major trail systems are established and that seasonal shifts emerge for the herd to better exploit the resources within their entire North Baffin range. From local knowledge, when caribou are abundant, calving appears more concentrated, surrounding and north and east of the mine site. Animals then expand westward and move north in fall and winter, returning to calving sites in the spring.

- *To test a range of potential impacts of development we developed 5 scenarios from least to most impact. Thus the following assumptions were merely for the purpose of setting up the Scenarios*
    - Scenario 1. The baseline condition, with no development but with an expanding and thus increasingly dense caribou population.
    - Scenario 2. The impact of caribou abandoning the ZOI completely. The negative effect of caribou abandoning the ZOI was an increased density on the rest of the range, thus reducing the effective biomass per individual.
    - Scenario 3. The impact of the potential for caribou to fail to cross the railway in key places, thus abandoning a portion of the RSA over and above the ZOI. In this scenario we assumed that the caribou would abandon 35% of the RSA which includes all the ZOI (representing about 25% of the RSA) and an additional 25% of the RSA north and west of the development. We modeled the same source of impact: increased density outside the abandoned zone with a proportional decrease in biomass per individual.
    - Scenario 4**.** The same scenario as #3 above, except we assumed they would abandon the entire RSA north and west of the infrastructure, including the ZOI on the south and east side of the mine and railroad (65% of the RSA).

  - Scenario 5. The impact of caribou being in the Zone of Influence (ZOI) for the whole year. Impacts were modelled based on a reduction in foraging time and eating intensity (the proportion of the foraging time spent eating) and an increase in walking and running time (Murphy and Curatolo, 1987; Murphy et al 2000; Gunn et al 2011).

- *Based on the data presented in the original EIS, especially the analysis by Brody (1976), when the population was considerably higher than current, the model process assumes the RSA acts as a centre of habitation when the population is at a low and as the population grows, the range expands proportionally.*

  - Caribou currently exist in the study area in low densities following population highs in the late 1990s. As the population recovers and densities increase there is ample historic information that major trail systems are established and that seasonal shifts emerge for the herd to better exploit the resources within their entire North Baffin range. From local knowledge, when caribou are abundant, calving appears more concentrated, surrounding and north and east of the mine site. Animals then expand westward and move north in fall and winter, returning to calving sites in the spring.

- *We assume the herd declines due to deteriorating range.*
  - Based on local knowledge that caribou return when the trails become green again.

- *We assume the herd cycles every 65 years, is characterized by a slow initial recovery, rapid mid recovery, and rapid decline*

  - This also helps us to project the future and assumes a recovery rate at the high end of conventional wisdom on caribou cycles of abundance (40-70 years)

- *If we assume that the general strategy of caribou throughout the abundance cycle is to maximize lifetime reproductive effort, then we can assume that a deteriorating range would first be noticed in adult body size, then pregnancy rates, then in calf survival, and finally in adult cow mortality*
  - Based on literature: (Crete and Huot, 1993; Russell et al 1997; Russell et al 1998; Russell and White 2000; Gerhart et al 1997).

From Russell 2014

- *If we assume that the collared sample is indicative of all North Baffin caribou, then 70*.25 =* ***17.5% of caribou use days would occur in the ZOI****.*

- *If we assume Figure 3 is synonymous with displacement, then there is potentially 14*4=56 caribou "units" in the ZOI.*
  - These assumptions are explained in the text and refer to work on the Bathurst herd by John Boulanger (2012). See Figure 1 below.

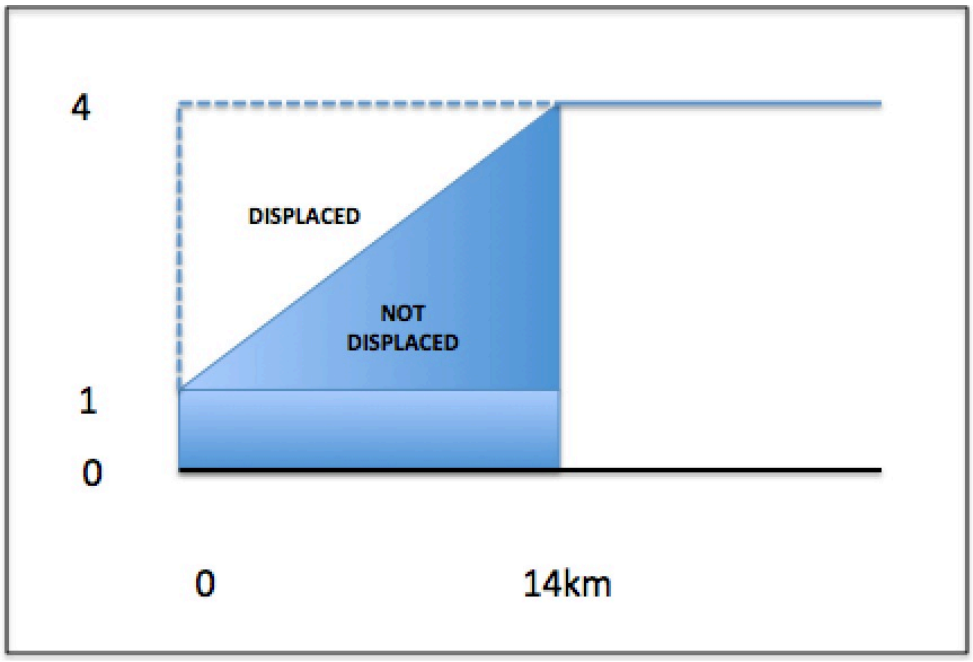


Figure 1. Schematic of Boulanger's et al (2012) "odds ratio" and how the proportion of caribou displaced was calculated

- *For our modeling we conservatively assumed a peak abundance of 50,000 animals with displacement effects beginning as the population exceeds 15,000 animals and maximizing (i.e., a percent reduction in biomass per individual equal to the percent of the range abandoned by displaced caribou) at 50,000 animals.*
    - For the modeling into the future we needed to assume a peak density as a feedback to range deterioration.

- *Although we do not think caribou would absolutely avoid the area within the ZOI, and there is no precedent for this in the literature for either roads or railway, high displacement assumes that 100% of animals are displaced from the ZOI, thus 17.5% (from above) of North Baffin caribou use days would be displaced from the ZOI.*
    - This errs on the side of conservative — a worst case scenario

- *For those caribou disturbed, behavioural activity is affected: 6% decrease in feeding; 3% increase in walking and running*
    - Rationale: literature estimates vary considerably, however for paired studies (simultaneously monitoring activity of caribou inside and outside a ZOI) the effect on caribou activity was not consistently different. Thus this is a liberal application of disturbance effects on activity.

- *If we assume that disturbance will occur out to 1 km, especially with heavy traffic from the source, than our **"moderate"** percent of time an animal is disturbed in the ZOI (assume evenly distributed in the ZOI, i.e. no displacement from the source of disturbance) = 25% of time/14 (only disturbed 1 km of the 14 km ZOI) = **1.7%** of their time. Although we do not think caribou would be disturbed throughout the entire 14km ZOI, our **high disturbance** scenario assumes all caribou in the ZOI are disturbed.*
    - This assumption required to set up a moderate scenario. Literature data on disturbance effects are equivocal, so set up a moderate and a High disturbance scenario

- *Harvested animals were assumed to be taken in proportion (by age and sex) to their occurrence in the population.*
    - The Nunavut harvest study determined that North Baffin Island caribou harvest from Pond Inlet is ~63% females, relative in proportion to female abundance in the population (Priest and Usher 2004).

- *We have assumed that population density in the north is similar to conditions in south Baffin Island.*
    - Jenkins et al. (2012) surveyed south Baffin Island and recorded a mean population density (without calves) of 0.0054 caribou km². Regions surveyed varied from 0.02558 to 0.00094 caribou km².

- *We assumed harvest was additive to the natural mortality rates and that harvest by age and sex was proportional to occurrence in the population.*
    - Again, if additive then the impact would be worst-case scenario

- *We assumed that displacement of caribou from the ZOI would result in higher densities outside of the ZOI and thus a reduction in the forage per animal available. However, we assumed that at lower population levels (0–15,000 animals) displacing caribou from the ZOI would have no effect because the extra animals could be accommodated within the existing range. We assumed that when the caribou population is between 15,000 and 50,000 animals that there was a linear increase from 0% biomass reduction at 15,000 caribou to maximum reduction, depending on the scenario, at 50,000 caribou.*
    - Assumption was necessary to quantify a "cost" to displacement. At low densities the assumption is that displaced caribou could find equal quality habitats, as population size increases higher densities. These values are for transparency purposes, not based on any empirical data

- *In the absence of any studies that provide implications of such small body changes on overwinter mortality of North Baffin Island caribou, we conservatively assumed that a 1 kg change on calf body weight was equivalent to a 2% increase in overwinter mortality.*
    - Although initially we assumed that a 2% decline in survival for each kg reduction in fall calf weight was conservative, since the 2014 report, sum evidence from other studies in Alaska indicate that the value may be as high as 5% reduced survival for each kg.

- *To account for additional calf mortality from the proportion of cows that weaned early, we assumed that a proportion of those calves were already accounted for in the base mortality rate (our population run assumed a base mortality of female calves of 45%). For this analysis therefore we assumed a 70% compensatory mortality and the remaining mortality was added to the overwinter mortality already calculated from average fall calf weights.*
    - These assumptions were needed to avoid double counting sources of calf mortality.

- *We assumed if a reduction in harvest were implemented, a reduction in cows would be the focus.*
    - Throughout North America as herds experienced drastic declines and harvest becomes a mitigation tool, non-resident hunting is eliminated, licensed hunting is curtailed and if aboriginal hunting is affected a voluntary shift away from harvesting females is encouraged. We assume that as almost all hunting in North Baffin is from northern communities the mitigation would be a shift from female harvest

- *High displacement scenario assumes that 100% of caribou are displaced from the 14 km ZOI and High disturbance assumes caribou are equally disturbed throughout the 14 km ZOI.*
    - Both these extremes have no precedence in the literature; however modeling these scenarios allows us to explore the extremes in caribou reaction.

GN 46 ATTACHMENT 2: TABLES

Table 1. Energetics model input data sources

Input	Baffin Specific Source	Non-Baffin specific	Reference
Vegetation communities	Olthof et al. 2009		Russell 2012 page 12-14
Habitat use	Collar X communities X season		Russell 2012 page 15
Plant biomass	Sirmilik National Park from CCRS		Russell 2012 page 16
Phenological change	Sirmilik National Park from CCRS		Russell 2012 page 17-18
Plant nutrients	no data available	Johnstone et al. 2002; Finstad et al. 2000 (data held by CARMA)	Russell 2012 page 19
Climate variables	CARMA climate data for North Baffin		Russell 2012 page 19-20
Diet	Ferguson et al. 2001	White et al. 1999	Russell 2012 page 12-14
Activity budget	Active/rest for North Baffin latitude as described by van Oort et al. 2005	Russell et al. 1993	Russell 2012 page 20-22
Body weight starting conditions	Caribou collections by Elkin 1992, 1993, 1999; Dauphine 1965 — data held by CARMA		Russell 2012 page 22-23
Link body condition to Pregnancy Probability	derived from: Elkin 1992, 1993, 1999 and Dauphine 1965 data — data held by CARMA		Russell 2012 page 23-25
Peak of calving	Based on Baffin caribou collar movement rate		Russell 2012 page 25-26

Table 2. Population model input data sources

Input	Baffin Specific Source	Non-Baffin specific	Reference
Starting population size	Based on South Baffin Island caribou densities: (Jenkins et al. 2012)		Russell 2014 page 7-8
Age structure	Based on South Baffin Island age/sex composition: (Jenkins et al. 2012); and Elkin collections 1992, 1993 (data held by CARMA)		Russell 2014 page 8
Pregnancy rates	Based on collection from Elkin 1992, 1993 (data held by CARMA)		Russell 2014 page 8
Mortality rates	no data available	based on typical mortality for expanding populations	Russell 2014 page 8-9

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GN 49 ATTACHMENT 1: FIGURE 1. THE EXTENT OF THE PDA ENCOMPASSED BY CARIBOU WALK PATHS (LINES JOINING CONSECUTIVE COLLAR LOCATIONS THAT ARE ≥ 11 HOURS APART) SHOWING THE PDA, MAPPED TRAILS AND MOVEMENT IDENTIFIED BY INUIT QAUJIMAJATUQANGIT

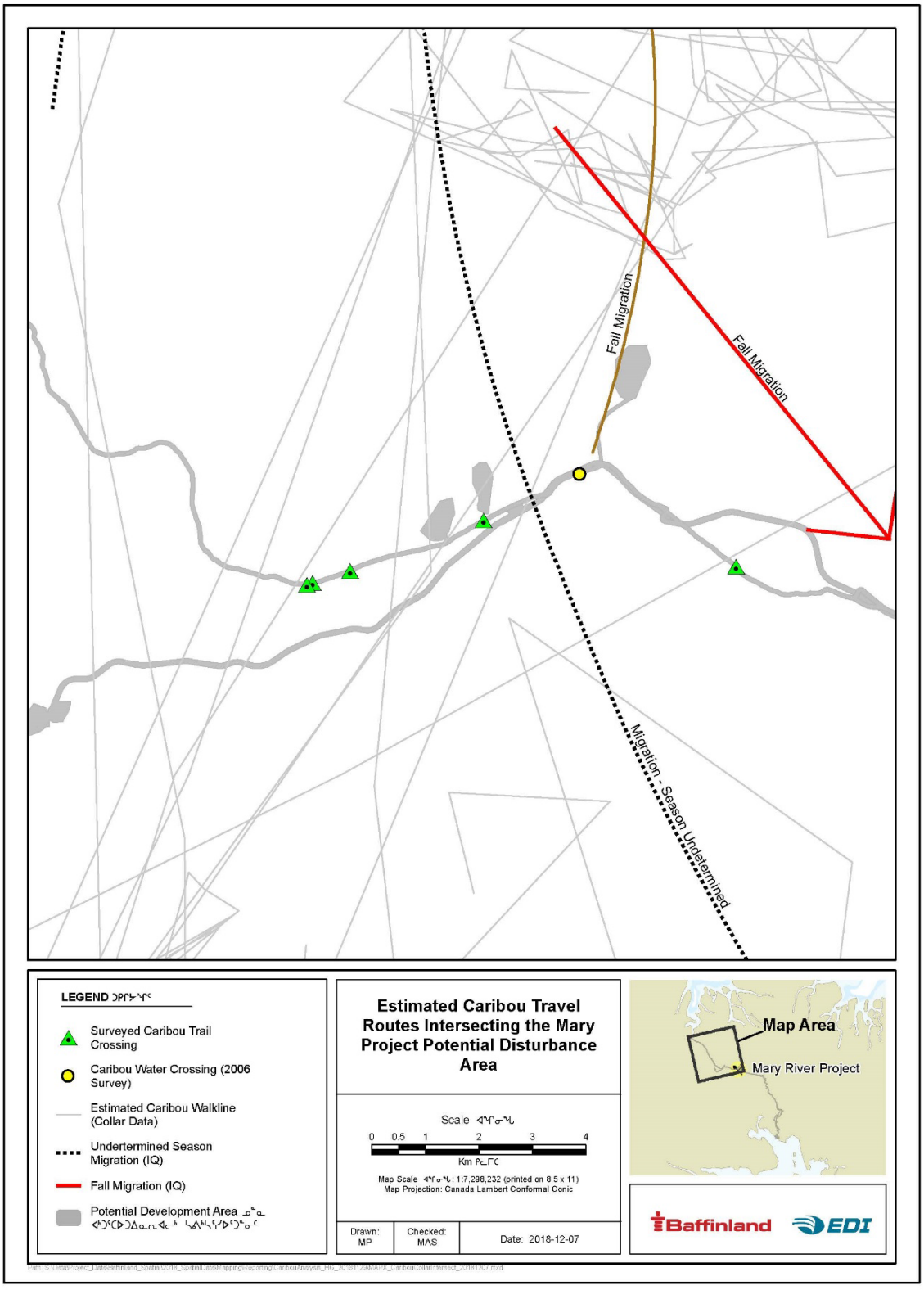


Figure 1. The extent of the PDA encompassed by caribou walk paths (lines joining consecutive collar locations that are ≥ 11 hours apart) showing the PDA, mapped trails and movement identified by Inuit Qaujimajatuqangit

GN 55 ATTACHMENT 1: TABLE 1 - SOIL AND CHEMICAL CHARACTERISTICS AFFECTING ORAL BIOAVAILABILITY OF METALS

Table 1: Soil[1] and Chemical Characteristics Affecting Oral

Oral Bioavailability				
Soil Characteristics	Low	Medium	High	Mary River Ore Characteristics
Metal Forms:				
Sulfides	X			<20% sulfides
Elemental (metallic)	X			
Sulfates		X		
Carbonates			X	
Oxides	X (Cr, Ni & Hg)		X (As, Pb)	As and Pb are not predominant in ore[4]
Particle Size:				
Fine			X	
Coarse	X			Dust is coarse
Weathered/Aged Contamination:				
Sulfides	X	X		<20% sulfides
Elemental	X	X		
Carbonates		X	X	
Oxides		X	X	Mostly Fe2O3 and Fe3O2
Organic Compounds[3]	X			
Soil Chemistry:				
Acidic		X		

Table 1: Soil[1] and Chemical Characteristics Affecting Oral

Oral Bioavailability				
Soil Characteristics	Low	Medium	High	Mary River Ore Characteristics
Basic (alkaline)			X (Cd, Hg, Pb, Ni)	Cd, Hg, Pb, Ni not predominant in ore)[4]
High total organic carbon			X (Hg, Pb)	
High Fe and Mn		X (As)		
Sulfide-producing soil		X (Cd, Hg, Pb, Ni)		

Notes: shading indicates predominant characteristic of Mary River ore or environment soils

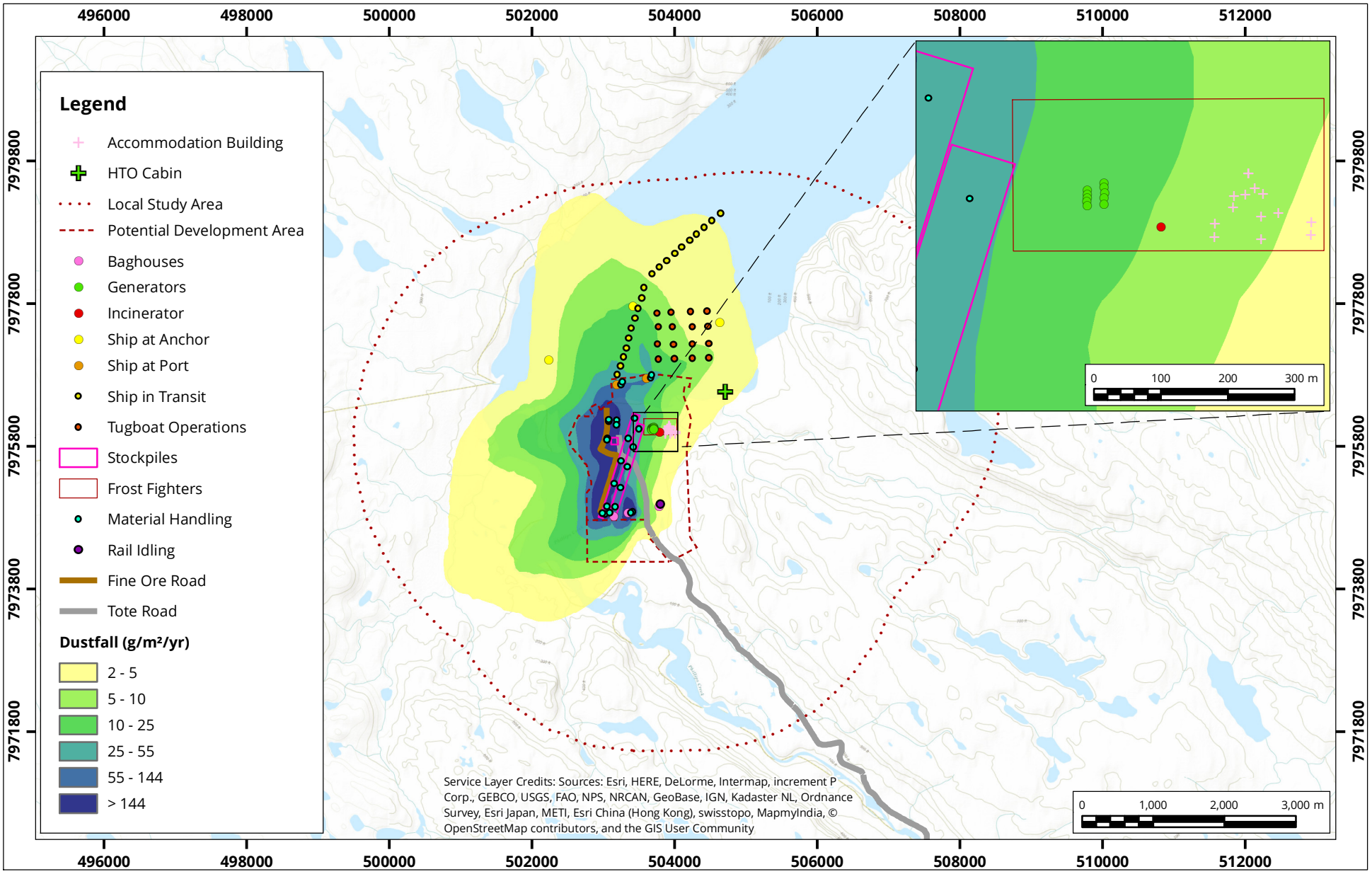
[1] Soil includes soil-like media, e.g., dust, sediment and waste materials such as slag and mine tailings.

[2] ENVIRON (2011) modified from Table 3–1 in the United States Department of Defense (US DoD) *Guide for incorporating bioavailability adjustments* (US DoD 2003).

[3] Note that bioavailability of metal compounds may increase during ageing because of the formation of more bioaccessible organo-metallic species (MacLean *et al.* 2013; Rasmussen *et al.* 2014; Beauchemin *et al.* 2014).

[4] TSD-11; Table 2-1a;b
Cr (chromium), Ni (nickel), Hg (mercury), As (arsenic), Pb (lead), Cd (cadmium), Fe (iron), Mn (manganese).

GN 56 ATTACHMENT 1: FIGURES



Predicted Annual Dustfall
Milne Port

Map Projection: NAD 1983 UTM Zone 17N

Baffinland Iron Mines Corporation - Nunavut, Canada

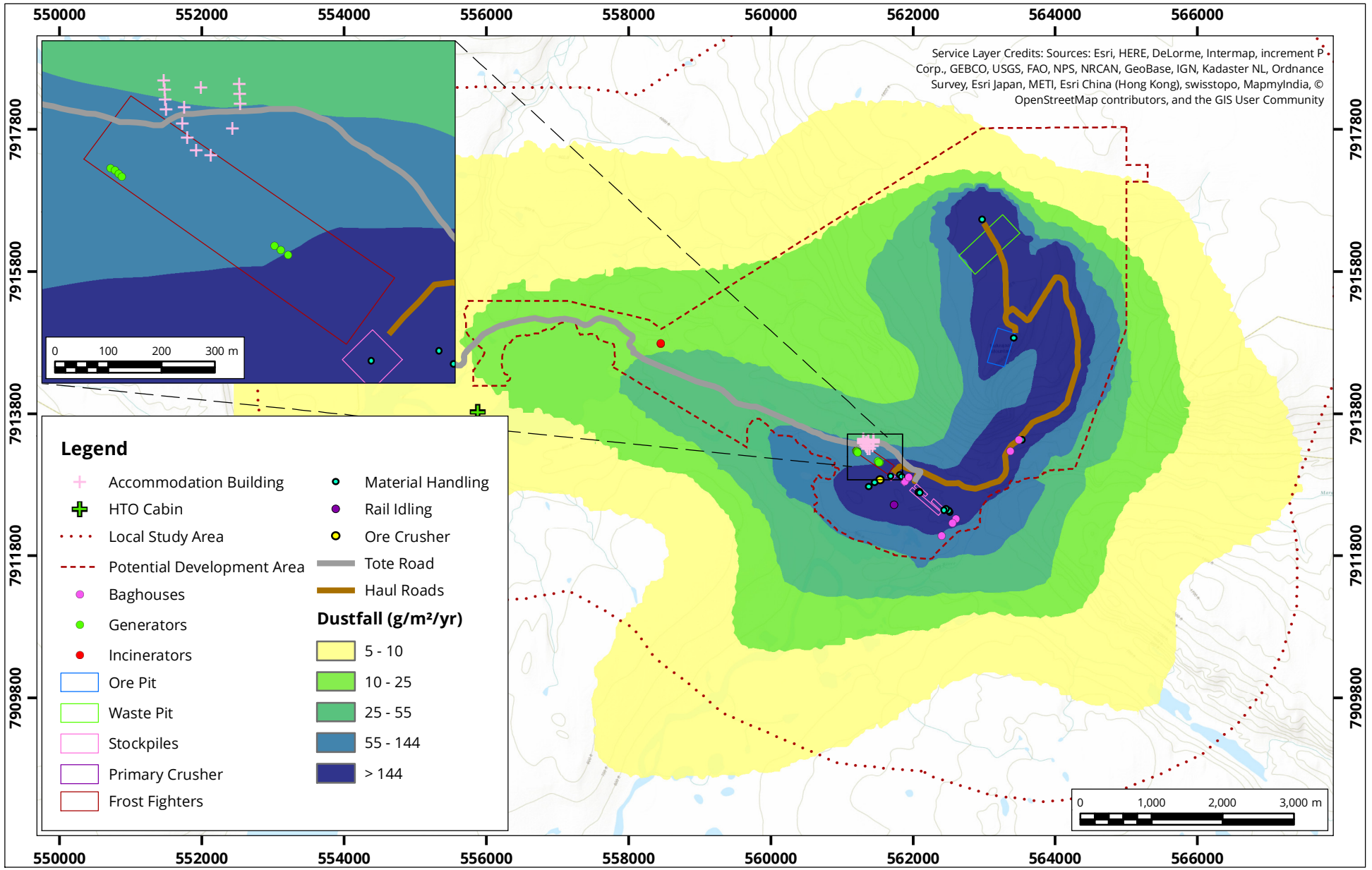
Annual Dustfall Indicator Threshold: 55 g/m²/yr

True North

Project #: 1402090

Drawn by: DJH	Figure:D-14
Approx. Scale:	1:75,000
Date Revised:	Dec 5, 2018

Map Document: C:\Users\djh\OneDrive - ROWAN WILLIAMS DAVIES & IRWIN INC-VGIS Temp\1402090\BKP\ortdust_ann_extra_level_181204.mxd



Predicted Annual Dustfall
Mine Site

Map Projection: NAD 1983 UTM Zone 17N

Baffinland Iron Mines Corporation - Nunavut, Canada

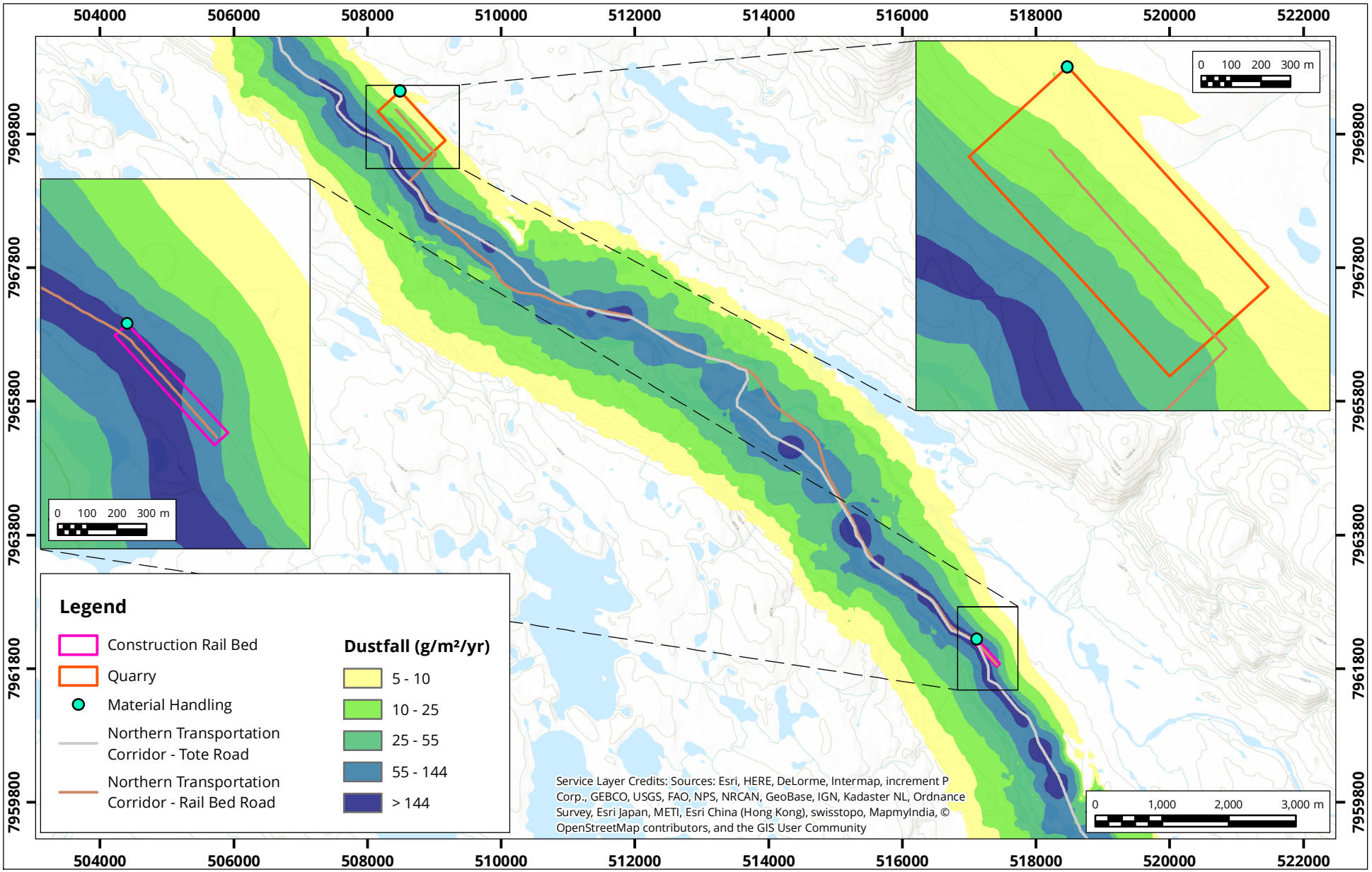
Annual Dustfall Indicator Threshold: 55 g/m²/yr

True North

Project #: 1402090

Drawn by: DJH	Figure: E-14
Approx. Scale:	1:75,000
Date Revised:	Dec 4, 2018

Map Document: C:\Users\djh\OneDrive - ROWAN WILLIAMS DAVIES & IRWIN INC-VGIS Temp\1402090\BKMine\dust_ann_extra_level_181204.mxd



Predicted Annual Dustfall

Construction Scenario - Tote Road and Construction Sources

Map Projection: NAD 1983 UTM Zone 17N

Annual Dustfall Indicator Threshold: 55 g/m²/yr

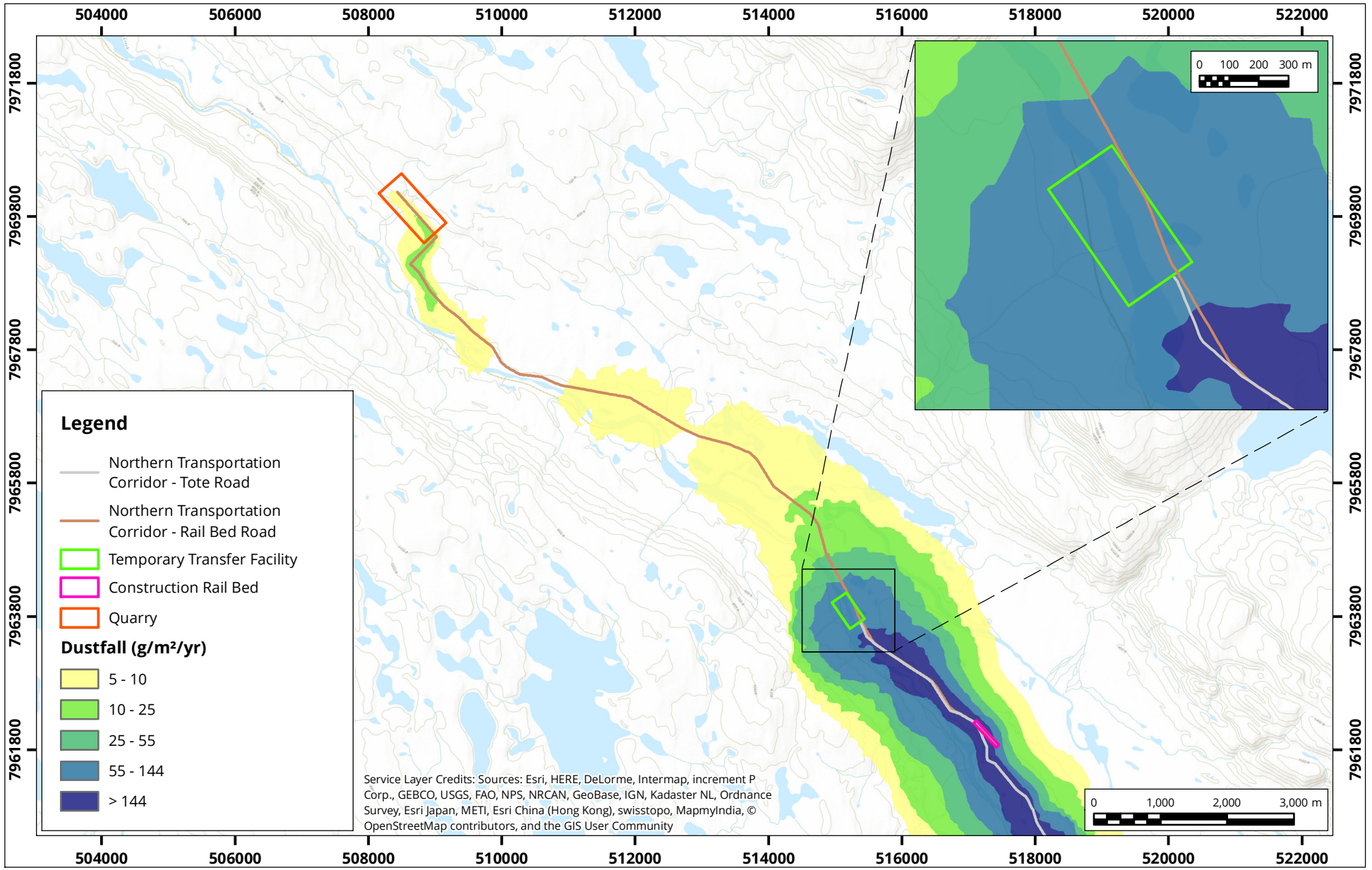
Baffinland Iron Mines Corporation - Nunavut, Canada

Project #: 1402090

True North

Drawn by: DJH	Figure: F-18
Approx. Scale:	1:80,000
Date Revised:	Dec 4, 2018

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Predicted Annual Dustfall

Temporary Transfer Facility Scenario - Tote Road, Temporary Transfer Facility, and Construction Sources

Annual Dustfall Indicator Threshold: 55 g/m²/yr

Baffinland Iron Mines Corporation - Nunavut, Canada

True North

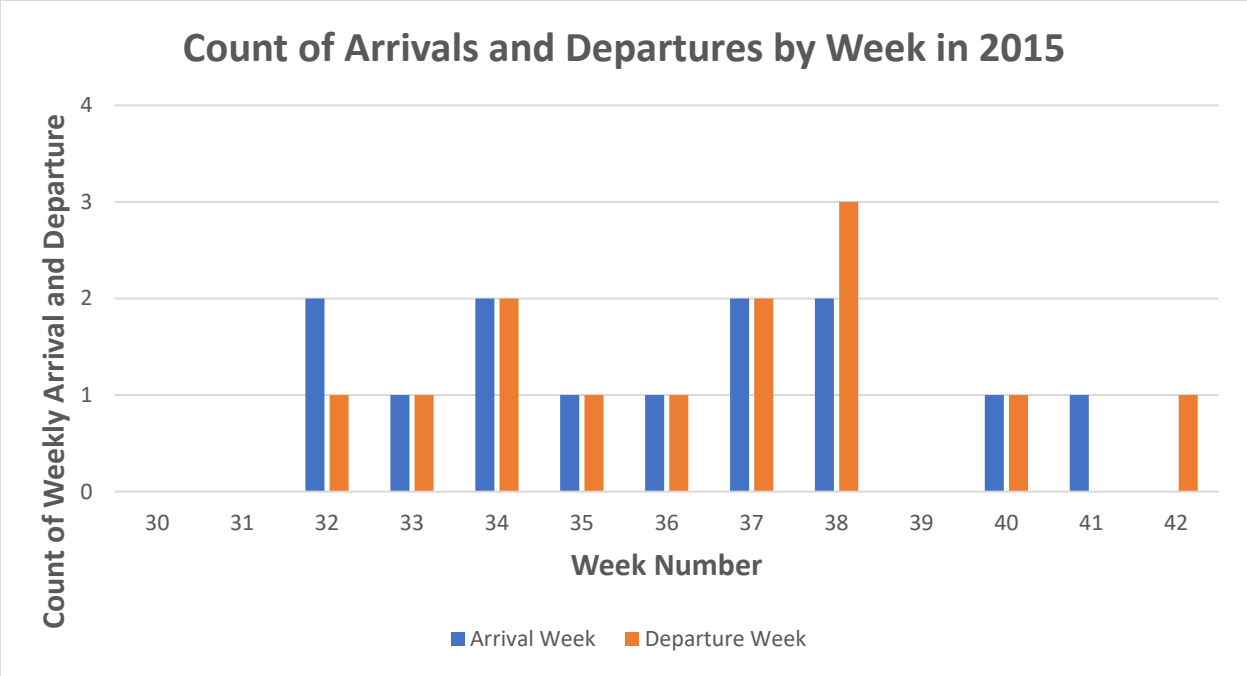
Map Projection: NAD 1983 UTM Zone 17N

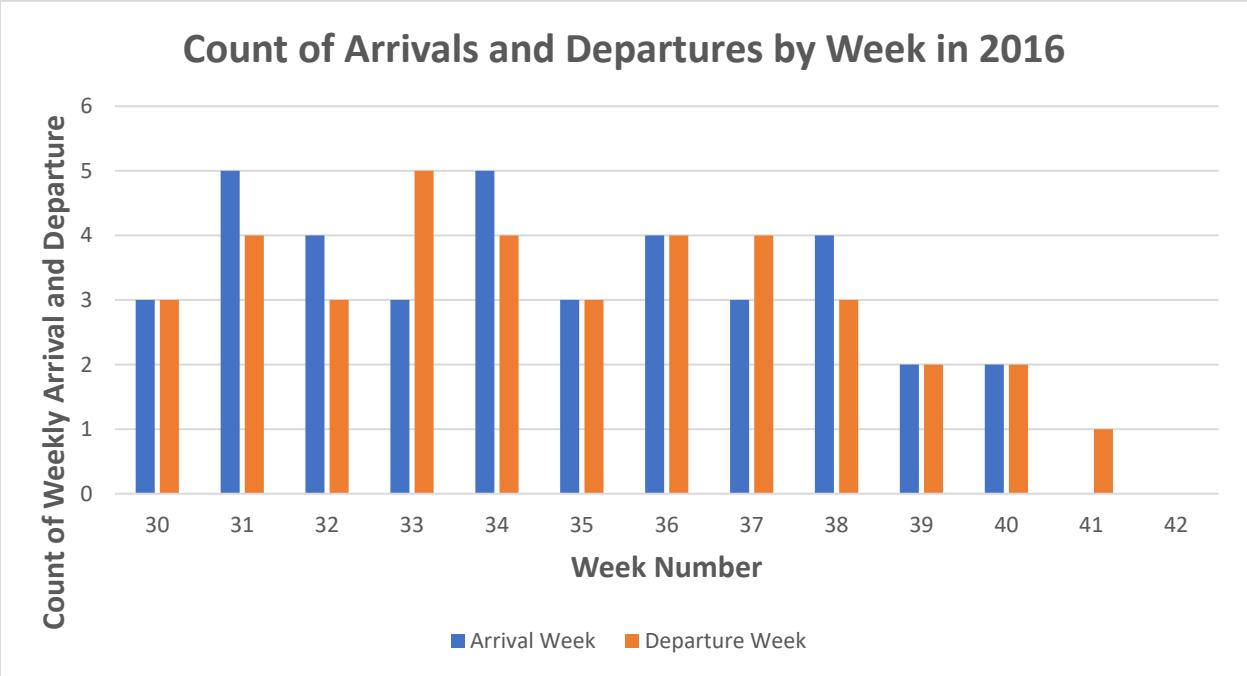
Project #: 1402090

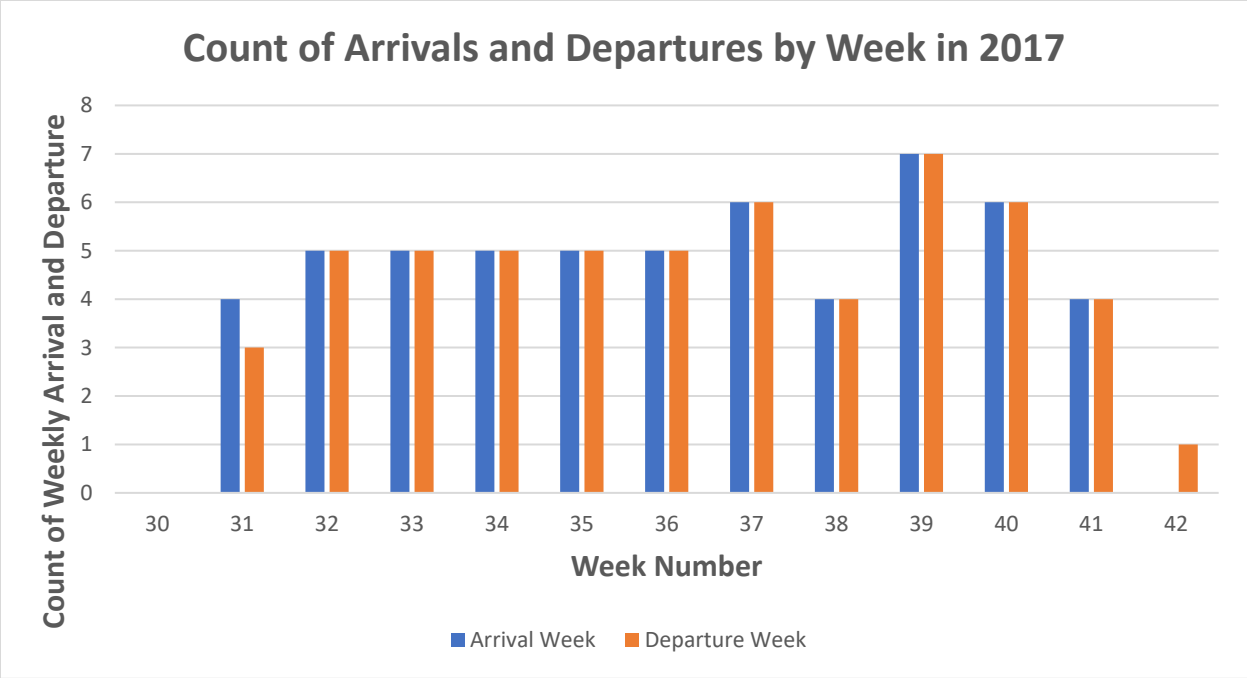
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Approx. Scale:	1:80,000
Date Revised:	Dec 5, 2018

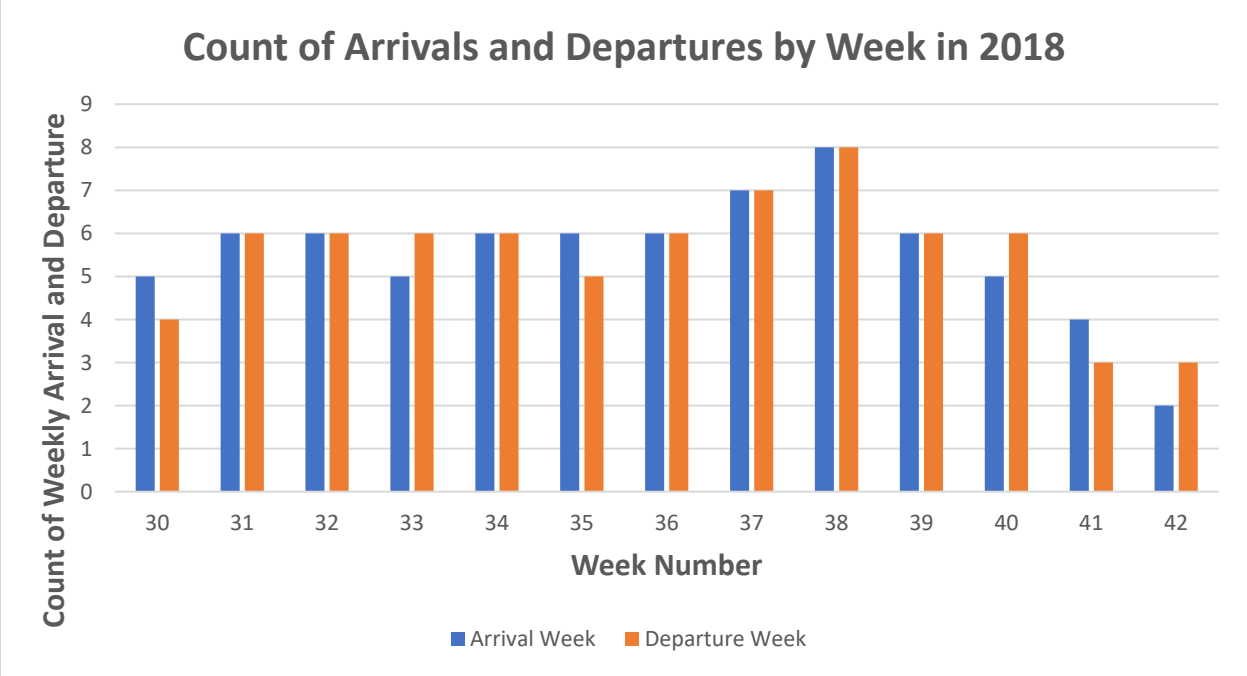
Map Document: C:\Users\djh\OneDrive - ROWAN WILLIAMS DAVIES & IRWIN INC-\GIS Temp\1402090\1402090 - Baffinland - AQ Transfer Facility Contour Plots_180608.mxd

GN 66 ATTACHMENT 1: SUMMARY OF SHIPPING FREQUENCY


Count of Arrivals and Departures by Week in 2015
Count of Weekly Arrival and Departure
0
1
2
3
4
30
31
32
33
34
35
36
37
38
39
40
41
42
Week Number
Arrival Week
Departure Week


Count of Arrivals and Departures by Week in 2016
Count of Weekly Arrival and Departure
0
1
2
3
4
5
6
30
31
32
33
34
35
36
37
38
39
40
41
42
Week Number
Arrival Week
Departure Week


Count of Arrivals and Departures by Week in 2017
Count of Weekly Arrival and Departure
0
1
2
3
4
5
6
7
8
30
31
32
33
34
35
36
37
38
39
40
41
42
Week Number
Arrival Week
Departure Week


Count of Arrivals and Departures by Week in 2018
Count of Weekly Arrival and Departure
0
1
2
3
4
5
6
7
8
9
30
31
32
33
34
35
36
37
38
39
40
41
42
Week Number
Arrival Week
Departure Week

GN 68 ATTACHMENT 1: FULL RESPONSE TO GN 68

GN IR-68:

Provide the following information:

1. Clarification on the methods used for data collection. Describe how knowledge gathering was conducted, how participants were selected, etc.
2. A list of the questions asked during workshops
3. Clarification on the number of people that attended the workshops.
4. Clarification on the methods used in data analysis.
5. Clarify whether there was consensus on topics and how many people agreed or disagreed.
6. Robust and complete results from marine mammal survey within the RSA.

Baffinland Response:

The summary of marine mammal IQ from community workshops presented in *Appendix A of TSD-24: Marine Mammal Effects Assessment* was drawn from the source document *TSD-03: Phase 2 Workshop Report*. While responses to GN IR #68 are provided below, TSD-03 should be consulted for any additional information on the Phase 2 community workshops.

1. Methods used in the Phase 2 community workshops are described more fully in Section 2 (Methodology) of TSD-03, although a summary of data collection methods used is presented below. Baffinland identified the need for additional information to be collected in regard to contemporary Inuit land uses in areas potentially affected by the Phase 2 Proposal. In addition to this land use information, there was a need for community concerns specific to the Phase 2 Proposal to be discussed and for potential mitigation measures to be reviewed and assessed. In order to do this, Baffinland and the Qikiqtani Inuit Association (QIA) organized a series of 'invited persons' workshops and public open houses in Pond Inlet and Arctic Bay, Nunavut between March 2015 and May 2016. These workshops were focused on five main themes:

- Contemporary Inuit land use in the Eclipse Sound and Navy Board Inlet areas
- Shipping through ice
- Open water shipping
- Caribou
- Phase 2 and Arctic Bay

These workshops had the following objectives:

- To determine the location, timing, and intensity of contemporary Inuit land use activities in the Eclipse Sound and Navy Board Inlet areas, so the effects of Phase 2 can be more accurately assessed.
- To document community feedback regarding the shipping through ice component of Baffinland's Phase 2 Proposal, and to identify potential mitigation measures.
- To document community feedback regarding the open water shipping component of Baffinland's Phase 2 Proposal, and to identify potential mitigation measures.
- To document community feedback regarding Baffinland's Phase 2 Proposal and caribou, and to identify potential mitigation measures.
- To engage the community of Arctic Bay on Baffinland's Phase 2 Proposal, document their feedback, and have them identify potential mitigation measures.

Pond Inlet was chosen as the location for Workshops #1-4 as it is the closest community to the mine site and proposed Phase 2 shipping activities in the Eclipse Sound area, and because its residents regularly use the Eclipse Sound area for harvesting and other land use activities. Workshop #5 occurred in Arctic Bay because residents of Arctic Bay have some overlapping interests and land uses related to Baffinland's Phase 2 Proposal.

Contemporary land users, Elders, and other residents of Pond Inlet and Arctic Bay were asked to participate in the invited persons workshops. More specifically, invitations were sent to the following organizations in Pond Inlet and Arctic Bay so they could nominate individuals to participate:

Hunters and Trappers Organization

- Hamlet Council
- High School

These organizations were informed that only those individuals with detailed knowledge about the scheduled workshop topics should be nominated. These organizations were permitted to nominate individuals outside of their respective organizations (in lieu of their own organizational representative(s) attending) if they felt the workshop topics would be better addressed by other individuals. The QIA was also asked to nominate participants in Workshops #1-3 held in Pond Inlet. Participants sometimes varied between the workshops (e.g. due to their availability and/or knowledge). Furthermore, Workshops #1-3 consisted only of Pond Inlet residents, while Workshop #4 consisted of both Pond Inlet and Arctic Bay residents, and Workshop #5 consisted only of Arctic Bay residents.

At the beginning of each workshop, Baffinland representatives provided an overview of the Phase 2 Proposal and described the purpose and objectives of the workshop. Interpretation services were provided as necessary. Workshop agendas and consent forms were also provided (in English and Inuktitut) and discussed, and data collection activities only began once the consent forms had been reviewed. Each workshop followed an agenda and questionnaire/workshop guide that was prepared in advance. Information shared during the workshops was recorded in detailed meeting notes and on poster-sized paper base maps, as appropriate. Each of the workshops were also audio recorded.

Summarized results from the workshops were presented in public open houses. The same consent form utilized in the workshops was used in the open houses and served the dual purpose of being a sign-in sheet. A number of methods were employed to engage the public during the open houses, including summary posters and maps, PowerPoint presentations, and various handouts. Baffinland and QIA representatives were also present to engage the public, provide information, and record any feedback that was shared. Data recorded in the open houses was differentiated both in the data collection process (e.g. by using different coloured markers or annotations on the maps) and in the GIS databases (e.g. in separate attribute or notes files). Any written notes produced from the open houses also distinguished the source of the data. The open houses were not audio recorded, due to the difficulties associated with audio recording in large group settings where multiple conversations could be occurring simultaneously.

The open houses provided an opportunity for the general public to view and verify workshop data, while also allowing for new insights and information to be shared. The hosting of open houses also helped ensure all community members and organizations had an opportunity to participate in the data collection process, while improving the validity of the results. Open houses were advertised throughout the community (e.g. using radio announcements and posters in the Co-op and Northern Stores, Hamlet and HTO offices) and interpreters were available at each event.

Baffinland developed and consulted with the QIA on its community workshop methodology proposals

before commencing the workshops, in order to provide the QIA with an opportunity to comment on and approve all Phase 2 community workshop plans. Various suggestions were made by the QIA during their review of these documents, which were considered and incorporated by Baffinland as appropriate. QIA provided formal approval of the final workshop methodology proposals before any of the workshops proceeded.

Following the five workshops, Baffinland organized a data verification meeting with participants from the invited persons workshops in Pond Inlet. Summaries of information collected during previous workshops were presented by Baffinland to the participants, and participants were provided an opportunity to edit, remove, or add new information. This served to help verify the workshop data that had been previously collected.

2. Workshop questionnaires and data collection guides are presented in Appendix C of TSD-03. Separate questionnaires and data collection guides were developed for Workshops #1-5.

3. Participant lists for each workshop can be found in Appendix D (Workshop Notes) and completed consent forms can be found in Appendix B of TSD-03. Over the course of the invited persons workshops, a total of 25 community members participated.

4. Two types of data were collected in the workshops and open houses: verbal/textual data and spatial data. Verbal/textual data were recorded primarily in detailed workshop notes (see Appendix D of TSD-03). Key points, agreements, disagreements, concerns, and suggestions raised by workshop and open house participants were recorded in these notes. Data analysis was then accomplished through a form of associative analysis. In associative analysis, "the researcher looks for patterns, replication and linkages in the dataset" (GSRU 2007: 8:38). Data obtained from the workshops were thus analyzed to see if general themes emerged amongst the data sets and, if so, to qualitatively describe those themes. Organization of workshop notes was also aided in some instances by using the NVivo 10 software package, which is a commonly used application for analyzing qualitative research data. The software assists users to sort and organize ('code') collected information, identify data similarities and differences, and uncover key themes and findings.

All spatial information that was provided by workshop and open house participants (e.g. mapped land use activities and wildlife information) was digitized using Geographic Information System (GIS) software, similar to what was done in the original IQ study. A number of theme-based maps were then prepared, final versions of which are provided in Sections 3 through 6 and in Appendix E of TSD-03. GIS databases were developed to store workshop and open house spatial information and were organized, to the greatest degree practical, using a format previously suggested by the QIA.

Textual and spatial information obtained during the workshops and open houses were then analyzed for common themes and findings. However, some workshop discussions were unrelated to the specific workshop topic at hand or were a follow-up to previous workshop topics that had been discussed. In these instances, the information that was provided was analyzed as part of the data obtained from those other workshops.

5. The workshops and open houses were not designed to result in final Project decisions being made by the participants or communities. Rather, TSD-03 provides a scoping-level review of key issues and suggestions raised by community members with regards to the Phase 2 Proposal. Participants also provided independent perspectives and were never assumed to be representing the viewpoints of their communities and/or nominating organizations. While TSD-03 strives to present the information shared by workshop participants in a

comprehensive manner, TSD-03 isn't intended to reflect workshop and/or open house participant consensus on the issues raised, or be a complete representation of all viewpoints or knowledge held by community members. Baffinland acknowledged additional community engagement would be necessary to fully satisfy public consultation requirements on the Phase 2 Proposal.

Workshop participant comment and discussion summaries are presented throughout TSD-03. For greater clarity, however, specific comments made by individual workshop participants in TSD-03 are typically identified in *italics*. The workshop notes in Appendix D of TSD-03 provide additional details on the workshop discussions that took place.

6. Marine mammal studies have been completed that would represent baseline for the Phase 2 and considered in the assessment were provided in Table 2.1 of TSD 24 (Appendix X). These monitoring programs and associated results are described in TSD 24, Appendix A. Future monitoring programs that occur prior to construction of Phase 2 would also be considered as baseline for Phase 2. In addition to Baffinland's marine mammal baseline studies, other sources of data from government, university researchers, and available scientific publications were also used.

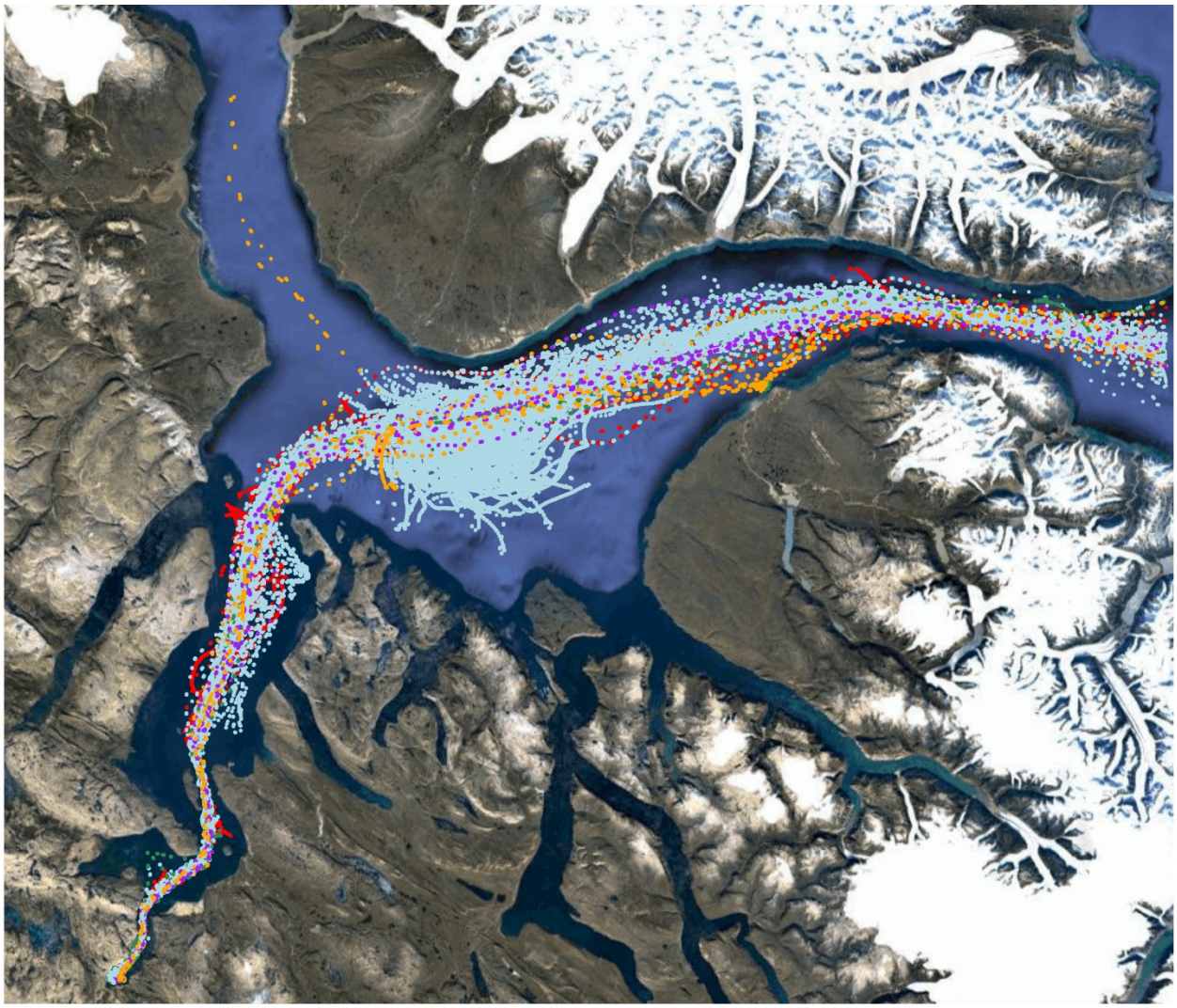
Inuit Qaujimajatuqnagit (IQ) shared and recorded at workshops was integrated into the report of baseline studies. For example, IQ indicated that bowhead whales may be found in the RSA during Upirngaaq (late May to July (TSD 24, Appendix A, page 17).

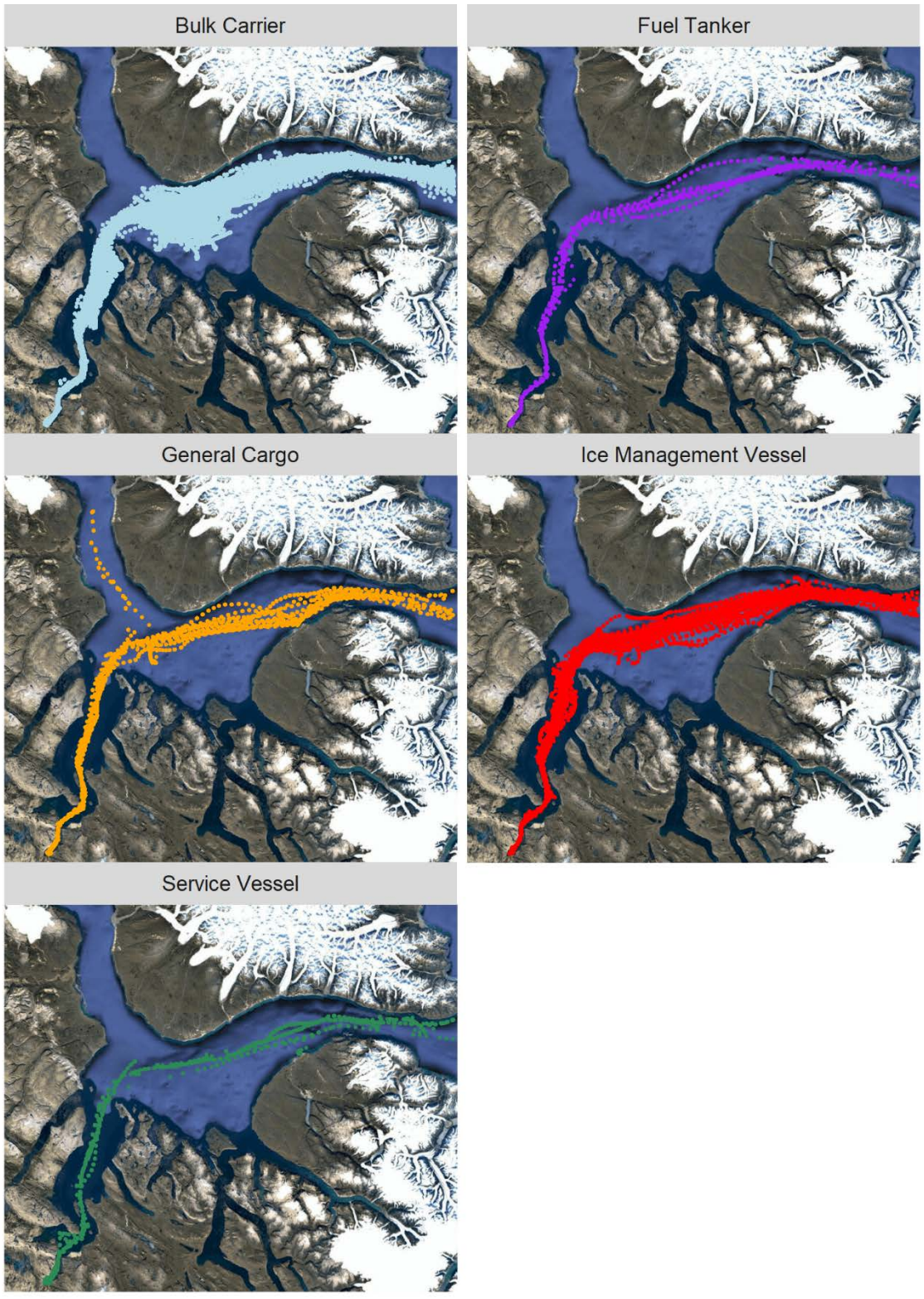
Table 2.1: Summary of Baffinland's Marine Mammal Monitoring Programs - Mary River Project

Survey Method	Year							
	2006	2007	2008	2013	2014	2015	2016	2017
Marine mammal aerial surveys	✓	✓	✓	✓	✓	✓	✓*	
Shore-based marine mammal monitoring				✓	✓	✓	✓	✓
Ship-based marine mammal monitoring				✓	✓	✓		
Acoustic monitoring				✓	✓			✓
Narwhal tagging study								✓

Notes: (*) Baffinland analysis of DFO-collected aerial survey photographs. Grey shaded areas indicate pre-operations (ERP) sampling

GN 73 ATTACHMENT 1: SUMMARY OF SHIP TRACK DATA 2017-2018


Bulk Carrier
Fuel Tanker
General Cargo
Ice Management Vessel
Service Vessel


Bulk Carrier
Fuel Tanker
General Cargo
Ice Management Vessel
Service Vessel
Bulk Carrier
Fuel Tanker
General Cargo
Ice Management Vessel
Service Vessel

GN 76 ATTACHMENT 1: TABLE 1: PROJECT TRAINING PROGRAMS OFFERED IN 2017

Table 1: Project Training Programs Offered in 2017

Training Course	Recognized Transferable Certification or Credential?	Inuit Hours	Non-Inuit Hours	Total Hours
Site Orientation		923	7,158	8,081
Tote Road		56	564	620
Mine License	X	10.5	217	227.5
Light Vehicle/Vehicle Fueling		49	472	521
VHF Radio		41.5	351.5	393
Fire Extinguisher		77	430	507
ICAM Training		0	387	387
Crusher Access Training		11	99	110
First Aid/CPR	X	49	1,245	1,294
Hoisting/Rigging/Crane	X	7	659	666
Fall Arrest (In Class)		4	248	252
Defensive Driving		17	73.5	90.5
Confined Space Training		5	487	492
Heavy Equipment Operator Classroom	X	997	5,362	6,359
Heavy Equipment Operator Coaching/Training	X	646	1,604	2,250
Heavy Equipment Operator Evaluation	X	149	2,435	2,584
Heavy Equipment Operator Re-evaluation	X	11	24.5	35.5
MAINT. Start/Move/Test		2	212	214
Snow Plow/Snow Blower		3	28.5	31.5
Live Bottom/End Dump		0	18	18
Flat-Deck/Float/Container		2	49	51
Bus		13.5	75	88.5
Fuel Truck		56.5	53	109.5
Mobile Support Equipment Classroom	X	274	1,632	1,906
Mobile Support Equipment Coaching/Training	X	43	435	478
Mobile Support Equipment Evaluation	X	128	1,068	1,196
Ore Haul Truck Classroom	X	60	2,380	2,440
Ore Haul Truck Coaching/Training	X	49	6,510	6,559
Ore Haul Truck Evaluation	X	12	915	927
Ore Haul Truck Re-evaluation	X	0	300	300
Sandvik Screener		0	20	20
Masaba Stacker		3	15	18
Wash Plant		4	0	4
Supervisor Exam	X	4	220	224
Advanced Lock Out Training	X	0	36	36

Table 1: Project Training Programs Offered in 2017

Training Course	Recognized Transferable Certification or Credential?	Inuit Hours	Non-Inuit Hours	Total Hours
SAP Training	**X**	4	58	62
New Onsite Zes Loto Review		100	472	572
WHMIS in Class		36	2	38
Environmental Protection Plan		5	24	29
Snowmobile		0	8	8
Online Confined Space		0	39	39
Online Fall Arrest		0	271	271
Online ZES Lockout/Tagout		13	392	405
Online Orientation		0	39	39
Online TDG		0	50	50
Online FLRA		0	161	161
Online WHMIS		14	527	541
Online Cultural Awareness		18	452	470
Supervisor Part 1	**X**	1	17	18
Compliance Training		86	718	804
Advanced Medical First Responder	**X**	40	360	400
TOTALS	–	**4,024**	**39,373**	**43,397**

GN 76 ATTACHMENT 2: TABLE 2: PROJECT TRAINING PROGRAMS OFFERED IN Q1-Q3 2018

Table 2: Project Training Programs Offered in Q1-Q3 2018

Training Course	Recognized Transferable Certification or Credential?	Inuit Hours	Non-Inuit Hours	Total Hours
Site Orientation		1,590	8,955	10,545
Light Vehicle/Vehicle Fueling		8	0	8
ICAM Training		0	94	94
Mine Drive Practical		0	33	33
Crusher Access Training		5	131	136
First Aid/CPR	X	48	289	337
Hoisting/Rigging/Crane	X	0	127	127
Fall Arrest (In Class)		60	154	214
Advanced LOTO		0	15	15
Defensive Driving		0	96	96
Confined Space Training		67	678	745
Heavy Equipment Operator Classroom	X	1,176	5,880	7,056
Heavy Equipment Operator Coaching/Training	X	1,227	2,108	3,335
Heavy Equipment Operator Evaluation	X	260	2,443	2,703
Heavy Equipment Operator Re-evaluation	X	24	80	104
MAINT. Start/Move/Test		2	189	191
Snow Plow/Snow Blower		0	9	9
Live Bottom/End Dump		0	35	35
Flat-Deck/Float/Container		0	115	115
Bus		17	29	46
Fuel Truck		134	55	189
Mobile Support Equipment Classroom	X	150	1,103	1,253
Mobile Support Equipment Coaching/Training	X	49	192	241
Mobile Support Equipment Evaluation	X	47	342	389
Ore Haul Truck Classroom	X	1	663	664
Ore Haul Truck Coaching/Training	X	48	1,293	1,341
Ore Haul Truck Evaluation	X	0	317	317
Ore Haul Truck Re-evaluation	X	0	937	937
Masaba Stacker		0	16	16
Wash Plant		0	10	10
Supervisor Exam	X	0	221	221
Advanced Lock Out Training	X	5	266	271
New Onsite Zes Loto Review		0	30	30
WHMIS in Class		81	11	92

Table 2: Project Training Programs Offered in Q1-Q3 2018

Training Course	Recognized Transferable Certification or Credential?	Inuit Hours	Non-Inuit Hours	Total Hours
Environmental Protection Plan		14	119	133
Norcat Courses		2	12	14
Online Confined Space		16	43	59
Online Fall Arrest		46	110	156
Online ZES Lockout/Tagout		53	63	116
Online TDG		12	8	20
Online WHMIS		79	62	141
Online Cultural Awareness		73	24	97
Heavy Equipment Operator – Morrisburg Training	**X**	9,176	0	9,176
Apprenticeship	**X**	8,550	0	8,550
Work Ready		884	0	884
TOTALS	–	**23,904**	**27,357**	**51,261**

GN 81 ATTACHMENT 1: FEIS APPENDIX 6A

APPENDIX 6A

PALAEONTOLOGY REPORT

Paleontological report for the proposed Mary River Project, Baffin Island, Nunavut.

Prepared by
Natalia Rybczynski, Ph.D.



June 2008

Contents

1.0 Methodology 1

2.0 Bedrock geology background 1
2.1 Gallery and Turner Cliffs Formations 1
2.2 Ship Point Formation 1
2.3 Baillarge Formation 2

3.0 Location of known fossil sites 2

4.0 Significance of bedrock fossils 2

5.0 Regulation overview 2

6.0 Results and additional considerations 3
6.1 Bedrock fossils 3
6.2 Pliocene forest fossils 3

6.1 Recommendations 4

7.0 References consulted for this report 4

Appendix A: Figures 5

Figure 1. Geological map of Mary River Project area. 5

Figure 2. *Maclurites* sp. fossil (snail). 6

Figure 3. *Receptaculites* fossil 6

Figure 4. Pliocene fossil log from Bylot Island. 7

Appendix B: Reference list from GeoRef search (Search on Baillarge and Ship Point Formation) 8

Appendix C: Rudkin correspondence 12

1.0 Methodology

This report is the result of a desk study of paleontological resources in the Mary River Project area Relevant maps and publications were identified with the assistance of employees of the Geological Survey of Canada library (Booth Street, Ottawa). These sources were consulted (see section 7.0) with the aim of identifying paleontological resources that might be encountered within or adjacent to the Mary River project area. A literature search on the relevant fossiliferous rock units was conducted using Web of Science and GeoRef (online, through Carleton University library) to see if fossils have been or are currently under paleobiological investigation.

I also contacted David M. Rudkin, an invertebrate paleontologist at the Royal Ontario Museum, to determine whether there was existing expertise in Canada that might be able to assist, should Paleozoic macrofossils (see section 2.0) be encountered.

2.0 Bedrock geology background.

Most of the bedrock underlying the Mary River Project area is Paleozoic (carbonate and siliclastic) and Archean/Paleoproterozic (gneisses and plutonic) rocks. A third rock type occurs in small areas only, and comprises Archean volcanic rocks (Mary River and Prince Albert groups). Of these three bedrock types only Paleozoic rocks hold any possibility of containing fossils. The location of these Paleozoic rocks is shown in Figure 1. The Paleozoic rock units and associated fossils are described below, from oldest to youngest.

2.1 Gallery and Turner Cliffs Formations.— Cambrian to Ordovician in age, these formations together comprise up to 650m of carbonate and siliclastic rocks. The Gallery Formation is roughly 340m of quartzose sandstone with minor siltstone, conglomerate and shale, with rare breccia, dolomitic sandstone and dolostone. The Turner Cliffs Formation overlies the Gallery Formation and comprises about 310m of shaly to pure dolostone, interbedded with dolomitic conglomerates, dolomitic sandstone, minor dolomitic siltstone and shale.

"Body fossils" (e.g., shells) have not yet been reported but trace fossils (e.g., invertebrate burrows) have been described from both formations.

2.2 Ship Point Formation. — This Ordovician aged formation unconformably overlies the Turner Cliffs Formation and is represented on Northwestern Baffin Island by 50 to 275 m of cliff forming microcrystalline dolostone, interbedded with dolomitic sandstone and minor dolostone conglomerate (flat pebbles and cobbles) and dolostone chip breccia. Fossils collected from this formation include *Maclurites* sp. (see Fig. 2 in Appendix A), *Liospira* sp., *Lophospira* sp. and

Metaspiroceras sp. and are consistent with an early Middle Ordovician age (Lemon and Blackadar, 1963). On nearby Melville Peninsula, to the south, this unit has also yielded conodonts (Barnes, 1977).

2.3 Baillarge Formation**.** — The Baillarge Formation (410 m) is considered Ordovician to Silurian in age and is represented by fine grained, light bluish-grey limestone interbedded with minor dolostone, breccia, chip conglomerate, sandstone and cherty beds. Fossils suggest that the base of the formation is late Middle Ordovician Age, whereas the upper 150 m is Lower Silurian. Fossils commonly recovered include *Receptaculites* cf. *R. arcticus* Etheridge (see Fig. 3 in Appendix A), *Catenipora* cf. *C. rubra* Sinclair and Bolton, *Maclurites manitobensis* Whiteaves (see Fig. 2 in Appendix A), in addition to crinoids (stems) (Lemon and Blackadar, 1963; Trettin, 1969). This unit unconformably overlies the Ship Point formation.

3.0 Location of known fossil sites.

The above fossils are described from localities in the Admirality Inlet region, just west of the Mary River Project area (Lemon and Blackadar, 1963). There seems to be no known localities reported from the Mary River project area itself, however the creation of new exposures, resulting for example from road or railway construction, may reveal new fossil localities.

4.0 Significance of bedrock fossils

From my survey of the scientific literature (using Web of Science and GeoRef) it appears that the Northwestern Baffin Island fossils have not themselves been recently studied in a paleobiological context, although work has been done on the geology of the Ship Point and Baillarge Formations (see Appendix B).

Even so, the fossil record of Northwestern Baffin does document an important period in the history of reef ecosystems. During the Ordovician the arctic landmass was located near the equator and the Northwestern Baffin Island area was covered by shallow seas. Fossils from this time are of interest because they represent members of among the earliest reef-like ecosystems, and therefore provide an early analogue for modern reef ecosystems. Moreover, towards the end of the Ordovician the planet experienced significant cooling, culminating in glaciations, which led to the demise of these reefs. This dramatic period of earth history is captured in the Baffin Island fossil record. Thus the Baffin Island fossil record is significant in part because it may provide an opportunity to investigate the relationship between the evolution of reef ecosystems and climate.

5.0 Regulation overview.

Protection of the paleontology heritage of Nunavut is a joint responsibility of the Governments of Nunavut and of Canada. The federal government regulates the protection and care of paleontological resources, whereas the territorial government (Department of Culture, Language, Elders and Youth) administrates permitting for field and laboratory research. The Canadian Museum of Nature is the official repository of Nunavut fossils (collected since 2001), until such time as Nunavut has its own paleontological collections facility.

6.0 Results and additional considerations

6.1 Bedrock fossils**.** — The most important fossils that might be recovered from the bedrock of the Mary River project area are Ordovician and Silurian invertebrate fossils, such as shells and sponge-like animals. These will tend to be found in bluish grey limestone deposits.

6.2 Pliocene forest fossils**.** — An additional kind of fossil deposit that might exist in the project area is not identifiable from surficial or bedrock geology maps. These unconsolidated fossil deposits are mostly Pliocene in age (2-5 million years old), and are found overlying bedrock deposits (usually near hilltops). The deposits preserve ancient bogs and forests and can be identified from the appearance of unpetrified wood and/or peat (grey, dark brown or black). The best studied Pliocene forest/peat deposit site is the Beaver Pond site, on Ellesmere Island (Strathcona Fiord). The Beaver Pond site has yielded the remains of a diverse assemblage of organisms including mosses, water plants, mollusks and trees, along with numerous extinct mammals including a horse, deerlet and beaver (Tedford & Harington, 2003). Similar wood/peat deposits are known from Bylot Island as well (see Fig. 4). It is entirely possible that such deposits might occur on northwest Baffin Island.

Such deposits are important because they can be used to derive climate (temperature and humidity) and CO^2 data from before the onset of the last Ice Ages. Ultimately, such results will be useful for testing global climate models that are often used to predict future climate change in response to projected greenhouse gas emissions. If these climate models can accurately recreate past climates (especially arctic climates), then we will be more confident in our ability to predict future climate changes.

7.0 Recommendations

If any fossils are uncovered (e.g., Ordovician invertebrates or Pliocene wood- see Fig. 4) through the activities of the Mary River Project, work in the immediate area will cease and a paleontologist will be notified so that the significance of the find can be evaluated.

The Canadian Museum of Nature (CMN) will be contacted, and additional experts would be brought in if need be. Currently there are no researchers at the CMN that specialize in invertebrate paleontology, however I have made contact with David Rudkin at the Royal Ontario Museum who would be willing to assist should the need arise (See Appendix C for correspondence).

8.0 References consulted for this report

Barnes, C.R. 1977. Ordovician conodonts from the Ship Point and Bad Cache Rapids formations, Melville Peninsula, southeastern District of Franklin; in Geology of Ordovician rocks, Melville Peninsula and region, southeastern District of Franklin. Bolton, T.E. Sanford, B.V., Copeland, M.J., Barnes, C.R., and Rigby, J.K.; Geological Survey of Canada, Bulletin 269, p. 99-119.

Kemp, E.A de and D.J. Scott. 1998. Geoscience compilation of northern Baffin Island and northern Melville Peninsula, Northwest Territories. Geological Survey of Canada, Open source file D3636. 2 CD-ROMS, volumes 1 and 2.

Lemon, R.R.H., and Blackadar, R.G. 1963. Admiralty Inlet area, Baffin Island, District of Franklin; Geological Survey of Canada, Memoir 328, 84 p.

Trettin, H.P.1969. LowerPaleozoic sediments of northwestern Baffin Island, District of Franklin. Geological Survey of Canada, Bulletin 157, 70p.

Scott, D.J. 1998. Bedrock Geology Compilation Northern Bafffin Island and Northern Melville Peninsula, Northwest Territories geological compilation by D. J. Scott and E. A. de Kemp. Geological Survey of Canada, Open source file 3633. 2 maps : col. + legend (1 sh.).

Appendix A. Figures



Figure 1. Geological Map of Mary River Project area. Ordovician/Silurian deposits that are fossiliferous are shown in blue. Most of these deposits are located in the area surrounding the Mary River site itself, and between the Mary Rive site and Milne Inlet. Abbreviations for lettering in yellow polygons: MI, Milne Inlet Camp and Port; MR, Mary River site; SI, Steensby Inlet. Map parts are from Scott, 1998: GSC, Open source file 3633.



Figure 2. *Maclurites* sp. fossil (snail). The shell is distinctive because one side is flat, and the other side (shown here) is strongly concave. Image South Dakota School of Mines and Technology - Museum of Geology. See http://www.palaeos.com/Invertebrates/Molluscs/Gastropoda/Eogastropoda/Macluritoidea.html



Figure 3. *Receptaculites* fossil. Specimen from Carleton College collection. This enigmatic organism appears superficially similar to corals or sponges, but may in fact be a calcareous green algae. Photo by Kelsey Dyck. see http://en.wikipedia.org/wiki/Receptaculites



Figure 4. Pliocene fossil log from Bylot Island**.** Such specimens originate from deposits in hilltop areas. The wood is not petrified, but rather appears modern. This sample is currently housed at the Parks office in Pond Inlet, Baffin Island. Photograph by N. Rybczynski, July 2007.

Appendix B. Reference list from GeoRef search (Search on Baillarge and Ship Point Formation). If fossils are discovered in Paleozoic deposits of the Mary River Project area, research would involve consultation with these references.

Record 1 of 12

DN: Database Name
GeoRef
TI: Title
Lower Paleozoic geology, Foxe Basin, northeastern Melville Peninsula, and part of northern and central Baffin Island
AU: Author
Trettin, H P; Norford, B S; Barnes, C S; Boucot, A J; Copeland, M J
SO: Source
Open-File Report - Geological Survey of Canada, Report: 64, 151 pp., 1971

Record 2 of 12

DN: Database Name
GeoRef
TI: Title
Geology, Phillips Creek, District of Franklin
AU: Author
Blackadar, R G; Davison, W L; Trettin, H P
SO: Source
Geological Survey of Canada Map, 1968
AB: Abstract
Precambrian rocks in the Phillips Creek area are limited to gneissic rocks of Aphebian age and gabbro dikes of presumed Neohelikian age; lower Paleozoic strata rest with pronounced unconformity on the Aphebian rocks. Paleozoic rocks include the Cambrian Admiralty Group, Ordovician Ship Point Formation, and Ordovician and Silurian Baillarge Formation. Paleozoic strata are nearly horizontal, but locally are disturbed by several fault zones, the most important being a group of southeasterly striking normal faults that mark the northeastern boundary of the Paleozoic outcrop area. Drainage is partly rectilinear and is controlled, to some extent, by a complicated pattern of bedrock fractures that affect bedrock as old as Precambrian as well as unconsolidated Holocene sediments.

Record 3 of 12

DN: Database Name
GeoRef
TI: Title
Stratigraphic sections and reconnaissance studies of the geological structure in widely separated areas of Foxe Basin, Melville Peninsula and Baffin Island
AU: Author
Trettin, H P; Bolton, T E; Sanford, B V

SO: Source
Open-File Report - Geological Survey of Canada, Report: 236, 123 pp., 1974

Record 4 of 12

DN: Database Name
GeoRef
TI: Title
Investigations of lower Paleozoic geology, Foxe Basin, northeastern Melville Peninsula, and parts of northwestern and central Baffin Island
AU: Author
Trettin, H P
SO: Source
Bulletin - Geological Survey of Canada, no.251, 177 pp., 1975

Record 5 of 12

DN: Database Name
GeoRef
TI: Title
Stratigraphy and sedimentology of Ordovician and Silurian strata, northern Brodeur Peninsula, Baffin Island
AU: Author
Nentwich, Franz W; Jones, Brian
SO: Source
Bulletin of Canadian Petroleum Geology, vol.37, no.4, pp.428-442, Dec 1989

Record 6 of 12

DN: Database Name
GeoRef
TI: Title
Geological framework of the Ordovician system in the Southeast Arctic Platform, Nunavut
AU: Author
Sanford, B V; Grant, A C
MT: Monograph Title
Geology and paleontology of the Southeast Arctic Platform and southern Baffin Island, Nunavut
ED: Editor
McCracken, A D; Bolton, T E
SO: Source
Bulletin - Geological Survey of Canada, Report: 557, pp.13-38, 2000

Record 7 of 12

DN: Database Name
GeoRef In Process
TI: Title

Ordovician conodonts from Akpatok Island, Nunavut
AU: Author
McCracken, A D
MT: Monograph Title
Geological Association of Canada, Mineralogical Association of Canada; joint annual meeting abstracts--Association geologique du Canada, Association mineralogique du Canada; congres annuel conjointe recueil des resumes
AU: Author
Anonymous
SO: Source
Program with Abstracts - Geological Association of Canada; Mineralogical Association of Canada; Canadian Geophysical Union, Joint Annual Meeting, vol. 29, pp.80, 2004
PB: Publisher
Geological Association of Canada, Waterloo, ON, Canada (CAN)
PY: Publication Year
2004

Record 8 of 12

DN: Database Name
GeoRef
TI: Title
Geology, Nauja Bay, Baffin Island, Nunavut
AU: Author
St-Onge, M R (compiler); Scott, D J (compiler); Corrigan, D (compiler)
SO: Source
Open-File Report - Geological Survey of Canada, Report: 4482, 1 sheet, 1 disc, 2004

Record 9 of 12

DN: Database Name
GeoRef
TI: Title
Telychian (Lower Silurian) stromatoporoids from the Charlestown Inlier, Co. Mayo, Ireland
AU: Author
Nestor, Heldur
SO: Source
Irish Journal of Earth Sciences, vol. 17, pp.115-121, 1999
AB: Abstract
Four stromatoporoid species: Pachystylostroma sp., Petridiostroma cf. simplex (Nestor, 1966), Gerronostroma juveneforme sp. nov. and Eostromatopora ringerikensis (Mori, 1978), are described from the Uggool Limestone Member of the Cloonnamna Formation (upper Llandovery) in the Charlestown Inlier, Co. Mayo, Ireland. A new genus Eostromatopora is established with the type species Stromatopora impexa Nestor, 1966. The fauna described here is closely related to the Telychian stromatoporoid faunas from the Vik Formation of the Oslo

area and from the Baillarge Formation of north-western Baffin Island, Canada.

Record 10 of 12

DN: Database Name
GeoRef
TI: Title
Stratigraphy and sedimentology of the Ordovician and Silurian Brodeur Group, northern Brodeur Peninsula, Baffin Island
AU: Author
Nentwich, Franz Werner

Record 11 of 12

DN: Database Name
GeoRef
TI: Title
Paleokarst and origin of carbonate breccias of the Ordovician-Silurian Brodeur Group, northwestern Brodeur Peninsula, Baffin Island
AU: Author
Nentwich, Franz W; Jones, Brian
MT: Monograph Title
GAC, MAC, CGU 1986 joint annual meeting; program with abstracts
SO: Source
Program with Abstracts - Geological Association of Canada; Mineralogical Association of Canada; Canadian Geophysical Union, Joint Annual Meeting, vol.11, pp.107, Feb 1986

Record 12 of 12

DN: Database Name
GeoRef
TI: Title
Ordovician and Silurian depositional framework of Prince Regent Basin, Brodeur Peninsula to Somerset Island, N.W.T.
AU: Author
Nentwich, Franz W; Jones, Brian
MT: Monograph Title
GAC/MAC, joint annual meeting
AU: Author
Anonymous
SO: Source
Program with Abstracts - Geological Association of Canada; Mineralogical Association of Canada; Canadian Geophysical Union, Joint Annual Meeting, vol.10, pp.A43, 1985

Appendix C. Rudkin correspondence

-----Original Message-----
From: David Rudkin [mailto:davidru@rom.on.ca]
Sent: Thursday, June 26, 2008 8:31 AM
To: Natalia Rybczynski
Subject: Re: Ordovician Arctic fossils?

Hi Natalia,

If your Arctic Ordovician project involves macrofossils, I'd be happy to try and help you out myself ... microfossils are another story, but I can steer you towards some appropriate colleagues if that's the case. I'm reasonably familiar with most of the major groups of Ordovician shelly invertebrates (trilobites, nautiloid cephalopods, corals, etc.) from the southern Baffin Island Middle through Upper Ordovician sequences (the classic "Silliman's Fossil Mount" material) and have worked on similar stuff from mainland subarctic sections. There are several other references to the regional paleontology that would be worth consulting, but the most recent and comprehensive account is Geological Survey of Canada Bulletin 557 (2000), edited by McCracken and Bolton.

Please let me know how I can be of further assistance.

Best regards,

Dave

David M. Rudkin
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E-mail: davidru@rom.on.ca

http://www.rom.on.ca/collections/curators/rudkin.php
http://www.rom.on.ca/collections/research/drarthropoda.php
http://www.geology.utoronto.ca/facultyrudkin.htm

>>> "Natalia Rybczynski" <NRybczynski@mus-nature.ca> 6/25/2008 8:49 PM >>>
Dear David Rudkin,

I am a researcher in vertebrate paleontology, and I have fallen into a project that might down the road require collaboration with someone who has invertebrate expertise.

I am looking for someone in Canada who might have experience with Ordovician fossils from the Arctic (esp. Baffin Island).

Do you know of anyone who has done work in this area? Or who would be interested in work in this area?

The most recent papers in this area I have found so far are :
Lemon, R.R.H., and Blackadar, R.G. 1963. Admiralty Inlet area, Baffin Island, District of Franklin; Geological Survey of Canada, Memoir 328, 84 p.
Trettin, H.P.1969. LowerPaleozoic sediments of northwestern Baffin Island, District of Franklin. Geological Survey of Canada, Bulletin 157, 70p.

Thank you in advance for your time and consideration.

Regards,

Natalia

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physical address:
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APPENDIX 2
THE QIKIQTANI INUIT ASSOCIATION IR ATTACHMENTS

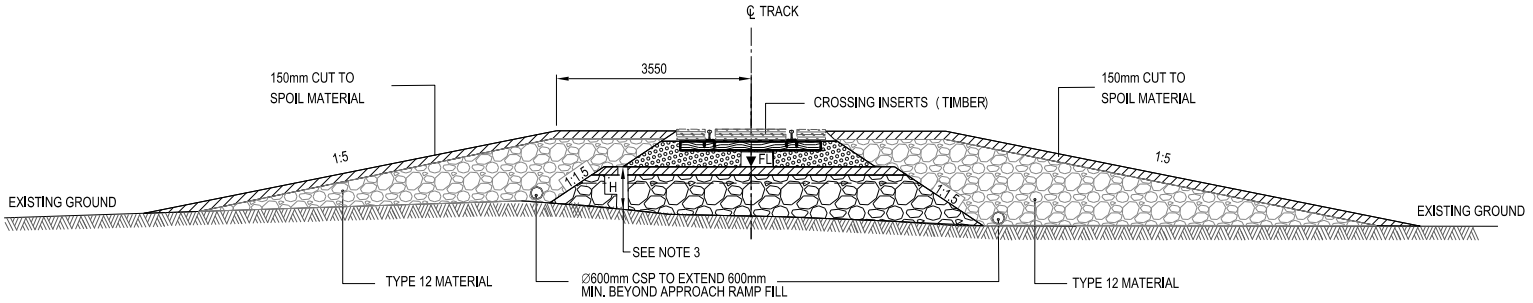
QIA 12 ATTACHMENT 1: SUMMARY OF PLANNED ENGAGEMENT ACTIVITIES FOR 2018 AND 2019 RELATED TO THE PHASE 2 PROPOSAL

Planned Community Engagements Relevant to Phase 2

Engagement	Objective	Location	Timeframe
Community Feasts	Make Phase 2 information available to community members to better inform subsequent engagements	LSA Communities	December 13th - 17th, 2018
Information Tour	Provide summary of Phase 2 project description and effects assessment; identify outstanding issues with proposal to address through EA process	LSA Communities Resolute & Grise Fiord	Jan 7th - 11th, 2019 TBD* - last week of January 2019
Risk Workshops -Terrestrial and Marine (Railway and Shipping Management)	Involve community knowledge holders in practical environmental management planning around the railway and shipping components of Phase 2	Iqaluit (Workshop 1) Pond Inlet (Workshop 2) Pond Inlet (Workshop 3)	January 14th - 18th TBD* - second week of February 2019 TBD* - last week of March 2019
Risk Workshops -Atmospheric (Dust Management)	Involve community knowledge holders in practical environmental management planning around the railway and dust generating of Phase 2	LSA Communities	TBD* - February/March 2019
Community Update Tour	Update community on progress of review and resolution of issues of concern leading into the Public Hearing	LSA Communities Resolute and Grise Fiord (TBD)	TBD* - last two weeks of April 2019

*Baffinland resources are aligned, however, proposed dates still need to be agreed to by participants, and final logistics arranged.

QIA 21 ATTACHMENT 1: TYPICAL CROSS SECTION FOR CARIBOU CROSSING



TYPICAL CROSS SECTION FOR CARIBOU AND SNOW MOBILE CROSSING

NTS

NOTES:

1. MATERIAL TYPE DEFINITION:
   - TYPE 5: 32mm MINUS
   - TYPE 8: 150mm MINUS
   - TYPE 12: RUN OF QUARRY/ROCK FILL LAYER
   - TYPE 25: BALLAST LAYER
   - TYPE 26: SUB-BALLAST LAYER
2. MINIMUM EMBANKMENT (TYPE 12 PLUS SUB-BALLAST) THICKNESS VARIES DEPENDING ON SUB-GRADE CONDITION
   H= 700mm STANDARD DIMENSION
   H= 1500mm FOR ICE RICH PERMAFROST.

   542 NON-WOVEN GEOTEXTILE UNDER TYPE 12 MATERIAL ON ICE RICH SILT.
3. TIMBER CROSSING INSERTS SHALL BE 178mm HIGH AND 229mm WIDE INSERTS TO BE FASTENED TO TIMBER TIES USING 305mm LAG SCREWS. MINIMUM OF 76mm SHALL BE MAINTAINED BETWEEN GAUGE FACE OF THE RAIL AND NEAREST CROSSING INSERT.

QIA 86 ATTACHMENT 01: FULL RESPONSE

QIA IR-86:

Provide additional details on training delivered to date and planned for Phase 2:

A. Breakdown of Mandatory vs. On-the-job (advancement) training delivered to Inuit and Non-Inuit in hours by year.
B. New Inuit hires by year, age and educational attainment. This helps understand the number of Inuit who are accepting the opportunity cost of not finishing secondary school.
C. The number of apprenticeships offered to Inuit and Non-Inuit; number of successful vs. attempted Trades Entrance Exams; instances of level advancement within an apprenticeship; number of Red Seals earned.
D. Additional Inuit employment hours that Baffinland expects to generate from its current Apprenticeship Program and HEO Training (Q-STEP).
E. Explanation of how Baffinland confirms "Inuit Ethnicity" if not through NTI number (p. 33)
F. How exactly Baffinland will adapt training programs to account for the "small shift in employee level skill requirements" (p. 24).
G. Identify the precise training programs that will upgrade employees' skill levels from D to C to B Positions (p. 27). Baffinland rather simply refer to the IHRS (not a training program) and Q-STEP generally. This is a critical question that Baffinland has been asked to consider in the EIS guidelines and it has not done son.
H. Additional details on Inuit promotions, such as lateral vs skill level advancement.
I. Additional details on Inuit departures, including rehires and those ineligible for rehire.
J. Provide career paths for each department that operates in Nunavut, and example career path development plans. This has been a Baffinland commitment from over one year.

Baffinland Response:

A. Breakdown of mandatory vs on-the-job (advancement) training delivered to Inuit and Non-Inuit in hours by year.

As noted in Section 3.4 of TSD-25 a total of 122,950 hours of training have been provided since Project development, of which 15,867 hours were provided to Inuit. In addition, there have been considerable work-related experience and informal on-the-job training opportunities generated by the Project. In 2017, 43,397 hours of training were completed at the Project site, of which 4,024 hours were provided to Inuit. In 2017, over 50 different types of training were completed on-site. A breakdown of mandatory vs. advancement-related training delivered to Inuit and non-Inuit in 2017 is provided in Table 1. This annual snapshot provides a useful indication of mandatory vs. advancement-related training that has been delivered by Baffinland.

Training at Baffinland is role specific. Therefore, all training offered by Baffinland is mandatory in some instances depending on the role that is being trained for. For example, someone working on a hoisting and rigging team is required to take mandatory hoisting and rigging training. However, an employee who has expressed an interest in advancement into a new career that involves hoisting and rigging may request from their manager or supervisor the opportunity to take specific training to allow them to receive the necessary training to be able to advance into a position when a vacancy occurs.

Table 1: Project Training Programs Offered in 2017

Training Course	Mandatory Training?	Advancement -Related Training?	Inuit Hours	Non-Inuit Hours	Total Hours
Site Orientation	**X**		923	7,158	8,081
Tote Road	**X**		56	564	620
Mine License	**X**		10.5	217	227.5
Light Vehicle/Vehicle Fueling	**X**		49	472	521
VHF Radio	**X**		41.5	351.5	393
Fire Extinguisher	**X**		77	430	507
ICAM Training	**X**		0	387	387
Crusher Access Training	**X**		11	99	110
First Aid/CPR	**X**		49	1,245	1,294
Hoisting/Rigging/Crane	**X**	**X**	7	659	666
Fall Arrest (In Class)	**X**		4	248	252
Defensive Driving	**X**		17	73.5	90.5
Confined Space Training	**X**		5	487	492
Heavy Equipment Operator Classroom	**X**	**X**	997	5,362	6,359
Heavy Equipment Operator Coaching/Training	**X**	**X**	646	1,604	2,250
Heavy Equipment Operator Evaluation	**X**	**X**	149	2,435	2,584
Heavy Equipment Operator Re-evaluation	**X**		11	24.5	35.5

Table 1: Project Training Programs Offered in 2017

Training Course	Mandatory Training?	Advancement -Related Training?	Inuit Hours	Non-Inuit Hours	Total Hours
MAINT. Start/Move/Test	**X**		2	212	214
Snow Plow/Snow Blower	**X**		3	28.5	31.5
Live Bottom/End Dump	**X**		0	18	18
Flat-Deck/Float/Container	**X**		2	49	51
Bus	**X**		13.5	75	88.5
Fuel Truck	**X**		56.5	53	109.5
Mobile Support Equipment Classroom	**X**	**X**	274	1,632	1,906
Mobile Support Equipment Coaching/Training	**X**	**X**	43	435	478
Mobile Support Equipment Evaluation	**X**		128	1,068	1,196
Ore Haul Truck Classroom	**X**	**X**	60	2,380	2,440
Ore Haul Truck Coaching/Training	**X**	**X**	49	6,510	6,559
Ore Haul Truck Evaluation	**X**	**X**	12	915	927
Ore Haul Truck Re-evaluation	**X**		0	300	300

Table 1: Project Training Programs Offered in 2017

Training Course	Mandatory Training?	Advancement -Related Training?	Inuit Hours	Non-Inuit Hours	Total Hours
Sandvik Screener	**X**		0	20	20
Masaba Stacker	**X**		3	15	18
Wash Plant	**X**		4	0	4
Supervisor Exam	**X**	**X**	4	220	224
Advanced Lock Out Training	**X**		0	36	36
SAP Training	**X**	**X**	4	58	62
New Onsite Zes Loto Review	**X**		100	472	572
WHMIS in Class	**X**		36	2	38
Environmental Protection Plan	**X**		5	24	29
Snowmobile	**X**		0	8	8
Online Confined Space	**X**		0	39	39
Online Fall Arrest	**X**		0	271	271
Online ZES Lockout/Tagout	**X**		13	392	405
Online Orientation	**X**		0	39	39
Online TDG	**X**		0	50	50
Online FLRA	**X**		0	161	161
Online WHMIS	**X**		14	527	541
Online Cultural Awareness	**X**		18	452	470
Supervisor Part 1	**X**	**X**	1	17	18
Compliance Training	**X**		86	718	804

Table 1: Project Training Programs Offered in 2017

Training Course	Mandatory Training?	Advancement -Related Training?	Inuit Hours	Non-Inuit Hours	Total Hours
Advanced Medical First Responder	**X**	**X**	40	360	400
TOTALS	–	–	**4,024**	**39,373**	**43,397**

Additional training information is available for Q1-Q3 2018 and is presented in Table 2. In Q1-Q3 2018, 51,261 hours of training were completed at the Project site, of which 23,904 hours were provided to Inuit. Even without Q4 2018 data included, this already represents a significant increase in Inuit training hours over previous years. Many of these new training hours can be attributed to Baffinland's Apprenticeship Program and Morrisburg Heavy Equipment Operator Program, which can be considered additional types of advancement-related training. Annual data pertaining to these programs will be presented in future socio-economic monitoring reports to NIRB and in IIBA implementation reports to QIA.

Table 2: Project Training Programs Offered in Q1-Q3 2018

Training Course	Mandatory Training?	Advancement-Related Training?	Inuit Hours	Non-Inuit Hours	Total Hours
Site Orientation	**X**		1,590	8,955	10,545
Light Vehicle/Vehicle Fueling	**X**		8	0	8
ICAM Training	**X**		0	94	94
Mine Drive Practical	**X**		0	33	33
Crusher Access Training	**X**		5	131	136
First Aid/CPR	**X**		48	289	337
Hoisting/Rigging/ Crane	**X**	**X**	0	127	127
Fall Arrest (In Class)	**X**		60	154	214
Advanced LOTO	**X**		0	15	15
Defensive Driving	**X**		0	96	96
Confined Space Training	**X**		67	678	745
Heavy Equipment Operator Classroom	**X**	**X**	1,176	5,880	7,056

Table 2: Project Training Programs Offered in Q1-Q3 2018

Training Course	Mandatory Training?	Advancement-Related Training?	Inuit Hours	Non-Inuit Hours	Total Hours
Heavy Equipment Operator Coaching/Training	**X**	**X**	1,227	2,108	3,335
Heavy Equipment Operator Evaluation	**X**	**X**	260	2,443	2,703
Heavy Equipment Operator Re-evaluation	**X**		24	80	104
MAINT. Start/Move/Test	**X**		2	189	191
Snow Plow/Snow Blower	**X**		0	9	9
Live Bottom/End Dump	**X**		0	35	35
Flat-Deck/Float/Container	**X**		0	115	115
Bus	**X**		17	29	46
Fuel Truck	**X**		134	55	189
Mobile Support Equipment Classroom	**X**	**X**	150	1,103	1,253
Mobile Support Equipment Coaching/Training	**X**	**X**	49	192	241
Mobile Support Equipment Evaluation	**X**		47	342	389
Ore Haul Truck Classroom	**X**	**X**	1	663	664
Ore Haul Truck Coaching/Training	**X**	**X**	48	1,293	1,341
Ore Haul Truck Evaluation	**X**	**X**	0	317	317

Table 2: Project Training Programs Offered in Q1-Q3 2018

Training Course	Mandatory Training?	Advancement-Related Training?	Inuit Hours	Non-Inuit Hours	Total Hours
Ore Haul Truck Re-evaluation	**X**		0	937	937
Masaba Stacker	**X**		0	16	16
Wash Plant	**X**		0	10	10
Supervisor Exam	**X**	**X**	0	221	221
Advanced Lock Out Training	**X**		5	266	271
New Onsite Zes Loto Review	**X**		0	30	30
WHMIS in Class	**X**		81	11	92
Environmental Protection Plan	**X**		14	119	133
Norcat Courses	**X**		2	12	14
Online Confined Space	**X**		16	43	59
Online Fall Arrest	**X**		46	110	156
Online ZES Lockout/Tagout	**X**		53	63	116
Online TDG	**X**		12	8	20
Online WHMIS	**X**		79	62	141
Online Cultural Awareness	**X**		73	24	97
Heavy Equipment Operator – Morrisburg Training	**X**	**X**	9,176	0	9,176
Apprenticeship	**X**	**X**	8,550	0	8,550
Work Ready	**X**		884	0	884
TOTALS	–	–	**23,904**	**27,357**	**51,261**

B. New Inuit hires by year, age and educational attainment. This helps understand the number of Inuit who are accepting the opportunity cost of not finishing secondary school.

To-date, Baffinland has not monitored new Inuit hires by year, age, or educational attainment. However, Baffinland can acknowledge that as of Q3 2018, 357 Inuit worked at the Project for Baffinland or a contractor. This represents a 20% increase over the number of Inuit who worked at the Project in Q2 2018. Baffinland and QIA have agreed to conduct a Workplace Conditions Review annually, and both parties could consider adding these type of data requests to the annual review process.

However, Baffinland has monitored Company employee and contractor employee education levels, and education status prior to Project employment, through an Inuit Employee Survey. The most recent version of this survey was administered by a survey team consisting of Baffinland and QIA representatives at Project sites in January 2018. A total of 71 surveys were completed by Inuit employees and contractors. Selected survey results were presented in Appendix B of TSD-25, but are also summarized below. Full survey results were provided under separate cover directly to QIA.

Table 3 summarizes results on the highest level of education obtained by survey respondents. 38.0% of respondents had no certificate, diploma, or degree. 22.5% had a high school diploma or equivalent, 5.6% had an apprenticeship or trades certificate or diploma, and 4.2% had a college, CEGEP, or other non-university certificate or diploma. 0.0% had any type of university certificate, diploma, or degree, and 29.6% of respondents had unknown educational levels (*n*=71). When 'unknown' results are removed, 54.0% had no certificate, diploma, or degree, 32.0% had a high school diploma or equivalent, and 14.0% had higher than a high school diploma or equivalent.

By comparison, data from the 2016 Census indicate the proportion of the North Baffin LSA's population (aged 25 to 64 years) with no certificate, diploma or degree was 50.8%; with a secondary school diploma or equivalency certificate was 14.4%; and with a postsecondary certificate, diploma, or degree was 36.0%. Likewise, the proportion of Nunavut's population (aged 25 to 64 years) with no certificate, diploma or degree was 40.9%; with a secondary school diploma or equivalency certificate was 14.6%; and with a postsecondary certificate, diploma, or degree was 44.4% (Statistics Canada 2017a, b, c, d, e, f).

Table 3: Highest Level of Education Obtained (January 2018 Inuit Employee Survey Results)

Highest Level of Education Obtained (January 2018 Inuit Employee Survey Results)		
Highest Level of Education	**Number of Respondents**	**Percentage of Respondents**
No certificate, diploma or degree	27	38.0%
High school diploma or equivalent	16	22.5%
Apprenticeship or trades certificate or diploma	4	5.6%
College, CEGEP or other non-university certificate or diploma	3	4.2%
University certificate or diploma below bachelor level	0	0.0%
University certificate, diploma or degree - Bachelor's degree	0	0.0%
University certificate, diploma or degree above bachelor level	0	0.0%
Unknown	21	29.6%
Total	**71**	**99.9%**
Notes: Total percentage may not equal 100.0% due to rounding		

Table 4 summarizes results on the education status of survey respondents prior to Project employment. 9.9% of respondents were enrolled in an academic or vocational program at the time of their hire at the Project, while 81.7% were not. Results were unknown for 8.5% of respondents (*n*=71). When 'unknown' results are removed, 10.8% of respondents were enrolled in an academic or vocational program at the time of their hire at the Project while 89.2% were not. Of those respondents that were enrolled in an academic or vocational program at the time of their hire at the Project (*n*=7), 28.6% (or 3.1% of known survey responses) suspended or discontinued their education because they were hired to work at the Project while 71.4% (or 7.7% of known responses) did not.

Table 4: Education Status Prior to Project Employment (January 2018 Inuit Employee Survey Results)

Education Status Prior to Project Employment (January 2018 Inuit Employee Survey Results)		
Pre-Employment Status	**Number of Respondents**	**Percentage of Respondents**
Were you enrolled in an academic or vocational program at the time of your hire at the Mary River Project? (n=71)		
Yes	7	9.9%
No	58	81.7%
Unknown	6	8.5%
Total	**71**	**100.1%**
If yes, did you suspend or discontinue your education because you were hired to work at the Mary River Project? (n=7)		
Yes	2	28.6%
No	5	71.4%
Total	**7**	**100.0%**
Notes: Total percentages may not equal 100.0% due to rounding		

In addition to the above survey results which have been publicly reported (see Appendix B of TSD-25), Baffinland has compiled additional survey results which may be relevant to this Information Request. Table 5 summarizes results pertaining to January 2018 Inuit Employee Survey respondents who indicated their length of employment with the Project as being 'less than 1 year' and who were also 'under 30 years old'. Individuals in this cohort are considered most likely to be a 'new hire'. Data from this cohort can also be investigated to help understand the number of Inuit who may be accepting the opportunity cost of not finishing secondary school.

For example, of the cohort who indicated they were both employed 'less than 1 year' and were 'under 30 years old' (*n*=23), 39.1% had no certificate diploma or degree, 34.7% had a high school diploma or equivalent, and 0.0% had higher than a high school diploma or equivalent. Results were unknown for 26.1% of respondents. When 'unknown' results are removed, 53.0% of respondents had no certificate diploma or degree, and 47.1% had a high school diploma or equivalent.

Also within this cohort (*n*=23), 8.7% were enrolled in an academic or vocational program at the time of their hire at the Project, while 82.6% were not. Results were unknown for 8.7% of respondents. When 'unknown' results are removed, 9.5% of respondents were enrolled in an academic or vocational program at the time of their hire at the Project while 90.5% were not. Of the known respondents from this cohort that were enrolled in an academic or vocational program at the time of their hire at the Project (*n*=2), 1 individual suspended or discontinued their education because they were hired to work at the Project. Further analysis revealed this individual had been in high school and was employed by a contractor.

It is important to note that Baffinland does not target or solicit current high school students for employment opportunities. The Company works with high schools throughout the point-of-hire communities to discuss and share information about opportunities for future employment but only targets those who have graduated for existing opportunities.

Table 5: Employment Duration, Age, and Educational Status - Select Survey Results (January 2018 Inuit Employee Survey Results)

Employment Duration, Age, and Educational Status - Select Survey Results (January 2018 Inuit Employee Survey Results)		
Pre-Employment Status	**Number of Respondents**	**Percentage of Respondents**
How long have you worked for your current employer (Baffinland or contractor)? (n=71)		
Less than 1 year	35	49.3%
At least 1 year, but less than 2 years	8	11.3%
At least 2 years, but less than 3 years	7	9.8%
3+ years	20	28.2%
Unknown	1	1.4%
Total	**71**	**100.0%**
Please indicate your age (n=71)		
Under 30 years old	30	42.2%
30 to 39 years old	20	28.2%
40 to 49 years old	12	16.9%
50 to 59 years old	5	7.0%
Over 60 years old	2	2.8%
Unknown	2	2.8%
Total	**71**	**99.9%**
If 'less than 1 year' and 'under 30 years old', what is the highest		

Table 5: Employment Duration, Age, and Educational Status - Select Survey Results (January 2018 Inuit Employee Survey Results)

Employment Duration, Age, and Educational Status - Select Survey Results (January 2018 Inuit Employee Survey Results)		
Pre-Employment Status	**Number of Respondents**	**Percentage of Respondents**
level of education you have obtained? (n=23)		
No certificate, diploma or degree	9	39.1%
High school diploma or equivalent	8	34.7%
Higher than a high school diploma or equivalent	0	0.0%
Unknown	6	26.1%
Total	**23**	**99.9%**
If 'less than 1 year' and 'under 30 years old', were you enrolled in an academic or vocational program at the time of your hire at the Mary River Project? (n=23)		
Yes	2	8.7%
No	19	82.6%
Unknown	2	8.7%
Total	**23**	**100.0%**
If yes, did you suspend or discontinue your education because you were hired to work at the Mary River Project? (n=2)		
Yes	1	50.0%
No	1	50.0%
Unknown	0	0.0%
Total	**2**	**100.0%**
Notes: Total percentages may not equal 100.0% due to rounding		

C. The number of apprenticeships offered to Inuit and non-Inuit; number of successful vs attempted Trades Entrance Exams; instances of level advancement within an apprenticeship; number of Red Seals earned.

Data related to apprenticeship programming prior to 2015 is limited. In 2015, Baffinland committed to support its first group of apprentices in the following trades: oil burner mechanic, welder, and heavy-duty equipment mechanic. There were four Inuit apprentices enrolled in various stages of the program in 2015. In 2016, Baffinland employed one Inuit apprentice. In 2017, Baffinland employed one Inuit apprentice and zero non-Inuit apprentices. Zero apprenticeships were completed by Inuit or non-Inuit during 2017.

In late 2017, Baffinland launched a new Apprenticeship Program. The Apprenticeship Program has participants join Baffinland as trades assistants for six months and participate in job shadowing activities to learn about the trade and Baffinland's operations. Upon successful completion of the six-month term, candidates write their Trades Entrance Exam. Upon successful completion of the exam, candidates are offered full-time, permanent apprenticeship positions with Baffinland.

To further support the Apprenticeship Program and prepare trades assistants for the Trades Entrance Exam, Baffinland also started a Pre-Trades Program with Nunavut Arctic College at site during Q1 2018. The Pre-Trades Program assists individuals in gaining a foundation in the physical sciences and improving their English and mathematics skills, which is intended to assist these individuals when taking the Trades Entrance Exam.

As of November 2018, 9 Inuit apprentices are currently employed by Baffinland in the Apprenticeship Program. Baffinland regularly reports on the success of its Apprenticeship Program to the QIA through regular IIBA implementation reports as well as Project Advisory Committee meetings through the Qikiqtani Skills and Training for Employment Partnership (Q-STEP) program. As of Q3 2018, Inuit are enrolled in the following areas of the Apprenticeship Program:

- Housing Maintainer
- Oil Burner Mechanic
- Electrician
- Heavy Duty/Truck Mechanic
- Welder
- Heavy Equipment Mechanic

Since 2015, 11 Inuit have passed their Trades Entrance Exam while employed by Baffinland. Of those 11, 2 withdrew from the program of their own volition. Currently, 2 Inuit apprentices are in their third year and 7 are in the first year of their programs. No Inuit have earned Red Seals to-date. The next cohort of apprentices are currently being selected. The position postings closed as of September 30, 2018 and the selection process will occur in Q4 2018. The next cohort of apprentices are expected to start the program in December 2018 in the areas of:

- Heavy Equipment Service Technician/Mechanic
- Heavy Truck and Trailer Service Technician/Mechanic
- Automotive Service Technician/Mechanic
- Oil Heat Systems Technician/Oil Burner Mechanic
- Welder
- Electrician
- Millwright
- Parts Technician
- Machinist

D. Additional Inuit employment hours that Baffinland expects to generate from its current Apprenticeship Program and HEO Training (Q-STEP).

Baffinland and QIA were recently successful in securing funds through Employment and Social Development Canada's (ESDC) Skills and Partnership Fund for their Qikiqtani Skills and Training for

Employment Partnership (Q-STEP) training program. Q-STEP is a four-year initiative that will be undertaken by QIA in close partnership with Baffinland to provide Inuit with skills and qualifications to meet the employment needs of the Mary River Project as well as other employment opportunities in the region. The program will consist of both work readiness measures as well as targeted training programs directed at apprenticeships, skills development, supervisor training, and formal certification in heavy equipment operation. The total value of the program is $19 million. The Government of Canada will provide $7.9 million, Baffinland will provide $9.4 million of in-kind support, and Kakivak Association will provide up to $1.6 million of in-kind support. The Government of Nunavut will also offer operational support to Q-STEP.

The program is expected to provide wage subsidized training for at least 300 Inuit, and lead to a minimum of 110 permanent jobs. In addition, Q-STEP will provide on-the-job training to new and current Inuit employees with Baffinland. Finally, Q-STEP will also help to reduce barriers to Inuit employment across the Qikiqtaaluk Region by teaching relevant and transferable skills to participants beyond the operational needs of the Mary River Project.

As of November 2018, the Heavy Equipment Operator (HEO) program has resulted in 26 permanent employment opportunities at Mary River and the Work Readiness program has resulted in 1 permanent employment opportunity. Baffinland expects its training-to-employment programs will continue to produce positive outcomes throughout the life of the Project.

E. Explanation of how Baffinland confirms "Inuit Ethnicity" if not through NTI number. (p 33)

Most Inuit candidates who apply for employment with Baffinland self-declare their Inuit ethnicity on their resume. In cases where this does not occur, Baffinland employees are asked to self-declare their Inuit ethnicity through the recruitment and hiring process. NTI numbers cannot be compelled by the Company from an employee, but the Company does explain the reason for the request to obtain these numbers from Inuit employees. Contractor employees are asked to self-declare their Inuit ethnicity through the process used to arrange for travel to the Project site. Contractors are also required to submit quarterly Inuit content reports to Baffinland, which includes information about the number of Inuit employees they have on staff. When potential discrepancies have been found in Project employment monitoring records, Baffinland validates records against the Inuit Enrolment List assigned by Nunavut Tunngavik Inc. pursuant to Article 35 of the Nunavut Agreement.

F. How exactly Baffinland will adapt training programs to account for the "small shift in employee level skill requirements" (p 24).

Baffinland human resources and training staff will conduct an internal review of training needs for the Phase 2 Proposal and identify any gaps in current training programs. This will occur in the near future and in an ongoing manner during Project operations. Where appropriate, new training programs may be developed, or existing programs may be modified. For example, Baffinland will, over time, place less focus on training related to road haulage (to address the switch from road to rail haulage) and additional focus on training related to rail, port, shipping, and other operations.

In addition, in accordance with the IIBA (Article 8.6.7) QIA and the Company will collaborate to ensure that training opportunities for Inuit are filled to the greatest degree possible, with priority to Inuit from point-of-hire communities. QIA and Baffinland will also work together to direct all decisions on the use

and expenditure of funding for training (Article 8.6.10). Baffinland believes that effective collaboration on these activities will be key components in the work that will be required to adapt training programs for Phase 2.

G. Identify the precise training programs that will upgrade employees' skill levels from D to C to B Positions (p 27). Baffinland rather simply refers to the IHRS (not a training program) and Q-STEP generally. This is a critical question that Baffinland has been asked to consider in the EIS guidelines and it has not done so.

Baffinland has outlined how its training programs will upgrade employees' skill levels in Table 3.3 of TSD-25. Baffinland has further highlighted the importance of the IHRS and Q-STEP program as key strategic and overarching elements of this process. While some specific training programs have not been created by Baffinland yet, other programs are currently in operation and/or development. For example, Baffinland currently offers an Apprenticeship Program (see responses to 'C' and 'D' above, for details) aimed at upgrading employees' skill levels. Baffinland, along with the Operating Engineers Training Institute of Ontario has also continued to run the Heavy Equipment Operator Program in Morrisburg, Ontario. The Program consists of two weeks (78 hours) of in class theory followed by four weeks (162 hours) of practical training on a Grader, Skid Steer, Excavator, and Loader. 26 individuals have been employed at the Project following completion of this training. The above-noted training is in addition to various other training programs offered by Baffinland (see Tables 1 and 2 above) that contribute to overall employee skill development.

As per IIBA Article 7.20 (QIA and Baffinland 2018), Baffinland recently made a new commitment to develop and operate an Inuit Internship Program. This program will operate for a minimum of 10 years and will offer a minimum of four internship positions per year, two of which will be for occupations outside the traditional trades and heavy equipment operation. Upon completion of a one-year internship, an Inuit Intern shall receive priority hiring for any position with the Company or its contractors for which he or she subsequently applies and for which he or she satisfies the minimum requirements of the position. This program should also contribute to upgrading individuals' skill levels over time. Furthermore, IIBA Article 8.8 commits the Company to providing a minimum of $25,000 annually for a scholarship fund. While not directly linked to Project employment, ongoing implementation of this fund supports educational and skill level development amongst Inuit.

To guide current employee progression planning Baffinland also has a 'Lines of Progression Policy'. The purpose of this policy is to ensure that employees and managers/supervisors clearly understand the interrelationship between roles, the pathways for promotion, and accompanying policies and procedures. This current policy applies to all site employees who are employed in maintenance and operations roles.

Article 7.15 of the IIBA further commits Baffinland to developing career path development plans for every Inuk employee and developing career paths for each department. Baffinland is in the process of developing these in collaboration with the Mining Industry Human Resources Council (MIHR), which are expected to be completed in late 2019 or early 2020. As precise skill upgrading/training programs will vary depending on employee and position, this represents a considerable amount of work to be completed and requires careful consideration by Baffinland's human resources team. Career development plans and career paths will be provided to QIA for review once they are complete through the IIBA Employment Committee.

H. Additional details on Inuit promotions, such as lateral vs skill level advancement.

Baffinland provides data on Inuit promotions through its annual socio-economic monitoring reports to NIRB and its IIBA implementation reports to QIA, and included some information on this topic in TSD-25 (Section 3 - Education and Training). Additional information on Inuit promotions and position promoted from/to, for 2016 to 2018 is summarized in Table 6. Options for skill level (e.g. NOC code) monitoring will be developed by Baffinland in the future and in accordance with IIBA provisions on this topic. Conversations between Baffinland and QIA are ongoing on the topic of tracking positions by NOC code through the IIBA Employment Committee. Baffinland has engaged with MIHR to assist in this work and to ensure that positions at the Project are accurately categorized according to NOC code standards. This is part of a package of work with MIHR that is expected to be complete in late 2019 or early 2020.

Table 6: Baffinland Inuit Employee Promotions, by Position Promoted From/To (2016 to 2018)

Year	Position Promoted From	Position Promoted To
2016	Operator 3	Operator 2
	Operator 3	Operator 1
	Operator 3	Operator 2
	Operator 3	Operator 2
	Operator 2	Operator 1*
	Operator 2	Operator 1*
	Operator 3	Operator 2
	Operator 3	Operator 2
	Operator 3	Operator 2
	Operator 2	Operator 1
	Operator 3	Operator 2
	Operator 3	Operator 2
	Operator 3	Operator 2 - OHT driver
	Operator 3	Operator 2
2017	Environmental Technician	Environmental Coordinator
	Operator 3	Operator 2 - Crusher
	Operator 3 - Heavy Equipment	Operator 1
Q1-Q3 2018	Operator 3	Operator 2
	Operator 3 - Haul Truck	Operator 2 - Haul Truck
	Operator 2	Operator 1
	Operator 3	Operator 2
	Environmental Site Administrative Assistant	Cultural Advisor
Notes: An asterisk (*) denotes a temporary promotion		

I. Additional details on Inuit departures, including rehires and those ineligible for rehire.

Some additional details on Inuit departures (and non-Inuit departures) have been presented in Appendix B of TSD-25 and/or in IIBA implementation reports provided to QIA, but are also summarized here for convenience. Table 7 displays information on Baffinland Inuit and non-Inuit employee departures from 2013 to 2017 (not including contractors).[1] Baffinland remains committed to reducing turnover and increasing Inuit employment as the Project advances. Initiatives Baffinland has developed, or has committed to developing, in this area have already been reviewed in Section 4.6.3 of TSD-25 and the IHRS (TSD-28, Appendix AG). The IIBA also provides guidance on Inuit retention initiatives at the Project.

Table 7: Baffinland Employee Departures (2013 to 2017)

Baffinland Employee Departures				
Year	**Inuit Employees**		**Non-Inuit Employees**	
	Number of Departures	Turnover Rate	Number of Departures	Turnover Rate
2013	9	—	—	—
2014	45	—	—	—
2015	41	—	165	—
2016	44	45%	210	39%
2017	42	45%	211	31%
Source: Baffinland Notes: 2013 and 2014 numbers are for indeterminate employees only and information for non-Inuit employees was unavailable. Comparable employee turnover rates for 2013-2015 are not provided, due to differences in how employee numbers and departures were previously calculated by Baffinland.				

Baffinland looks at each potential rehire case individually and on its own merits. If the employee was dismissed because of safety infringement or policy violation, the minimum waiting period for rehire is six months. The period of rehire is communicated to the individual at the time of dismissal or resignation by management and human resources staff. If an employee resigns, they have the opportunity to be rehired when they are ready for employment. Whenever possible, a Cultural Advisor (this was previously the on-site Elder position) is present for a dismissal.

Baffinland reviews dismissal and rehire policies with Inuit employees during the hiring and onboarding process as well as during employment reviews and has also committed to ensuring reports that such reviews took place are made available to QIA through the IIBA Employment Committee. Baffinland will also ensure its dismissal and rehire policies are sufficiently referenced and described in Employee Handbooks, which are currently under development.

Baffinland began collecting information on rehires in 2018. Data are currently available for Q1-Q3 2018:

- In Q1 of 2018 Baffinland had 9 rehires, 6 of which were Inuit.
- In Q2 of 2018 Baffinland had 27 rehires, 8 of which were Inuit.
- In Q3 of 2018 Baffinland had 6 rehires, 4 of which were Inuit.

J. Provide career paths for each department that operates in Nunavut, and example career path development plans. This has been a Baffinland commitment for over one year.

Baffinland respectfully notes that this level of information is not a requirement of the EIS Guidelines, and is addressed under the IIBA (QIA and Baffinland 2018). To guide current employee progression planning Baffinland has a 'Lines of Progression Policy'. The purpose of this policy is to ensure that employees and managers/supervisors clearly understand the interrelationship between roles, the pathways for promotion, and accompanying policies and procedures. This current policy applies to all site employees who are employed in maintenance and operations roles.

Article 7.15 of the IIBA also commits Baffinland to developing career path development plans for every Inuk employee and developing career paths for each department. Baffinland is in the process of developing these in collaboration with MIHR, which are expected to be completed in late 2019 or early 2020. As precise skill upgrading/training programs will vary depending on employee and position, this represents a considerable amount of work to be completed and requires careful consideration by Baffinland's human resources team. Career development plans and career paths will be provided to QIA for review once they are complete through the IIBA Employment Committee.

References:

Qikiqtani Inuit Association (QIA) and Baffinland Iron Mines Corporation (Baffinland). 2018. *The Mary River Project Inuit Impact and Benefit Agreement.* Amended and restated agreement made on October 22, 2018.

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Taylor, S. 2002. *The Employee Retention Handbook*. London, England: Chartered Institute of Personnel and Development.

[1] The employee turnover rate has been calculated using guidance provided by Taylor (2002). For example, the 2017 Inuit employee turnover rate was calculated by dividing the total number of Inuit employee departures in the calendar year (42) by the average number of Inuit employees employed in the same calendar year (93 – see Table 4.3 in Appendix B), multiplied by 100.

QIA 90 ATTACHMENT 01: FULL RESPONSE

QIA 90:

Can Baffinland expand upon how it intends to improve its engagement efforts with Inuit and Inuit Firms regarding the opportunities of Phase 2?

Baffinland Response:

Please see Baffinland's response to QIA IR #89 for a discussion of how the Company intends to engage *Inuit Firms*, specifically, regarding the opportunities of the Phase 2 Proposal.

Baffinland's Stakeholder Engagement Plan is presented in Appendix Z of TSD-28 and establishes the approach, strategy, and means by which Baffinland communicates with Project stakeholders. It has several objectives, including the provision of up-to-date information about the Project to the public, ensuring that parties have the opportunity to understand and meaningfully engage in the processes initiated by the Project, and focusing priorities so that potential adverse impacts are mitigated and Project benefits are enhanced. It also describes stakeholder engagement methods that may be used by Baffinland to engage Inuit on opportunities associated with the Phase 2 Proposal or about the Project itself:

- Leaflets/Brochures/ Fact Sheets/Tri-Folds
- Newsletters
- Unstaffed Exhibits/Displays
- Newspaper Articles
- Local Radio Announcements
- Site Visits
- Staffed Exhibits/Displays
- Staffed Telephone Lines
- Staffed emails such as contact@baffinland.com
- Internet
- Public Meetings
- Call-In Radio Shows
- Surveys, Interviews, and Questionnaires
- Workshops
- Open Houses
- Community Advisory/Liaison Groups
- IIBA Reporting

In addition, the Company has implemented, or has committed to implementing, several initiatives through the IIBA (QIA and Baffinland 2018) that contribute to improved engagement with Inuit on the Project:

- Establishment of offices in each point-of-hire community (Article 7.8), staffed by Baffinland Community Liaison Officers (BCLOs)
- Provision of employment and training information sessions once per quarter in each point-of-hire-community (Article 7.8)
- Hiring of an Inuit Employment and Training Specialist and funding for QIA to hire an Inuit Engagement Specialist (Article 7.9)
- Hiring of an Inuit Recruiter to be based in Iqaluit (Article 7.11)

- Development of an Inuit Human Resources Strategy (Article 7.13)
- Operation of an Inuit Summer Student Program (Article 7.19)
- Operation of an Inuit Internship Program (Article 7.20)
- Delivery of the Work Ready Program (Article 8.12)

Baffinland has finalized an Inuit Human Resources Strategy (IHRS; see Appendix AG of TSD-28) with the QIA. It outlines eight pillars of strategic actions, several that are relevant to improved engagement with Inuit on the Project. Selected pillars and priorities for Baffinland are summarized in Table 1 below.

Table 1: Example Pillars of Strategic Action and Priorities from the IHRS Related to Inuit Engagement on the Project

Pillar of Strategic Action	Priority
Strengthen Stakeholder Collaboration	• Promote frequent and open outreach to and dialogue with relevant stakeholders to share information and resources • Undertake collaborative and cooperative initiatives with stakeholders to support and enhance Baffinland's programs and initiatives under the IHRS
Engage and Develop Inuit Employees	• Development of enhanced techniques of communication of Project-related employment information • Outreach to educational institutions and training agencies in order to commence dialogue respecting addressing gaps in education and training
Workforce Readiness	• Develop and deliver a work readiness program • Develop and implement apprenticeship opportunities in the skilled trades • Institute on-site job-shadowing and mentorship programs • Profile Inuit employees through corporate newsletters and institute an Inuit-employee recognition program • In addition to bi-annual recruitment tours in the 5 North Baffin communities, integrate human resources in all community tours undertaken by Baffinland personnel and participate in career fairs and trade shows to raise awareness of Baffinland employment opportunities

Table 1: Example Pillars of Strategic Action and Priorities from the IHRS Related to Inuit Engagement on the Project

Pillar of Strategic Action	Priority
Gender Balancing	• Development of recruitment and selection processes and methods to encourage applications for employment by Inuit women • Link with Inuit women's networks to support employment of Inuit women • Work with other industry players and Inuit women's organizations to develop information kits to promote interest in careers in mining • Use gender sensitivity language in all advertisements, written and verbal assessment tools and other materials utilized in the hiring process • Participate in career fairs, school visits and other community events, utilizing Inuit women employees in such events
Students and Youth	• Consideration and identification of summer internships, mentoring programs and work with Baffinland Community Liaison Officers • Maintain the Baffinland scholarship program and review scholarship award criteria to encourage student participation in programs with high employment potential in the mining sector • Work with secondary and post-secondary educational institutions through participation in school fairs and similar events and conduct site field trips and visits to encourage consideration of careers in mining • Work with post-secondary institutions • Provide career information to guidance counsellors in secondary school systems • Develop co-operative education work and study opportunities

Baffinland also utilizes its BCLOs to provide updates to the public on local radio about Company activities such as the outcomes of meetings, upcoming engagement sessions, and efforts to recruit Inuit for employment and training opportunities.

The Company remains committed to ensuring the North Baffin communities and the individuals who call them home are meaningfully engaged regarding Company operations and future planning. The Company is undertaking planning to incrementally increase staff at its Oakville and Iqaluit offices to allow for expanded engagement efforts. An increase in staff will allow there to be more employees dedicated to working with the general public and the North Baffin communities in particular, thus further improving engagement efforts with Inuit.

Through Article 15.10 of the amended IIBA (QIA and Baffinland, 2018) the Company further supports enhanced engagement efforts with Inuit by paying for QIA's participation, including technical advisory support, in NPC, NIRB, and NWB proceedings as they relate to the Project. These payments will further the participation of QIA in the regulatory process, ensuring that Inuit are engaged both directly and indirectly through QIA.

Through the initiatives and efforts listed above, Baffinland expects improved engagement with Inuit regarding the opportunities of the Phase 2 Proposal will occur over time.

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[1] The employee turnover rate has been calculated using guidance provided by Taylor (2002). For example, the 2017 Inuit employee turnover rate was calculated by dividing the total number of Inuit employee departures in the calendar year (42) by the average number of Inuit employees employed in the same calendar year (93 – see Table 4.3 in Appendix B), multiplied by 100.

APPENDIX 3
CIRNAC IR ATTACHMENTS

CIRNAC 10 ATTACHMENT 1: APPENDIX 6B-3 GEOCHEMICAL EVALUATION OF RAILWAY QUARRY MATERIALS

APPENDIX 6B-3

GEOCHEMICAL EVALUATION OF RAILWAY QUARRY MATERIALS

TECHNICAL MEMORANDUM

To	**Doron Golan, AMEC** **Matthew Pickard, Baffinland** **Dick Matthews, Baffinland**	File no	**TC 101507**
From	**Judy Andrina, AMEC** **Steve Walker, AMEC**	cc	**Stephan Theben, AMEC** **Steve Sibbick, AMEC** **Jim Millard, Baffinland** **Richard Cook, Knight Piésold**
Tel	**905-568-2929**		
Email	**steve.walker@amec.com**		
Date	**December 14, 2010**		

Subject **Interim ML/ARD Assessment of Railway Quarry Rock Samples**
Baffinland Mary River Project – Issued for DEIS

1.0 INTRODUCTION

AMEC was retained by Baffinland Iron Mines Corporation (Baffinland) to conduct environmental studies in support of an environmental impact assessment (EIA). As part of the supporting environmental studies, AMEC assessed the metal leaching and acid rock drainage (ML/ARD) characteristics of rock samples to support future quarry development along the proposed railway alignment.

Thirty eight rock core samples were selected for testing from a set of stored samples at SGS Mineral Services (SGS) in Lakefield, ON. These rock samples were collected by Knight Piésold in 2008. This memo provides a summary of the geochemical testing of the selected samples.

2.0 GEOLOGY

Regional geologic mapping is available for the entire route of the railway alignment (Scott and de Kemp, 1998). The first 29 km or so of the proposed railway alignment heading generally east to south-east of the Mary River site follows the boundary between the relatively flat lying Paleozoic sedimentary rock and complex Precambrian terrane. The remaining generally southward leg of the railway alignment (some 120 km) traverses only Precambrian rocks. Paleozoic rocks along the northerly leg of the railway include the Cambrian-Ordovician age Gallery and Turner Cliffs Formations and the Ordovician age Ship Point Formation.

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The Gallery formation is ~340m thick medium to coarse grained quartzose sandstone with minor siltstone, conglomerate and shale, and rare breccia, dolomitic sandstone and dolostone. The Turner Cliffs Formation is ~310m thick shaly to pure dolostone with intra-beds of dolomitic clastic sedimentary rocks. The Ship Point Formation is 50 to 275 m thick cliff forming finely crystalline dolostone commonly silty or sandy and interbedded with clastic dolomitic rocks.

The most common Precambrian rocks are Archean age migmatitic gneisses and Paleoproterozoic age granitic migmatites. The migmatites and gneisses tend to be heterogeneous with common inclusions and bands of mafic, metasedimentary and other granitic rocks. Other common Precambrian rocks along the route include Archean and Paleoproterozoic granitic intrusive rocks. Less common, but locally important in places along the route are the Archean Mary River Group rocks which are predominantly siliciclastic and mafic volcanic rocks.

3.0 TESTING PROGRAM

3.1 Sampling

Samples available for this study were collected as part of previous work by Knight Piésold mostly between July and September 2008. These samples consisted of drill core, surface saw-cut, surface grab and rock chip samples. A portion of this 2008 work by Knight Piésold was directed at geochemical assessment with respect to ML/ARD; however, samples were not analyzed at that time, but rather were stored at SGS Lakefield. The list of samples, as well as the sampling techniques and methodology employed by Knight Piésold, are documented in the memo by Knight Piésold (2010) (attached). AMEC was directed to identify a sub-set of these stored samples suitable for ML/ARD assessment. Available borehole logs from the Knight Piésold work were also provided at the request of AMEC to aid in sample selection.

3.2 Sample Selection for Testing

A review of the available information, determined that the most suitable samples for geochemical testing were the rock core samples. The increased surface areas of the surface saw-cut, chip and grab samples may have resulted in additional weathering and oxidation, making their ML/ARD characteristics unrepresentative of the pristine rock in the proposed quarry areas. AMEC has assumed that storage conditions of the rock core samples at SGS were sufficiently dry to have had a minimal effect on the samples during the two years of storage. The core samples were collected from 41 boreholes with sample depth varying from 3.9 to 138.6 m. In total, 105 rock core samples out of the 156 tabulated by Knight Piésold had corresponding borehole log information available.

Based on the available number of samples and the fact that AMEC was not involved in the siting of any of the quarries or sampling locations, a preliminary lithology-based strategy was adopted for sample selection. Samples were selected on the basis of recorded lithology and spatial

distribution along the proposed railway alignment. Sample site spacing based on this strategy is on the order of a sampled site every 3 to 7 km along the route. Sample descriptions by Knight Piésold were generally consistent with the government mapped regional geology (Scott and de Kemp, 1998).

In total, 38 rock core samples from 26 boreholes were selected for geochemical testing. Where available, two samples were selected from each borehole. These included 7 sandstone, 6 granite, and 25 granitoid gneiss samples, according to rock descriptions provided by Knight Piésold.

3.3 Testing Methods

Laboratory analyses were conducted at SGS Lakefield to assess the ML/ARD characteristics of the samples. Testing methodologies followed those described in the document ***Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials*** (MEND, 2009).

Analytical testing conducted on the samples consisted of:

- Acid-base accounting (ABA) including total sulphur, sulphate sulphur, sulphide by difference, total carbon (TC), total inorganic carbon (TIC), modified Sobek NP, and paste pH;
- Single addition Net Acid Generation (NAG) testing;
- Total metals by aqua regia digestion with ICP-MS finish;
- Leachable metals by the Shake Flask Extraction (SFE) test;
- Mineralogy by Rietveld XRD.

All rock samples were analyzed for ABA, NAG and total metals. The SFE and Rietveld XRD analyses were performed on selected samples.

4.0 GEOCHEMICAL TESTING RESULTS

4.1 Acid Base Accounting (ABA)

Results of ABA testing are summarized in Figure 1, with detailed results presented in Table 1. For the purposes of this screening level assessment, acid potential (AP) has been conservatively interpreted as maximum acid potential calculated on the basis of total sulphur.

Overall findings of these ABA results, based on rock descriptions provided by Knight Piésold are summarized as follows:

- All samples exhibited very low to low carbonate NP and low to moderate Sobek neutralization potential (NP).
- Rocks identified as granites and sandstone consistently exhibited very low acid potential (AP).
- Granite samples had neutralization potential ratios (NPR) ranging from 10 to 100.
- Sandstone samples had NPR values ranging from 19 to 24.
- Rocks identified as granitoid gneisses had a usually low but variable AP with low carbonate NP and low to moderate Sobek NP.
- Two granitoid gneiss samples had NPR values <2, with the remainder having NPR values ranging from 3 to 90.

Paste pH of the granite and granitoid gneiss rocks ranged from 8.6 to 10.1 (median 9.8). The paste pH of sandstone samples was distinctly lower and ranged from 6.1 to 7.9 (median 6.6).

Results of NAG testing on the 38 rock samples are shown in Table 2. The NAG test is a complimentary test to ABA which provides an assessment of the potential of a sample to generate acid. Values of NAG_{pH} greater than 4.5 indicate that a sample has little potential to produce net acidity in the future. The majority of rock samples (36 of 38 samples) had NAG_{pH} values greater than 4.5. The NAG_{pH} of two granitoid gneiss samples were below 4.5 suggesting the potential to produce net acidity. The two samples with low NAG_{pH} were the same two samples that exhibited the NPR <2 in traditional ABA testing.

4.2 Metal Analysis

4.2.1 Total Metals (aqua-regia extraction)

In order to identify metals of potential environmental significance, total metals results were compared to average continental crustal abundances (Price 1997). The concentration of an element was considered enriched if concentrations were greater than ten times the average crustal abundance. Metal results are presented in Table 3. It should be noted that the total concentration of an element does not determine the metal leaching potential of that element.

In general, all rock samples contained low metal contents and only two results were present that exceeded 10 times the average crustal abundance. No metal enrichment was detected from the samples identified in borehole logs as granite or sandstone. A single highly anomalous Ni value was reported from one granitoid gneiss sample, with a concentration of 2000 µg/g in comparison to 750 µg/g for 10 times crustal abundance. The bismuth content of another

granitoid gneiss sample was 0.11 µg/g compared to ten times the average crustal abundance of of 0.085 µg/g. This bismuth concentration is close to the MDL of 0.09 µg/g..

4.2.2 Leachable Metals

Six samples representing the three different rock types identified from borehole logs underwent Shake Flask Extraction (SFE) testing. The SFE testing results (Table 4) were compared to the Metal Mining Effluent Regulation values (MMER, 2002). More stringent guideline values are also provided for reference purposes only. Guidelines for protection of aquatic life and the drinking water guidelines (CWQG-PAL and CDWG values in Table 4) which are focused on the preservation of water quality in the receiving waterbody for specific receptors (i.e., aquatic life, drinking water) are conservative since these values represent concentrations at point of use or exposure, not point of discharge. These guidelines are useful to identify parameters of interest when evaluating final discharge to receiving waters.

Results of SFE analyses (Table 4) for all samples, had a final pH that was neutral to alkaline with generally low concentrations of metals and no exceedances of MMER limits. The pH in SFE leachates for a number of these samples marginally exceeded the MMER limit of 9.5. This is not unexpected for freshly exposed rock materials under agitation and at the high solid-solution ratios of the test. The high pH (and corresponding elevated aluminum concentrations) were likely related to the weak alkalinity associated with aluminosilicate mineral dissolution. It is unlikely the elevated pH (and associated aluminum) will be observed under field conditions.

Two additional samples have been submitted for SFE analysis on the basis of ABA and total metal results (see Tables 1 and 3).

4.3 Mineralogy

The same six samples selected for SFE analysis were also analyzed by Rietveld XRD with results presented in Table 5. Carbonates and sulphides were not detected in any of the samples analyzed.

Mineralogy of the selected samples is generally consistent with rock descriptions in the Knight Piésold borehole logs for five of the six samples. The lack of quartz and the high plagioclase feldspar content of one of the “granite” samples indicated this rock is not granitic, but more likely an intermediate intrusive or other calcium-plagioclase rich rock. The other granite sample and the granitoid gneiss samples exhibited similar mineralogy consistent with granitoid rocks. The major differences among these three granitoid samples were variations in the feldspar mineral contents. Minor ferromagnesian mineral content of one of the gneiss samples had chlorite (clinochlore) instead of biotite.

Sandstone samples were quartz-rich with only minor feldspar and trace clay mineral kaolinite. Two additional samples were submitted for XRD analysis on the basis of ABA and total metal resuts (see Tables 1 and 3).

5.0 DISCUSSION OF RESULTS

Characterization of the net acid potential of the rock follows the criteria outlined in MEND (2009). The threshold between potentially acid generating (PAG) and non potentially acid generating (Non-PAG) materials is defined by the neutralization potential ratio (NPR), a measure of the ratio of the acid potential (AP) to neutralization potential (NP). Following the guidelines provided in MEND (2009), mine rock materials with NPR >2 are classified as Non-PAG. Mine rock samples with NPR <1 are considered PAG and materials with NPR between 1 and 2 are classified as having an uncertain potential of generating acid. Based on NPR values, the majority of rock samples (95%) are Non-PAG materials.

Results of this ML/ARD assessment suggest that potential railway quarry rock, represented by the samples analyzed, will have little potential to generate acid or produce leachable metals at concentrations of concern. The sulphide content of the samples analyzed were typically low (average 0.02%) and more than 50% of the samples contained negligible amounts of sulphide. The minimum total NP measured was very low (3 to 6 kg CaCO3/t for sandstone and granitic rocks respectively). However, even with this low NP, a sulphide content in excess of about 0.1% is still required to be classified as net acid generating.

The two samples with NPR <2 (based on MPA, or maximum acid potential) are from the same regionally mapped migmatite unit in the vicinity of Cockburn Lake; however, they are from two sites more than 4 km apart. Other gneiss samples at each of these sites and a site in between have NPRs ranging from 3 to 78. This suggests that PAG rock can occur within the migmatite unit in this area, but its distribution is complex.

Of the 38 samples in total, 36 had metal contents less than 10 times the average crustal abundance. A single highly anomalous sample with Ni at a concentration more than 10 times average crustal abundance also contains anomalous Mg (7.4 wt.%) and had a NPR of 70 and carbonate NPR of 15. Reitveld XRD and SFE analysis is currently underway on this sample to determine its mineralogical composition and the presence or absence of readily leachable metals of this apparently unique sample. SFE analyses on otherwise typical samples of each of the three rock types indicated low levels of easily leachable metals.

This lithologically-based screening study of targeted sandstone, felsic intrusive and gneissic rocks within the railway alignment suggests these materials are suitable as quarry source material with low potential for ML/ARD. Additional analysis is required at the individual quarry scale that considers anticipated tonnages to be utilized and more completely verifies whether PAG and/or metal leaching materials are present. Future evaluations would benefit from greater consideration of the regional geological mapping in relation to specific quarry locations

and more detailed geological study of the proposed quarry rocks. In particular, this work suggests that sandstones and intrusive granitic rocks show greater homogeneity and less potential for ML/ARD, and may require lower levels of characterization; whereas, the heterogeneity of the gneisses (probably migmatites) may warrant a greater level of scrutiny, especially for the unit in the vicinity of Cockburn Lake.

6.0 CONCLUSIONS

A lithologically-based ML/ARD screening assessment has been completed on targeted sandstone, felsic intrusive and gneissic rocks sampled by Knight Piésold in 2008 along the proposed railway alignment.

Based on the results of this assessment, the following conclusions are made.

- The three rock-types investigated along the proposed railway alignment appear to have a low potential for metal leaching and acid rock drainage (ML/ARD) and should be suitable as quarry sources.
- However, due to the screening level nature of this assessment, individual quarry sites should be subjected to additional site specific ML/ARD characterization.
- The relatively low NP in most of these rock types means that the presence of low contents of sulphide could result in ML/ARD conditions. Diligence through adequate levels of sampling will be necessary to ensure that even low concentrations of sulphide are identified.
- Two samples of gneiss were identified that are potentially acid generating. This result and the expected heterogeneity of this unit suggest a greater level of characterization of gneiss over the other rock types may be warranted.
- Better integration of regional geological information may aid in further assessment in the Precambrian terrane. Characterizing on the basis of specific mapped units rather than simply “granite” and “gneiss” may lead to more predictable and cost effective management of potential ML/ARD.

7.0 FUTURE WORK

A small number of pending analyses for XRD and SFE will be integrated with this data upon receipt from the laboratory. These results may provide additional detail on the more anomalous samples within this data set, but are not expected to change the overall findings.

Development of the proposed quarries will require, additional site specific sampling and analysis to assess each location to an acceptable level of detail for regulatory review. This data and additional stored samples at SGS Lakefield may be suitable to supplement these additional

studies, where sample locations can be adequately verified as directly representative of quarry material. Further assessment could benefit from integration of regional geological information with site scale geology.

8.0 REFERENCES

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Attachments:
Table 1: Acid Base Accounting Analysis of Rock Samples
Table 2: Net Acid Generating Analysis of Rock Samples
Table 3: Total Metal Analysis of Rock Samples
Table 4: Shake Flask Extraction Analysis of Rock Samples
Table 5: Mineralogy of Rock (quantitative Rietveld phase analysis (%wt.))
Figure 1: Railway Quarry Rock Samples – Neutralization Potential vs. Acid Potential
Memo From Knight Piésold Consulting – Summary of Railway Quarry Sample Collection for Geochemical Testing

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TABLES

Table 1. Acid Base Accounting Analysis for Rock Samples

Sample ID	Rock Type	Paste pH	Total Sulphur	Sulphate Sulphur	Sulphide Sulphur*	Total Carbon	AP*	NP	Carb-NP	NPR	Carb-NPR
			(wt.%)				(kg $CaCO_3$/tonne)				
BH3-2008-146 ARD-01	Granite	10.0	0.005	<0.01	<0.01	0.018	0.2	9.0	1.5	58	10
BH3-2008-146 ARD-03	Granite	9.9	<0.005	<0.01	<0.01	0.015	0.2	16	1.3	101	8
BH3-2008-178 ARD-01	Granite	9.8	0.013	0.01	<0.01	0.029	0.4	7.3	2.4	18	6
BH3-2008-179 ARD-02	Granite	9.9	0.034	0.03	<0.01	0.020	1.1	11	1.7	10	2
BH3-2008-180 ARD-03	Granite	9.9	0.028	0.03	<0.01	0.047	0.9	10	3.9	12	4
BH4-2008-125RD ARD-01	Granite	9.6	0.010	0.01	<0.01	0.030	0.3	5.8	2.5	19	8
BH4-2008-125RD ARD-03	Granite	9.7	0.017	0.02	<0.01	0.027	0.5	7.3	2.3	14	4
BH2007-36 ARD-01	Granitoid gneiss	9.4	0.133	0.09	0.043	0.036	4.2	17	3.0	4	1
BH2007-36 ARD-03	Granitoid gneiss	9.9	0.169	0.08	0.089	0.020	5.3	22	1.7	4.1	0
BH3-2008-148 ARD-01	Granitoid gneiss	9.6	0.025	0.03	<0.01	0.076	0.8	15	6.3	19	8
BH3-2008-148 ARD-03	Granitoid gneiss	9.9	<0.005	<0.01	<0.01	0.052	0.2	12	4.3	74	28
BH3-2008-165RD2 ARD-01	Granitoid gneiss	9.9	0.066	0.04	0.026	0.016	2.1	14	1.3	7	1
BH3-2008-165RD2 ARD-03	Granitoid gneiss	9.9	0.026	0.03	<0.01	0.023	0.8	7	1.9	9	2
BH3-2008-83 ARD-03	Granitoid gneiss	10.0	0.005	<0.01	<0.01	0.069	0.2	12	5.8	78	37
BH4-2008-83 ARD-01	Granitoid gneiss	10.1	0.008	<0.01	<0.01	0.026	0.3	9	2.2	34	9
BOR12B-DH1 ARD-01	Granitoid gneiss	9.9	0.008	<0.01	<0.01	0.017	0.3	10	1.4	38	6
BOR12B-DH2 ARD-03	Granitoid gneiss	9.5	0.151	0.06	0.091	0.019	4.7	9.2	1.6	1.9	0
BOR12B-DH3 ARD-02	Granitoid gneiss	9.8	0.045	0.03	0.015	0.017	1.4	10	1.4	7	1
BOR13A-DH1 ARD-01	Granitoid gneiss	8.9	0.006	<0.01	<0.01	0.165	0.2	17	14	91	73
BOR13A-DH1 ARD-03	Granitoid gneiss	9.4	<0.005	<0.01	<0.01	0.017	0.2	6.0	1.4	38	9
BOR7D-DH1 ARD-01	Granitoid gneiss	9.5	0.008	<0.01	<0.01	0.068	0.3	10	5.7	41	23
BOR7D-DH2 ARD-02	Granitoid gneiss	9.8	0.032	0.03	<0.01	0.024	1.0	10	2.0	10	2
BOR7D-DH3 ARD-03	Granitoid gneiss	9.9	0.020	0.02	<0.01	0.021	0.6	9	1.8	14	3
BR13-DH1(RD)-ARD-01	Granitoid gneiss	9.9	0.071	0.04	0.031	0.029	2.2	6	2.4	2.8	1
BR13-DH1(RD)-ARD-03	Granitoid gneiss	9.8	0.416	0.24	0.176	0.034	13.0	7	2.8	0.5	0
BR1B-DH ARD-02	Granitoid gneiss	8.6	0.046	0.05	<0.01	0.258	1.4	96	22	67	15
BR1C-DH ARD-01	Granitoid gneiss	9.5	0.012	0.01	<0.01	0.038	0.4	18	3.2	48	8
BR1C-DH ARD-03	Granitoid gneiss	9.2	0.052	0.04	<0.01	0.077	1.6	19	6.4	12	4
BR3A-DH2 ARD-02	Granitoid gneiss	9.3	<0.005	<0.01	<0.01	0.007	0.2	5.2	0.6	33	4
BR3A-DH3 ARD-01	Granitoid gneiss	9.5	<0.005	<0.01	<0.01	0.007	0.2	6.6	0.6	42	4
BR7-DH1 ARD-01	Granitoid gneiss	9.7	0.035	0.04	<0.01	0.026	1.1	10	2.2	9	2
BR7-DH1 ARD-03	Granitoid gneiss	9.8	0.049	0.03	0.019	0.018	1.5	12	1.5	8	1
BR3A-DH1 ARD-01	Sand	7.1	<0.005	<0.01	<0.01	0.010	0.2	3.0	0.8	19.2	5
BOR2A-DH1 ARD-01	Sandstone	6.6	<0.005	<0.01	<0.01	0.009	0.2	3.8	0.8	24	5
BOR2A-DH1 ARD-02	Sandstone	6.1	<0.005	<0.01	<0.01	0.010	0.2	3.5	0.8	22	5
BOR2A-DH2 ARD-03	Sandstone	6.6	0.005	<0.01	<0.01	0.007	0.2	3.3	0.6	21	4
BR3A-DH1 ARD-02	Sandstone	6.7	<0.005	<0.01	<0.01	0.007	0.2	3.0	0.6	19.2	4
BR3A-DH2 ARD-03	Sandstone	7.9	<0.005	<0.01	<0.01	0.008	0.2	3.5	0.7	22	4
No. of sample		38	38	38	38	38	38	38	38	38	38
Minimum		6.1	0.005	0.010	0.010	0.007	0.2	3.0	0.6	0.5	0.2
Maximum		10.1	0.416	0.240	0.176	0.258	13.0	96	22	101	73
Mean			0.041	0.030	0.021	0.037	1.3	12	3.1	9	2
Median		9.7	0.013	0.010	0.010	0.022	0.4	9.4	1.8	24	5
Standard Deviation		1.1	0.074	0.040	0.032	0.047	2.3	15	3.9	26	13
10^{th} Percentile		7.0	0.005	0.010	0.010	0.008	0.2	3.5	0.6	4.1	0.7
90^{th} Percentile		9.9	0.090	0.053	0.035	0.071	2.8	17	5.9	69	17

Notes:

AP = Acid potential in tonnes $CaCO_3$ equivalent per 1000 tonnes of material. * AP is calculated conservatively from the total sulphur content (maximum potential acidity).

NP = Neutralization potential in tonnes $CaCO_3$ equivalent per 1000 tonnes of material.

Carbonate NP is calculated from total carbon originating from carbonates and is expressed in kg $CaCO_3$/tonne.

NPR = Net Potential Ratio = NP/AP; Carb-NPR = Carb-NP/AP

Shaded samples selected for SFE and Reitveld XRD analysis based on ABA or aqua-regia metal results (results pending).

Table 2. Net Acid Generating Test Results on Rock Samples

Sample ID	Rock Type	NAG_{pH}	NAG (pH 4.5) kg H2SO4/tonne	NAG (pH 7.0) kg H2SO4/tonne
BH3-2008-146 ARD-01	Granite	6.94	0	0.7
BH3-2008-146 ARD-03	Granite	7.17	0	0.0
BH3-2008-178 ARD-01	Granite	6.92	0	0.7
BH3-2008-179 ARD-02	Granite	7.02	0	0
BH3-2008-180 ARD-03	Granite	7.22	0	0
BH4-2008-125RD ARD-01	Granite	6.54	0	2.9
BH4-2008-125RD ARD-03	Granite	6.82	0	1.3
BH2007-36 ARD-01	Granitoid gneiss	5.71	0	0.6
BH2007-36 ARD-03	Granitoid gneiss	5.83	0	0.6
BH3-2008-148 ARD-01	Granitoid gneiss	7.86	0	0
BH3-2008-148 ARD-03	Granitoid gneiss	7.41	0	0
BH3-2008-165RD2 ARD-01	Granitoid gneiss	6.70	0	1.0
BH3-2008-165RD2 ARD-03	Granitoid gneiss	7.02	0	0
BH4-2008-83 ARD-01	Granitoid gneiss	6.88	0	0.7
BH3-2008-83 ARD-03	Granitoid gneiss	7.49	0	0
BOR12B-DH1 ARD-01	Granitoid gneiss	7.13	0	0
BOR12B-DH2 ARD-03	Granitoid gneiss	3.87	1.0	1.3
BOR12B-DH3 ARD-02	Granitoid gneiss	7.02	0	0
BOR13A-DH1 ARD-01	Granitoid gneiss	8.49	0	0
BOR13A-DH1 ARD-03	Granitoid gneiss	7.05	0	0.0
BOR7D-DH1 ARD-01	Granitoid gneiss	7.59	0	0
BOR7D-DH2 ARD-02	Granitoid gneiss	7.04	0	0
BOR7D-DH3 ARD-03	Granitoid gneiss	7.06	0	0
BR13-DH1(RD)-ARD-01	Granitoid gneiss	6.59	0	1.0
BR13-DH1(RD)-ARD-03	Granitoid gneiss	2.92	8.9	9.6
BR1B-DH ARD-02	Granitoid gneiss	9.50	0	0
BR1C-DH ARD-01	Granitoid gneiss	7.93	0	0
BR1C-DH ARD-03	Granitoid gneiss	8.39	0	0
BR3A-DH2 ARD-02	Granitoid gneiss	6.44	0	2.9
BR3A-DH3 ARD-01	Granitoid gneiss	6.84	0	1.0
BR7-DH1 ARD-01	Granitoid gneiss	7.12	0	0
BR7-DH1 ARD-03	Granitoid gneiss	7.14	0	0
BR3A-DH1 ARD-01	Sand	6.08	0	1.3
BOR2A-DH1 ARD-01	Sandstone	6.07	0	2.2
BOR2A-DH1 ARD-02	Sandstone	5.78	0	3.8
BOR2A-DH2 ARD-03	Sandstone	5.59	0	3.5
BR3A-DH2 ARD-03	Sandstone	5.86	0	3.3
BR3A-DH1 ARD-02	Sandstone	6.17	0	2.0
No. of sample		38	38	38
Minimum		2.9	0	0
Maximum		9.5	8.9	9.6
Mean			0.3	1.1
Median		7.0	0	0.3
Standard Deviation		1.1	1.4	1.8
10^{th} Percentile		5.8	0	0
90^{th} Percentile		7.9	0	3.0

Table 3. Total Metal Analysis of Rock Samples

Sample ID	Rock Type	Hg	Al	As	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	K	Li	Mg	Mn	Mo	Na	Ni	Pb	Sb	Se	Sn	Sr	Ti	Tl	U	V	Zn
		µg/g	%	µg/g	µg/g	µg/g	µg/g	%	µg/g	µg/g	µg/g	µg/g	%	%	µg/g	%	µg/g	µg/g	%	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	%	µg/g	µg/g	µg/g	µg/g
Average Concentration (Continental Crustal)*		0.09	8.23	1.8	425	3	0.0085	4.15	0.15	25	102	60	5.63	2.085	20	2.33	950	1.2	2.355	84	14	0.2	0.05	2.3	370	0.565	0.85	2.7	120	70
Ten Times Average Concentration (Crustal)		0.85	82.3	18	4250	30	0.085	41.5	1.5	250	1020	600	56.3	20.85	200	23.3	9500	12	23.55	840	140	2	0.5	23	3700	5.65	8.5	27	1200	700
BH3-2008-146 ARD-01	Granite	< 0.1	1.40	1.1	19	0.40	< 0.09	0.78	< 0.02	4.6	85	2.0	2.00	0.23	18	0.34	120	0.4	0.40	15	3.5	< 0.8	< 0.7	1.8	120	0.10	0.09	0.43	25	16
BH3-2008-146 ARD-03	Granite	< 0.1	1.70	1.4	240	0.38	< 0.09	1.10	< 0.02	10	92	3.9	3.40	0.62	25	1.10	260	1.4	0.32	45	4.6	< 0.8	< 0.7	1.9	63	0.19	0.19	3.1	55	21
BH3-2008-178 ARD-01	Granite	< 0.1	1.10	0.9	110	0.20	< 0.09	0.23	0.03	2.9	180	5.6	1.50	0.78	15	0.23	76	0.8	0.23	6.0	15	< 0.8	< 0.7	0.6	30	0.07	0.23	3.9	14	20
BH3-2008-179 ARD-02	Granite	< 0.1	1.30	0.8	140	0.24	< 0.09	0.50	0.03	6.6	96	12	2.60	0.87	16	0.55	180	2.0	0.24	8.3	9.6	< 0.8	< 0.7	1.0	37	0.13	0.34	1.3	41	45
BH3-2008-180 ARD-03	Granite	< 0.1	1.10	1.4	92	0.26	< 0.09	0.42	< 0.02	5.0	160	14	1.70	0.74	15	0.39	180	0.8	0.22	7.8	7.1	< 0.8	< 0.7	0.9	31	0.09	0.30	1.4	25	33
BH4-2008-125RD ARD-01	Granite	< 0.1	0.38	< 0.5	36	0.21	< 0.09	0.17	< 0.02	2.0	98	5.0	0.90	0.24	16	0.15	66	1.4	0.08	3.6	11	< 0.8	< 0.7	2.9	9.9	0.05	0.16	7.5	4	20
BH4-2008-125RD ARD-03	Granite	< 0.1	0.70	0.9	53	0.34	< 0.09	0.19	0.02	3.1	63	8.4	1.40	0.48	24	0.32	120	1.1	0.13	5.2	6.9	< 0.8	< 0.7	0.9	12	0.06	0.26	3.5	14	28
BH2007-36 ARD-01	Granitoid gneiss	< 0.1	1.10	1.1	110	0.26	< 0.09	0.87	< 0.02	10	70	19	3.50	0.83	21	0.92	270	1.2	0.07	11	3.3	< 0.8	< 0.7	0.8	20	0.17	0.41	0.70	49	75
BH2007-36 ARD-03	Granitoid gneiss	< 0.1	1.60	1.1	170	0.26	< 0.09	1.40	0.02	12	69	49	4.80	1.20	21	0.96	280	1.3	0.21	13	7.1	< 0.8	< 0.7	1.7	61	0.29	0.62	2.0	69	86
BH3-2008-148 ARD-01	Granitoid gneiss	< 0.1	1.40	0.8	120	0.26	< 0.09	0.78	< 0.02	11	66	46	2.90	0.88	23	0.92	210	1.8	0.20	31	6.0	< 0.8	< 0.7	1.4	27	0.18	0.33	0.19	57	44
BH3-2008-148 ARD-03	Granitoid gneiss	< 0.1	1.30	1.7	110	0.20	< 0.09	0.48	< 0.02	7.0	180	7.4	1.70	0.89	18	0.61	180	0.4	0.22	23	6.0	< 0.8	< 0.7	0.9	34	0.13	0.40	0.45	23	34
BH3-2008-165RD2 ARD-01	Granitoid gneiss	< 0.1	1.10	0.9	110	0.17	< 0.09	0.71	< 0.02	8.3	110	41	2.90	0.58	12	0.54	150	0.7	0.19	13	4.7	< 0.8	< 0.7	1.3	24	0.16	0.16	0.56	43	56
BH3-2008-165RD2 ARD-03	Granitoid gneiss	< 0.1	1.10	1.0	69	0.25	< 0.09	0.32	0.07	3.9	150	16	1.40	0.47	10	0.20	95	0.2	0.30	7.1	11	< 0.8	< 0.7	0.5	17	0.06	0.10	2.8	11	26
BH3-2008-83 ARD-03	Granitoid gneiss	< 0.1	1.30	1.0	100	0.16	< 0.09	0.52	0.03	5.4	150	2.2	1.70	0.87	9	0.61	190	0.5	0.22	17	8.2	< 0.8	< 0.7	0.7	33	0.10	0.25	0.17	18	36
BH4-2008-83 ARD-01	Granitoid gneiss	< 0.1	1.00	1.1	100	0.19	< 0.09	0.39	< 0.02	5.0	110	6.8	1.50	0.71	10	0.47	140	0.3	0.22	15	4.0	< 0.8	< 0.7	0.5	26	0.10	0.25	0.37	19	29
BOR12B-DH1 ARD-01	Granitoid gneiss	< 0.1	1.30	1.1	82	0.24	< 0.09	0.31	< 0.02	4.0	54	5.1	2.00	0.91	25	0.48	250	1.0	0.18	5.5	12	< 0.8	< 0.7	1.9	24	0.11	0.41	3.5	21	36
BOR12B-DH2 ARD-03	Granitoid gneiss	< 0.1	1.20	0.9	74	0.21	< 0.09	0.20	0.04	8.2	89	22	2.30	0.98	29	0.82	330	0.4	0.07	19	20	< 0.8	< 0.7	2.0	9.4	0.16	0.56	5.5	27	51
BOR12B-DH3 ARD-02	Granitoid gneiss	< 0.1	1.50	1.2	110	0.44	< 0.09	0.32	< 0.02	6.3	57	11	2.10	1.10	25	0.67	290	1.4	0.19	11	8.4	< 0.8	< 0.7	1.8	21	0.14	0.47	2.5	27	41
BOR13A-DH1 ARD-01	Granitoid gneiss	< 0.1	0.94	1.2	49	0.39	**0.11**	0.53	< 0.02	4.6	150	5.4	1.20	0.66	24	0.43	160	0.3	0.09	12	2.5	< 0.8	< 0.7	0.5	8.9	0.05	0.24	1.3	13	18
BOR13A-DH1 ARD-03	Granitoid gneiss	< 0.1	1.10	0.6	50	0.78	< 0.09	0.08	0.07	3.0	110	8.7	1.30	0.73	15	0.34	120	0.6	0.13	4.0	8.7	< 0.8	< 0.7	0.8	8.4	0.01	0.10	9.4	25	19
BOR7D-DH1 ARD-01	Granitoid gneiss	< 0.1	1.10	1.2	49	0.27	< 0.09	0.30	0.10	1.9	170	7.8	1.40	0.69	12	0.18	120	5.4	0.22	4.6	35	< 0.8	< 0.7	0.8	17	0.04	0.17	10	5	33
BOR7D-DH2 ARD-02	Granitoid gneiss	< 0.1	1.10	0.8	140	0.16	< 0.09	0.32	0.03	4.7	60	22	2.00	0.83	21	0.45	260	1.1	0.18	7.4	17	< 0.8	< 0.7	0.9	23	0.12	0.59	5.4	25	50
BOR7D-DH3 ARD-03	Granitoid gneiss	< 0.1	1.00	0.6	74	0.06	< 0.09	0.26	< 0.02	3.4	130	20	1.20	0.46	17	0.31	140	0.5	0.25	5.6	2.4	< 0.8	< 0.7	< 0.5	22	0.08	0.20	0.15	14	25
BR13-DH1(RD)-ARD-01	Granitoid gneiss	< 0.1	1.00	1.1	68	0.07	< 0.09	0.17	0.12	2.3	66	21	1.00	0.57	13	0.23	120	0.9	0.23	6.1	7.7	< 0.8	< 0.7	1.7	8.8	0.06	0.17	0.26	5	41
BR13-DH1(RD)-ARD-03	Granitoid gneiss	< 0.1	1.10	1.2	110	0.05	< 0.09	0.16	0.42	3.8	80	72	2.00	0.79	22	0.53	190	1.2	0.11	2.6	11	< 0.8	< 0.7	3.5	4.8	0.13	0.32	2.2	12	120
BR1B-DH ARD-02	Granitoid gneiss	< 0.1	0.09	8.8	1.1	0.03	< 0.09	0.59	< 0.02	70	290	8.7	4.00	0.001	< 2	7.40	620	0.4	0.02	**2000**	0.51	< 0.8	< 0.7	< 0.5	7.8	0.01	< 0.02	0.007	11	20
BR1C-DH ARD-01	Granitoid gneiss	< 0.1	2.00	1.2	300	0.02	< 0.09	0.66	< 0.02	16	46	58	2.30	0.79	24	1.70	200	0.3	0.14	72	0.49	< 0.8	< 0.7	< 0.5	9.1	0.14	0.18	0.039	50	21
BR1C-DH ARD-03	Granitoid gneiss	< 0.1	1.40	1.9	35	0.18	< 0.09	0.92	0.03	13	86	73	2.30	0.16	18	1.20	230	0.8	0.18	23	1.6	< 0.8	< 0.7	< 0.5	7.3	0.18	0.05	1.4	55	18
BR3A-DH2 ARD-02	Granitoid gneiss	< 0.1	0.68	0.9	9.5	0.44	< 0.09	0.04	0.02	3.9	73	1.7	1.40	0.14	14	0.68	100	1.0	0.03	15	3.5	< 0.8	< 0.7	0.6	2.6	0.01	< 0.02	2.7	8	18
BR3A-DH3 ARD-01	Granitoid gneiss	< 0.1	0.80	0.7	26	0.35	< 0.09	0.07	< 0.02	2.6	160	2.4	1.30	0.37	12	0.42	93	0.3	0.13	7.2	3.8	< 0.8	< 0.7	< 0.5	5.5	0.005	0.04	3.8	7	20
BR7-DH1 ARD-01	Granitoid gneiss	< 0.1	1.00	0.8	82	0.10	< 0.09	0.29	< 0.02	8.4	72	31	1.70	0.78	21	0.64	260	0.9	0.08	13	6.0	< 0.8	< 0.7	< 0.5	7.5	0.15	0.35	2.8	32	37
BR7-DH1 ARD-03	Granitoid gneiss	< 0.1	1.10	0.9	88	0.14	< 0.09	0.65	0.03	9.5	95	44	1.80	0.61	16	0.64	260	0.4	0.18	17	3.6	< 0.8	< 0.7	0.6	13	0.15	0.29	0.81	36	35
BR3A-DH1 ARD-01	Sand	< 0.1	0.04	0.8	5.0	< 0.02	< 0.09	0.004	< 0.02	0.61	210	3.0	0.27	0.03	< 2	0.00	23	0.7	0.02	4.4	1.1	< 0.8	< 0.7	< 0.5	3.8	0.002	< 0.02	1.1	< 1	1.3
BOR2A-DH1 ARD-01	Sandstone	< 0.1	0.18	1.1	2.6	0.04	< 0.09	0.01	< 0.02	0.53	120	4.0	0.42	0.03	2	0.01	34	2.5	0.02	8.9	1.8	< 0.8	< 0.7	< 0.5	2.6	0.003	< 0.02	1.0	< 1	1.7
BOR2A-DH1 ARD-02	Sandstone	< 0.1	0.19	1.1	2.0	0.03	< 0.09	0.01	< 0.02	0.82	230	2.4	0.33	0.02	< 2	0.01	30	0.3	0.02	4.7	1.5	< 0.8	< 0.7	< 0.5	2.7	0.002	< 0.02	0.77	1	1.3
BOR2A-DH2 ARD-03	Sandstone	< 0.1	0.12	0.9	2.4	0.03	< 0.09	0.01	< 0.02	0.29	85	1.4	0.20	0.02	< 2	0.00	13	0.2	0.02	2.2	1.3	< 0.8	< 0.7	< 0.5	1.9	0.002	< 0.02	0.62	< 1	1.2
BR3A-DH1 ARD-02	Sandstone	< 0.1	0.20	1.0	2.5	0.03	< 0.09	0.005	< 0.02	0.53	100	4.4	0.32	0.06	< 2	0.00	32	1.8	0.02	6.5	1.5	< 0.8	< 0.7	< 0.5	3.3	0.002	< 0.02	0.96	< 1	2.7
BR3A-DH2 ARD-03	Sandstone	< 0.1	0.06	0.8	2.5	< 0.02	< 0.09	0.01	< 0.02	0.69	230	3.9	0.29	0.07	< 2	0.01	27	0.5	0.02	5.0	0.89	< 0.8	< 0.7	< 0.5	3.3	0.002	< 0.02	0.63	< 1	2.3
No. of sample		38	38	38	38	38	38	38	38	38	38	38	38	38	32	38	38	38	38	38	38	38	38	38	38	38	38	33	38
Minimum		< 0.1	0.04	< 0.5	1.1	< 0.02	< 0.09	0.004	< 0.02	0.29	46	1.4	0.20	0.001	< 2	0.003	13	0.2	0.02	2.2	0.49	< 0.8	< 0.7	< 0.5	1.9	0.002	< 0.02	0.007	< 1	1.2
Maximum		< 0.1	2.00	8.80	300	0.78	< 0.09	1.40	0.42	70	290	73.0	4.80	1.20	29.0	7.40	620	5.4	0.40	2000	35.0	< 0.8	< 0.7	3.5	120	0.29	0.62	10	69	120
Mean		< 0.1	0.97	1.24	77	0.22	< 0.09	0.39	0.07	7.0	117	17.7	1.76	0.56	17.6	0.67	169	1.0	0.15	65	6.8	< 0.8	< 0.7	1.3	20	0.09	0.27	2.2	25	8
Median		< 0.1	1.10	1.00	74	0.21	< 0.09	0.32	0.03	4.6	97	8.6	1.70	0.64	17.5	0.46	155	0.8	0.18	8.6	5.4	< 0.8	< 0.7	0.9	13	0.09	0.25	1.3	23	5
Standard Deviation			0.49	1.30	65	0.16		0.34	0.10	11	57	19.9	1.04	0.35	6.0	1.18	115	0.9	0.10	323	6.6			0.8	22	0.07	0.15	2.5	18	24
10th Percentile		< 0.1	0.16	0.80	2.5	0.03	< 0.09	0.01	0.02	0.67	62	2.3	0.33	0.03	10.2	0.007	31	0.3	0.02	4.3	1.2	< 0.8	< 0.7	0.6	3.1	0.002	0.10	0.2	5.4	2.1
90th Percentile		<0.1	1.43	1.40	140	0.40	<0.09	0.81	0.11	11	189	46.9	3.05	0.90	24.9	1.00	273	1.8	0.24	25	12.9	<0.8	<0.7	2.0	35	0.17	0.48	5.4	54	53

Note :

* From Price (1997)

Bold result exceeds 10 continental crust value.

Shaded samples selected for SFE and Reitveld XRD analysis based on ABA or aqua-regia metal results (results pending).

Table 4. Shake Flask Extraction Analysis of Rock Samples

Sample ID	Unit	MMER	CWQG (PAL)	CDWQ	NWB	BH3-2008-180 ARD-03	BH3-2008-165RD2 ARD-03	BH3-2008-146 ARD-01	BOR7D-DH1 ARD-01	BOR2A-DH1 ARD-02	BR3A-DH1 ARD-02
Sample	weight(g)					250	250	250	250	250	250
Volume mL	D.I. H2O					750	750	750	750	750	750
InitialpH	units					8.98	9.19	8.82	9.60	6.99	7.47
Final pH	units	6.0 - 9.5	6.5 - 9.0	6.5 - 8.5	6.0 - 9.5	**9.53**	9.50	**9.74**	9.49	7.11	7.52
Mercury (Hg)	mg/L	-	0.026	0.001		< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Aluminum (Al)	mg/L	-	0.005-0.1[a)]	-		1.05	0.96	2.11	0.64	0.06	0.24
Antimony (Sb)	mg/L	-		0.006		< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Arsenic (As)	mg/L	0.5	0.005	0.005		< 0.0002	0.0038	< 0.0002	0.0002	0.0003	0.0003
Barium (Ba)	mg/L	-	-	1		0.00312	0.00245	0.00172	0.00389	0.00419	0.00355
Beryllium (Be)	mg/L	-	-	-		< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Bismuth (Bi)	mg/L	-	-	-		0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Calcium (Ca)	mg/L	-	-	-		2.29	2.53	1.80	3.00	2.87	0.15
Cadmium (Cd)	mg/L	-	0.000017	0.005		< 0.000003	< 0.000003	< 0.000003	< 0.000003	< 0.000003	< 0.000003
Cobalt (Co)	mg/L	-	-	-		0.000020	0.000023	0.000015	0.000006	0.000255	0.000131
Chromium (Cr)	mg/L	-	0.001	0.051		< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Copper (Cu)	mg/L	0.3	0.002-0.004[b)]	≤1.0[3)]		< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.0010
Iron (Fe)	mg/L	-	0.3	<0.3[3)]		0.048	0.030	0.034	0.047	0.007	0.009
Lead (Pb)	mg/L	0.2	0.001-0.007[b)]	0.01		0.00031	0.00037	0.00008	0.00074	0.00003	0.00023
Lithium (Li)	mg/L	-	-	-		0.010	0.005	0.012	0.003	0.005	0.003
Magnesium (Mg)	mg/L	-	-	-		0.339	0.228	0.233	0.320	1.59	0.154
Manganese (Mn)	mg/L	-	-	≤0.05		0.00223	0.00110	0.00065	0.00072	0.0326	0.00786
Molybdenum (Mo)	mg/L	-	0.073	-		0.00116	0.00174	0.00011	0.00272	0.00029	0.00107
Nickel (Ni)	mg/L	0.5	0.025-0.15[b)]	-		< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.0005	0.0002
Potassium (K)	mg/L	-	-	-		10.1	5.89	2.92	11.1	1.95	2.30
Selenium (Se)	mg/L	-	0.001	-		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Sodium (Na)	mg/L	-	-	-		11.4	7.72	8.47	17.1	9.68	9.83
Strontium (Sr)	mg/L	-		-		0.0146	0.0095	0.0209	0.0169	0.0359	0.0029
Thallium (Tl)	mg/L	-		-		< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	0.00005
Tin (Sn)	mg/L	-		-		0.00003	< 0.00001	0.00001	< 0.00001	< 0.00001	< 0.00001
Titanium (Ti)	mg/L	-		-		0.0066	0.0034	0.0033	0.0024	0.0005	0.0057
Uranium (U)	mg/L	-		-		0.00246	0.00200	0.000201	0.0254	0.000670	0.000771
Vanadium (V)	mg/L	-		-		0.00626	0.00373	0.00422	0.00567	0.00176	0.00214
Zinc (Zn)	mg/L	0.5	0.03	≤5.0		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

Note:
MMER = Metal Mining Effluent Regulation
Bold value indicates parameter exceeds the MMER value.
CWGQ (PAL) and CDWG provided for reference only (see text)
CWGQ (PAL) = Canadian Council of Ministers of the Environment (CCME) Canadian Water Quality Guideline for the protection of Aquatic Life
CDWG = Health Canada - Canadian Drinking Water Guideline
NWB = Nunavut Water Board Wastewater Criteria
a) varies with pH
b) varies with hardness
c) aesthetic objective

Baffinland Iron Mines Corporation

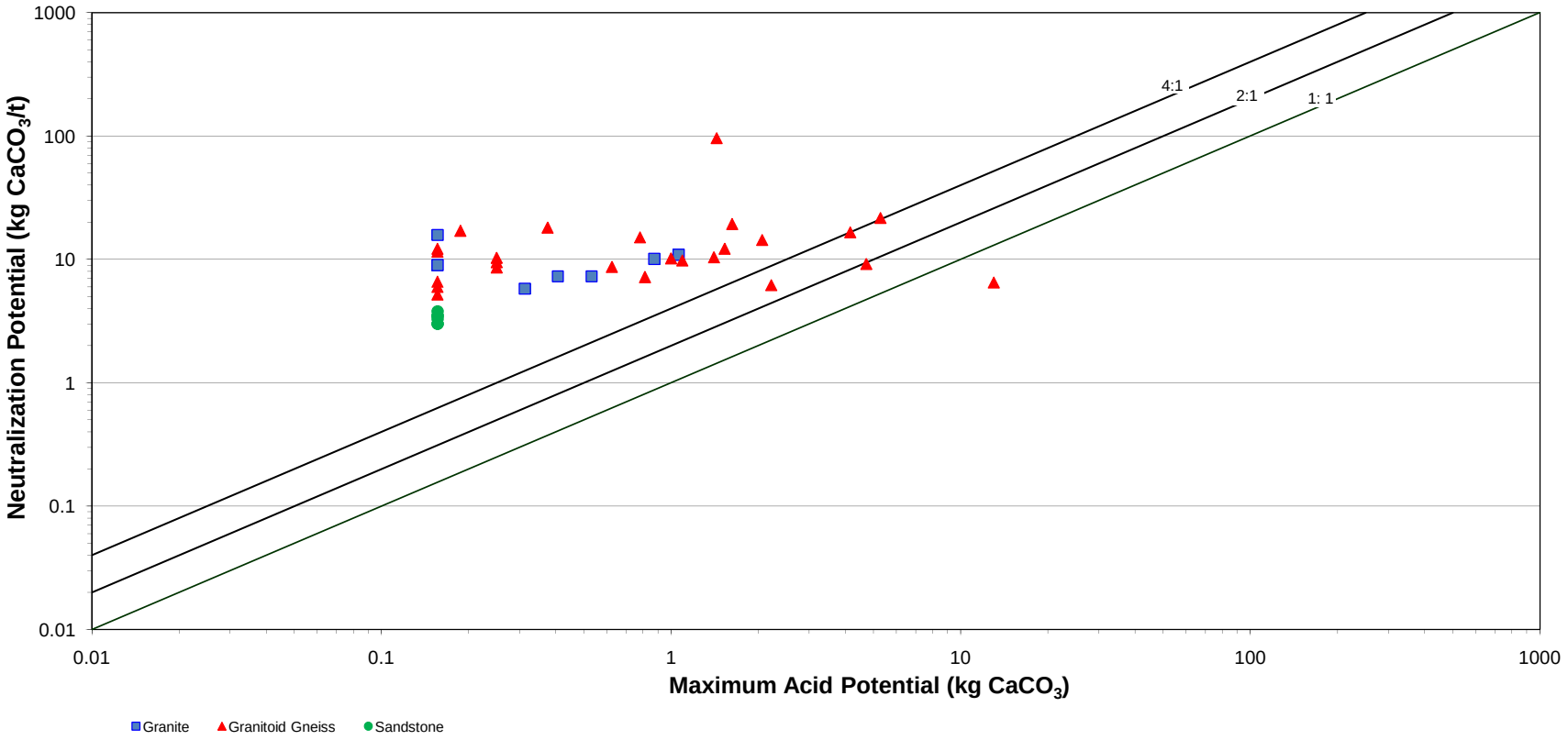
amec

Table 5. Mineralogy of Rock Samples (quantitative Rietveld phase analysis (%wt.))

Mineral		Ideal Formula	Granite *		Granitoid Gneiss *		Sandstone *	
			BH3-2008-180 ARD-03 (wt %)	BH3-2008-146 ARD-01 (wt %)	BH3-2008-165RD2 ARD-03 (wt %)	BOR7D-DH1 ARD-01 (wt %)	BOR2A-DH1 ARD-02 (wt %)	BR3A-DH1 ARD-02 (wt %)
Quartz		SiO_2	25.8	0.0	27.2	28.3	98.4	97.7
Orthoclase	Feldspars	$KAlSi_3O_8$	11.0	3.0	13.2	5.5	0.2	0.4
Microcline	Feldspars	$KAlSi_3O_8$	5.4	1.5	3.2	26.1	1.2	1.7
Albite	Feldspars	$NaAlSi_3O_5$	11.9	3.4	12.0	20.7	--	--
Anorthite	Feldspars	$CaAl_2Si_2O_8$	26.7	68.4	31.0	5.6	--	--
Enstatite (orthopyroxene)		$(Mg, Fe)_2Si_2O_6$	4.8	5.2	3.6	1.7	--	--
Diopside (clinopyroxene)		$CaMgSi_2O_6$	6.7	6.6	4.9	5.3	--	--
Actinolite (amphibole)		$Ca_2(Mg,Fe^{2+})_5Si_8O_{22}(OH)_2$	3.0	9.0	2.6	3.0	--	--
Biotite		$K(Mg,Fe^{2+})_3AlSi_3O_{10}(OH)_2$	4.5	2.6	2.1	0.1	--	--
Magnetite		Fe_3O_4	0.2	0.3	0.3	0.4	--	--
Clinochlore		$(Mg, Fe)_5(Si_3Al)O_{10}(OH)_8$	--	--	--	3.2	--	--
Kaolinite		$Al_2Si_2O_5(OH)_4$	--	--	--	--	0.2	0.2
Total			100	100	100	100	100	100

* Rock name from Knight Piésold borehole log

FIGURE



Baffinland Iron Mines Corporation

amec

Mary River Project

Railway Quarry Rock Samples
NP vs. MPA

Drawn by: JA	Checked by: SW	Date: December 2010
Project: TC101507		FIGURE 1

MEMO FROM KNIGHT PIÉSOLD CONSULTING

Knight Piésold
CONSULTING

MEMORANDUM

To:	Doron Golan	Date:	September 10, 2010
Copy To:	Matthew Pickard, Bill Napier, Stephan Theban	File No.:	NB102-181/25-A.01
From:	Ryan Weir	Cont. No.:	NB10-00467
Re:	Summary of Railway Quarry Sample Collection for Geochemical Testing		

The purpose of this memorandum is to summarize the sampling methods and inventory of samples collected by Knight Piésold Ltd. (Knight Piésold) in 2008 for geochemical testing. These samples were sent to SGS Minerals Services (SGS) in Lakefield, ON in 2008 and have remained in storage since that time.

Sample sites (quarry IDs) and locations are shown on the attached progress prints, Figures 3-2.5 to 3-2.8.

Sampling Methods

Geochemical samples were collected through July to September 2008 by Knight Piésold field personnel. Samples were collected by surface saw-cut sampling to assess suitable ballast material; chip sampling for geochemical testing; surface grab sampling mainly for durability testing; or core sampling also for geochemical testing.

Surface saw-cut sampling was conducted using a cutoff saw equipped with a diamond concrete cutting blade. Cuts were made in a rectangular pattern on a portion of bedrock exposed at surface within the site. The cuts were made as deep as the blade could cut into the rock to obtain the largest manageable sample as possible. The rock was then broken out using a large chisel and small sledge/rock hammer.

Chip sampling was conducted using a large chisel and/or a small sledge/rock hammer. On a portion of bedrock exposed at surface within a proposed site, small composite samples of approximately 5 kg of chips were collected.

Surface grab sampling was conducted by sampling naturally fractured/broken pieces of bedrock exposed at surface within a proposed site. Sample size was approximately 25 to 30 kg.

Core sampling was conducted using rotary diamond drill rigs equipped with various sized core barrels set up on various geotechnical and geomechanical programs holes. Suitable samples of lengths varying from 0.17 to 1.10 m were taken from various rock types encountered during the programs.

All samples were properly bagged and/or placed in buckets or core boxes; labelled; manifested; and submitted to SGS for analyses and/or eventual testing. All samples remain in their original containers stored in a covered outdoor storage area at SGS.

A summary of all samples is provided on Table 1.

Knight Piésold
CONSULTING

Signed: _____ Approved: _____

Ryan Weir, E.I.T.
Geological Engineering

Steve Aiken, P.Eng.
Manager, Environmental Services

Attachments:
Table 1 Rev 0 Summary of Saw-cut, Chip, Grab and Core Sampling
Figure 3-2.5 Rev A Railway Construction Potential Development Area (Sheet 1 of 4) – Progress Print
Figure 3-2.6 Rev A Railway Construction Potential Development Area (Sheet 2 of 4) – Progress Print
Figure 3-2.7 Rev A Railway Construction Potential Development Area (Sheet 3 of 4) – Progress Print
Figure 3-2.8 Rev A Railway Construction Potential Development Area (Sheet 4 of 4) – Progress Print

/rdw

Knight Piésold CONSULTING

TABLE 1

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

SUMMARY OF SAW-CUT, CHIP, GRAB AND CORE SAMPLING

Print Sep/10/10 14:02:38

Sample Site	Sample ID	Date Sampled	Drillhole (if applicable)	Depth (if applicable) (m)	Length (if applicable) (m)	Location		Buckets	Pallets
						Northing (m)	Easting (m)		
Saw-Cut Samples									
BAL1-2008	BAL1-08-1	1-Jul-08	-	-	-	7811137	601065	BAL1-08-1A	1 of 16
								BAL1-08-1B	5 of 17
								BAL1-08-1C	4 of 17
BAL1-2008	BAL1-08-2	1-Jul-08	-	-	-	7811065	601049	BAL1-08-2A	9 of 17
								BAL1-08-2B	7 of 17
								BAL1-08-2C	17 of 17
BAL1-2008	BAL1-08-3	30-Jun-08	-	-	-	7811035	601078	BAL1-08-3A	13 of 17
								BAL1-08-3B	14 of 17
								BAL1-08-3C	16 of 17
BAL1-2008	BAL1-08-4	30-Jun-08	-	-	-	7811027	601153	BAL1-08-4A	11 of 17
								BAL1-08-4B	12 of 17
								BAL1-08-4C	15 of 17
BAL1-2008	BAL1-08-5	30-Jun-08	-	-	-	7810941	601103	BAL1-08-5A	16 of 16
								BAL1-08-5B	8 of 17
								BAL1-08-5C	10 of 17
BAL2-2008	BAL2-08-1	3-Jul-08	-	-	-	7807589	598784	BAL2-08-1A	7 of 16
								BAL2-08-1B	3 of 17
								BAL2-08-1C	6 of 17
BAL2-2008	BAL2-08-2	3-Jul-08	-	-	-	7807534	598794	BAL2-08-2A	6 of 16
								BAL2-08-2B	2 of 17
								BAL2-08-2C	1 of 17
BAL2-2008	BAL2-08-3	3-Jul-08	-	-	-	7807431	598793	BAL2-08-3A	5 of 16
								BAL2-08-3B	14 of 16
								BAL2-08-3C	15 of 16
BAL3-2008	BAL3-08-1	4-Jul-08	-	-	-	7806539	598737	BAL3-08-1A	4 of 16
								BAL3-08-1B	11 of 16
								BAL3-08-1C	12 of 16
BAL3-2008	BAL3-08-2	4-Jul-08	-	-	-	7806484	598715	BAL3-08-2A	2 of 16
								BAL3-08-2B	9 of 16
								BAL3-08-2C	13 of 16
BAL4-2008	BAL3-08-1	4-Jul-08	-	-	-	7806100	598472	BAL4-08-1A	3 of 16
								BAL4-08-1B	8 of 16
								BAL4-08-1C	10 of 16
Chip Samples									
BAL1-2008	BAL1-C-01	30-Jun-08	-	-	-	7811039	601166	3	-
	BAL1-C-02	30-Jun-08	-	-	-	7811047	601159	5	-
	BAL1-C-03	30-Jun-08	-	-	-	7811046	601166	4	-
	BAL1-C-04	30-Jun-08	-	-	-	7811047	601112	3	-
	BAL1-C-05	30-Jun-08	-	-	-	7811046	601113	6	-
	BAL1-C-06	2-Jul-08	-	-	-	7811084	601026	1	-
	BAL1-C-07	2-Jul-08	-	-	-	7811095	601005	3	-
	BAL1-C-08	2-Jul-08	-	-	-	7811065	601049	1	-
	BAL1-C-09	2-Jul-08	-	-	-	7811035	601078	1	-
	BAL1-C-10	2-Jul-08	-	-	-	7811037	601100	2	-
BAL2-2008	BAL2-C-01	2-Jul-08	-	-	-	7807424	598800	-	-
	BAL2-C-02	2-Jul-08	-	-	-	7807480	598749	4	-
	BAL2-C-03	2-Jul-08	-	-	-	7807555	598804	-	-
	BAL2-C-04	2-Jul-08	-	-	-	7807557	598769	4	-
	BAL2-C-05	2-Jul-08	-	-	-	7807593	598808	6	-
	BAL2-C-06	3-Jul-08	-	-	-	7807606	598791	2	-
BAL3-2008	BAL3-C-01	4-Jul-08	-	-	-	7806385	598681	-	-
	BAL3-C-02	4-Jul-08	-	-	-	7806427	598691	2	-
	BAL3-C-03	4-Jul-08	-	-	-	7806461	598745	-	-
	BAL3-C-04	4-Jul-08	-	-	-	7806508	598748	6	-
BAL4-2008	BAL4-C-01	4-Jul-08	-	-	-	7806081	598442	5	-
	BAL4-C-02	4-Jul-08	-	-	-	7806011	598448	3	-

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TABLE 1

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

SUMMARY OF SAW-CUT, CHIP, GRAB AND CORE SAMPLING

Print Sep/10/10 14:02:38

Sample Site	Sample ID	Date Sampled	Drillhole (if applicable)	Depth (if applicable) (m)	Length (if applicable) (m)	Location		Buckets	Pallets
						Northing (m)	Easting (m)		
QMR2	QMR2-C01	23-Aug-08	-	-	-	7914123	560278	-	-
	QMR2-C02	23-Aug-08	-	-	-	7914065	560314	-	-
	QMR2-C03	23-Aug-08	-	-	-	7914147	560380	-	-
	QMR2-C04	23-Aug-08	-	-	-	7914278	560266	-	-
	QMR2-C05	23-Aug-08	-	-	-	7914204	560215	-	-
	QMR2-C06	23-Aug-08	-	-	-	7914189	560136	-	-
	QMR2-C07	23-Aug-08	-	-	-	7914237	560052	-	-
	QMR2-C08	23-Aug-08	-	-	-	7914331	560016	-	-
	QMR2-C09	23-Aug-08	-	-	-	7914330	559947	-	-
	QMR2-C10	23-Aug-08	-	-	-	7914104	560118	-	-
Q0-500	Q0-500-C01	21-Aug-08	-	-	-	7912025	563929	-	-
	Q0-500-C02	21-Aug-08	-	-	-	7912000	563918	-	-
	Q0-500-C03	21-Aug-08	-	-	-	7912002	563944	-	-
	Q0-500-C04	21-Aug-08	-	-	-	7911929	563969	-	-
	Q0-500-C05	21-Aug-08	-	-	-	7911878	563998	-	-
Q25+500	Q25+500-C01	25-Aug-08	-	-	-	7900471	586081	-	-
	Q25+500-C02	25-Aug-08	-	-	-	7900444	586122	-	-
	Q25+500-C03	25-Aug-08	-	-	-	7900449	586145	-	-
	Q25+500-C04	25-Aug-08	-	-	-	7900426	586168	-	-
	Q25+500-C05	25-Aug-08	-	-	-	7900393	586284	-	-
	Q25+500-C06	25-Aug-08	-	-	-	7900485	586168	-	-
	Q25+500-C07	25-Aug-08	-	-	-	7900480	586194	-	-
Q50+000	Q50+000-C01	24-Aug-08	-	-	-	7881055	597448	-	-
	Q50+000-C02	24-Aug-08	-	-	-	7881050	597503	-	-
	Q50+000-C03	24-Aug-08	-	-	-	7881007	597532	-	-
	Q50+000-C04	24-Aug-08	-	-	-	7880949	597509	-	-
	Q50+000-C05	24-Aug-08	-	-	-	7880981	597391	-	-
Q67+200	Q67+200-C01	24-Aug-08	-	-	-	7865512	599851	-	-
	Q67+200-C02	24-Aug-08	-	-	-	7865525	599861	-	-
	Q67+200-C03	24-Aug-08	-	-	-	7865546	599822	-	-
Q77+200	Q77+200-C01	22-Aug-08	-	-	-	7857932	605048	-	-
	Q77+200-C02	22-Aug-08	-	-	-	7857894	605045	-	-
	Q77+200-C03	22-Aug-08	-	-	-	7857837	605110	-	-
	Q77+200-C04	22-Aug-08	-	-	-	7857805	605109	-	-
	Q77+200-C05	22-Aug-08	-	-	-	7857815	605172	-	-
Q82+700	Q82+700-C01	22-Aug-08	-	-	-	7852797	606181	-	-
	Q82+700-C02	22-Aug-08	-	-	-	7852768	606230	-	-
	Q82+700-C03	22-Aug-08	-	-	-	7852722	606238	-	-
	Q82+700-C04	22-Aug-08	-	-	-	7852775	606285	-	-
	Q82+700-C05	22-Aug-08	-	-	-	7852703	606299	-	-
Grab Samples									
Q0-500	Q0-500-G01	21-Aug-08	-	-	-	7912029	563931	1/2	-
	Q0-500-G01	21-Aug-08	-	-	-			2/2	-
	Q0-500-G02	21-Aug-08	-	-	-	7911978	563915	1/2	-
	Q0-500-G02	21-Aug-08	-	-	-			2/2	-
	Q0-500-G03	21-Aug-08	-	-	-	7912003	563945	1/2	-
	Q0-500-G03	21-Aug-08	-	-	-			2/2	-
Q10+250	Q10+250-G01	25-Aug-08	-	-	-	7905676	572168	1/2	-
	Q10+250-G01	25-Aug-08	-	-	-			2/2	-
	Q10+250-G02	25-Aug-08	-	-	-	7905676	572168	1/2	-
	Q10+250-G02	25-Aug-08	-	-	-			2/2	-
Q50+000	Q50+000-G01	24-Aug-08	-	-	-	7880981	597391	1/2	-
	Q50+000-G01	24-Aug-08	-	-	-			2/2	-
	Q50+000-G02	24-Aug-08	-	-	-	7881067	597501	1/2	-
	Q50+000-G02	24-Aug-08	-	-	-			2/2	-
Q56+750	Q56+750-G01	24-Aug-08	-	-	-	7875333	598936	1/2	-
	Q56+750-G01	24-Aug-08	-	-	-			2/2	-
	Q56+750-G02	24-Aug-08	-	-	-	7875355	598874	1/2	-

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TABLE 1

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

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Print Sep/10/10 14:02:38

Sample Site	Sample ID	Date Sampled	Drillhole (if applicable)	Depth (if applicable) (m)	Length (if applicable) (m)	Location		Buckets	Pallets
						Northing (m)	Easting (m)		
Q56+750 (cont'd)	Q56+750-G02	24-Aug-08	-	-	-	(7875355)	(598874)	2/2	-
	Q56+750-G03	24-Aug-08	-	-	-	7875302	598891	1/2	-
	Q56+750-G03	24-Aug-08	-	-	-			2/2	-
Q64+400	Q64+400-G01	24-Aug-08	-	-	-	7868630	600079	1/2	-
	Q64+400-G01	24-Aug-08	-	-	-			2/2	-
	Q64+400-G02	24-Aug-08	-	-	-	7868608	600171	1/2	-
	Q64+400-G02	24-Aug-08	-	-	-			2/2	-
	Q64+400-G03	24-Aug-08	-	-	-	7868654	600176	1/2	-
	Q64+400-G03	24-Aug-08	-	-	-			2/2	-
Q67+200	Q67+200-G01	24-Aug-08	-	-	-	7865564	599799	1/2	-
	Q67+200-G01	24-Aug-08	-	-	-			2/2	-
	Q67+200-G02	24-Aug-08	-	-	-	7865489	599862	1/2	-
	Q67+200-G02	24-Aug-08	-	-	-			2/2	-
Q77+200	Q77+200-G01	22-Aug-08	-	-	-	7857894	605045	1/2	-
	Q77+200-G01	22-Aug-08	-	-	-			2/2	-
	Q77+200-G02	22-Aug-08	-	-	-	7857837	605110	1/2	-
	Q77+200-G02	22-Aug-08	-	-	-			2/2	-
	Q77+200-G03	22-Aug-08	-	-	-	7857815	605172	1/2	-
	Q77+200-G03	22-Aug-08	-	-	-			2/2	-
Q82+700	Q82+700-G01	22-Aug-08	-	-	-	7852799	606190	1/2	-
	Q82+700-G01	22-Aug-08	-	-	-			2/2	-
	Q82+700-G02	22-Aug-08	-	-	-	7852757	606252	1/2	-
	Q82+700-G02	22-Aug-08	-	-	-			2/2	-
	Q82+700-G03	22-Aug-08	-	-	-	7852715	606244	1/2	-
	Q82+700-G03	22-Aug-08	-	-	-			2/2	-
Core Samples									
-	ARD01	UNK.	BH4-2008-83	6	0.86	-	-	ARD-72	-
	ARD02	UNK.		11.9	0.94	-	-	ARD-72	-
	ARD03	UNK.		21.1	1.02	-	-	ARD-72	-
-	ARD01	UNK.	BH3-2008-83	16	0.29	-	-	ARD-74	-
	ARD02	UNK.		20.7	0.34	-	-	ARD-74	-
	ARD03	UNK.		24.6	0.36	-	-	ARD-74	-
-	ARD01	UNK.	BH2007-33	19.6	0.36	-	-	ARD-72	-
	ARD02	UNK.		41.3	0.33	-	-	ARD-72	-
	ARD03	UNK.		61	0.34	-	-	ARD-72	-
-	ARD01	UNK.	BH2007-36	7.5	0.33	-	-	ARD-74	-
	ARD02	UNK.		18.3	0.33	-	-	ARD-75	-
	ARD03	UNK.		30	0.33	-	-	ARD-75	-
CUT122+750	ARD01	6-Sep-08	BH3-2008-146	17.4	0.3	-	-	ARD-75	-
	ARD02	6-Sep-08		20.55	0.36	-	-	ARD-75	-
	ARD03	6-Sep-08		26.4	0.33	-	-	ARD-75	-
CUT122+750	ARD01	6-Sep-08	BH3-2008-148	5.4	0.25	-	-	ARD-75	-
	ARD02	6-Sep-08		19.2	0.31	-	-	ARD-75	-
	ARD03	6-Sep-08		26.3	0.27	-	-	ARD-75	-
Q138+100 (BAL2)	ARD01	6-Sep-08	BH3-2008-178	3.9	0.33	-	-	ARD-74	-
	ARD02	6-Sep-08		20.2	0.32	-	-	ARD-74	-
	ARD03	6-Sep-08		35.1	0.32	-	-	ARD-74	-
Q138+100 (BAL2)	ARD01	9-Sep-08	BH3-2008-179	10	0.34	-	-	ARD-75	-
	ARD02	9-Sep-08		18.6	0.31	-	-	ARD-75	-
	ARD03	9-Sep-08		29.7	0.32	-	-	ARD-75	-
Q139+600 (BAL3)	ARD01	8-Sep-08	BH3-2008-180	7.7	0.34	-	-	ARD-74	-
	ARD02	8-Sep-08		20.7	0.35	-	-	ARD-74	-
	ARD03	8-Sep-08		30.6	0.29	-	-	ARD-74	-
CUT137+515	ARD01	7-Sep-08	BH4-2008-125RD	6	0.94	-	-	ARD-76	-
	ARD02	7-Sep-08		14.55	0.9	-	-	ARD-76	-
	ARD03	7-Sep-08		20.1	0.8	-	-	ARD-76	-
North Tunnel	ARD01	7-Sep-08	NTUN-DH02	22.9	0.85	-	-	ARD-76	-
	ARD02	9-Sep-08		45.54	0.78	-	-	ARD-76	-

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TABLE 1

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

SUMMARY OF SAW-CUT, CHIP, GRAB AND CORE SAMPLING

Print Sep/10/10 14:02:38

Sample Site	Sample ID	Date Sampled	Drillhole (if applicable)	Depth (if applicable) (m)	Length (if applicable) (m)	Location		Buckets	Pallets
						Northing (m)	Easting (m)		
North Tunnel (cont'd)	ARD03	9-Sep-08	NTUN-DH02 (cont'd)	60.72	0.83	-	-	ARD-76	-
	BF01	9-Sep-08		39.63	0.17	-	-	KP-1	-
	BF02	9-Sep-08		49.33	0.2	-	-	KP-1	-
	BF03	9-Sep-08		59.1	0.21	-	-	KP-1	-
	UCS01	7-Sep-08		15.75	0.26	-	-	KP-1	-
	UCS02	7-Sep-08		29.5	0.27	-	-	KP-1	-
	UCS03	9-Sep-08		37.95	0.22	-	-	KP-1	-
	UCS04	9-Sep-08		49.1	0.23	-	-	KP-1	-
	UCS05	9-Sep-08		66.1	0.27	-	-	KP-1	-
North Tunnel	ARD01	22-Sep-08	NTUN-DH08	63.96	0.87	-	-	ARD-71	-
	ARD02	24-Sep-08		90.6	0.985	-	-	ARD-71	-
	ARD03	26-Sep-08		121.7	0.95	-	-	ARD-71	-
	BF01	23-Sep-08		73.37	0.32	-	-	KP-1	-
	BF02	24-Sep-08		92.1	0.25	-	-	KP-1	-
	BF03	25-Sep-08		113.19	0.34	-	-	KP-1	-
	UCS01	22-Sep-08		30.93	0.27	-	-	KP-2	-
	UCS02	22-Sep-08		51.29	0.31	-	-	KP-2	-
	UCS03	23-Sep-08		69.6	0.28	-	-	KP-2	-
	UCS04	24-Sep-08		92.61	0.3	-	-	KP-2	-
	UCS05	25-Sep-08		113.53	0.35	-	-	KP-2	-
	UCS06	26-Sep-08		118.45	0.43	-	-	KP-2	-
	UCS07	26-Sep-08		128.39	0.29	-	-	KP-2	-
	UCS08	27-Sep-08		138.6	0.23	-	-	KP-2	-
North Tunnel	ARD01	24-Sep-08	NTUN-DH10	24.5	1	-	-	ARD-73	-
	ARD02	25-Sep-08		49.9	1.05	-	-	ARD-73	-
	ARD03	26-Sep-08		73.03	0.97	-	-	ARD-73	-
	BF01	24-Sep-08		22.35	0.22	-	-	KP-1	-
	BF02	25-Sep-08		47.9	0.23	-	-	KP-1	-
	BF03	26-Sep-08		69.5	0.34	-	-	KP-1	-
	UCS01	24-Sep-08		21.78	0.24	-	-	KP-2	-
	UCS02	24-Sep-08		28.58	0.22	-	-	KP-2	-
	UCS03	25-Sep-08		40.26	0.26	-	-	KP-2	-
	UCS04	25-Sep-08		57.8	0.27	-	-	KP-2	-
	UCS05	26-Sep-08		80.58	0.31	-	-	KP-2	-
	UCS06	26-Sep-08		96.78	0.32	-	-	KP-2	-
South Tunnel	ARD01	11-Sep-08	STUN-DH01	25.92	0.81	-	-	ARD-72	-
	ARD02	12-Sep-08		45.42	0.73	-	-	ARD-72	-
	ARD03	21-Sep-08		60.3	0.92	-	-	ARD-72	-
	BF01	12-Sep-08		37.4	0.26	-	-	KP-1	-
	BF02	12-Sep-08		46.15	0.21	-	-	KP-1	-
	BF03	21-Sep-08		59.19	0.41	-	-	KP-1	-
	UCS01	10-Sep-08		15.75	0.21	-	-	KP-1	-
	UCS02	11-Sep-08		32.52	0.22	-	-	KP-1	-
	UCS03	12-Sep-08		39.11	0.18	-	-	KP-1	-
	UCS04	12-Sep-08		47.49	0.24	-	-	KP-1	-
	UCS05	22-Sep-08		65.31	0.31	-	-	KP-2	-
Ballast 1	ARD01	5-Sep-08	BAL1-DH1	46.3, 47.6	0.47, 0.46	-	-	ARD-57	-
	ARD02	5-Sep-08		32.1	1.02	-	-	ARD-57	-
	ARD03	5-Sep-08		14	0.94	-	-	ARD-57	-
Ballast 1	ARD01	5-Sep-08	BAL1-DH2	15	1.02	-	-	ARD-57	-
	ARD02	5-Sep-08		30.3	1.01	-	-	ARD-58	-
	ARD03	5-Sep-08		47.1	0.96	-	-	ARD-58	-
Ballast 1	ARD01	5-Sep-08	BAL1-DH3	5.8	1	-	-	ARD-58	-
	ARD02	5-Sep-08		15.7	0.97	-	-	ARD-58	-
	ARD03	5-Sep-08		22.7	23.7	-	-	ARD-60	-
Ballast 1	ARD01	5-Sep-08	BH3-2008-166	6.6	0.76	-	-	ARD-59	-
	ARD02	5-Sep-08		17.6	0.66	-	-	ARD-59	-
	ARD03	5-Sep-08		32.2	0.65	-	-	ARD-59	-

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TABLE 1

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MARY RIVER PROJECT

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Print Sep/10/10 14:02:38

Sample Site	Sample ID	Date Sampled	Drillhole (if applicable)	Depth (if applicable) (m)	Length (if applicable) (m)	Location		Buckets	Pallets
						Northing (m)	Easting (m)		
Ballast 1	ARD01	5-Sep-08	BH4-2008-122	6.15	1	-	-	ARD-60	-
	ARD02	5-Sep-08		17.9	0.97	-	-	ARD-60	-
	ARD03	5-Sep-08		28	1	-	-	ARD-60	-
BR3A/3B	ARD01	18-Sep-08	BR3A-DH1	11.2	0.96	7905630	572191	ARD-63	-
	ARD02	18-Sep-08		22.7	0.9			ARD-63	-
	ARD03	18-Sep-08		28.9	0.96			ARD-63	-
BR3A/3B	ARD01	19-Sep-08	BR3A-DH2	13.3	1.05	7905590	572258	ARD-70	-
	ARD02	19-Sep-08		20.1	1			ARD-70	-
	ARD03	19-Sep-08		28.3	1.1			ARD-70	-
BR3A/3B	ARD01	18-Sep-08	BR3A-DH3RD2	9.7	1	7905619	572305	ARD-64	-
	ARD02	18-Sep-08		16.3	1			ARD-64	-
	ARD03	18-Sep-08		23	1			ARD-64	-
BOR2A	ARD01	19-Sep-08	BOR2A-DH1	11.4	0.95	7902411	579168	ARD-67	-
	ARD02	19-Sep-08		21.1	0.86			ARD-67	-
	ARD03	19-Sep-08		29.4	0.97			ARD-67	-
BOR2A	ARD01	19-Sep-08	BOR2A-DH2	19.4	0.99	7902497	579092	ARD-69	-
	ARD02	19-Sep-08		25.5	0.94			ARD-69	-
	ARD03	19-Sep-08		34.4	1.02			ARD-69	-
BOR7D	ARD01	18-Sep-08	BOR7D-DH1	4.8	1	7889364	595915	ARD-61	-
	ARD02	18-Sep-08		13	1			ARD-62	-
	ARD03	18-Sep-08		22.9	1			ARD-62	-
BOR7D	ARD01	18-Sep-08	BOR7D-DH2	6.9	0.86	7889478	595925	ARD-65	-
	ARD02	18-Sep-08		13.4	1			ARD-65	-
	ARD03	18-Sep-08		22.7	0.98			ARD-66	-
BOR7D	ARD01	18-Sep-08	BOR7D-DH3RD	5.9	0.93	7889387	596018	ARD-64	-
	ARD02	18-Sep-08		13.9	0.95			ARD-65	-
	ARD03	18-Sep-08		22.4	1.04			ARD-65	-
BR7	ARD01	18-Sep-08	BR7-DH1	7.1	0.91	7882597	598495	ARD-66	-
	ARD02	18-Sep-08		13.9	1.02			ARD-66	-
	ARD03	18-Sep-08		23.7	0.9			ARD-66	-
BOR12B	ARD01	19-Sep-08	BOR12B-DH1	7	1	7868662	600176	ARD-68	-
	ARD02	19-Sep-08		13.3	0.85			ARD-68	-
	ARD03	19-Sep-08		22.3	1.01			ARD-69	-
BOR12B	ARD01	19-Sep-08	BOR12B-DH2	6.2	1.04	7868605	600162	ARD-67	-
	ARD02	19-Sep-08		14.2	0.95			ARD-68	-
	ARD03	19-Sep-08		22.2	1			ARD-68	-
BOR12B	ARD01	18-Sep-08	BOR12B-DH3	8.2	1	7868628	600057	ARD-62	-
	ARD02	18-Sep-08		15.9	0.95			ARD-62	-
	ARD03	18-Sep-08		23.3	0.97			ARD-63	-
BOR13A	ARD01	18-Sep-08	BOR13A-DH1	10.3	1	7865499	599785	ARD-61	-
	ARD02	18-Sep-08		19.5	1			ARD-61	-
	ARD03	18-Sep-08		29	1			ARD-61	-
BR13	ARD01	26-Sep-08	BR13-DH1RD	9.91	0.99	7841006	607648	ARD-71	-
	ARD02	26-Sep-08		16.9	1.03			ARD-71	-
	ARD03	26-Sep-08		23.96	1.04			ARD-71	-
CUT132+750	ARD01	27-Sep-08	BH3-2008-165RD2	10	0.96	-	-	ARD-73	-
	ARD02	27-Sep-08		19.1	1			ARD-73	-
	ARD03	27-Sep-08		28.11	0.99			ARD-73	-
QMR2	ARD01	-	QMR2	-	-	-	-	-	-
	ARD02	-		-	-			-	-
	ARD03	-		-	-			-	-
BR1B	ARD01	-	BR1B-DH	4.65	0.8	7912030	563867	ARD-80	-
	ARD02	-		15.4	0.75			ARD-80	-
	ARD03	-		24.6	0.75			ARD-80	-
BR1C	ARD01	-	BR1C-DH	5.2	0.55	7911028	564458	ARD-81	-
	ARD02	-		14.5	0.7			ARD-81	-
	ARD03	-		24.2	0.8			ARD-81	-
BR1D	ARD01	-	BR1D-DH	5.4	0.85	7910819	564632	ARD-78	-

Knight Piésold CONSULTING

TABLE 1

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

SUMMARY OF SAW-CUT, CHIP, GRAB AND CORE SAMPLING

Print Sep/10/10 14:02:38

Sample Site	Sample ID	Date Sampled	Drillhole (if applicable)	Depth (if applicable) (m)	Length (if applicable) (m)	Location		Buckets	Pallets
						Northing (m)	Easting (m)		
BR1D (cont'd)	ARD02	-	BR1D-DH (cont'd)	15.3	0.75	(7910819)	(564632)	ARD-78	-
	ARD03	-		25	0.7			ARD-78	-
BR1E	ARD01	-	BR1E-DH	7.55	0.85	7910655	564959	ARD-79	-
	ARD02	-		16.9	0.9			ARD-79	-
	ARD03	-		25.55	0.9			ARD-79	-
BR1F	ARD01	-	BR1F-DH	6	0.75	7910467	565183	ARD-77	-
	ARD02	-		15.9	0.85			ARD-77	-
	ARD03	-		26.75	0.75			ARD-77	-

I:\1\02\00181\25\A\Correspondence\NB10-00467 Railway Quarry Geochemistry\[Table 1.xls]Table 1

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	10SEP'10	ISSUED WITH MEMO NB10-00467	RDW	RAC	KDE

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565,000
570,000
575,000
580,000
585,000
590,000
595,000

7,915,000
7,910,000
7,905,000
7,900,000
7,895,000

MINE SITE POTENTIAL DEVELOPMENT AREA

QMR2 (7914203, 560128)

Q-0+500 (7912027, 563871)

MINE SITE CONSTRUCTION CAMP

Q4+100 (7909555, 566420)

Q7+500 (7907635, 569266)

Q10+250 (7905223, 572892)

Q14+500 (7904553, 575634)

Q18+100 (7902454, 579052)

Q22+500 (7901545, 583188)

Q25+500 (7900278, 586451)

Q28+400 (7898582, 588324)

Q31+500 (7897799, 590918)

Q35+000 (7896830, 594460)

Q35+500 (7896249, 595362)

SCALE 1 0.5 0 1 2 3 4 5 km

LEGEND:

- WATER
- ESTIMATED QUARRY POTENTIAL DEVELOPMENT AREA
- AREA OF POTENTIAL ACCESS (PRELIMINARY)
- MINE SITE POTENTIAL DEVELOPMENT AREA
- POTENTIAL DEVELOPMENT AREA
- RIVER/STREAM/DRAINAGE
- MILNE INLET TOTE ROAD
- PROPOSED RAILWAY ALIGNMENT
- PROPOSED CONSTRUCTION ACCESS ROAD

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
-	DDMMM'10	ISSUED FOR ---	-	-	-	-

PROGRESS PRINT
SEP 02, 2010 (5:35 PM)

NOTES:

1. BASE MAP 1:250,000 © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA, DEPARTMENT OF NATURAL RESOURCES (2004).
2. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 17 AND IS IN METRES.
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL VARIES.
4. RAILWAY ALIGNMENT PROVIDED BY CANARAIL CONSULTANTS INC. (AUGUST 12, 2010).

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

RAILWAY CONSTRUCTION POTENTIAL DEVELOPMENT AREA (SHEET 1 OF 4)

Knight Piésold CONSULTING

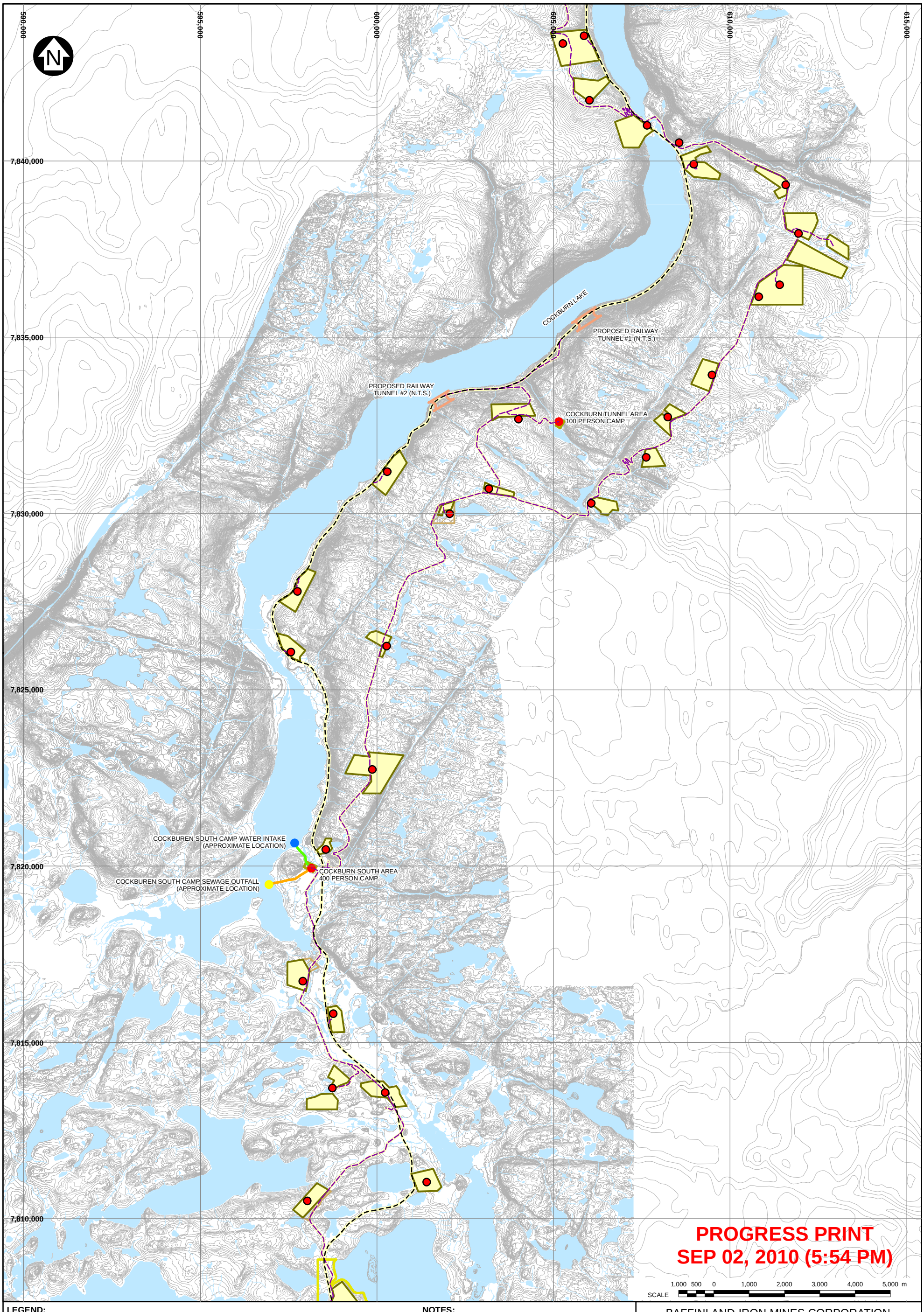
P/A NO. NB102-181/25

REF NO. 8

FIGURE 3-2.5

REV A

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LEGEND:

- WATER
- ESTIMATED QUARRY POTENTIAL DEVELOPMENT AREA
- AREA OF POTENTIAL ACCESS (PRELIMINARY)
- POTENTIAL DEVELOPMENT AREA
- RIVER/STREAM/DRAINAGE
- MILNE INLET TOTE ROAD
- PROPOSED RAILWAY ALIGNMENT
- PROPOSED CONSTRUCTION ACCESS ROAD
- POTENTIAL RAILWAY CONSTRUCTION CAMP LOCATION

NOTES:

1. BASE MAP 1:250,000 © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA, DEPARTMENT OF NATURAL RESOURCES (2004).
2. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 17 AND IS IN METRES.
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL VARIES.
4. RAILWAY ALIGNMENT PROVIDED BY CANARAIL CONSULTANTS INC. (AUGUST 12, 2010).

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	DDMMM'10	ISSUED FOR -	RAC	ASM	-	-

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

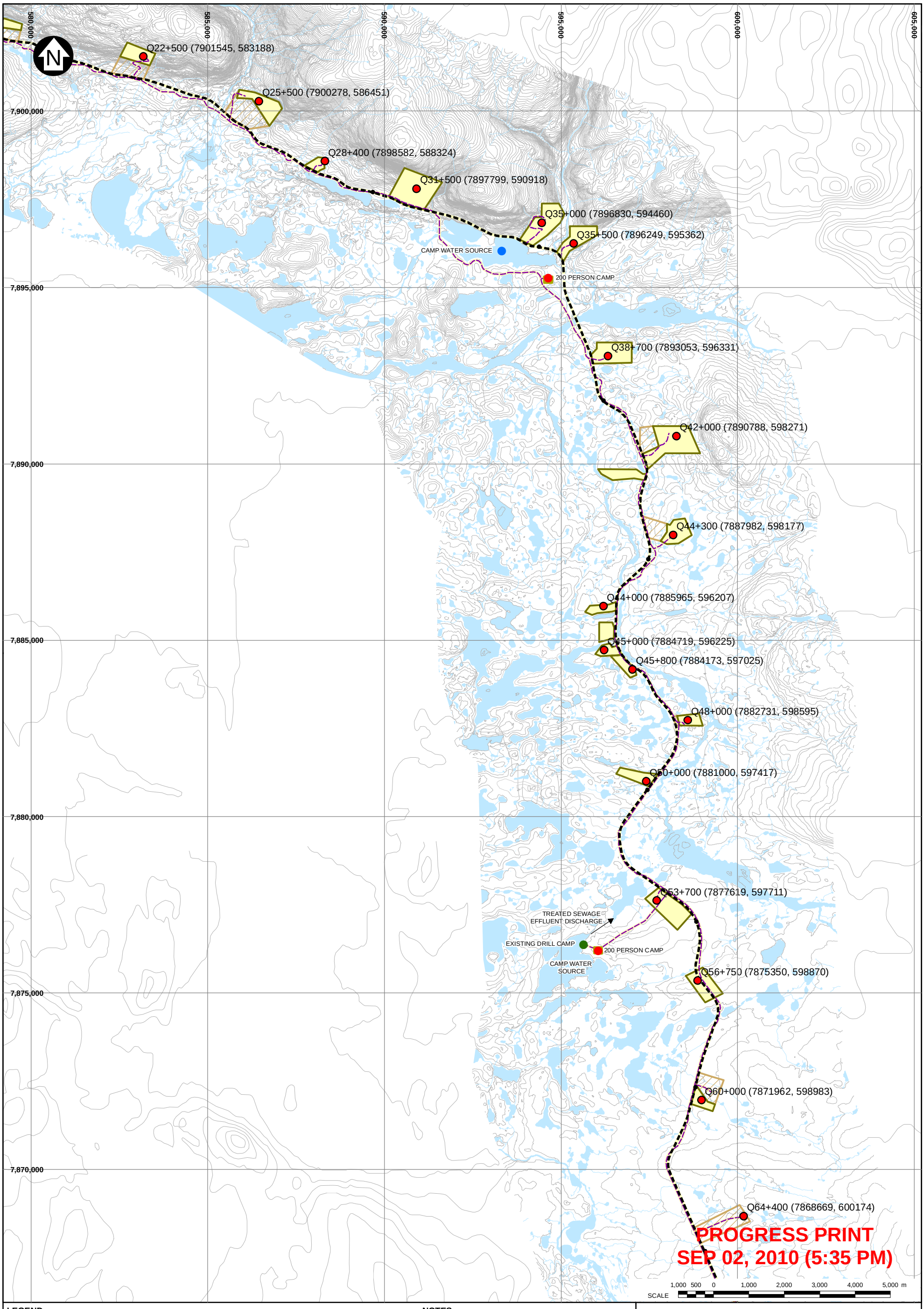
RAILWAY CONSTRUCTION POTENTIAL DEVELOPMENT AREA (SHEET 3 OF 4)

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-181/25	8

FIGURE 3-2.7 REV A

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LEGEND:

- WATER
- ESTIMATED QUARRY POTENTIAL DEVELOPMENT AREA
- AREA OF POTENTIAL ACCESS (PRELIMINARY)
- POTENTIAL DEVELOPMENT AREA
- RIVER/STREAM/DRAINAGE
- MILNE INLET TOTE ROAD
- PROPOSED RAILWAY ALIGNMENT
- PROPOSED CONSTRUCTION ACCESS ROAD
- EXISTING CAMP LOCATION
- POTENTIAL RAILWAY CONSTRUCTION CAMP LOCATION

NOTES:

1. BASE MAP 1:250,000 © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA, DEPARTMENT OF NATURAL RESOURCES (2004).
2. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 17 AND IS IN METRES.
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL VARIES.
4. RAILWAY ALIGNMENT PROVIDED BY CANARAIL CONSULTANTS INC. (AUGUST 12, 2010).

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	DDMMM'10	ISSUED FOR -	RAC	ASM	-	-

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

RAILWAY CONSTRUCTION POTENTIAL DEVELOPMENT AREA (SHEET 2 OF 4)

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P/A NO. NB102-181/25

REF NO. 8

FIGURE 3-2.6

REV A

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590,000
595,000
600,000
605,000
610,000
7,830,000
7,825,000
7,820,000
7,815,000
7,810,000
7,805,000
7,800,000

COCKBURN TUNNEL AREA
100 PERSON CAMP

COCKBUREN SOUTH CAMP WATER INTAKE
(APPROXIMATE LOCATION)

COCKBURN SOUTH AREA
400 PERSON CAMP

COCKBUREN SOUTH CAMP SEWAGE OUTFALL
(APPROXIMATE LOCATION)

STEENSBY POTENTIAL
DEVELOPMENT AREA

STEENSBY CONSTRUCTION CAMP

SEWAGE OUTFALL

STEENSBY INLET

PROGRESS PRINT
SEP 02, 2010 (6:02 PM)

SCALE 1,000 500 0 1,000 2,000 3,000 4,000 5,000 m

LEGEND:

- WATER
- ESTIMATED QUARRY POTENTIAL DEVELOPMENT AREA
- AREA OF POTENTIAL ACCESS (PRELIMINARY)
- STEENSBY INLET POTENTIAL DEVELOPMENT AREA
- POTENTIAL DEVELOPMENT AREA
- RIVER/STREAM/DRAINAGE
- MILNE INLET TOTE ROAD
- PROPOSED RAILWAY ALIGNMENT
- PROPOSED CONSTRUCTION ACCESS ROAD
- WATER INTAKE PIPELINE
- SEWAGE OUTFALL PIPELINE
- POTENTIAL RAILWAY CONSTRUCTION CAMP LOCATION
- WATER INTAKE LOCATION (APPROXIMATE ONLY)
- SEWAGE OUTFALL LOCATION (APPROXIMATE ONLY)
- POTENTIAL QUARRY LOCATION

NOTES:

1. BASE MAP 1:250,000 © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA, DEPARTMENT OF NATURAL RESOURCES (2004).
2. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 17 AND IS IN METRES.
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL VARIES.
4. RAILWAY ALIGNMENT PROVIDED BY CANARAIL CONSULTANTS INC. (AUGUST 12, 2010).

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	DDMMM'10	ISSUED FOR -	RAC	ASM	-	-

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

RAILWAY CONSTRUCTION POTENTIAL DEVELOPMENT AREA (SHEET 4 OF 4)

Knight Piésold CONSULTING

P/A NO. NB102-181/25

REF NO. 8

FIGURE 3-2.8

REV A

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CIRNAC 10 ATTACHMENT 2: GEOTECHNICAL INVESTIGATIONS - ACID ROCK DRAINAGE ASSESSMENT

Project Memo

H353004

September 11, 2017

To: M Weaver

From: W Hoyle

cc:

BIM
T Atiba
F Pittman
R Stefan

Hatch
A Aquil
S Heiner
S Hinchberger
J Howes
N Mills
N Mason
F van Biljon

Baffinland Iron Ore Mines LP
Mary River Project

Geotechnical Investigations - Acid Rock Drainage Assessment

1. Introduction

Hatch Ltd. (Hatch) was retained by Baffinland Iron Mines (BIM) to complete an assessment of bedrock materials that will potentially be used as construction materials associated with the proposed railway from Mary River to Milne Port on Baffin Island, Nunavut. Testing was carried out on three rock samples, representative of the likely materials available during the construction of the railway. Hatch's objective was to assess the suitability of rock materials for use as construction materials.

Acid Rock Drainage (ARD) occurs when minerals containing sulphide and elemental sulphur are exposed to the weathering effects of oxygen and water. Acidity is generated from the oxidation of sulphur and precipitation of ferric iron. ARD occurs when the resulting acidity is entrained by water. High metal solubility and sulphide weathering occur under acidic conditions. Metal Leaching (ML) is typically associated with acid rock drainage. Although a neutral pH does not necessarily prevent metal leaching, in many environments, metal leaching will only be significant if the drainage pH is less than 5.5 or 6 (Price and Errigton 1998).

The Fizz Rating test is another aspect of the acid-base accounting testing program. This test is carried out by adding 1 to 2 drops of 25 % HCL to a prepared sample. The 'fizz' is rated on a scale for 0 to 3, with 0 for no reaction, 1 for a slight reaction, 2 for a moderate reaction and 3 for a strong reaction. There should be a correlation between NP and Fizz Rating. As an example, for a Fizz Rating of 3, there would likely be a highly positive NP and for a Fizz Rating of 0, a likely very low positive or negative NP.

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An assessment of the potential of acid generating potential of excavated bedrock is typically required as part of the regulatory permitting and approvals process for facilities where imported natural materials will be potentially exposed to weathering.

During the geotechnical investigation program, a number of bedrock samples were collected, including samples of granitic gneiss, limestone and diabase that are located along the alignment of the proposed railway.

2. Testing Methodology

The rock samples were considered to be representative of the bedrock encountered along the railway. The samples were shipped to SGS Lakefield Research Limited for static laboratory analysis. The analysis procedure utilized was the acid-base accounting which included measurement of sulphur species, total carbon and carbonate, Neutralization Potential (NP), pH, acid potential (AP), and the NP/AP ratio. Testing was carried out as per Government of British Columbia Technical Circular T-04/13.

3. Results

The bedrock samples included:

- granitic gneiss sampled at approximately Km 3; medium to coarse, fresh, comprised mostly of plagioclase, quartz and mafic minerals
- diabase sampled at approximately Km 95; fine to medium, fresh, blackish green comprised of mostly mafic minerals, some quartz
- limestone sampled at approximately Km 62; fine to medium, fresh, light yellowish grey.

The results of the ABA testing are summarized in Table 1 and the laboratory test reports are attached. The ABA test includes several components that provide an indicator of the acid—generating potential of the materials sampled, including paste pH, the sulphide sulphur component (%), neutralization potential (NP): acid potential (AP) ratio and net neutralization potential (NP-AP) (tonnes $CaCO_3$/1000 tonnes). The AP is calculated based on the sulphide sulphur concentration, and the NP is measurement of the amount of neutralizing base minerals, including carbonate in the samples. The net NP is the difference between the NP and the AP and the NP/AP ratio is the NP divided by the AP.

Table 1: Results of ABA Testing

Laboratory Sample Number	Description	Paste pH	NP/AP Ratio	Net NP (tonnes $CaCO_3$/ 1000 tonnes)	Total Sulphur (%)	Sulphide Sulphur (%)	Fizz Rate	Carbonate (%)
NF17-07	Granitic Gneiss	9.89	9.10	5.43	0.035	<0.02	1	0.110
NF17-08	Diabase	8.89	16.9	10.6	0.042	<0.02	1	<0.025
NF17-09	Limestone	8.24	1608	1077	0.029	<0.02	3	54.1

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While there is a very low concentration of total sulphur in the samples, the majority of the sulphur in the sample is likely sulphide sulphur. The samples had a paste pH near or over 9, which indicates that neutralization potential will be available immediately under leaching conditions. Based on results from ARD studies in the Appalachian coal mines (Brady et al. 1994), a net NP value that exceeds 15 tonnes $CaCO_3$/tonne was considered to be non-acid generating, a net NP value less than or equal to 0 tonnes $CaCO_3$/tonne was considered to be acid generating, and a net NP value between 0 and 15 tonnes $CaCO_3$/tonne represented a grey zone that was potentially acid generating, but for which prediction was difficult.

Based on this classification system, the limestone sample (NF17-09) with a net NP value at 1077 is classified as non-acid generating and the diabase (NF17-08) at a net NP value of 10.6 is likely non-acid generating. The granitic gneiss (NF17-07) with a net NP value of 5.4 falls in the zone that is difficult to predict, however likely closer to the non-acid generating classification as there is a very low percentage of sulphides (sulphur) present. The ABA screening criteria developed by the BC Ministry of Energy and Mines, (Price 1997) (Table 6.4), are described in Table 2.

Table 2: **Acid-Base Accounting Screening Criteria (Price 1997)**

Potential for ARD	Initial Screening Criteria	Comments
Likely	NPR < 1	Likely ARD-generating unless sulphide minerals are non-reactive.
Possible	1 < NPR < 2	Possibly ARD-generating if NP is insufficiently reactive or is depleted at a faster rate than sulphides.
Low	2 < NPR < 4	Not potentially ARD-generating unless there is significant preferential exposure of sulphides along fracture planes or extremely reactive sulphides in combination with an insufficiently reactive NP.
None	NPR > 4	

The results of the ABA testing indicated that for the tested rock samples from the BIM site, the Net NP was more than or slightly less than 15 tonnes $CaCO_3$ and the NP/AP ratio was greater than 4. Therefore the rock is unlikely to be acid-generating. Given the high paste pH for the sample, metal leaching is unlikely to be an issue since most metals are not soluble under alkaline conditions.

4. Recommendations

△2

Based on the results, no further testing is recommended if rock material is consistent with the samples of rock that were collected during the geotechnical investigation program. Since the excavated bedrock is unlikely to be acid-generating, there is very little concern, with respect to ARD, with its use as a source of construction material.

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5. References

Brady, K.B., Perry, E.F., Beam, R.L., Bisko, D.C., Gardner, M.D. and Tarantino, J.M. (1994). Evaluation of Acid-Base Accounting to Predict the Quality of Drainage at Surface Coal Mines in Pennsylvania, USA, Proc. International Land Reclamation and Mine Drainage Conference and 3rd International Conference on the Abatement of Acidic Drainage, Pittsburgh, PA; USBM SP 06A-94, v1, p138-146.

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Price, W.A. and Errington, J.C. (1998): Guidelines for Metal Leaching and Acid Rock Drainage at Minesites in British Columbia.



W Hoyle

WH:kf

Attachments:
Attachment A: C of C CA13857-JUN17
Attachment B: Report CA13857-JUN17

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Jun 13857
06/27/17 JB

HATCH

GEOTECHNICAL LABORATORY
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GEOTECHNICAL LABORATORY SAMPLE - CHAIN OF CUSTODY

SAMPLE I.D	QUANTITY	TESTS REQUIRED	
NF17-07	1 Bag 350 g	Test for Acid Rock Drainage Potential / ABA	(Granitic Gneiss)
NF17-08	1 Bag 350 g	Test for Acid Rock Drainage Potential / ABA	(Diabase)
NF17-09	1 Bag 350 g	Test for Acid Rock Drainage Potential / ABA	(Limestone)

Samples Relinquished By:	R Serluca	Samples Recieved By:	Jeanette Barker
Date:	June 26th 2017	Date:	Jun 27/17
Time:	3:00 PM	Time:	15:00
Signature:		Signature:	Jeanette Barker
Reciving Labs Address:	185 Concession St. P.O Box 4300		
	Lakefield Ontario, K0L 2H0		
	1-705-652-2000 Attention Mr. Chris Sullivan		

FedEx

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

10-July-2017

Hatch LTD
Attn : Ralph Serluca

4342 Queen St Suite500
Niagara Falls, ON
L2E 6W1,

Phone: 905-374-5200
Fax:905-374-0701

Date Rec. : 27 June 2017
LR Report: **CA13857-JUN17**

Copy: #1

CERTIFICATE OF ANALYSIS
Partial Report

Analysis	5: NF17-07	6: NF17-08	7: NF17-09
Sample Date & Time	Date:N/A	Date:N/A	Date:N/A
Paste pH	9.89	8.89	8.24
Fizz Rate [---]	1	1	3
Sample weight [g]	2.05	1.99	2.00
HCl Added [mL]	20.00	20.00	540.00
HCl [Normality]	0.10	0.10	0.10
NaOH [Normality]	0.10	0.10	0.10
NaOH to [pH=8.3 mL]	17.48	15.50	109
Final pH	1.14	1.73	1.68
NP [t CaCO3/1000 t]	6.1	11	1077
AP [t CaCO3/1000 t]	0.67	0.67	0.67
Net NP [t CaCO3/1000 t]	5.43	10.6	1077
NP/AP [ratio]	9.10	16.9	1608
Sulphur (total) [%]	0.035	0.042	0.029
Acid Leachable SO4-S [%]	0.04	0.04	0.03
Sulphide [%]	< 0.02	< 0.02	< 0.02
Carbon (total) [%]	0.044	0.061	11.1
Carbonate [%]	0.110	< 0.025	54.1

Brian Graham B.Sc.
Project Specialist
Environmental Services, Analytical

OnLine LIMS

0001059049

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Test method information available upon request. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

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LR Report : **CA13857-JUN17**

*NP (Neutralization Potential)

$$= \frac{50 \times (N \text{ of HCL} \times \text{Total HCL added} - N \text{ NaOH} \times \text{NaOH added})}{\text{Weight of Sample}}$$

*AP (Acid Potential) = % Sulphide Sulphur x 31.25
*Net NP (Net Neutralization Potential) = NP-AP
NP/AP Ratio = NP/AP
*Results expressed as tonnes CaCO3 equivalent/1000 tonnes of material
Samples with a % Sulphide value of <0.02 will be calculated using a 0.02 value.

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Test method information available upon request. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

0001059049

CIRNAC 10 ATTACHMENT 3: TRUCKING FEASIBILITY STUDY INTERIM ML/ARD ASSESSMENT OF TOTE ROAD QUARRY AND BORROW PIT SAMPLES REV1 – ISSUED FOR DEIS

TECHNICAL MEMORANDUM

To	**Greg Wortman, AMEC** **Doron Golan, AMEC**	Project No. File No.	**TC101510** **017**
From	**Catherine Daniels, AMEC** **Steve Walker, AMEC**	cc	**Brian Lapos – AMEC** **Stephan Theben - AMEC** **Steve Sibbick – AMEC**
Tel	**905-568-2929 x 4104**		
Email	steve.walker@amec.com		
Date	**December 10, 2010**		

Subject **Baffinland Mary River Project – Trucking Feasibility Study**
Interim ML/ARD Assessment of Tote Road Quarry and Borrow Pit Samples
Rev1 – Issued for DEIS

1.0 INTRODUCTION

AMEC was retained by Baffinland Iron Mines Corporation (Baffinland) to conduct environmental studies in support of an environmental impact assessment (EIA). As part of the supporting environmental studies, AMEC assessed the metal leaching and acid rock drainage (ML/ARD) characteristics of rock samples to support future borrow pit and quarry development along the proposed Milne Inlet Tote Road alignment upgrade.

Drill core and unconsolidated surficial materials were collected from potential quarry and borrow pit locations along the Tote Road alignment during a geotechnical investigation aggregate sourcing program. AMEC submitted selected samples to SGS Mineral Services (SGS) of Lakefield for geochemical analyses on the potential quarry and borrow pit materials. This memo reports on a screening level ML/ARD assessment of these materials.

2.0 SITE DESCRIPTION

The Mary River Project is located in the northern region of Baffin Island in Nunavut territory, Canada. This area experiences a mean annual temperature of approximately -12^{o}C and monthly averages below -20^{o}C from December to March. Above freezing temperatures occur only from June to August, with an average high of 4.4^{o}C in July.

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The existing all-season Milne Inlet Tote Road (Tote Road) is currently undergoing design for the purpose of upgrades for the transportation of ore from the mine site to Milne Inlet. The road was originally established in the 1960's and runs approximately 107 km from the Mary River exploration camp to Milne Inlet.

The majority of the Tote Road alignment follows the valley of Phillips Creek which is bounded by steep ridges located on either side of the road corridor.

Regional geologic mapping is available for the entire route of the Tote Road (Scott and de Kemp, 1998). Approximately the first 20 km of the Tote Road from Milne Inlet passes through Precambrian terrane. The middle 73 km of the road travels across relatively flat lying Paleozoic rocks and the final 14 km of the road to the Mary River site again passes through Precambrian terrane near the boundary with the Paleozoic units.

Paleozoic rocks along the route include the Cambrian-Ordovician age Gallery and Turner Cliffs Formations, the Ordovician age Ship Point Formation, and the Ordovician Sillurian age Baillarge Formation. The Gallery Formation is ~340 m thick medium to coarse grained quartzose sandstone with minor siltstone, conglomerate and shale, and rare breccia, dolomitic sandstone and dolostone. The Turner Cliffs Formation is an approximately 310 m thick shaly to pure dolostone unit with intra-beds of dolomitic clastic sedimentary rocks. The Ship Point Formation is a 50 to 275 m thick finely crystalline dolostone that is commonly silty or sandy and interbedded with clastic dolomitic rocks. The formation is resistate and forms prominent cliffs in the area. The Baillarge Formation is an ~490 m thick unit of fine-grained limestones interbedded with minor dolostone, breccia, conglomerate, sandstone and cherty beds, and is often fossiliferous.

The Precambrian rocks are interpreted to be Archean age migmatitic gneisses in the region between Milne Inlet and the Paleozoic rocks and again between the Paleozoic sediments and the Mary River site. The migmatitic gneisses are heterogeneous commonly with inclusions and bands of mafic, metasedimentary and other granitic rocks. Archean Mary River Group rocks are present in close proximity to the migmatites along the route near the Mary River site. Mary River Group rocks consist mainly of siliciclastic sedimentary and mafic volcanic rocks. The Mary River Group hosts the Algoman-type iron formation deposits at the site.

3.0 METHODS

3.1 Sampling

During the autumn of 2010, AMEC conducted a geotechnical investigation of proposed quarry and borrow pit locations along the Tote Road alignment. The investigation included the collection of drill core from the quarry locations and the collection of unconsolidated material from borrow pit locations. .

3.2 Sample Selection for Testing

The objective in sample selection for ML/ARD characterization was to collect a set of samples for analysis which are representative of the geochemical variation of the different soil and rock types that will be used as quarry and borrow material for the Tote Road upgrade . Samples were selected from drill core and from the collected borrow pit material.

Intervals for rock sample selection were identified by AMEC after reviewing available drill logs, photographs and following direct inspection of the core. The strategy for sample selection and collection was based upon the guidance found within the document *Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials* (MEND 2009). Borehole locations and observed rock types are tabulated below.

Regional Mapped Geology and Borehole Rock Type

Regional Mapped Geology*	Borehole Number	Approximate Tote Road Chainage	Rock Type
Archean Migmatitic Gneiss	BH-10-04	2+100	Granitic Gneiss
	BH-10-05	3+100	Granitic Gneiss
	BH-10-06	4+100	Granitic Gneiss
	BH-10-07	5+000	Granitic Gneiss
	BH-10-08	6+000	Granitic Gneiss
	BH-10-09	7+000	Granitic Gneiss
	BH-10-12	22+000	Granitic Gneiss
Cambrian-Ordovician Gallery or Turner Cliffs Formation	BH-10-13	39+100	Carbonate bound quartz sandstone with silty interlayers
	BH-10-14	45+200	Sandy carbonate
	BH-10-15	50+000	Carbonate with minor shale and mudstone
	BH-10-16	61+500	Carbonate
Archean Migmatitic Gneiss	BH-10-21	85+000	Schist with pegmatite veining

* Scott and de Kemp, 1998

The drill core and material from 14 of the 15 borrow pits were shipped from the site to AMEC offices in Hamilton Ontario where the samples were split for ML/ARD analyses and aggregate testing. For the purposes of ML/ARD characterization, three sections of 1 m lengths of drill core

were selected from each of the 12 boreholes. The 1 m lengths of core were split in half with half retained and half submitted for geochemical analysis.

Borrow pit material was crushed and screened to <20 mm. The unconsolidated material from the borrow pits was then split such that approximately two kilograms of each sample was sent for geochemical analyses. The remainder of the borrow pit material and the remainder of quarry material will be used for aggregate source material testing presently underway.

The drill core samples selected represented 21 samples of gneiss and three samples of schist from the Precambrian units, and 12 samples of clastic and carbonate sedimentary rocks from the Paleozoic units. The borrow pit materials were typically sand or silty sand with varying quantities of gravel cobbles and boulders. Some had finer grained material as well as occasional small boulders. Cobbles and boulders in the samples generally consisted of carbonate or gneiss.

Visual inspection of the Precambrian core during the sample collection indicated the rare presence of sulphide minerals, primarily on fractured surfaces. No visible sulphide minerals were observed during inspection of the Paleozoic rock core samples at the time of sample selection. However, there was some iron staining noted in some samples.

3.3 Testing Methods

Split samples were shipped to SGS Lakefield for analysis. Testing methodologies followed those described in MEND (2009).

Analytical tests conducted included:

- Acid base accounting (ABA), including paste pH, modified Sobek neutralization potential (NP), total sulphur, sulphate sulphur, sulphide sulphur by difference, total carbon (TC) and total inorganic carbon (TIC);
- Total metals analysis by aqua regia digestion with ICP-MS finish;
- Leachable metals by shake flask extraction (SFE); and
- Mineralogy by X-ray diffraction (XRD) with Rietveld refinement.

Each sample was analysed for ABA and total metals. Testing by SFE and XRD were performed on a subset of samples, selected from the initial sample set. Considering project time-lines, the subset was selected prior to completion of the ABA and metals analyses. The subset was selected to best represent the entire sample set using the data available at the time.

4.0 GEOCHEMICAL TESTING RESULTS

4.1 Acid Base Accounting (ABA)

Results of ABA testing are summarized in Figures 1 and 2, with complete results presented in Table 1. A statistical summary of the results presented in Table 2. Results for rock samples are subdivided by lithology.

Figure 1 shows the relationship between modified Sobek NP and carbonate NP (CaNP) and indicates that carbonate minerals are the main source of NP in the sedimentary rocks and unconsolidated borrow pit materials. Non-carbonate minerals appear to be the primary source of NP for the schist and gneiss samples (Figure 1).

For the purposes of this screening level assessment, the calculated acid potential of the samples has been conservatively based on the total sulphur content, and is referred to as the maximum potential acidity (MPA) (Figure 2).

Overall findings of the results are summarized as follows:

- Paste pH of all samples were weakly alkaline. Carbonate rocks had a median paste pH of 8.3), whereas the schist and gneiss samples had the higher paste pH with a median of 9.8). Borrow pit materials reported a median paste pH of 8.9.
- Sulphide content of all samples was very low with the maximum concentrations ranging from 0.04% in carbonate sedimentary rocks to 0.02% in schist and 0.01% in gneiss and unconsolidated borrow pit materials.
- All samples had neutralization potential ratios (NPR) well in excess of 2 based on the more conservative MPA (Figure 2). These materials are considered non potentially acid generating (non-PAG).
- Gneiss and schist samples exhibited low NP values (median 8 and 10 kg $CaCO_3$/t respectively).
- Carbonate rich sedimentary rocks exhibited high NP (median carbonate NP of 890 kg $CaCO_3$/t).
- Unconsolidated materials had a generally high NP with most samples reporting >100 kg $CaCO_3$/t (median CaNP of 218 kg $CaCO_3$/t). However, the lowest NP of the sample set (5 kg $CaCO_3$/t) was from an unconsolidated borrow pit sample.

4.2 Metals Analyses

4.2.1 Total Metals

In order to identify metals of potential environmental significance, total metals results were compared to average continental crustal abundances (Price 1997). For screening purposes the concentration of an element was considered enriched if concentrations were greater than ten times the average crustal abundance. Metal results are presented in Table 3 and a statistical summary is provided in Table 4. It should be noted that the total concentration of an element does not determine the metal leaching potential of that element.

In general, the quarry and borrow pit samples demonstrated no notable elevation of elements relative to the average composition of the continental crust. However, the MDL values for bismuth and selenium were greater than ten times the average continental crust values. Therefore, any detectable values for bismuth or selenium were above ten times the average continental concentration.

4.2.2 Shake Flask Extraction Test

Eleven samples representing the three different rock types and four samples of unconsolidated borrow material underwent Shake Flask Extraction (SFE) testing. The SFE testing (Table 5) were compared to Metal Mining Effluent Regulation values (MMER, 2002). More stringent guideline values are also provided for reference purposes only. Guidelines for the protection of aquatic life and the drinking water guidelines (CWQG-PAL and CDWG guidelines in Table 5), which are focused on the preservation of water quality in the receiving waterbody for specific receptors (i.e., aquatic life, drinking water) are conservative since these values represent concentrations at point of use or exposure, not point of discharge. These guidelines are useful to identify parameters of interest when evaluating final discharge to receiving waters.

Results of SFE analyses (Table 5) for all samples, had a final pH that was neutral to alkaline with generally low concentrations of metals and no exceedances of MMER limits. The pH in SFE leachates for a number of these samples exceeded the MMER limit of 9.5. This is not unexpected for freshly exposed rock materials under agitation and at the high solid-solution ratios of the test. The high pH (and corresponding elevated aluminum concentrations) were likely related to the weak alkalinity associated with aluminosilicate mineral dissolution. It is unlikely the elevated pH (and associated aluminum) will be observed under field conditions. A single borrow material sample had an elevated copper concentration in comparison to the rest of the sample set. However, the concentration was an order of magnitude lower than the MMER limit.

4.3 Mineralogy

Rietveld XRD analysis was completed on 15 selected quarry and unconsolidated borrow pit samples. Results are presented in Table 6. The Rietveld method is effective at identifying crystalline phases present in abundance greater than a few weight percent. Lower abundances can be quantified where favourable scattering properties exist.

There were no acid producing sulphide minerals identified by XRD in the quarry or borrow pit samples, which is consistent with the low AP of all samples analysed. There were carbonate minerals identified in most of the samples.

Calcite was identified at low weight percent to trace values (<1.2%) in all but one of the granitic gneiss samples. Trace amounts of dolomite and rhodocrosite were also identified in a single granitic gneiss sample along with similarly low calcite. No carbonates were identified in one granitic gneiss sample and the single schist sample analysed.

Calcite was the dominant mineral (>98 wt.%) identified in the three carbonate samples. Trace dolomite and ankerite were also identified in these samples. In the carbonate cemented sandstone, dolomite (approximately 26%) was the only carbonate mineral identified.

Calcite, dolomite and ankerite were identified in most of the borrow material samples. Rhodocrosite was also identified in one sample. In the fourth sample the only carbonate mineral identified was calcite at very low weight percent (0.2%).

Calcite and dolomite have effective acid neutralizing properties, while the neutralizing ability of iron and manganese bearing carbonate minerals such as ankerite and rhodocrosite is uncertain. Dissolution rates of these minerals may be slower and under oxidizing conditions, hydrolysis of the iron and manganese released leads to no net neutralization. However, for this sample set the iron and manganese carbonates, when present, are always in low abundance compared to calcite and dolomite. Therefore, the presence of these minerals in this case will have only a minor influence on the neutralization potential of the materials.

5.0 CONCLUSIONS

Lithologically-based ML/ARD assessments have been completed on selected quarry and borrow materials along the Tote Road. Based on the results of this assessment, the following conclusions are made:

- The materials investigated in the proposed quarries and borrow pits along the Tote Road route appear to have a low potential for ML/ARD and are expected to be suitable as quarry or borrow sources. However, individual quarry and borrow sites should be

subjected to additional site specific ML/ARD characterization with consideration given for additional assessment depending upon the tonnages to be used and anticipated geological variability.

- The relatively low NP in the Precambrian rocks suggests that the presence of low contents of sulphide could potentially result in ML/ARD conditions. Diligence through adequate levels of sampling and monitoring during extraction operations will be necessary to ensure that the low concentrations of sulphide observed in this study are confirmed elsewhere.
- Paleozoic sedimentary rocks selected as potential quarry sources in this study are all carbonate rich and pose no ML/ARD risk. However, other non-carbonate sedimentary rocks are present in the region, so caution should be exercised should other quarry locations in the Paleozoic region be selected.
- Rietveld XRD results are consistent with ABA data for the rock-types analysed. Calcite or dolomite is confirmed to be in abundance in all carbonate rich samples and low to trace carbonate minerals are present in the granitic gneiss samples. For the gneiss samples neutralization from silicate minerals present in greater abundance than the carbonates is inferred.
- Borrow materials tested have high NPR values and pose no apparent ML/ARD risk.
- Carbonate as calcite and dolomite appear to be common components in most borrow materials tested; however, one sample was identified that was carbonate poor and quartz rich, thus having very low NP and suggesting not all borrow sources will have high carbonate NP.
- Ankerite and rhodocrosite were sometimes identified in carbonate-bearing samples, suggesting a portion of the carbonate content may not contribute to neutralization under oxidizing conditions. However, these carbonate forms were always subordinate to calcite or dolomite.

6.0 FUTURE WORK

The following work is planned and proposed.

- Continued collection and analysis of material from any future drilling or excavation programs along the Tote Road alignment to the extent necessary to minimize risk of ML/ARD.

7.0 REFERENCES

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Attachments:
Table 1 — Acid Base Accounting Results
Table 2 — Acid Base Accounting Statistics
Table 3 — Total Metals Results
Table 4 — Total Metals Statistics
Table 5 — Shake Flask Analysis Results
Table 6 — Rietveld Quantitative Analysis X-ray Diffraction Results
Figure 1 — ABA Results - CaNP vs. NP
Figure 2 — ABA Results – NP vs. MPA

TABLES

Table 1 Acid Base Accounting Results

Sample ID	Drill Log Lithology	Sample weight(g)	HCl added mL	HCl Normality	NaOH Normality	NaOH to pH=8.3 mL	Final pH units	Fizz Rate ---	Paste pH units
10-TR-001 BH10-04	gneiss	2.05	20.00	0.10	0.10	16.77	1.36	1	9.56
10-TR-002 BH10-04	gneiss	2.01	20.00	0.10	0.10	16.75	1.39	1	9.92
10-TR-003 BH10-04	gneiss	1.98	20.00	0.10	0.10	16.50	1.39	1	9.58
10-TR-004 BH10-05	gneiss	2.03	20.00	0.10	0.10	17.00	1.40	1	9.79
10-TR-005 BH10-05	gneiss	1.97	20.00	0.10	0.10	17.41	1.38	1	9.76
10-TR-006 BH10-05	gneiss	2.03	20.00	0.10	0.10	17.48	1.38	1	9.73
10-TR-007 BH10-06	gneiss	1.98	20.00	0.10	0.10	17.03	1.39	1	9.78
10-TR-008 BH10-06	gneiss	2.01	20.00	0.10	0.10	17.05	1.42	1	9.65
10-TR-009 BH10-06	gneiss	1.98	20.00	0.10	0.10	16.95	1.41	1	9.90
10-TR-010 BH10-07	gneiss	2.00	20.00	0.10	0.10	16.18	1.46	1	9.98
10-TR-011 BH10-07	gneiss	1.98	20.00	0.10	0.10	15.37	1.50	1	9.66
10-TR-012 BH10-07	gneiss	1.96	20.00	0.10	0.10	15.48	1.43	1	9.90
10-TR-013 BH10-08	gneiss	2.00	20.00	0.10	0.10	17.47	1.38	1	9.68
10-TR-014 BH10-08	gneiss	2.04	20.00	0.10	0.10	16.10	1.44	1	9.46
10-TR-015 BH10-08	gneiss	2.04	20.00	0.10	0.10	15.75	1.46	1	9.52
10-TR-016 BH10-09	gneiss	1.98	20.00	0.10	0.10	17.53	1.40	1	10.00
10-TR-017 BH10-09	gneiss	2.04	20.00	0.10	0.10	17.10	1.41	1	9.91
10-TR-018 BH10-09	gneiss	1.99	20.00	0.10	0.10	17.36	1.37	1	9.99
10-TR-019 BH10-12	gneiss	2.05	20.00	0.10	0.10	16.74	1.42	1	9.94
10-TR-020 BH10-12	gneiss	1.98	20.00	0.10	0.10	15.89	1.44	1	9.93
10-TR-021 BH10-12	gneiss	2.04	20.00	0.10	0.10	16.43	1.42	1	9.84
10-TR-034 BH10-21	schist	1.97	20.00	0.10	0.10	15.09	1.26	2	9.97
10-TR-035 BH10-12	schist	2.02	20.00	0.10	0.10	15.86	1.26	1	9.80
10-TR-036 BH10-12	schist	2.03	20.00	0.10	0.10	15.76	1.17	1	9.67
10-TR-022 BH10-13	sandstone	2.01	118.20	0.10	0.10	26.10	1.70	3	9.43
10-TR-023 BH10-13	sandstone	2.00	127.75	0.10	0.10	27.00	1.76	3	9.34
10-TR-024 BH10-13	sandstone	1.95	135.60	0.10	0.10	29.10	1.75	3	9.38
10-TR-025 BH10-14	sandy carbonate	2.03	589.90	0.10	0.10	200	1.51	4	8.27
10-TR-026 BH10-14	sandy carbonate	2.02	643.90	0.10	0.10	268	1.52	4	8.07
10-TR-027 BH10-14	sandy carbonate	2.00	641.20	0.10	0.10	259	1.50	4	8.22
10-TR-028 BH10-15	carbonate	1.97	685.90	0.10	0.10	301	1.50	4	8.22
10-TR-029 BH10-15	carbonate	1.96	640.00	0.10	0.10	266	1.50	4	8.38
10-TR-030 BH10-15	carbonate	1.98	490.00	0.10	0.10	116	1.71	4	8.23
10-TR-031 BH10-16	carbonate	1.99	490.00	0.10	0.10	106	1.74	4	8.23
10-TR-032 BH10-16	carbonate	1.98	474.20	0.10	0.10	93.80	1.78	4	8.27
10-TR-033 BH10-16	carbonate	1.96	470.00	0.10	0.10	96.20	1.76	4	8.26
S449-10	sand/gravel	2.00	393.20	0.10	0.10	122	1.60	4	8.75
S450-10	sand/gravel	2.01	338.10	0.10	0.10	57.00	1.85	4	8.38
S451-10	sand/gravel	1.97	131.70	0.10	0.10	38.20	1.55	4	8.55
S452-10	sand/gravel	1.97	146.40	0.10	0.10	48.00	1.59	4	8.97
S453-10	sand/gravel	1.99	135.30	0.10	0.10	29.10	1.69	4	8.87
S454-10	sand/gravel	1.95	20.00	0.10	0.10	17.94	1.11	1	8.42
S455-10	sand/gravel	1.96	26.00	0.10	0.10	11.31	1.57	1	9.51
S456-10	sand/gravel	1.97	79.10	0.10	0.10	20.21	1.75	3	8.99
S457-10	sand/gravel	2.00	83.90	0.10	0.10	15.24	1.85	3	9.07
S458-10	sand/gravel	1.97	55.40	0.10	0.10	21.25	1.58	3	9.24
S459-10	sand/gravel	2.03	154.20	0.10	0.10	28.60	1.83	4	8.86
S460-10	sand/gravel	1.96	77.40	0.10	0.10	23.81	1.65	4	8.93
S461-10	sand/gravel	1.99	97.90	0.10	0.10	21.30	1.78	3	9.14
S462-10	sand/gravel	2.01	153.10	0.10	0.10	28.40	1.82	3	8.95

Table 1 Acid Base Accounting Results (Continued)

Sample ID	Drill Log Lithology	Total Carbon	CO3	Total Sulphur	Sulphate Sulphur	Sulphide Sulphur	Neutralization Potential	Acid Potential
		%	%	%	%	%	kg $CaCO_3$/t	kg $CaCO_3$/t
10-TR-001 BH10-04	gneiss	0.059	0.103	0.014	0.01	<0.01	7.9	0.31
10-TR-002 BH10-04	gneiss	0.050	0.101	<0.005	<0.01	<0.01	8.1	0.31
10-TR-003 BH10-04	gneiss	0.064	0.137	<0.005	<0.01	<0.01	8.8	0.31
10-TR-004 BH10-05	gneiss	0.041	0.059	0.020	0.02	<0.01	7.4	0.31
10-TR-005 BH10-05	gneiss	0.032	0.033	0.015	0.01	<0.01	6.6	0.31
10-TR-006 BH10-05	gneiss	0.029	0.028	0.038	0.02	0.01	6.2	0.44
10-TR-007 BH10-06	gneiss	0.036	0.048	<0.005	<0.01	<0.01	7.5	0.31
10-TR-008 BH10-06	gneiss	0.028	0.025	0.008	<0.01	<0.01	7.3	0.31
10-TR-009 BH10-06	gneiss	0.035	0.075	0.006	<0.01	<0.01	7.7	0.31
10-TR-010 BH10-07	gneiss	0.027	0.014	0.035	0.02	0.01	9.5	0.36
10-TR-011 BH10-07	gneiss	0.038	0.027	0.036	0.04	<0.01	11.7	0.31
10-TR-012 BH10-07	gneiss	0.036	0.052	0.019	0.02	<0.01	11.5	0.31
10-TR-013 BH10-08	gneiss	0.028	0.035	<0.005	<0.01	<0.01	6.3	0.31
10-TR-014 BH10-08	gneiss	0.044	0.380	0.020	0.02	<0.01	9.6	0.31
10-TR-015 BH10-08	gneiss	0.043	0.062	0.028	0.03	<0.01	10.4	0.31
10-TR-016 BH10-09	gneiss	0.020	0.034	0.012	0.01	<0.01	6.2	0.31
10-TR-017 BH10-09	gneiss	0.070	0.048	0.012	0.01	<0.01	7.1	0.31
10-TR-018 BH10-09	gneiss	0.023	<0.005	0.038	0.04	<0.01	6.6	0.31
10-TR-019 BH10-12	gneiss	0.035	0.018	0.029	0.03	<0.01	8.0	0.31
10-TR-020 BH10-12	gneiss	0.051	0.071	0.028	0.02	0.01	10.4	0.40
10-TR-021 BH10-12	gneiss	0.046	0.065	0.006	<0.01	<0.01	8.8	0.31
10-TR-034 BH10-21	schist	0.096	0.282	0.015	0.02	<0.01	12.5	0.31
10-TR-035 BH10-12	schist	0.052	0.054	0.060	0.04	0.02	10.2	0.77
10-TR-036 BH10-12	schist	0.049	0.023	0.023	0.01	0.01	10.4	0.41
10-TR-022 BH10-13	sandstone	2.77	12.0	<0.005	<0.01	<0.01	229	0.31
10-TR-023 BH10-13	sandstone	2.98	12.5	<0.005	<0.01	<0.01	252	0.31
10-TR-024 BH10-13	sandstone	3.25	14.0	<0.005	<0.01	<0.01	273	0.31
10-TR-025 BH10-14	sandy carbonate	11.1	54.3	<0.005	<0.01	<0.01	959	0.31
10-TR-026 BH10-14	sandy carbonate	10.8	52.3	<0.005	<0.01	<0.01	930	0.31
10-TR-027 BH10-14	sandy carbonate	11.2	54.0	0.071	0.03	0.04	956	1.29
10-TR-028 BH10-15	carbonate	10.9	53.2	0.014	0.01	<0.01	978	0.31
10-TR-029 BH10-15	carbonate	10.7	51.3	0.041	0.02	0.02	953	0.77
10-TR-030 BH10-15	carbonate	10.7	51.5	0.020	<0.01	0.01	945	0.34
10-TR-031 BH10-16	carbonate	10.8	53.5	<0.005	<0.01	<0.01	965	0.31
10-TR-032 BH10-16	carbonate	10.7	52.9	<0.005	<0.01	<0.01	961	0.31
10-TR-033 BH10-16	carbonate	10.7	52.1	<0.005	<0.01	<0.01	954	0.31
S449-10	sand/gravel	7.86	33.9	0.011	0.01	<0.01	678	0.31
S450-10	sand/gravel	8.02	36.0	<0.005	<0.01	<0.01	699	0.31
S451-10	sand/gravel	2.92	11.7	<0.005	<0.01	<0.01	237	0.31
S452-10	sand/gravel	2.89	12.4	0.014	0.01	<0.01	250	0.31
S453-10	sand/gravel	3.22	13.9	<0.005	<0.01	<0.01	267	0.31
S454-10	sand/gravel	0.061	0.016	<0.005	<0.01	<0.01	5.3	0.31
S455-10	sand/gravel	0.410	0.255	<0.005	<0.01	<0.01	37.5	0.31
S456-10	sand/gravel	1.82	6.20	0.007	<0.01	<0.01	150	0.31
S457-10	sand/gravel	1.44	5.37	<0.005	<0.01	<0.01	172	0.31
S458-10	sand/gravel	1.12	4.17	0.007	<0.01	<0.01	86.7	0.31
S459-10	sand/gravel	3.87	16.2	<0.005	<0.01	<0.01	309	0.31
S460-10	sand/gravel	1.71	7.29	<0.005	<0.01	<0.01	137	0.31
S461-10	sand/gravel	2.33	10.2	0.005	<0.01	<0.01	192	0.31
S462-10	sand/gravel	3.75	16.7	0.007	<0.01	<0.01	310	0.31

Table 1 Acid Base Accounting Results (Continued)

Sample ID	Drill Log Lithology	Maximum Potential Acidity kg $CaCO_3$/t	Carbonate Neutralization Potential kg $CaCO_3$/t	Ratio NP/AP ratio	Ratio NP/MPA ratio	Ratio CaNP/AP ratio	Net NP kg $CaCO_3$/t
10-TR-001 BH10-04	gneiss	0.44	4.92	25.5	18.1	15.9	7.59
10-TR-002 BH10-04	gneiss	0.16	4.17	26.1	51.8	13.4	7.79
10-TR-003 BH10-04	gneiss	0.16	5.33	28.4	56.3	17.2	8.49
10-TR-004 BH10-05	gneiss	0.63	3.42	23.9	11.8	11.0	7.09
10-TR-005 BH10-05	gneiss	0.47	2.67	21.3	14.1	8.6	6.29
10-TR-006 BH10-05	gneiss	1.19	2.42	14.2	5.2	5.5	5.76
10-TR-007 BH10-06	gneiss	0.16	3.00	24.2	48.0	9.7	7.19
10-TR-008 BH10-06	gneiss	0.25	2.33	23.5	29.2	7.5	6.99
10-TR-009 BH10-06	gneiss	0.19	2.92	24.8	41.1	9.4	7.39
10-TR-010 BH10-07	gneiss	1.09	2.25	26.2	8.7	6.3	9.14
10-TR-011 BH10-07	gneiss	1.13	3.17	37.7	10.4	10.2	11.4
10-TR-012 BH10-07	gneiss	0.59	3.00	37.1	19.4	9.7	11.2
10-TR-013 BH10-08	gneiss	0.16	2.33	20.3	40.3	7.5	5.99
10-TR-014 BH10-08	gneiss	0.63	3.67	31.0	15.4	11.8	9.29
10-TR-015 BH10-08	gneiss	0.88	3.58	33.5	11.9	11.6	10.1
10-TR-016 BH10-09	gneiss	0.38	1.67	20.0	16.5	5.4	5.89
10-TR-017 BH10-09	gneiss	0.38	5.83	22.9	18.9	18.8	6.79
10-TR-018 BH10-09	gneiss	1.19	1.92	21.3	5.6	6.2	6.29
10-TR-019 BH10-12	gneiss	0.91	2.92	25.8	8.8	9.4	7.69
10-TR-020 BH10-12	gneiss	0.88	4.25	26.0	11.9	10.6	10.0
10-TR-021 BH10-12	gneiss	0.19	3.83	28.4	46.9	12.4	8.49
10-TR-034 BH10-21	schist	0.47	8.00	40.3	26.7	25.8	12.2
10-TR-035 BH10-12	schist	1.88	4.33	13.3	5.4	5.6	9.43
10-TR-036 BH10-12	schist	0.72	4.08	25.6	14.5	10.0	9.99
10-TR-022 BH10-13	sandstone	0.16	230.85	739	1465.6	744.7	229
10-TR-023 BH10-13	sandstone	0.16	248.35	813	1612.8	801.1	252
10-TR-024 BH10-13	sandstone	0.16	270.85	881	1747.2	873.7	273
10-TR-025 BH10-14	sandy carbonate	0.16	925.06	3095	6137.6	2984.1	959
10-TR-026 BH10-14	sandy carbonate	0.16	900.06	2998	5952.0	2903.4	929
10-TR-027 BH10-14	sandy carbonate	2.22	933.40	742	430.9	723.6	955
10-TR-028 BH10-15	carbonate	0.44	908.39	3155	2235.4	2930.3	978
10-TR-029 BH10-15	carbonate	1.28	891.73	1245	743.8	1158.1	952
10-TR-030 BH10-15	carbonate	0.63	891.73	2749	1512.0	2622.7	945
10-TR-031 BH10-16	carbonate	0.16	900.06	3114	6176.0	2903.4	965
10-TR-032 BH10-16	carbonate	0.16	891.73	3099	6150.4	2876.5	960
10-TR-033 BH10-16	carbonate	0.16	891.73	3076	6105.6	2876.5	953
S449-10	sand/gravel	0.34	655.04	2185	1972.4	2113.0	677
S450-10	sand/gravel	0.16	668.38	2256	4473.6	2156.1	699
S451-10	sand/gravel	0.16	243.35	765	1516.8	785.0	237
S452-10	sand/gravel	0.44	240.85	805	571.4	776.9	249
S453-10	sand/gravel	0.16	268.35	861	1708.8	865.6	266
S454-10	sand/gravel	0.16	5.08	17.1	33.9	16.4	4.99
S455-10	sand/gravel	0.16	34.17	121	240.0	110.2	37.2
S456-10	sand/gravel	0.22	151.68	482	685.7	489.3	149
S457-10	sand/gravel	0.16	120.01	554	1100.8	387.1	171
S458-10	sand/gravel	0.22	93.34	280	396.3	301.1	86.4
S459-10	sand/gravel	0.16	322.52	998	1977.6	1040.4	309
S460-10	sand/gravel	0.16	142.51	441	876.8	459.7	136
S461-10	sand/gravel	0.16	194.18	621	1228.8	626.4	192
S462-10	sand/gravel	0.22	312.52	1001	1417.1	1008.1	310

Note:
CaNP = Carbonate neutralization potential was calculated based on total carbon content (%C)
MPA = Maximum potential acidity was calculated based on total sulphur content (%S)

Table 2 Statistical Summary of Acid Base Accounting Results

	Paste pH	Total Carbon %	Total Sulphur %	Sulphate Sulphur %	Sulphide Sulphur %	Neutral-ization Potential kg $CaCO_3$/t	Acid Potential kg $CaCO_3$/t	CaNP kg $CaCO_3$/t	Maximum Potential Acidity kg $CaCO_3$/t	Ratio NP/AP (NPR) calculated ratio	Ratio NP/MPA calculated ratio	Ratio CaNP/AP calculated ratio
All Quarry Pit Rock (gneiss, schist, carbonate rocks)												
Min	8.1	0.02	<0.005	<0.01	<0.01	6.2	0.31	1.7	0.16	13	5.2	5.4
Max	10	11	0.071	0.04	0.04	978	1.29	933	2.2	3155	6176	2984
Mean	-	2.99	0.019	0.02	0.01	266	0.37	249	0.58	710	458	666
Median	9.7	0.1	<0.014	<0.01	<0.01	10.3	0.31	4.2	0.44	33	24	13.6
Standard Deviation	0.7	4.7	0.016	0.01	0.01	410	0.19	389	0.51	1191	2111	1130
No. of Samples	36	36	36	36	36	36	36	36	36	36	36	36
5th Percentile	8.2	0.026	0.005	0.01	0.01	6.3	0.31	2.2	0.16	19	5.5	5.6
25th Percentile	9.1	0.036	0.005	0.01	0.01	7.7	0.31	3.0	0.16	24	14	9.4
75th Percentile	9.9	5.1	0.028	0.02	0.01	437	0.31	426	0.88	830	1477	819
95th Percentile	10	11	0.046	0.04	0.02	962	0.77	913	1.43	3103	6141	2910
Gneiss												
Min	9.5	0.02	<0.005	<0.01	<0.01	6.2	0.31	1.7	0.16	14	5.2	5.4
Max	10	0.07	0.038	0.04	0.01	11.7	0.44	5.8	1.19	38	56	19
Mean	-	0.04	0.018	0.02	0.01	8.3	0.32	3.3	0.57	26	14	10
Median	9.8	0.04	0.015	<0.01	<0.01	7.9	0.31	3.0	0.47	25	17	9.7
Standard Deviation	0.17	0.01	0.012	0.01	0.00	1.7	0.03	1.1	0.38	5.6	17	3.7
No. of Samples	21	21	21	21	21	21	21	21	21	21	21	21
5th Percentile	9.5	0.02	0.005	0.01	0.01	6.2	0.31	1.9	0.16	20	5.6	5.5
25th Percentile	9.7	0.03	0.006	0.01	0.01	7.1	0.31	2.4	0.19	23	12	7.5
75th Percentile	9.9	0.05	0.028	0.02	0.01	9.5	0.31	3.8	0.88	28	40	12
95th Percentile	10	0.06	0.038	0.04	0.01	12	0.40	5.3	1.19	37	52	17
Schist												
Min	9.7	0.05	0.015	<0.01	<0.01	10	0.31	4.1	0.47	13.3	5.4	5.6
Max	10	0.10	0.060	0.04	0.02	13	0.77	8.0	1.88	40	27	26
Median	9.8	0.05	0.023	0.02	0.01	10	0.41	4.3	0.72	26	14	10
No. of Samples	3	3	3	3	3	3	3.00	3	3.00	3	3	3

Table 2 Statistical Summary of Acid Base Accounting Results (Continued)

	Paste pH	Total Carbon %	Total Sulphur %	Sulphate Sulphur %	Sulphide Sulphur %	Neutral-ization Potential kg $CaCO_3$/t	Acid Potential kg $CaCO_3$/t	CaNP kg $CaCO_3$/t	Maximum Potential Acidity kg $CaCO_3$/t	Ratio NP/AP (NPR)	Ratio NP/MPA	Ratio CaNP/AP
										calculated ratio		
Carbonate Rocks												
Min	8.1	2.8	<0.005	<0.01	<0.01	229	0.31	231	0.16	739	431	724
Max	9.4	11	0.071	0.03	0.04	978	1.29	933	2.2	3155	6176	2984
Mean	-	8.9	0.016	0.01	0.01	780	0.43	740	0.48	1803	1609	1712
Median	8.3	11	<0.005	<0.01	<0.01	954	0.31	892	0.16	3076	6102	2877
Standard Deviation	0.5	3.6	0.021	0.01	0.01	319	0.30	296	0.64	1122	2469	1044
No. of Samples	12	12	12	12	12	12	12	12	12	12	12	12
5th Percentile	8.2	2.9	0.005	0.01	0.01	242	0.31	240	0.16	741	603	735
25th Percentile	8.2	8.8	0.005	0.01	0.01	766	0.31	737	0.16	864	1500	856
75th Percentile	8.2	11	0.005	0.01	0.01	932	0.31	892	0.16	930	1526	912
95th Percentile	9.4	11	0.055	0.02	0.03	971	1.00	929	1.70	3132	6162	2954
Unconsolidated Borrow Material												
Min	8.4	0.1	<0.005	<0.01	<0.01	5.3	0.31	5.1	0.16	17	34	16
Max	9.5	8.0	0.014	0.01	0.01	699	0.31	668	0.44	2256	4474	2156
Mean	-	3.0	0.0065	0.01	0.01	252	0.31	247	0.20	813	1241	795
Median	8.9	2.6	<0.005	<0.01	<0.01	215	0.31	218	0.16	692	1373	702
Standard Deviation	0.3	2.4	0	0	0	207	0	200	0.09	667	1105	646
No. of Samples	14	14	14	14	14	14	14	14	14	14	14	14
5th Percentile	8.4	0.3	0.005	0.01	0.01	26	0.31	24	0.16	85	168	77
25th Percentile	8.8	1.5	0.005	0.01	0.01	140	0.31	126	0.16	451	600	405
75th Percentile	8.9	2.2	0.005	0.01	0.01	185	0.31	180	0.16	598	1024	579
95th Percentile	9.3	7.9	0.012	0.01	0.01	685	0.31	660	0.38	2210	2851	2128

Note:

CaNP = Carbonate neutralization potential was calculated based on total carbon content (%C)

MPA = Maximum potential acidity was calculated based on total sulphur content (%S)

Table 3 Results of Metals Analyses

Sample ID	Drill Log Lithology	Al %	As µg/g	Ba µg/g	Be µg/g	Bi µg/g	Ca %	Cd µg/g	Co µg/g	Cr µg/g	Cu µg/g
Average Crustal Abundance		8.23	1.8	425	3	0.0085	4.15	0.15	25	102	60
10x Average Crustal Abundance		82.3	18	4250	30	0.085	41.5	1.5	250	1020	600
10-TR-001 BH10-04	gneiss	0.33	<0.5	21	0.13	<0.09	0.12	<0.02	1.2	100	18
10-TR-002 BH10-04	gneiss	0.36	<0.5	23	0.15	<0.09	0.13	<0.02	1.1	99	5.0
10-TR-003 BH10-04	gneiss	0.35	<0.5	24	0.13	<0.09	0.14	<0.02	1.1	110	8.5
10-TR-004 BH10-05	gneiss	0.41	<0.5	23	0.17	<0.09	0.11	<0.02	1.5	91	2.9
10-TR-005 BH10-05	gneiss	0.39	<0.5	27	0.15	<0.09	0.07	<0.02	1.3	110	8.1
10-TR-006 BH10-05	gneiss	0.37	<0.5	20	0.18	<0.09	0.06	<0.02	1.3	87	3.2
10-TR-007 BH10-06	gneiss	0.43	<0.5	23	0.20	<0.09	0.10	<0.02	2.0	110	5.2
10-TR-008 BH10-06	gneiss	0.50	<0.5	25	0.29	<0.09	0.10	<0.02	2.3	110	6.6
10-TR-009 BH10-06	gneiss	0.49	<0.5	39	0.19	<0.09	0.14	<0.02	2.5	94	8.4
10-TR-010 BH10-07	gneiss	0.78	<0.5	68	0.25	<0.09	0.29	<0.02	5.2	92	17
10-TR-011 BH10-07	gneiss	1.20	<0.5	110	0.40	0.09	0.36	<0.02	8.0	75	17
10-TR-012 BH10-07	gneiss	1.10	<0.5	57	0.27	0.10	0.36	<0.02	9.9	110	16
10-TR-013 BH10-08	gneiss	0.32	<0.5	23	0.16	<0.09	0.07	<0.02	1.4	110	5.3
10-TR-014 BH10-08	gneiss	0.85	<0.5	64	0.49	<0.09	0.21	<0.02	4.4	79	10
10-TR-015 BH10-08	gneiss	1.00	<0.5	78	0.48	<0.09	0.23	<0.02	5.9	78	12
10-TR-016 BH10-09	gneiss	0.43	<0.5	33	0.14	<0.09	0.09	<0.02	2.4	82	4.3
10-TR-017 BH10-09	gneiss	0.45	<0.5	33	0.17	<0.09	0.14	<0.02	2.6	100	7.2
10-TR-018 BH10-09	gneiss	0.39	<0.5	32	0.14	0.13	0.11	0.05	4.9	81	12
10-TR-019 BH10-12	gneiss	0.59	<0.5	30	0.17	<0.09	0.26	<0.02	5.7	100	28
10-TR-020 BH10-12	gneiss	0.83	<0.5	51	0.18	<0.09	0.23	<0.02	6.1	100	14
10-TR-021 BH10-12	gneiss	0.49	<0.5	24	0.15	<0.09	0.19	<0.02	2.8	100	8.8
10-TR-034 BH10-21	schist	0.74	<0.5	36	0.17	<0.09	0.30	<0.02	2.2	67	6.3
10-TR-035 BH10-12	schist	1.10	<0.5	35	0.27	0.09	0.18	0.03	3.6	69	13
10-TR-036 BH10-12	schist	1.30	1.1	37	0.41	<0.09	0.14	<0.02	3.6	70	8.0
10-TR-022 BH10-13	carbonate rocks	0.05	<0.5	5.5	0.06	<0.09	3.9	<0.02	1.3	99	5.0
10-TR-023 BH10-13	carbonate rocks	0.31	<0.5	16	0.32	<0.09	4.1	0.03	2.1	96	6.1
10-TR-024 BH10-13	carbonate rocks	0.23	<0.5	13	0.22	<0.09	4.8	0.02	1.5	82	2.0
10-TR-025 BH10-14	carbonate rocks	0.08	<0.5	3.0	0.06	<0.09	28.8	<0.02	1.6	2.2	4.0
10-TR-026 BH10-14	carbonate rocks	0.16	0.7	5.3	0.14	<0.09	28.3	0.06	2.1	3.4	3.9
10-TR-027 BH10-14	carbonate rocks	0.08	0.5	2.7	0.06	<0.09	27.0	<0.02	1.6	2.6	4.3
10-TR-028 BH10-15	carbonate rocks	0.08	0.6	3.4	0.07	<0.09	28.2	<0.02	1.7	4.1	2.2
10-TR-029 BH10-15	carbonate rocks	0.12	1.8	4.5	0.08	<0.09	26.7	<0.02	1.9	2.2	4.5
10-TR-030 BH10-15	carbonate rocks	0.13	1.2	4.2	0.08	<0.09	28.4	<0.02	2.0	2.6	5.4
10-TR-031 BH10-16	carbonate rocks	0.08	<0.5	3.2	0.06	<0.09	27.4	<0.02	1.7	2.1	2.0
10-TR-032 BH10-16	carbonate rocks	0.08	1.2	3.1	0.07	<0.09	27.3	<0.02	1.7	2.2	3.9
10-TR-033 BH10-16	carbonate rocks	0.13	1.1	3.9	0.07	<0.09	27.5	<0.02	1.9	2.6	2.4
S449-10	borrow pit material	0.26	1.7	11	0.18	<0.09	13.4	0.03	2.9	39	8.1
S450-10	borrow pit material	0.12	<0.5	6.7	0.09	<0.09	17.2	<0.02	1.9	30	3.5
S451-10	borrow pit material	0.29	0.8	16	0.20	<0.09	4.0	0.03	3.0	89	12
S452-10	borrow pit material	0.39	<0.5	29	0.18	<0.09	5.0	<0.02	3.2	64	8.3
S453-10	borrow pit material	0.20	1.2	16	0.27	<0.09	4.8	0.02	3.4	79	7.5
S454-10	borrow pit material	0.08	<0.5	5.0	0.03	<0.09	0.1	<0.02	0.73	110	2.0
S455-10	borrow pit material	0.24	<0.5	20	0.12	<0.09	0.6	0.02	7.0	170	10
S456-10	borrow pit material	0.35	<0.5	16	0.21	<0.09	3.6	<0.02	2.0	75	6.9
S457-10	borrow pit material	0.39	<0.5	25	0.25	<0.09	2.4	<0.02	2.5	90	4.3
S458-10	borrow pit material	0.38	0.7	25	0.21	<0.09	1.8	<0.02	2.0	82	6.7
S459-10	borrow pit material	0.18	<0.5	9.6	0.14	<0.09	7.4	<0.02	1.7	68	4.2
S460-10	borrow pit material	0.20	<0.5	12	0.13	<0.09	3.6	<0.02	1.5	93	19
S461-10	borrow pit material	0.29	<0.5	15	0.17	<0.09	3.6	<0.02	1.8	74	38
S462-10	borrow pit material	0.25	<0.5	14	0.19	<0.09	6.2	<0.02	1.8	73	8.7

Table 3 Results of Metals Analyses (Continued)

Sample ID	Drill Log Lithology	Fe %	K %	Li µg/g	Mg %	Mn µg/g	Mo µg/g	Na %	Ni µg/g	P µg/g	Pb µg/g
Average Crustal Abundance		5.63	2.085	20	2.33	950	1.2	2.355	84	1050	14
10x Average Crustal Abundance		56.3	20.85	200	23.3	9500	12	23.55	840	10500	140
10-TR-001 BH10-04	gneiss	0.71	0.15	15	0.12	150	0.4	0.05	3.9	25	11
10-TR-002 BH10-04	gneiss	0.66	0.17	18	0.13	180	0.4	0.05	4.1	28	9.3
10-TR-003 BH10-04	gneiss	0.76	0.17	14	0.13	160	0.4	0.05	3.9	47	7.1
10-TR-004 BH10-05	gneiss	0.88	0.17	13	0.20	200	0.4	0.05	3.8	140	5.4
10-TR-005 BH10-05	gneiss	0.82	0.16	11	0.16	190	0.3	0.05	4.3	67	4.1
10-TR-006 BH10-05	gneiss	0.75	0.11	10	0.16	170	0.6	0.05	3.7	61	4.0
10-TR-007 BH10-06	gneiss	0.88	0.24	15	0.22	140	0.3	0.05	3.8	210	4.2
10-TR-008 BH10-06	gneiss	0.93	0.19	15	0.29	160	0.2	0.05	3.7	230	3.8
10-TR-009 BH10-06	gneiss	1.20	0.33	19	0.24	160	0.2	0.05	4.3	270	6.5
10-TR-010 BH10-07	gneiss	1.90	0.56	23	0.50	280	0.4	0.06	5.6	630	9.3
10-TR-011 BH10-07	gneiss	2.60	0.71	36	0.93	300	0.5	0.05	7.1	1000	2.8
10-TR-012 BH10-07	gneiss	1.86	0.72	34	1.10	290	2.1	0.06	25	440	3.2
10-TR-013 BH10-08	gneiss	0.83	0.17	11	0.16	150	0.3	0.05	3.4	92	5.3
10-TR-014 BH10-08	gneiss	1.40	0.49	26	0.59	240	0.4	0.04	4.9	490	2.5
10-TR-015 BH10-08	gneiss	1.70	0.70	29	0.76	320	0.2	0.04	5.3	670	2.0
10-TR-016 BH10-09	gneiss	1.00	0.28	17	0.23	150	2.5	0.05	3.2	230	6.6
10-TR-017 BH10-09	gneiss	1.20	0.30	20	0.25	180	1.1	0.05	4.2	260	5.8
10-TR-018 BH10-09	gneiss	0.95	0.28	13	0.20	140	1.5	0.05	3.4	220	29
10-TR-019 BH10-12	gneiss	1.10	0.35	10	0.46	180	1.0	0.06	20	160	5.0
10-TR-020 BH10-12	gneiss	1.90	0.54	20	0.64	280	6.8	0.05	15	220	6.8
10-TR-021 BH10-12	gneiss	1.40	0.27	9	0.30	140	3.4	0.05	5.0	250	12
10-TR-034 BH10-21	schist	1.10	0.54	8	0.41	250	0.4	0.03	2.9	120	3.2
10-TR-035 BH10-12	schist	1.60	0.60	12	0.74	280	0.2	0.03	3.1	260	3.3
10-TR-036 BH10-12	schist	1.80	0.50	17	1.00	280	0.4	0.03	3.8	120	1.7
10-TR-022 BH10-13	carbonate rocks	0.40	0.04	<2	2.20	270	0.5	0.01	5.0	370	0.83
10-TR-023 BH10-13	carbonate rocks	0.73	0.17	18	2.60	280	0.4	0.01	8.9	540	0.98
10-TR-024 BH10-13	carbonate rocks	0.58	0.14	13	2.80	340	<0.1	0.02	7.0	1090	0.89
10-TR-025 BH10-14	carbonate rocks	0.16	0.03	<2	0.65	70	<0.1	0.02	14	21	1.0
10-TR-026 BH10-14	carbonate rocks	0.28	0.04	<2	0.41	120	<0.1	0.01	15	43	1.6
10-TR-027 BH10-14	carbonate rocks	0.17	0.03	<2	1.30	71	<0.1	0.01	14	42	1.1
10-TR-028 BH10-15	carbonate rocks	0.19	0.03	<2	0.95	77	<0.1	0.02	14	78	1.3
10-TR-029 BH10-15	carbonate rocks	0.25	0.04	2	0.57	170	<0.1	0.02	15	85	2.0
10-TR-030 BH10-15	carbonate rocks	0.25	0.04	3	0.66	120	<0.1	0.02	15	86	1.6
10-TR-031 BH10-16	carbonate rocks	0.17	0.03	<2	0.98	66	<0.1	0.02	14	57	1.2
10-TR-032 BH10-16	carbonate rocks	0.18	0.03	<2	0.98	62	<0.1	0.02	14	70	1.4
10-TR-033 BH10-16	carbonate rocks	0.26	0.05	3	0.86	89	<0.1	0.02	15	92	1.8
S449-10	borrow pit material	0.59	0.18	24	4.90	140	0.5	0.02	11	130	4.3
S450-10	borrow pit material	0.34	0.07	<2	2.90	100	0.2	0.02	10	120	1.9
S451-10	borrow pit material	0.74	0.12	5	2.50	130	0.3	0.02	10	230	7.0
S452-10	borrow pit material	0.99	0.24	10	2.10	140	0.2	0.03	6.9	200	3.8
S453-10	borrow pit material	0.89	0.09	4	2.80	270	0.1	0.02	8.6	830	2.1
S454-10	borrow pit material	0.30	0.03	<2	0.03	25	0.4	0.01	3.4	16	0.75
S455-10	borrow pit material	1.10	0.09	2	1.20	120	0.3	0.02	110	130	2.7
S456-10	borrow pit material	0.79	0.13	9	1.10	140	0.5	0.03	5.2	140	3.5
S457-10	borrow pit material	0.81	0.15	11	1.20	130	0.2	0.03	5.7	140	3.7
S458-10	borrow pit material	0.87	0.16	9	1.00	130	0.4	0.03	5.1	240	4.5
S459-10	borrow pit material	0.50	0.07	5	2.00	94	0.3	0.02	6.3	120	2.2
S460-10	borrow pit material	0.53	0.09	3	0.77	74	0.6	0.02	5.5	140	2.0
S461-10	borrow pit material	0.70	0.12	8	1.90	130	0.3	0.03	4.6	170	3.8
S462-10	borrow pit material	0.63	0.11	7	2.70	100	0.3	0.02	6.6	110	3.3

Table 3 Results of Metals Analyses (Continued)

Sample ID	Drill Log Lithology	Sb µg/g	Se µg/g	Si µg/g	Sn µg/g	Sr µg/g	Ti %	Tl µg/g	U µg/g	V µg/g	Y µg/g	Zn µg/g
Average Crustal Abundance		0.2	0.05	281500	2.3	370	0.565	0.85	2.7	120	33	70
10x Average Crustal Abundance		2	0.5	2815000	23	3700	5.65	8.5	27	1200	330	700
10-TR-001 BH10-04	gneiss	<0.8	0.8	530	<0.5	6.6	0.02	0.07	4.8	3	2.0	20
10-TR-002 BH10-04	gneiss	<0.8	<0.7	450	<0.5	6.6	0.02	0.09	5.2	3	2.2	20
10-TR-003 BH10-04	gneiss	<0.8	<0.7	480	<0.5	6.2	0.02	0.08	4.4	3	2.4	21
10-TR-004 BH10-05	gneiss	<0.8	<0.7	440	<0.5	5.6	0.02	0.10	5.2	5	4.1	21
10-TR-005 BH10-05	gneiss	<0.8	<0.7	460	<0.5	6.3	0.02	0.07	2.8	3	2.7	22
10-TR-006 BH10-05	gneiss	<0.8	<0.7	440	<0.5	5.6	0.01	0.06	13	3	3.9	18
10-TR-007 BH10-06	gneiss	<0.8	<0.7	490	<0.5	6.5	0.04	0.12	2.1	9	4.1	24
10-TR-008 BH10-06	gneiss	<0.8	<0.7	560	<0.5	6.2	0.03	0.10	2.7	10	4.9	27
10-TR-009 BH10-06	gneiss	<0.8	<0.7	530	0.6	7.6	0.06	0.23	6.0	14	6.7	31
10-TR-010 BH10-07	gneiss	<0.8	<0.7	700	1.2	13	0.17	0.38	4.5	32	16	46
10-TR-011 BH10-07	gneiss	<0.8	<0.7	650	0.8	14	0.19	0.44	4.0	48	14	49
10-TR-012 BH10-07	gneiss	<0.8	<0.7	780	<0.5	7.3	0.14	0.48	3.5	43	9.8	36
10-TR-013 BH10-08	gneiss	<0.8	<0.7	500	<0.5	6.6	0.03	0.07	2.5	5	3.3	19
10-TR-014 BH10-08	gneiss	<0.8	<0.7	690	<0.5	8.5	0.09	0.31	4.7	22	7.1	34
10-TR-015 BH10-08	gneiss	<0.8	<0.7	610	<0.5	8.2	0.13	0.46	3.1	28	8.2	50
10-TR-016 BH10-09	gneiss	<0.8	<0.7	470	<0.5	6.6	0.06	0.17	2.6	13	3.7	23
10-TR-017 BH10-09	gneiss	<0.8	<0.7	460	0.6	7.1	0.07	0.19	4.2	15	4.7	31
10-TR-018 BH10-09	gneiss	<0.8	<0.7	520	<0.5	8.1	0.06	0.22	9.6	12	5.5	29
10-TR-019 BH10-12	gneiss	<0.8	<0.7	470	<0.5	6.8	0.08	0.19	2.9	19	3.5	24
10-TR-020 BH10-12	gneiss	<0.8	<0.7	600	1.2	9.7	0.12	0.31	4.0	30	3.4	38
10-TR-021 BH10-12	gneiss	<0.8	<0.7	600	0.8	17	0.07	0.13	4.9	12	8.2	31
10-TR-034 BH10-21	schist	<0.8	1.5	540	<0.5	5.8	0.06	0.21	2.2	6	3.9	23
10-TR-035 BH10-12	schist	<0.8	2.2	590	<0.5	4.8	0.06	0.21	2.3	6	7.4	26
10-TR-036 BH10-12	schist	<0.8	0.9	630	<0.5	3.4	0.03	0.15	2.2	7	5.2	28
10-TR-022 BH10-13	carbonate rocks	<0.8	<0.7	270	<0.5	14	0.00	0.02	0.31	7	2.3	2.2
10-TR-023 BH10-13	carbonate rocks	<0.8	<0.7	590	<0.5	24	0.02	0.04	0.40	11	5.0	9.9
10-TR-024 BH10-13	carbonate rocks	<0.8	1.0	450	<0.5	22	0.01	0.02	0.41	7	9.1	5.8
10-TR-025 BH10-14	carbonate rocks	<0.8	<0.7	390	<0.5	290	0.00	<0.02	0.30	4	1.5	4.0
10-TR-026 BH10-14	carbonate rocks	<0.8	<0.7	420	<0.5	300	0.00	<0.02	0.34	5	4.0	6.4
10-TR-027 BH10-14	carbonate rocks	<0.8	0.9	350	<0.5	280	0.00	<0.02	0.34	4	1.6	4.5
10-TR-028 BH10-15	carbonate rocks	<0.8	0.9	530	<0.5	270	0.00	<0.02	0.34	4	2.2	3.3
10-TR-029 BH10-15	carbonate rocks	<0.8	1.0	340	<0.5	240	0.00	<0.02	0.39	5	2.8	6.1
10-TR-030 BH10-15	carbonate rocks	<0.8	1.0	430	<0.5	290	0.00	<0.02	0.33	5	2.9	6.2
10-TR-031 BH10-16	carbonate rocks	<0.8	1.5	440	<0.5	270	0.00	<0.02	0.28	4	1.8	3.0
10-TR-032 BH10-16	carbonate rocks	<0.8	1.8	400	<0.5	260	0.00	<0.02	0.32	4	2.2	5.0
10-TR-033 BH10-16	carbonate rocks	<0.8	1.0	420	<0.5	270	0.00	<0.02	0.34	5	2.7	3.9
S449-10	borrow pit material	<0.8	2.1	520	<0.5	85	0.01	0.05	0.37	12	3.5	9.6
S450-10	borrow pit material	<0.8	0.9	350	<0.5	130	0.01	0.03	0.36	7	2.1	4.4
S451-10	borrow pit material	<0.8	1.2	470	<0.5	18	0.03	0.07	0.47	13	4.4	14
S452-10	borrow pit material	<0.8	1.1	530	0.7	31	0.05	0.11	1.2	15	3.2	18
S453-10	borrow pit material	<0.8	1.7	430	<0.5	21	0.01	<0.02	0.57	10	3.4	7.7
S454-10	borrow pit material	<0.8	1.9	310	<0.5	2.2	0.00	<0.02	0.24	1	0.60	1.7
S455-10	borrow pit material	<0.8	2.0	610	<0.5	5.3	0.02	0.03	0.71	8	2.2	13
S456-10	borrow pit material	<0.8	1.8	370	0.6	27	0.02	0.06	1.7	9	3.8	17
S457-10	borrow pit material	<0.8	1.4	440	<0.5	18	0.02	0.07	2.3	10	4.3	14
S458-10	borrow pit material	<0.8	2.0	520	0.6	13	0.03	0.08	2.6	9	4.8	18
S459-10	borrow pit material	<0.8	2.0	380	<0.5	47	0.01	<0.02	0.68	7	2.4	6.9
S460-10	borrow pit material	<0.8	1.7	370	<0.5	27	0.01	<0.02	0.62	6	2.0	12
S461-10	borrow pit material	<0.8	1.9	400	0.8	21	0.02	0.04	1.8	8	3.4	20
S462-10	borrow pit material	<0.8	1.8	400	<0.5	36	0.02	0.03	1.3	8	2.8	13

*Price (1997)

Table 4 Statistical Summary of Metals Analyses

	Al	As	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	K	Li	Mg	Mn
	%	µg/g	µg/g	µg/g	µg/g	%	µg/g	µg/g	µg/g	µg/g	%	%	µg/g	%	µg/g
Average Concentration (Continental Crust)*	8.2	1.8	425	3	0.0085	4.15	0.15	25	102	60	5.63	2.09	20	2.33	950
Ten Times Average Concentration (Continental Crust)*	82	18	4250	30	0.085	42	1.5	250	1020	600	56	21	200	23.3	9500
All Quarry Pit Rock (gneiss, schist, carbonate rocks)															
Min	0.05	0.50	2.7	0.1	0.09	0.06	0.02	1.1	2.1	2.0	0.16	0.03	2.0	0.12	62
Max	1.30	1.8	110	0.5	0.13	29	0.06	9.9	110	28	2.60	0.72	36	2.80	340
Mean	0.46	0.62	28	0.2	0.09	7.40	0.02	2.9	70	8.1	0.93	0.26	13	0.69	186
Median	0.39	0.50	24	0.2	0.09	0.23	0.02	2.1	85	6.2	0.86	0.17	13	0.54	170
Standard Deviation	0.35	0.29	24	0.1	0.01	12	0.01	2.1	41	5.7	0.62	0.22	9.2	0.66	80
No. of Samples	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
5th Percentile	0.08	0.5	3.1	0.06	0.09	0.07	0.02	1.2	2.2	2.2	0.17	0.03	2.0	0.13	69
25th Percentile	0.15	0.5	5.5	0.12	0.09	0.13	0.02	1.6	51	4.2	0.37	0.05	3.0	0.23	140
75th Percentile	0.63	0.5	35	0.23	0.09	10	0.02	3.6	100	11	1.25	0.39	18	0.94	273
95th Percentile	1.13	1.2	71	0.43	0.09	28	0.04	6.6	110	17	1.90	0.70	30	2.30	305
Gneiss															
Min	0.32	0.5	20	0.13	0.09	0.06	0.02	1.1	75	2.9	0.66	0.11	9.0	0.12	140
Max	1.20	0.5	110	0.49	0.13	0.36	0.1	9.9	110	28	2.60	0.72	36	1.10	320
Mean	0.57	0.5	39	0.22	0.09	0.17	0.02	3.5	96	10	1.21	0.34	18	0.37	198
Median	0.45	0.5	30	0.17	0.09	0.14	0.02	2.5	100	8.5	1.00	0.28	15	0.24	180
Standard Deviation	0.27	0.0	24	0.11	0.01	0.09	0.01	2.5	12	6.2	0.51	0.20	7.7	0.28	60
No. of Samples	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21
5th Percentile	0.33	0.5	21	0.13	0.09	0.07	0.02	1.1	78	3.2	0.71	0.15	10	0.13	140
25th Percentile	0.39	0.5	23	0.15	0.09	0.10	0.02	1.4	87	5.3	0.83	0.17	13	0.16	150
75th Percentile	0.78	0.5	51	0.25	0.09	0.23	0.02	5.2	110	14	1.40	0.49	20	0.50	240
95th Percentile	1.10	0.5	78	0.48	0.10	0.36	0.02	8.0	110	18	1.90	0.71	34	0.93	300
Schist															
Min	0.74	0.5	35	0.2	0.09	0.14	0.02	2.2	67	6.3	1.10	0.50	8.0	0.41	250
Max	1.30	1.1	37	0.4	0.09	0.30	0.03	3.6	70	13	1.80	0.60	17.0	1.00	280
Median	1.10	0.5	36	0.3	0.09	0.18	0.02	3.6	69	8.0	1.60	0.54	12.0	0.74	280
No. of Samples	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Table 4 Statistical Summary of Metals Analyses (Continued)

	Al	As	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	K	Li	Mg	Mn
	%	µg/g	µg/g	µg/g	µg/g	%	µg/g	µg/g	µg/g	µg/g	%	%	µg/g	%	µg/g
Average Concentration (Continental Crust)*	8.2	1.8	425	3	0.0085	4.15	0.15	25	102	60	5.63	2.09	20	2.33	950
Ten Times Average Concentration (Continental Crust)*	82	18	4250	30	0.085	42	1.5	250	1020	600	56	21	200	23.3	9500
Carbonate Rocks															
Min	0.05	0.5	2.7	0.06	0.09	3.90	0.02	1.3	2.1	2.0	0.16	0.03	2.0	0.41	62
Max	0.31	1.8	16	0.32	0.09	29	0.06	2.1	99	6.1	0.73	0.17	18	2.80	340
Mean	0.13	0.8	5.7	0.11	0.09	22	0.02	1.8	25	3.8	0.30	0.06	4.4	1.25	145
Median	0.10	0.6	4.1	0.07	0.09	27	0.02	1.7	2.6	4.0	0.25	0.04	2.0	0.97	105
Standard Deviation	0.08	0.4	4.3	0.08	0	11	0.01	0.2	41	1.4	0.18	0.05	5.3	0.82	98
No. of Samples	12.0	12	12	12	12	12	12	12	12	12	12	12	12	12	12
5th Percentile	0.07	0.5	2.9	0.06	0.09	4.01	0.02	1.4	2.2	2.0	0.17	0.03	2.0	0.50	64
25th Percentile	0.08	0.5	3.2	0.06	0.09	21	0.02	1.6	2.2	2.4	0.18	0.03	2.0	0.66	71
75th Percentile	0.14	1.1	5.4	0.10	0.09	28	0.02	1.9	24	4.6	0.31	0.04	3.0	1.53	195
95th Percentile	0.27	1.5	14	0.27	0.09	29	0.04	2.1	97	5.7	0.65	0.15	15	2.69	307
Unconsolidated Borrow Material															
Min	0.08	0.5	5.0	0.03	0.09	0.05	0.02	0.7	30	2.0	0.30	0.03	2.0	0.03	25
Max	0.39	1.7	29	0.27	0.09	17	0.03	7.0	170	38.0	1.10	0.24	24	4.90	270
Mean	0.26	0.7	16	0.17	0.09	5.3	0.02	2.5	81	9.9	0.70	0.12	7.2	1.94	123
Median	0.26	0.5	16	0.18	0.09	3.8	0.02	2.0	77	7.8	0.72	0.12	6.0	1.95	130
Standard Deviation	0.10	0.4	7.0	0.06	0	4.8	0.004	1.5	33	9.1	0.23	0.05	5.8	1.21	53
No. of Samples	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
5th Percentile	0.11	0.5	6.1	0.07	0.09	0.41	0.02	1.2	36	3.0	0.33	0.05	2.0	0.51	57
25th Percentile	0.20	0.5	11	0.13	0.09	2.7	0.02	1.8	69	4.9	0.55	0.09	3.3	1.13	100
75th Percentile	0.34	0.7	19	0.21	0.09	5.9	0.02	3.0	90	9.7	0.86	0.15	9.0	2.65	138
95th Percentile	0.39	1.4	26	0.26	0.09	15	0.03	4.7	131	26	1.03	0.20	16	3.60	186

Table 4 Statistical Summary of Metals Analyses (Continued)

	Mo	Na	Ni	P	Pb	Sb	Se	Si	Sn	Sr	Ti	Tl	U	V	Y	Zn
	µg/g	%	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	%	µg/g	µg/g	µg/g	µg/g	µg/g
Average Concentration (Continental Crust)*	1.2	2.4	84	1050	14	0.2	0.05	281500	2.3	370	0.57	0.85	2.7	120	33	70
Ten Times Average Concentration (Continental Crust)*	12	24	840	10500	140	2	0.5	2815000	23	3700	5.7	8.5	27	1200	330	700
All Quarry Pit Rock (gneiss, sch																
Min	0.10	0.012	2.9	21	0.8	0.8	0.7	270	0.5	3.4	0.001	0.02	0.3	3.0	1.5	2.2
Max	6.8	0.062	25	1090	29.0	0.8	2.2	780	1.2	300	0.19	0.48	13.0	48.0	16	50.0
Mean	0.73	0.038	8.3	245	4.7	0.8	0.9	506	0.6	75.4	0.05	0.14	3.0	11.6	4.9	20.9
Median	0.40	0.047	5.0	150	3.3	0.8	0.7	485	0.5	8.2	0.03	0.10	2.7	6.5	3.9	21.5
Standard Deviation	1.3	0.017	5.8	261	5.1	0.0	0.3	108	0.2	117	0.05	0.14	2.8	11	3.3	14
No. of Samples	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
5th Percentile	0.10	0.014	3.2	27	1.0	0.8	0.7	348	0.5	5.4	0.001	0.02	0.3	3.0	1.8	3.2
25th Percentile	0.10	0.016	3.8	69	1.6	0.8	0.7	440	0.5	6.6	0.002	0.02	0.4	4.0	2.6	6.2
75th Percentile	0.50	0.052	14	263	6.0	0.8	0.9	590	0.5	78	0.06	0.21	4.4	13.3	5.8	29.5
95th Percentile	2.7	0.056	16	753	11.3	0.8	1.6	693	0.9	290	0.15	0.45	6.9	34.8	10.9	46.8
Gneiss																
Min	0.20	0.040	3.2	25	2.0	0.8	0.7	440	0.5	5.6	0.01	0.06	2.1	3.0	2.0	18.0
Max	6.8	0.062	25	1000	29.0	0.8	0.8	780	1.2	17	0.19	0.48	13.0	48.0	16	50.0
Mean	1.1	0.051	6.6	273	6.9	0.8	0.7	544	0.6	8.1	0.07	0.20	4.6	15.8	5.7	29.2
Median	0.40	0.051	4.2	220	5.4	0.8	0.7	520	0.5	6.8	0.06	0.17	4.2	12.0	4.1	27.0
Standard Deviation	1.6	0.005	5.9	248	5.7	0.0	0.0	97	0.2	3.0	0.05	0.14	2.5	13.4	3.8	9.9
No. of Samples	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21
5th Percentile	0.20	0.042	3.4	28	2.5	0.8	0.7	440	0.5	5.6	0.02	0.07	2.5	3.0	2.2	19.0
25th Percentile	0.30	0.049	3.8	92	4.0	0.8	0.7	470	0.5	6.5	0.02	0.09	2.9	5.0	3.4	21.0
75th Percentile	1.1	0.053	5.3	270	7.1	0.8	0.7	600	0.6	8.2	0.09	0.31	4.9	22.0	7.1	34.0
95th Percentile	3.4	0.056	20	670	12.0	0.8	0.7	700	1.2	14	0.17	0.46	9.6	43.0	14.0	49.0
Schist																
Min	0.20	0.031	2.9	120	1.7	0.8	0.9	540	0.5	3.4	0.03	0.2	2.2	6.0	3.9	23.0
Max	0.40	0.033	3.8	260	3.3	0.8	2.2	630	0.5	5.8	0.06	0.2	2.3	7.0	7.4	28.0
Median	0.40	0.033	3.1	120	3.2	0.8	1.5	590	0.5	4.8	0.06	0.2	2.2	6.0	5.2	26
No. of Samples	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Table 4 Statistical Summary of Metals Analyses (Continued)

	Mo	Na	Ni	P	Pb	Sb	Se	Si	Sn	Sr	Ti	Tl	U	V	Y	Zn
	µg/g	%	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	%	µg/g	µg/g	µg/g	µg/g	µg/g
Average Concentration (Continental Crust)*	1.2	2.4	84	1050	14	0.2	0.05	281500	2.3	370	0.57	0.85	2.7	120	33	70
Ten Times Average Concentration (Continental Crust)*	12	24	840	10500	140	2	0.5	2815000	23	3700	5.7	8.5	27	1200	330	700
Carbonate Rocks																
Min	0.10	0.012	5	21	0.8	0.8	0.7	270	0.5	14	0.001	0.02	0.3	4.0	1.5	2.2
Max	0.50	0.018	15	1090	2.0	0.8	1.8	590	0.5	300	0.02	0.04	0.4	11.0	9.1	9.9
Mean	0.16	0.015	13	215	1.3	0.8	1.0	419	0.5	211	0.004	0.02	0.3	5.4	3.2	5.0
Median	0.10	0.015	14	82	1.3	0.8	1.0	420	0.5	270	0.001	0.02	0.3	5.0	2.5	4.8
Standard Deviation	0.14	0.002	3.5	317	0.4	0	0.3	84	0	116	0.01	0.01	0.0	2.1	2.1	2.1
No. of Samples	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
5th Percentile	0.10	0.013	6.1	33	0.9	0.8	0.7	309	0.5	18	0.001	0.02	0.3	4.0	1.6	2.6
25th Percentile	0.10	0.014	13	54	1.0	0.8	0.7	380	0.5	186	0.001	0.02	0.3	4.0	2.1	3.8
75th Percentile	0.10	0.016	15	162	1.6	0.8	1.0	443	0.5	283	0.002	0.02	0.4	5.5	3.2	6.1
95th Percentile	0.45	0.017	15	788	1.9	0.8	1.6	557	0.5	295	0.02	0.03	0.4	8.8	6.8	8.0
Unconsolidated Borrow Materia																
Min	0.10	0.011	3.4	16	0.8	0.8	0.9	310	0.5	2.2	0.004	0.02	0.2	1.0	0.6	1.7
Max	0.60	0.031	110	830	7.0	0.8	2.1	610	0.8	130	0.05	0.11	2.6	15.0	4.8	20.0
Mean	0.33	0.021	14	194	3.3	0.8	1.7	436	0.6	34	0.02	0.05	1.1	8.8	3.1	12.1
Median	0.30	0.020	6.5	140	3.4	0.8	1.8	415	0.5	24	0.02	0.04	0.7	8.5	3.3	13.0
Standard Deviation	0.14	0.006	28	191	1.5	0.0	0.4	84	0.1	34	0.01	0.03	0.8	3.4	1.1	5.4
No. of Samples	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
5th Percentile	0.17	0.014	4.2	77	1.5	0.8	1.0	336	0.5	4.2	0.01	0.02	0.3	4.3	1.5	3.5
25th Percentile	0.23	0.017	5.3	123	2.1	0.8	1.5	373	0.5	18	0.01	0.02	0.5	7.3	2.3	8.2
75th Percentile	0.40	0.026	9.7	193	3.8	0.8	2.0	508	0.6	35	0.02	0.07	1.6	10.0	3.7	16.3
95th Percentile	0.54	0.030	46	447	5.4	0.8	2.0	558	0.7	101	0.03	0.09	2.4	13.7	4.5	18.7

*Price (1997)

Table 5 Results of Shake Flask Extraction Test

	Units	MMER	CWQG (PAL)	CDWQ	10-TR-001 BH10-04	10-TR-005 BH10-05	10-TR-009 BH10-06	10-TR-014 BH10-08	10-TR-017 BH10-09	10-TR-019 BH10-12	10-TR-035 BH10-12
					Gneiss	Gneiss	Gneiss	Gneiss	Gneiss	Gneiss	Schist
Sample Weight	g				250	250	250	250	250	250	250
Volume mL	D.I. H_2O				750	750	750	750	750	750	750
InitialpH	units				9.51	9.41	9.63	9.63	9.59	9.58	9.74
Final pH	units	6.0 - 9.5	6.5 - 9.0	6.5 - 8.5	9.45	**9.64**	**9.73**	**9.67**	**9.69**	**9.73**	**9.67**
Mercury (Hg)	mg/L	-	0.026	0.001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Aluminum (Al)	mg/L	-	0.005-0.1[a]	-	0.97	0.84	0.98	0.58	0.91	0.75	1.42
Arsenic (As)	mg/L	0.5	0.005	0.005	0.0013	0.0004	0.0009	0.0005	0.0005	<0.0002	0.0012
Barium (Ba)	mg/L	-	-	1	0.00450	0.00444	0.00438	0.00420	0.00340	0.00309	0.00449
Beryllium (Be)	mg/L	-	-	-	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Bismuth (Bi)	mg/L	-	-	-	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Calcium (Ca)	mg/L	-	-	-	2.95	3.01	2.86	2.96	2.59	2.25	1.29
Cadmium (Cd)	mg/L	-	0.000017	0.005	< 0.000003	< 0.000003	< 0.000003	< 0.000003	< 0.000003	< 0.000003	< 0.000003
Cobalt (Co)	mg/L	-	-	-	0.000028	0.000030	0.000049	0.000060	0.000053	0.000122	0.000062
Chromium (Cr)	mg/L	-	0.001	0.051	<0.0005	0.0009	0.0010	<0.0005	0.0011	0.0013	0.0010
Copper (Cu)	mg/L	0.3	0.002-0.004[b]	≤1.0[c]	0.0009	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	<0.0005
Iron (Fe)	mg/L	-	0.3	<0.3[c]	0.069	0.094	0.115	0.127	0.116	0.186	0.233
Potassium (K)	mg/L	-	-	-	6.75	6.51	8.50	8.88	7.66	8.41	13.8
Lithium (Li)	mg/L	-	-	-	0.006	0.006	0.011	0.016	0.012	0.010	0.003
Magnesium (Mg)	mg/L	-	-	-	0.245	0.477	0.370	0.788	0.345	0.422	0.321
Manganese (Mn)	mg/L	-	-	≤0.05	0.00225	0.00268	0.00279	0.00265	0.00308	0.00364	0.00330
Molybdenum (Mo)	mg/L	-	0.073	-	0.00125	0.00096	0.00039	0.00084	0.00073	0.00432	0.00118
Sodium (Na)	mg/L	-	-	-	5.94	5.21	5.39	6.26	5.53	3.75	11.7
Nickel (Ni)	mg/L	0.5	0.025-0.15[b]	-	0.0001	< 0.0001	0.0002	0.0002	0.0002	0.0006	0.0003
Lead (Pb)	mg/L	0.2	0.001-0.007[b]	0.01	0.00083	0.00029	0.00043	0.00013	0.00053	0.00046	0.00032
Antimony (Sb)	mg/L	-	-	0.006	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.0003
Selenium (Se)	mg/L	-	0.001	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Tin (Sn)	mg/L	-	-	-	0.00003	0.00004	0.00003	0.00003	0.00004	0.00002	< 0.00001
Strontium (Sr)	mg/L	-	-	-	0.0105	0.0109	0.0123	0.0190	0.0109	0.0077	0.0037
Titanium (Ti)	mg/L	-	-	-	0.0037	0.0047	0.0118	0.0138	0.0134	0.0185	0.0126
Thallium (Tl)	mg/L	-	-	-	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Uranium (U)	mg/L	-	-	-	0.00940	0.00860	0.00817	0.00277	0.00528	0.00242	0.00143
Vanadium (V)	mg/L	-	-	-	0.00200	0.00268	0.00547	0.0111	0.00557	0.0129	0.00299
Zinc (Zn)	mg/L	0.5	0.03	≤5.0	< 0.001	< 0.001	< 0.001	0.002	< 0.001	0.001	< 0.001

Table 5 Results of Shake Flask Extraction Test (Continued)

	Units	MMER	CWQG (PAL)	CDWQ	10-TR-024 BH10-13 Sand-stone	10-TR-025 BH10-14 Sandy Carbonate	10-TR-029 BH10-15 Carb-onate	10-TR-033 BH10-16 Carb-onate	S449-10 Sand/ Gravel	S454-10 Sand/ Gravel	S458-10 Sand/ Gravel	S461-10 Sand/ Gravel
Sample Weight	g				250	250	250	250	250	250	250	250
Volume mL	D.I. H_2O				750	750	750	750	750	750	750	750
InitialpH	units				9.66	9.52	9.60	9.64	9.46	7.44	9.53	9.31
Final pH	units	6.0 - 9.5	6.5 - 9.0	6.5 - 8.5	9.38	9.11	8.95	9.03	8.94	7.90	9.30	9.27
Mercury (Hg)	mg/L	-	0.026	0.001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Aluminum (Al)	mg/L	-	0.005-0.1[a]	-	0.04	0.23	0.16	0.10	0.04	0.50	0.21	0.25
Arsenic (As)	mg/L	0.5	0.005	0.005	0.0013	0.0003	0.0004	<0.0002	0.0008	0.0003	0.0014	0.0007
Barium (Ba)	mg/L	-	-	1	0.00385	0.00167	0.00170	0.00144	0.00376	0.00406	0.00324	0.00388
Beryllium (Be)	mg/L	-	-	-	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Bismuth (Bi)	mg/L	-	-	-	< 0.00001	< 0.00001	0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Calcium (Ca)	mg/L	-	-	-	8.32	10.8	12.2	11.4	11.3	4.61	9.28	13.0
Cadmium (Cd)	mg/L	-	0.000017	0.005	< 0.000003	< 0.000003	< 0.000003	< 0.000003	< 0.000003	< 0.000003	< 0.000003	< 0.000003
Cobalt (Co)	mg/L	-	-	-	0.000039	0.000051	0.000059	0.000054	0.000080	0.000137	0.000045	0.000099
Chromium (Cr)	mg/L	-	0.001	0.051	0.0013	0.0007	0.0006	0.0006	0.0027	0.0014	0.0006	0.0008
Copper (Cu)	mg/L	0.3	0.002-0.004[b]	≤1.0[c]	<0.0005	<0.0005	<0.0005	<0.0005	0.0011	0.0023	0.0015	0.0484
Iron (Fe)	mg/L	-	0.3	<0.3[c]	< 0.002	< 0.002	< 0.002	< 0.002	0.010	0.169	0.004	0.059
Potassium (K)	mg/L	-	-	-	8.56	2.03	2.27	2.51	6.90	0.818	7.14	4.94
Lithium (Li)	mg/L	-	-	-	0.009	0.004	0.005	0.006	0.028	< 0.001	0.004	0.010
Magnesium (Mg)	mg/L	-	-	-	7.40	2.55	2.74	3.71	11.3	1.73	3.42	3.83
Manganese (Mn)	mg/L	-	-	≤0.05	0.00037	0.00030	0.00065	0.00023	0.00064	0.00898	0.00024	0.00165
Molybdenum (Mo)	mg/L	-	0.073	-	0.00073	0.00048	0.00207	0.00069	0.00390	0.00053	0.00177	0.00226
Sodium (Na)	mg/L	-	-	-	0.94	1.38	1.82	1.65	1.85	0.15	4.06	2.35
Nickel (Ni)	mg/L	0.5	0.025-0.15[b]	-	0.0001	< 0.0001	0.0002	0.0001	0.0004	0.0006	0.0002	0.0004
Lead (Pb)	mg/L	0.2	0.001-0.007[b]	0.01	< 0.00002	0.00002	< 0.00002	< 0.00002	< 0.00002	0.00079	< 0.00002	0.00015
Antimony (Sb)	mg/L	-	-	0.006	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.0013
Selenium (Se)	mg/L	-	0.001	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Tin (Sn)	mg/L	-	-	-	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	0.00001	< 0.00001	0.00006
Strontium (Sr)	mg/L	-	-	-	0.0224	0.139	0.121	0.120	0.0422	0.0073	0.0217	0.0202
Titanium (Ti)	mg/L	-	-	-	0.0003	< 0.0001	0.0003	0.0001	0.0008	0.0111	0.0001	0.0037
Thallium (Tl)	mg/L	-	-	-	< 0.00002	< 0.00002	0.00006	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Uranium (U)	mg/L	-	-	-	0.000234	0.000071	0.000095	0.000107	0.000486	0.000243	0.000974	0.00225
Vanadium (V)	mg/L	-	-	-	0.00494	0.00084	0.00068	0.00042	0.00112	0.00109	0.00456	0.00417
Zinc (Zn)	mg/L	0.5	0.03	≤5.0	< 0.001	< 0.001	< 0.001	0.001	< 0.001	0.001	< 0.001	0.001

Note:

MMER = Metals, Mining Effluent (SOR 2002 - 222)

Bold values indicate parameters above the MMER value.

** Lab data reported for total chromium.

CWQG (PAL) and CDWQ provided for reference only (see text)

CWQG (PAL) = Canadian Water Quality Guidelines Protection of Aquatic Life, 2007

CDWQ = Health Canada - Canadian Drinking Water Guideline

a) varies with pH

b) varies with hardness

c) Aesthetic objective

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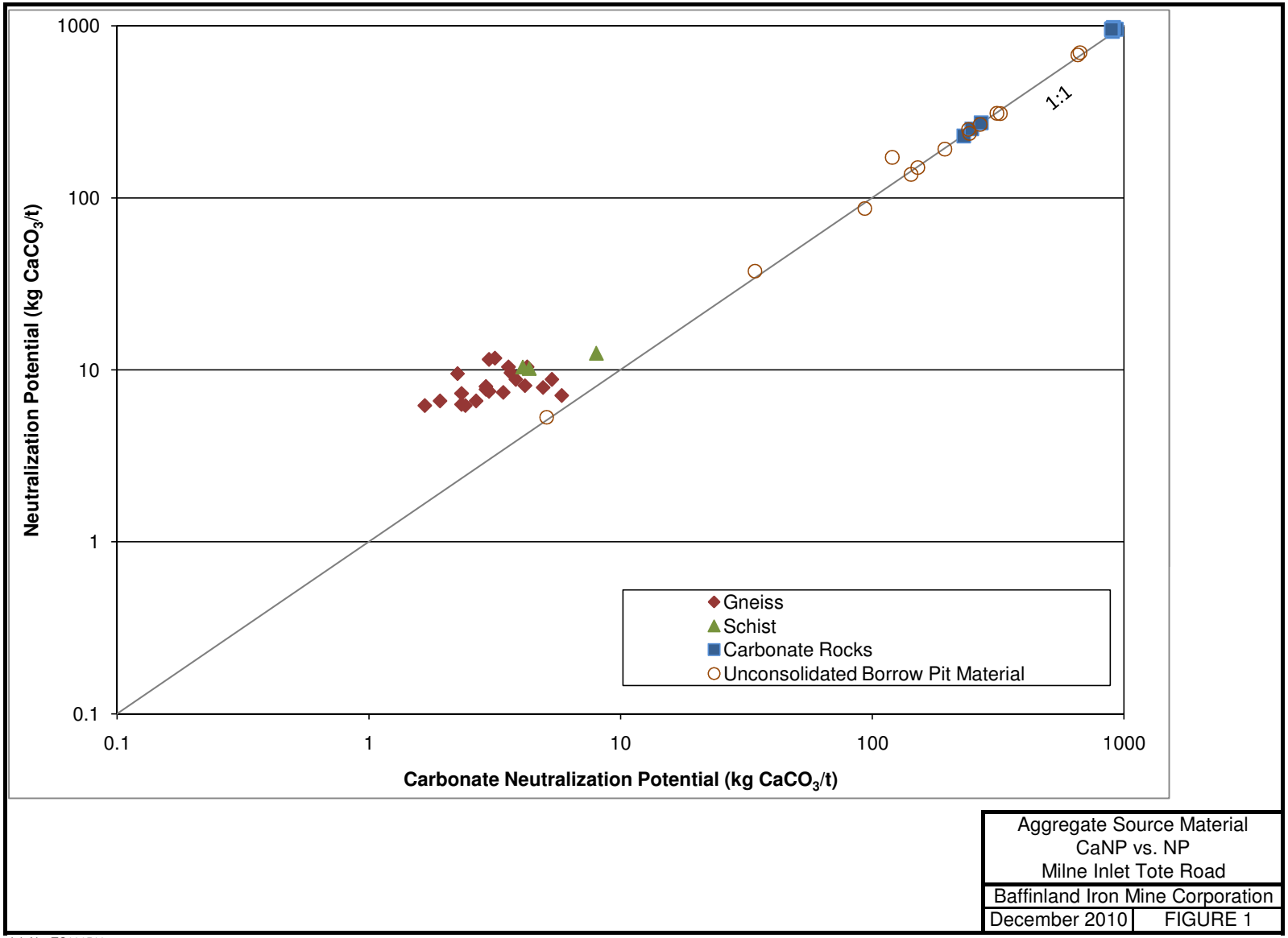
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Table 6 - Rietveld Quantitative Analysis X-ray Diffraction Results

Mineral/Compound		Ideal Formula	10-TR-001 BH10-4 *granitic gneiss* (wt %)	10-TR-005 BH10-5 *granitic gneiss* (wt %)	10-TR-009 BH10-6 *granitic gneiss* (wt %)	10-TR-014 BH10-8 *granitic gneiss* (wt %)	10-TR-017 BH10-9 *granitic gneiss* (wt %)	10-TR-019 BH10-12 *granitic gneiss* (wt %)	10-TR-035 BH10-12 *schist* (wt %)
Calcite	Carbonates	$CaCO_3$	1.2	0.6	0.1	--	0.3	0.2	--
Rhodochrosite	Carbonates	$MnCO_3$	--	--	--	--	--	0.7	--
Dolomite	Carbonates	$CaMg(CO_3)_2$	--	--	--	--	--	0.5	--
Ankerite	Carbonates	$Ca(Mg, Fe)(CO_3)_2$	--	--	--	--	--	--	--
Quartz		SiO_2	34.4	38.1	34.2	33.6	32.5	30.4	42.6
Albite	Feldspars	$NaAlSi_3O_8$	33.4	30.9	35.0	29.7	36.6	27.7	12.4
Anorthite	Feldspars	$CaAl_2Si_2O_8$	4.2	4.7	5.7	7.4	5.4	8.4	5.7
Orthoclase	Feldspars	$KAlSi_3O_8$	2.5	1.8	1.6	4.5	1.8	2.6	4.1
Microcline	Feldspars	$KAlSi_3O_8$	21.8	20.7	16.5	16.8	16.2	10.8	19.5
Diopside (clinopyroxene)		$CaMgSi_2O_6$	--	--	2.9	2.8	3.1	3.0	4.3
Actinolite (amphibole)		$Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$	--	--	--	--	--	9.5	--
Phlogopite	Phyllo-silicates	$KMg_3(AlSi_3O_{10})(OH)_2$	0.4	0.8	3.1	4.3	3.1	5.2	3.4
Biotite	Phyllo-silicates	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$	--	--	--	--	--	--	3.9
Clinochlore (chlorite)	Phyllo-silicates	$(Mg, Fe)_5 (Si_3Al)O_{10}(OH)_8$	1.3	1.4	0.01	0.01	0.01	0.9	4.1
Magnetite		Fe_3O_4	0.8	0.9	0.9	0.9	0.9	--	0.1
TOTAL			100	100	100	100	100	100	100

Mineral/Compound		Ideal Formula	10-TR-024 BH10-13 *carbonate cemented sandstone* (wt %)	10-TR-025 BH10-14 *carbonate* (wt %)	10-TR-029 BH10-15 *carbonate* (wt %)	10-TR-033 BH10-16 *carbonate* (wt %)	S449-10 *borrow material* (wt %)	S454-10 *borrow material* (wt %)	S458-10 *borrow material* (wt %)	S461-10 *borrow material* (wt %)
Calcite	Carbonates	$CaCO_3$	--	99.3	98.9	98.3	22.6	0.2	0.1	2.2
Rhodochrosite	Carbonates	$MnCO_3$	--	--	--	--	--	--	--	0.6
Dolomite	Carbonates	$CaMg(CO_3)_2$	25.9	0.3	0.3	0.6	46.4	--	6.2	11.5
Ankerite	Carbonates	$Ca(Mg, Fe)(CO_3)_2$	--	0.1	0.1	0.3	11.7	--	3.3	3.0
Quartz		SiO_2	56.3	0.3	0.7	0.8	9.7	98.8	33.0	28.5
Albite	Feldspars	$NaAlSi_3O_8$	1.2	--	--	--	1.1	0.7	22.7	25.2
Anorthite	Feldspars	$CaAl_2Si_2O_8$	--	--	--	--	--	--	5.1	3.5
Orthoclase	Feldspars	$KAlSi_3O_8$	1.4	--	--	--	1.3	--	3.9	4.1
Microcline	Feldspars	$KAlSi_3O_8$	15.2	--	--	--	4.6	--	18.3	12.8
Diopside (clinopyroxene)		$CaMgSi_2O_6$	--	--	--	--	--	--	2.8	3.1
Actinolite (amphibole)		$Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$	--	--	--	--	--	--	--	--
Phlogopite	Phyllo-silicates	$KMg_3(AlSi_3O_{10})(OH)_2$	--	--	--	--	--	--	3.7	3.4
Biotite	Phyllo-silicates	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$	--	--	--	--	--	--	--	--
Clinochlore (chlorite)	Phyllo-silicates	$(Mg, Fe)_5 (Si_3Al)O_{10}(OH)_8$	--	--	--	--	2.6	0.3	0.5	1.6
Magnetite		Fe_3O_4	--	--	--	--	--	--	0.4	0.5
TOTAL			100	100	100	100	100	100	100	100

FIGURES



Aggregate Source Material
CaNP vs. NP
Milne Inlet Tote Road

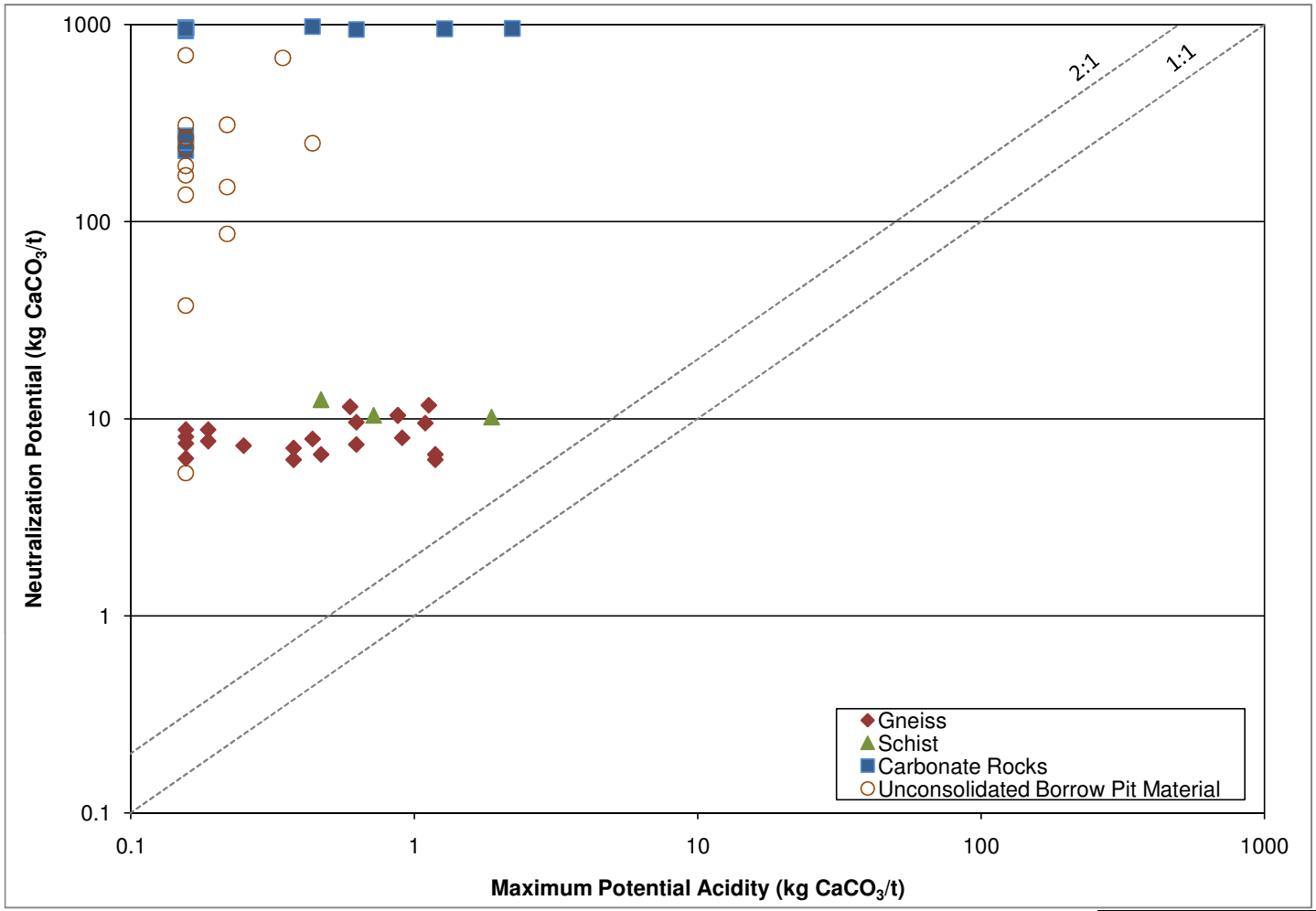
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Aggregate Source Material NP vs. MPA Milne Inlet Tote Road	
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APPENDIX 4
DFO IR ATTACHMENTS

DFO 3.1.1 ATTACHMENT 1: LIST OF STREAM CROSSINGS (CULVERTS), BRIDGES, CUTS/DIVERSIONS, AND LAKE/POND ENCROACHMENTS/INFILLS ALONG THE NORTH RAIL ALIGNMENT AND TOTE ROAD REALIGNMENT AND FISH HABITAT SUMMARY

DFO IR 3.1.1. **List of stream crossings (culverts), bridges, cuts/diversions, and lake/pond encroachments/infills along the north rail alignment and Tote Road realignment and fish habitat summary.**

Number	Site ID	Description	Waterbody Type	Diversion to	Receives Diversion From	Permanent/Temporary	Rail/Road	New/Replacement /Extension /Modification	Other Crossings/Bridges/Encroachments/Cuts on Same Waterbody [1]		Current UTM Coordinates		Arctic Char		Ninespine Stickleback		No. Barrels	Culvert Length (m)	Culvert Diameter (mm)	Stream Order at Crossing/Cut /Bridge	Stream Crossings			Bridges			Lake/Pond Encroachment /Infilling	Cuts		
									Rail Crossing	Road Crossing	Easting	Northing	Fish Bearing	Habitat Quality (MAR/IMP/NFB)	Fish Bearing	Habitat Quality (MAR/IMP/NFB)					Lost Habitat (m^2)	Altered Habitat (m^2)	Total (m^2)	Lost Habitat (m^2)	Altered Habitat (m^2)	Total (m^2)	Lost Habitat (m^2)	Lost Habitat (m^2)	Altered Habitat (m^2)	Total (m^2)
1	CV-0-1	Culvert	S		CV-0-2	PERM	Rail	New	No	Yes; Access road to port infrastructure	504289	7975593	No	NFB	No	NFB	1	6.0	900	n/a										
2	CV-0-2	Cut	S	CV-0-1		PERM	Rail	New	Yes; CV-0-1	Yes; Access road to port infrastructure	504234	7975572	No	NFB	No	NFB	NA	NA	NA	n/a									
3	CV-0-3	Culvert	S			PERM	Rail	New	No	Yes; CV-177	503796	7975281	No	NFB	No	NFB	TBD	TBD	TBD	n/a									
4	CV-1-1	Culvert	S			PERM	Rail	New	No	Yes; CV-176	503802	7975052	No	NFB	No	NFB	TBD	TBD	TBD	n/a									
5	CV-1-2	Culvert	S			PERM	Rail	New	Yes; CV-1-3	No	503830	7974912	No	NFB	No	NFB	TBD	TBD	TBD	n/a									
6	CV-1-3	Culvert	S/P			PERM	Rail	New	No	Yes; CV-175	503820	7974824	No	NFB	No	NFB	TBD	TBD	TBD	n/a									
7	CV-1-4	Culvert	LP			PERM	Rail	New	No	No	503877	7974421	No	NFB	No	NFB	TBD	TBD	TBD	n/a									
8	CV-1-5	Culvert	LP			PERM	Rail	New	No	No	503938	7974333	No	NFB	No	NFB	TBD	TBD	TBD	n/a									
9	CV-1-6	Culvert	S			PERM	Rail	New	No	Yes; CV-174	504292	7974064	No	NFB	No	NFB	1	12.0	900	n/a									
10	CV-1-7	Culvert	S			PERM	Rail	New	No	Yes; CV-173	504662	7973667	No	NFB	No	NFB	1	12.0	900	n/a									
11	CV-1-8	Culvert	S			PERM	Rail	New	No	Yes; CV-173	504895	7973426	No	NFB	No	NFB	1	12.0	900	n/a									
12	CV-1-9	Culvert	S			PERM	Rail	New	No	Yes; CV-173	504924	7973381	No	NFB	No	NFB	1	12.0	900	n/a									
13	CV-2-1	Culvert	S			PERM	Rail	New	No	Yes; CV-170	505154	7973121	No	NFB	No	NFB	1	12.0	900	n/a									
14	CV-2-2	Culvert	S			PERM	Rail	New	No	Yes; CV-170	505217	7973067	No	NFB	No	NFB	1	12.0	900	n/a									
15	CV-3-1	Culvert	S			PERM	Rail	New	No	No	505388	7972906	No	NFB	No	NFB	1	12.0	900	n/a									
16	CV-3-2	Culvert	S			PERM	Rail	New	No	Yes; Unnamed Tote Road	505396	7972893	No	NFB	No	NFB	1	12.0	900	n/a									
17	CV-4-1	Culvert	S			PERM	Rail	New	No	Yes; CV-167, CV-169-1	505666	7972585	No	NFB	No	NFB	1	12.0	900	n/a									
18	CV-4-2	Culvert	S			PERM	Rail	New	No	Yes; CV-167, CV-169-1	505774	7972512	No	NFB	No	NFB	1	12.0	900	n/a									
19	CV-4-3	Culvert	S			PERM	Rail	New	No	Yes; CV-167, CV-169-1	505836	7972435	No	NFB	No	NFB	1	12.0	900	n/a									
20	CV-4-4	Culvert	S			PERM	Rail	New	No	Yes; CV-167, CV-169-1	505862	7972397	No	NFB	No	NFB	1	12.0	900	n/a									
21	CV-4-5	Culvert	S			PERM	Rail	New	No	Yes; CV-166, CV-169-1	506070	7972201	No	NFB	No	NFB	1	12.0	900	n/a									
22	CV-5-1	Culvert	S			PERM	Rail	New	No	Yes; CV-166, CV-169-1	506158	7972031	No	NFB	No	NFB	1	10.0	900	n/a									
23	CV-5-2	Culvert	S			PERM	Rail	New	No	No	506172	7971999	No	NFB	No	NFB	1	10.0	900	n/a									
24	CV-5-3	Culvert	S			PERM	Rail	New	No	Yes; CV-165	506297	7971792	No	NFB	No	NFB	1	10.0	900	n/a									
25	CV-5-4	Culvert	S			PERM	Rail	New	No	Yes; CV-164	506540	7971622	No	NFB	No	NFB	1	10.0	900	n/a									
26	CV-5-5	Culvert	S			PERM	Rail	New	No	Yes; CV-163	506643	7971540	No	NFB	No	NFB	1	10.0	900	n/a									
27	CV-5-6	Culvert	S			PERM	Rail	New	No	Yes; CV-163	506661	7971526	No	NFB	No	NFB	1	10.0	900	n/a									
28	CV-5-7	Culvert	S			PERM	Rail	New	No	No	506781	7971420	No	NFB	No	NFB	1	10.0	900	n/a									
29	CV-6-1	Culvert	S			PERM	Rail	New	No	No	506927	7971257	No	NFB	No	NFB	2	24.0	1200	n/a									
30	CV-6-2	Culvert	S			PERM	Rail	New	No	No	507170	7971061	No	NFB	No	NFB	1	10.0	900	n/a									
31	CV-6-3	Culvert	S			PERM	Rail	New	No	Yes; CV-157	507417	7970910	No	NFB	No	NFB	1	10.0	900	n/a									
32	CV-6-4	Culvert	S			PERM	Rail	New	No	Yes; CV-157	507476	7970841	No	NFB	No	NFB	1	10.0	900	n/a									
33	CV-7-1	Culvert	LP			PERM	Rail	New	No	No	507732	7970526	No	NFB	No	NFB	1	12.0	900	n/a									
34	CV-7-2	Culvert	LP			PERM	Rail	New	No	No	507884	7970336	No	NFB	No	NFB	1	12.0	900	n/a									
35	CV-7-3	Culvert	LP			PERM	Rail	New	No	No	507953	7970255	No	NFB	No	NFB	1	12.0	900	n/a									
36	CV-7-4	Culvert	LP			PERM	Rail	New	No	No	508038	7970146	No	NFB	No	NFB	1	12.0	900	n/a									
37	CV-7-5	Culvert	LP			PERM	Rail	New	No	No	508060	7970116	No	NFB	No	NFB	1	12.0	900	n/a									
38	CV-7-6	Culvert	LP			PERM	Rail	New	No	No	508094	7970073	No	NFB	No	NFB	1	12.0	900	n/a									
39	CV-7-7	Culvert	LP			PERM	Rail	New	No	No	508097	7970069	No	NFB	No	NFB	1	12.0	900	n/a									
40	CV-8-0	Cut	S	CV-8-1 and CV-		PERM	Rail	New	No	Yes; CV-152	508293	7969747	No	NFB	No	NFB	0	NA	NA	n/a									
41	CV-8-1	Culvert	S		CV-8-0	PERM	Rail	New	No	Yes; CV-152	508311	7969712	No	NFB	No	NFB	1	12.0	1200	n/a									
42	CV-8-2	Culvert	S		CV-8-0	PERM	Rail	New	No	Yes; CV-152	508325	7969683	No	NFB	No	NFB	1	18.0	1200	n/a									
43	CV-8-3	Culvert	S			PERM	Rail	New	No	Yes; CV-151	508351	7969601	No	NFB	No	NFB	1	12.0	900	n/a									
44	CV-8-4	Culvert	S			PERM	Rail	New	No	No	508412	7969338	No	NFB	No	NFB	1	12.0	1200	n/a									
45	CV-9-1	Culvert	S			PERM	Rail	New	No	Yes; CV-146, CV-146-1	508805	7968873	No	NFB	No	NFB	6	12.0	900	n/a									
46	CV-10-1	Culvert	LP			PERM	Rail	New	No	No	509365	7968264	No	NFB	No	NFB	1	6.0	900	n/a									
47	CV-10-2	Culvert	LP			PERM	Rail	New	No	No	509637	7968011	No	NFB	No	NFB	1	6.0	900	n/a									
48	CV-10-3	Culvert	LP			PERM	Rail	New	No	No	509653	7967999	No	NFB	No	NFB	1	6.0	900	n/a									
49	CV-10-4	Culvert	LP			PERM	Rail	New	No	No	509829	7967867	No	NFB	No	NFB	1	6.0	900	n/a									
50	CV-10-5	Culvert	S			PERM	Rail	New	No	No	509872	7967824	No	NFB	No	NFB	1	12.0	900	n/a									
51	CV-11-1	Culvert	S			PERM	Rail	New	No	No	509931	7967723	Potential	MAR	Potential	MAR	1	6.0	900	1	17	20	37						
52	CV-11-2	Culvert	LP			PERM	Rail	New	No	No	510076	7967537	No	NFB	No	NFB	1	12.0	1200	n/a									
53	CV-11-3	Culvert	S			PERM	Rail	New	No	No	510214	7967455	No	NFB	No	NFB	1	12.0	900	n/a									
54	CV-11-4	Culvert	LP			PERM	Rail	New	No	No	510472	7967402	No	NFB	No	NFB	1	12.0	900	n/a									
55	CV-11-5	Culvert	LP			PERM	Rail	New	No	No	510589	7967385	No	NFB	No	NFB	1	12.0	900	n/a									
56	CV-12-1	Culvert	S			PERM	Rail	New	No	No	510933	7967256	Unlikely	MAR	Unlikely	MAR	1	18.0	900	1	50	20	71						
57	CV-12-2	Culvert	S			PERM	Rail	New	No	No	511019	7967241	Unlikely	MAR	Unlikely	MAR	1	18.0	900	1	50	20	71						
58	CV-12-3	Culvert	LP			PERM	Rail	New	No	No	511127	7967223	No	NFB	No	NFB	1	12.0	900	n/a									
59	CV-12-4	Culvert	LP			PERM	Rail	New	No	No	511355	7967185	No	NFB	No	NFB	1	6.0	900	n/a									
60	CV-12-4b	Cut	LP	CV-12-5 and CV-		PERM	Rail	New	No	No	511455	7967168	No	NFB	No	NFB	0	NA	NA	n/a									
61	CV-12-5	Culvert	S		CV-12-4b	PERM	Rail	New	No	Yes; CV-131	511552	7967152	No	NFB	No	NFB	1	10.0	900	n/a									
62	CV-13-1	Culvert	LP		CV-12-4b	PERM	Rail	New	No	No	511798	7967111	No	NFB	No	NFB	1	12.0	900	n/a									
63	CV-13-2	Culvert	LP			PERM	Rail	New	No	No	512120	7966981	No	NFB	No	NFB	1	12.0	900	n/a									
64	CV-13-3	Culvert	S			PERM	Rail	New	No	No	512375	7966823	No	NFB	No	NFB	1	7.5	900	n/a									
65	CV-13-4	Culvert	S			PERM	Rail	New	No	Yes; CV-129	512415	7966799	Yes	IMP	Yes	IMP	2	18.0	1400	3	293	183	476						
66	CV-13-5	Culvert	S			PERM	Rail	New	No	No	512556	7966712	No	NFB	No	NFB	1	12.0	900	n/a									
67	CV-14-1	Culvert	S			PERM	Rail	New	No	No	513252	7966428	No	NFB	No	NFB	1	12.5	1200	n/a									
68	CV-14-2	Culvert	P			PERM	Rail	New	No	No	513436	7966375	No	NFB	No	NFB	1	12.0	1200	n/a									
69	CV-14-3	Culvert	P			PERM	Rail	New	No	No	513532	7966333	No	NFB	No	NFB	1	12.0	1200	n/a									
70	CV-15-1	Culvert	LP			PERM	Rail	New	No	No	513624	7966294	No	NFB	No	NFB	1	12.0	1200	n/a									
71	CV-15-2	Culvert/encroachment	S/P			PERM	Rail	New	No	Yes; Unnamed Tote Road	513781	7966188	Yes	MAR	Yes	IMP	1	24.0	1400	3							722		
72	CV-15-3	Culvert/encroachment	S/P			PERM	Rail	New	No	Yes; Unnamed Tote Road	513892	7966034	Yes	MAR	Yes	IMP	2	17.5	900	2							523		
73	CV-15-4	Culvert	P			PERM	Rail	New	No	No	514123	7965711	No	NFB	No	NFB	1	15.0	1200	n/a									
74	CV-15-5	Bridge	S			PERM	Rail	New	No	Yes; CV-128 bridge	514239	7965626	Yes	IMP	Yes	IMP	N/A	N/A	N/A	3+				14.60	769	784			
75	CV-16-1	Culvert	LP			PERM	Rail	New	No	No	514325	7965565	No	NFB	No	NFB	4	15.0	1200	n/a									
76	CV-16-2	Culvert/encroachment	S/P			PERM	Rail	New	Yes; CV-15-5	Yes; CV-128 bridge	514768	7965089	No	NFB	No	NFB	4	12.5	1200	n/a									
77	CV-16-3	Culvert	S			PERM	Rail	New	Yes; CV-16-2, CV-15-5	Yes; CV-128 bridge	514811	7964916	No	NFB	Potential	MAR	1	12.0	900	n/a									
78	CV-17-1	Culvert	P			PERM	Rail	New	No	No	515261	7964025	No	NFB	No	NFB	1	17.5	900	n/a									
79	CV-18-1	Encroachment	P			PERM	Rail	New	No	Yes; CV-125	515331	7963846	No	NFB	Unlikely	MAR	1	30.0	900	1									
80	CV-18-2	Culvert	S			PERM	Rail	New	No	Yes; CV-124	515405	7963693	No	NFB	No	NFB	1	18.0	900	n/a									
81	CV-18-3	Culvert	S			PERM	Rail	New	No	No	515607	7963389	No	NFB	No	NFB	1	18.0	900	n/a									
82	CV-18-4	Culvert	S			PERM	Rail	New	No	No	515682	7963328	No	NFB	No	NFB	1	15.0	900	n/a									
83	CV-19-1	Culvert	S			PERM	Rail	New	No	Yes; CV-123	515927	7963175	No	NFB	No	NFB	1	18.0	900	n/a									
84	CV-19-2	Culvert	P			PERM	Rail	New	No	No	516161	7963031	No	NFB	No	NFB	1	30.0	900	n/a									
85	CV-19-3	Culvert	S			PERM	Rail	New	No	No	516613	7962587	No	NFB	No	NFB	1	18.0	900	n/a									
86	CV-20-1	Culvert	LP		CV-20-2	PERM	Rail	New	No	No	517040	7962255	No	NFB	No	NFB	1	12.0	900	n/a									
87	CV-20-2	Cut	S	CV-20-1		PERM	Rail	New	No	Yes; CV-121	517267	7962029	No	NFB	No	NFB	0	NA	NA	n/a									

DFO IR 3.1.1. **List of stream crossings (culverts), bridges, cuts/diversions, and lake/pond encroachments/infills along the north rail alignment and Tote Road realignment and fish habitat summary.**

Number	Site ID	Description	Waterbody Type	Diversion to	Receives Diversion From	Permanent/Temporary	Rail/Road	New/Replacement /Extension /Modification	Other Crossings/Bridges/Encroachments/Cuts on Same Waterbody [1]		Current UTM Coordinates		Arctic Char		Ninespine Stickleback		No. Barrels	Culvert Length (m)	Culvert Diameter (mm)	Stream Order at Crossing/Cut /Bridge	Stream Crossings			Bridges			Lake/Pond Encroachment /Infilling	Cuts		
									Rail Crossing	Road Crossing	Easting	Northing	Fish Bearing	Habitat Quality (MAR/IMP/NFB)	Fish Bearing	Habitat Quality (MAR/IMP/NFB)					Lost Habitat (m^2)	Altered Habitat (m^2)	Total (m^2)	Lost Habitat (m^2)	Altered Habitat (m^2)	Total (m^2)	Lost Habitat (m^2)	Lost Habitat (m^2)	Altered Habitat (m^2)	Total (m^2)
88	CV-21-1	Culvert	LP			PERM	Rail	New	No	No	517391	7961887	No	NFB	No	NFB	1	12.0	900	n/a										
89	CV-21-2	Culvert	LP			PERM	Rail	New	No	No	517607	7961640	No	NFB	No	NFB	1	12.0	900	n/a										
90	CV-21-3	Culvert	LP			PERM	Rail	New	No	Yes; CV-119	517928	7961308	No	NFB	No	NFB	1	18.0	900	n/a										
91	CV-21-4	Culvert	LP			PERM	Rail	New	No	No	518010	7961196	No	NFB	No	NFB	0	18.0	0	n/a										
92	CV-22-1	Pond Infilling	P			PERM	Rail	New	Yes; CV-21-3	Yes; CV-119	518123	7960950	No	NFB	Unlikely	MAR	1	12.0	900	n/a (LE)										
93	CV-22-2	Encroachment	P			PERM	Rail	New	Yes; CV-21-3, CV-22-1	Yes; CV-119	518232	7960617	No	NFB	Unlikely	MAR	1	12.0	900	n/a (LE)										
94	CV-22-3	Culvert	LP			PERM	Rail	New	No	No	518295	7960427	No	NFB	No	NFB	1	12.0	900	n/a										
95	CV-22-4	Encroachment	P			PERM	Rail	New	Yes; CV-21-3, CV-22-1, CV-22-2	Yes; CV-119	518370	7960198	No	NFB	Unlikely	MAR	does not require modeling			n/a (LE)										
96	CV-23-1	Culvert	S			PERM	Rail	New	No	No	518441	7959981	No	NFB	No	NFB	1	18.0	900	n/a										
97	CV-23-2	Culvert	S			PERM	Rail	New	No	Yes; CV-118	518501	7959798	No	NFB	No	NFB	1	12.0	900	n/a										
98	CV-23-3	Culvert	LP			PERM	Rail	New	No	No	518695	7959425	No	NFB	No	NFB	1	12.0	900	n/a										
99	CV-23-4	Culvert	S			PERM	Rail	New	No	Yes; CV-198	518754	7959335	No	NFB	No	NFB	1	18.0	900	n/a										
100	CV-24-1	Culvert	S			PERM	Rail	New	No	Yes; CV-199	518988	7958946	No	NFB	No	NFB	1	12.0	900	n/a										
101	CV-24-2	Culvert	S			PERM	Rail	New	No	Yes; Unnamed Tote Road	519081	7958667	No	NFB	No	NFB	1	18.0	900	n/a										
102	CV-24-3	Culvert	S			PERM	Rail	New	Yes; CV-24-2	Yes; Unnamed Tote Road	519153	7958481	No	NFB	No	NFB	1	12.0	900	n/a										
103	CV-25-1	Culvert	S			PERM	Rail	New	Yes; CV-24-2, CV-24-3	Yes; Unnamed Tote Road	519225	7958229	No	NFB	No	NFB	2	12.0	900	n/a										
104	CV-25-2	Culvert	S			PERM	Rail	New	No	Yes; CV-115	519507	7958144	Probable	MAR	Probable	MAR - IMP	1	13.6	900	1	38	20	58							
105	CV-25-3	Culvert	S			PERM	Rail	New	Yes; CV-25-2	Yes; CV-115	519661	7958016	Potential	MAR	Potential	MAR	2	20.6	1200	3	336	156	492							
106	CV-26-1	Culvert/Encroachment	S/P			PERM	Rail	New	Yes; CV-25-2, CV-25-3	Yes; CV-115	519989	7957450	Potential	MAR	Potential	MAR				3							3,114			
107	CV-26-3	Culvert	LP			PERM	Rail	New	No	No	520156	7957209	No	NFB	No	NFB	TBD	TBD	TBD	n/a										
108	CV-26-4	Culvert	LP			PERM	Rail	New	No	No	520224	7957110	No	NFB	No	NFB	TBD	TBD	TBD	n/a										
109	CV-26-5	Culvert	S			PERM	Rail	New	No	No	520386	7956847	No	NFB	No	NFB	TBD	TBD	TBD	n/a										
110	CV-27-1	Culvert	S			PERM	Rail	New	No	No	520406	7956775	Potential	MAR	Potential	MAR	1	13.6	900	1	3	0	3							
111	CV-27-2	Culvert	S			PERM	Rail	New	No	Yes; CV-114	520412	7956735	Potential	MAR	Potential	MAR	1	13.6	900	3	222	117	339							
112	CV-27-3	Culvert	LP			PERM	Rail	New	No	No	520516	7956235	No	NFB	No	NFB	1	12.5	900	n/a										
113	CV-27-4	Culvert	LP			PERM	Rail	New	No	No	520564	7956131	No	NFB	No	NFB	1	12.5	900	n/a										
114	CV-27-5	Culvert	S			PERM	Rail	New	No	No	520699	7955833	No	NFB	No	NFB	1	12.0	900	n/a										
115	CV-28-1	Culvert	LP			PERM	Rail	New	No	No	520722	7955784	No	NFB	No	NFB	1	12.0	900	n/a										
116	CV-28-2	Culvert	S			PERM	Rail	New	No	Yes; CV-113	520749	7955722	No	NFB	No	NFB	1	12.0	900	n/a										
117	CV-28-3	Culvert	LP			PERM	Rail	New	No	No	520891	7955261	No	NFB	No	NFB	1	18.0	900	n/a										
118	CV-28-4	Culvert	LP			PERM	Rail	New	No	No	520924	7955182	No	NFB	No	NFB	1	18.0	900	n/a										
119	CV-28-5	Culvert/encroachment	P			PERM	Rail	New	No	No	521005	7955067	No	NFB	No	NFB	1	18.0	900	n/a										
120	CV-28-6	Culvert	S			PERM	Rail	New	No	Yes; CV-112	521092	7954969	Yes	IMP	Yes	IMP	1	17.5	1400	3	285	183	468							
121	CV-28-7	Culvert	S			PERM	Rail	New	No	Yes; Unnamed Tote Road	521305	7954680	No	NFB	No	NFB	1	15.0	900	n/a										
122	CV-29-1	Culvert	S			PERM	Rail	New	No	Yes; Unnamed Tote Road	521341	7954608	No	NFB	No	NFB	1	17.5	900	n/a										
123	CV-29-2	Culvert	S			PERM	Rail	New	No	Yes; CV-111	521379	7954516	Yes	IMP	Yes	IMP	1	25.0	1400	3	408	183	590							
124	CV-29-3	Culvert	S			PERM	Rail	New	No	Yes; CV-110	521464	7954306	No	NFB	No	NFB	1	18.0	900	n/a										
125	CV-29-4	Culvert	S			PERM	Rail	New	No	No	521512	7954187	No	NFB	No	NFB	1	12.0	900	n/a										
126	CV-29-5	Culvert	S			PERM	Rail	New	No	Yes; CV-109	521541	7954115	No	NFB	No	NFB	1	12.0	900	n/a										
127	CV-30-1	Culvert	S			PERM	Rail	New	No	Yes; CV-108	521569	7954040	No	NFB	No	NFB	1	18.0	900	n/a										
128	CV-30-2	Culvert	LP			PERM	Rail	New	No	Yes; CV-202	521609	7953873	No	NFB	No	NFB	1	18.0	1200	n/a										
129	CV-30-3	Culvert	S/LP			PERM	Rail	New	No	No	521635	7953720	No	NFB	No	NFB	1	24.0	900	n/a										
130	CV-30-4	Culvert	S			PERM	Rail	New	No	No	521676	7953461	No	NFB	No	NFB	1	12.0	900	n/a										
131	CV-30-5	Culvert	S			PERM	Rail	New	No	Yes; CV-106	521687	7953363	Yes	IMP	Yes	IMP	1	7.5	900	2	51	49	100							
132	CV-30-6	Culvert	S			PERM	Rail	New	No	No	521700	7953250	No	NFB	Unlikely	MAR	1	12.0	900	1										
133	CV-30-7	Pond Infilling	S/P			PERM	Rail	New	Yes; CV-30-6	Yes; CV-105	521712	7953143	No	NFB	Unlikely	MAR	1	12.5	900	n/a (LE)										
134	CV-31-1	Culvert	S			PERM	Rail	New	No	Yes; CV-104	521748	7952788	Yes	IMP	Yes	IMP	1	20.0	1200	3	326	156	482							
135	CV-31-2	Culvert	S			PERM	Rail	New	No	Yes; CV-104	521749	7952776	Yes	IMP	Yes	IMP	1	20.0	1200	3	326	156	482							
136	CV-31-3	Culvert	LP			PERM	Rail	New	No	No	521763	7952346	No	NFB	No	NFB	1	12.0	900	n/a										
137	CV-31-4	Culvert	LP			PERM	Rail	New	No	No	521772	7952278	No	NFB	No	NFB	1	18.0	900	n/a										
138	CV-32-1	Culvert	LP			PERM	Rail	New	No	No	521827	7952066	No	NFB	No	NFB	1	18.0	900	n/a										
139	CV-32-2	Culvert	LP			PERM	Rail	New	No	No	521882	7951861	No	NFB	No	NFB	1	12.0	900	n/a										
140	CV-32-3	Culvert	LP			PERM	Rail	New	No	No	521946	7951620	No	NFB	No	NFB	1	12.0	900	n/a										
141	CV-32-4	Culvert	S			PERM	Rail	New	No	Yes; CV-204	521983	7951453	No	NFB	No	NFB	1	12.0	900	n/a										
142	CV-33-1	Culvert	LP			PERM	Rail	New	No	No	521990	7951011	No	NFB	No	NFB	1	12.0	900	n/a										
143	CV-33-2	Culvert	LP			PERM	Rail	New	No	Yes; Unnamed Tote Road	521991	7950911	No	NFB	No	NFB	1	12.0	900	n/a										
144	CV-33-3	Culvert	LP			PERM	Rail	New	No	No	521990	7950839	No	NFB	No	NFB	1	12.0	900	n/a										
145	CV-33-4	Culvert	S			PERM	Rail	New	No	Yes; CV-103	521976	7950733	No	NFB	No	NFB	1	18.0	900	n/a										
146	CV-33-5	Culvert	S			PERM	Rail	New	No	No	521964	7950662	No	NFB	No	NFB	1	12.0	900	n/a										
147	CV-33-6	Culvert	S			PERM	Rail	New	No	Yes; CV-102	521947	7950568	Yes	IMP	Yes	IMP	4	18.0	1200	3	293	156	450							
148	CV-33-7	Culvert	P			PERM	Rail	New	No	No	521885	7950215	No	NFB	No	NFB	1	10.0	900	n/a										
149	CV-34-1	Culvert	S			PERM	Rail	New	No	No	521789	7949673	No	NFB	No	NFB	1	24.0	1200	n/a										
150	CV-34-2	Culvert	S			PERM	Rail	New	No	No	521801	7949153	No	NFB	No	NFB	1	12.0	900	n/a										
151	CV-35-2	Culvert	S			PERM	Rail	New	No	Yes; CV-099	521947	7948828	Yes	IMP	Yes	IMP	5	22.5	1400	3+	317	158	475							
152	CV-35-4	Culvert	S		CV-35-5	PERM	Rail	New	No	No	522249	7948287	No	NFB	No	NFB	4	12.0	900	n/a										
153	CV-35-5	Cut	LP	CV-35-4		PERM	Rail	New	No	No	522298	7948170	No	NFB	No	NFB	0	NA	NA	n/a										
154	CV-37-1	Culvert	LP			PERM	Rail	New	No	No	522533	7946398	No	NFB	No	NFB	1	12.0	900	n/a										
155	CV-38-1	Culvert	S			PERM	Rail	New	No	Yes; Unnamed Tote Road	522570	7946000	No	NFB	No	NFB	1	30.0	900	n/a										
156	CV-38-2	Culvert	S			PERM	Rail	New	No	Yes; CV-095	522646	7945802	No	NFB	No	NFB	1	36.0	900	n/a										
157	CV-38-3	Culvert	S			PERM	Rail	New	No	Yes; CV-094	522846	7945387	No	NFB	No	NFB	3	30.0	1400	n/a										
158	CV-39-1	Culvert	S			PERM	Rail	New	No	Yes; CV-093	523125	7944922	No	NFB	No	NFB	1	36.0	900	n/a										
159	CV-40-1	Culvert	LP			PERM	Rail	New	No	No	523148	7944309	No	NFB	No	NFB	1	18.0	900	n/a										
160	CV-40-2	Culvert	S			PERM	Rail	New	No	Yes; CV-092	523147	7944150	No	NFB	No	NFB	2	18.0	1200	n/a										
161	CV-40-3	Culvert	LP			PERM	Rail	New	No	No	523231	7943898	No	NFB	No	NFB	1	18.0	900	n/a										
162	CV-40-4	Culvert	LP			PERM	Rail	New	No	No	523301	7943665	No	NFB	No	NFB	1	18.0	900	n/a										
163	CV-41-1	Culvert	S			PERM	Rail	New	No	No	523332	7943397	No	NFB	No	NFB	1	12.5	900	n/a										
164	CV-41-2	Culvert	S			PERM	Rail	New	No	No	523342	7943311	No	NFB	No	NFB	1	18.0	900	n/a										
165	CV-41-3	Culvert	LP			PERM	Rail	New	No	No	523359	7943152	No	NFB	No	NFB	1	12.0	900	n/a										
166	CV-41-4	Culvert	LP			PERM	Rail	New	No	No	523351	7942963	No	NFB	No	NFB	1	24.0	900	n/a										
167	CV-42-1	Culvert	S			PERM	Rail	New	No	Yes; CV-090	523423	7942323	No	NFB	No	NFB	1	24.0	1200	n/a										
168	CV-42-2	Culvert	S			PERM	Rail	New	No	No	523475	7941603	No	NFB	No	NFB	1	22.5	900	n/a										
169	CV-43-1	Culvert	S			PERM	Rail	New	No	Yes; CV-088	523647	7941268	No	NFB	No	NFB	1	18.0	900	n/a										
170	CV-43-2	Culvert	LP			PERM	Rail	New	No	No	523721	7941127	No	NFB	No	NFB	2	12.0	1200	n/a										
171	CV-43-3	Culvert	S			PERM	Rail	New	No	Yes; CV-087	523738	7941095	No	NFB	No	NFB	1	18.0	900	n/a										

DFO IR 3.1.1. **List of stream crossings (culverts), bridges, cuts/diversions, and lake/pond encroachments/infills along the north rail alignment and Tote Road realignment and fish habitat summary.**

Number	Site ID	Description	Waterbody Type	Diversion to	Receives Diversion From	Permanent/Temporary	Rail/Road	New/Replacement /Extension /Modification	Other Crossings/Bridges/Encroachments/Cuts on Same Waterbody [1]		Current UTM Coordinates		Arctic Char		Ninespine Stickleback		No. Barrels	Culvert Length (m)	Culvert Diameter (mm)	Stream Order at Crossing/Cut /Bridge	Stream Crossings			Bridges			Lake/Pond Encroachment /Infilling	Cuts		
									Rail Crossing	Road Crossing	Easting	Northing	Fish Bearing	Habitat Quality (MAR/IMP/NFB)	Fish Bearing	Habitat Quality (MAR/IMP/NFB)					Lost Habitat (m^2)	Altered Habitat (m^2)	Total (m^2)	Lost Habitat (m^2)	Altered Habitat (m^2)	Total (m^2)	Lost Habitat (m^2)	Lost Habitat (m^2)	Altered Habitat (m^2)	Total (m^2)
172	CV-43-4	Culvert	S			PERM	Rail	New	No	Yes; CV-087	523749	7941075	No	NFB	No	NFB	1	18.0	900	n/a										
173	CV-43-5	Culvert	S			PERM	Rail	New	No	Yes; CV-085	523846	7940904	No	NFB	No	NFB	1	30.0	900	n/a										
174	CV-44-1	Culvert	S			PERM	Rail	New	No	No	524074	7940563	No	NFB	No	NFB	2	12.0	900	n/a										
175	CV-44-2	Culvert	S			PERM	Rail	New	No	Yes; CV-084	524174	7940415	No	NFB	No	NFB	2	18.0	1200	n/a										
176	CV-44-3	Culvert	S			PERM	Rail	New	No	Yes; CV-083	524535.655	7939827.42	No	NFB	No	NFB	2	12.0	1200	n/a										
177	CV-45-1	Culvert	LP			PERM	Rail	New	No	No	525004.068	7938964.92	No	NFB	No	NFB	1	12.0	900	n/a										
178	CV-46-1	Culvert	LP			PERM	Rail	New	No	No	525118	7938743	No	NFB	No	NFB	1	18.0	900	n/a										
179	CV-46-1a	Cut	P	CV-46-3		PERM	Rail	New	No	Yes; CV-206	525226	7938529	No	NFB	No	NFB	NA	NA	NA	n/a										
180	CV-46-2	Culvert	S			PERM	Rail	New	No	No	525278	7938537	No	NFB	No	NFB	TBD	TBD	TBD	n/a										
181	CV-46-3	Culvert	S		CV-46-1a	PERM	Rail	New	No	Yes; Unnamed Tote Road	525380	7938336	No	NFB	No	NFB	TBD	TBD	TBD	n/a										
182	CV-46-4	Culvert	S			PERM	Rail	New	No	Yes; CV-082	525394	7938239	No	NFB	No	NFB	TBD	TBD	TBD	n/a										
183	CV-46-6	Culvert	S			PERM	Rail	New	No	Yes; CV-080	525404	7938168	No	NFB	No	NFB	TBD	TBD	TBD	n/a										
184	CV-47-1A	Culvert	S			PERM	Rail	New	No	Yes; CV-080	525415	7938089	No	NFB	No	NFB	TBD	TBD	TBD	n/a										
185	CV-47-1B	Culvert	S			PERM	Rail	New	No	Yes; CV-081	525454	7937939	No	NFB	No	NFB	TBD	TBD	TBD	n/a										
186	CV-47-1	Culvert	S			PERM	Rail	New	No	Yes; CV-079	525683	7937366	Yes	IMP	No	NFB	1	13.6	900	3	222	117	339							
187	CV-47-2	Culvert	S			PERM	Rail	New	No	Yes; CV-079	525698	7937327	Yes	IMP	Yes	IMP	4	15.0	1400	3	245	183	427							
188	CV-47-3	Culvert	S			PERM	Rail	New	Yes; CV-47-2	Yes; CV-079	525729	7937268	Yes	IMP	Yes	IMP	2	17.5	1400	3	285	183	468							
189	CV-48-1	Culvert	S/LP			PERM	Rail	New	No	Yes; CV-207	525839	7937127	No	NFB	No	NFB	TBD	TBD	TBD	1										
190	CV-48-2	Culvert	S/LP			PERM	Rail	New	No	Yes; CV-207	525916	7937063	No	NFB	No	NFB	TBD	TBD	TBD	1										
191	CV-48-3	Culvert	S/LP			PERM	Rail	New	No	Yes; CV-078	526356	7936875	No	NFB	No	NFB	TBD	TBD	TBD	3										
192	CV-48-4	Culvert	S			PERM	Rail	New	No	Yes; CV-078	526523	7936808	Yes	IMP	Yes	IMP	2	27.5	1200	3	448	156	605							
193	CV-49-1	Culvert	S			PERM	Rail	New	No	Yes; CV-076	526690	7936443	No	NFB	No	NFB	TBD	TBD	TBD	n/a										
194	CV-49-2	Culvert	S			PERM	Rail	New	No	Yes; CV-076	526737	7936101	Potential	MAR	Potential	MAR	1	16.1	900	2	109	49	158							
195	CV-49-3	Culvert	S/LP			PERM	Rail	New	No	No	526788	7935730	No	NFB	No	NFB	TBD	TBD	TBD	n/a										
196	CV-50-1	Culvert	S			PERM	Rail	New	No	No	526835	7935393	No	NFB	No	NFB	TBD	TBD	TBD	n/a										
197	CV-50-2	Culvert	S			PERM	Rail	New	No	No	526863	7935175	No	NFB	No	NFB	TBD	TBD	TBD	n/a										
198	CV-50-3	Culvert	S			PERM	Rail	New	No	No	526868	7935095	No	NFB	No	NFB	TBD	TBD	TBD	n/a										
199	CV-50-4	Culvert	LP			PERM	Rail	New	No	No	526874	7934905	No	NFB	No	NFB	TBD	TBD	TBD	n/a										
200	CV-50-4a	Culvert	LP			PERM	Rail	New	No	No	526876	7934875	No	NFB	No	NFB	TBD	TBD	TBD	n/a										
201	CV-50-4b	Culvert	LP			PERM	Rail	New	No	No	526888	7934776	No	NFB	No	NFB	TBD	TBD	TBD	n/a										
202	CV-50-5	Culvert	S			PERM	Rail	New	Yes; CV-50-6	Yes; CV-072	526924	7934630	Yes	MAR	Yes	MAR	2	30	1200	3	489	156	645							
203	CV-50-6	Culvert	S			PERM	Rail	New	Yes; CV-50-5	Yes; CV-072	526926	7934620	Yes	IMP	Yes	IMP	2	30	1200	3	489	156	645							
204	CV-51-1	Culvert	LP			PERM	Rail	New	No	No	527006	7934331	No	NFB	No	NFB	1	24	900	n/a										
205	CV-51-2	Culvert	LP			PERM	Rail	New	No	No	527054	7933628	No	NFB	No	NFB	1	30	1200	n/a										
206	CV-52-1	Culvert	S			PERM	Rail	New	No	Yes; CV-063	527080	7932998	No	NFB	No	NFB	1	12	900	n/a										
207	CV-52-2	Culvert	S			PERM	Rail	New	No	Yes; CV-062	527132	7932787	No	NFB	No	NFB	1	18	900	n/a										
208	CV-52-3	Culvert	LP			PERM	Rail	New	No	No	527180	7932698	No	NFB	No	NFB	1	12	900	n/a										
209	CV-53-1	Culvert	LP			PERM	Rail	New	No	No	527366	7932476	No	NFB	No	NFB	1	12	900	n/a										
210	CV-53-2	Culvert	P			PERM	Rail	New	No	No	527274	7932000	No	NFB	No	NFB	1	36	900	n/a										
211	CV-54-1	Culvert	S			PERM	Rail	New	No	Yes; CV-061	527333	7931375	No	NFB	No	NFB	1	24	1200	n/a										
212	CV-54-2	Culvert	S			PERM	Rail	New	No	Yes; Unnamed Tote Road	527529	7930869	No	NFB	No	NFB	2	12.5	900	n/a										
213	CV-55-1	Culvert	LP			PERM	Rail	New	No	No	527583	7930653	No	NFB	No	NFB	1	18	1200	n/a										
214	CV-55-2	Culvert	LP			PERM	Rail	New	No	No	527632	7930421	No	NFB	No	NFB	1	12	900	n/a										
215	CV-55-3	Culvert	S			PERM	Rail	New	No	Yes; CV-060, CV-60-1	527650	7930339	Yes	IMP	Yes	IMP	5	12.5	900	3	204	117	321							
216	CV-56-1	Culvert	S			PERM	Rail	New	No	Yes; CV-59-1	528085	7929337	Yes	MAR	Yes	MAR	2	12.2	1200	3	199	156	355							
217	CV-57-1	Culvert	S			PERM	Rail	New	No	No; Tote Road is US now	528309	7928841	Yes	MAR	Yes	MAR	1	12.2	900	2	83	49	132							
218	CV-57-2	Culvert	S			PERM	Rail	New	No	No; Tote Road is US now	528345	7928683	Yes	MAR	Yes	MAR	1	12.2	900	2	83	49	132							
219	CV-58-1	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	528241	7927966	Probable	MAR	Probable	MAR	2	9.76	900	1	27	20	47							
220	CV-58-2	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	528168	7927807	Yes	MAR - IMP	Yes	MAR - IMP	1	9.76	900	1	27	20	47							
221	CV-58-3	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	528109	7927716	Potential	MAR	Potential	MAR	1	9.76	900	1	27	20	47							
222	CV-58-4	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	528062	7927656	Yes	MAR - IMP	Yes	MAR - IMP	1	12.2	900	2	83	49	132							
223	CV-58-4a	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	527931	7927527	Yes	MAR - IMP	Yes	MAR - IMP	1	12.2	900	1	34	20	54							
224	CV-58-5	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	527751	7927378	Probable	MAR - IMP	Probable	MAR - IMP	1	12.2	900	2	83	49	132							
225	CV-58-6	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	527681	7927318	Probable	MAR - IMP	Probable	MAR - IMP	1	12.2	900	1	34	20	54							
226	CV-58-7	Cut	S	CV-59-1		PERM	Rail	New	Yes; CV-70-3 bridge	No	527650	7927282	Unlikely	MAR	Unlikely	MAR	NA	NA	NA	1								959	433	1,392
227	CV-58-8	Cut	S	CV-59-1		PERM	Rail	New	Yes; CV-70-3 bridge	No	527613	7927217	Potential	MAR	Potential	MAR	NA	NA	NA	1								530	-	530
228	CV-59-1	Culvert	S		CV-58-7 and CV-58-6	PERM	Rail	New	Yes; CV-70-3 bridge	No	527590	7927169	Probable	MAR - IMP	Probable	MAR - IMP	1	9.76	900	2	66	49	115							
229	CV-59-2	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	527553	7927052	Potential	MAR	Potential	MAR	1	14.64	900	1	41	20	61							
230	CV-59-3	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	527529	7926917	Potential	MAR	Potential	MAR	1	9.76	900	1	27	20	47							
231	CV-59-4b	Cut	LP	CV-59-4		PERM	Rail	New	Yes; CV-70-3 bridge	No	527467	7926817	No	NFB	No	NFB	0		0	n/a										
232	CV-59-4	Culvert	S		CV-59-4a and	PERM	Rail	New	Yes; CV-70-3 bridge	No	527395	7926734	Yes	IMP	Yes	IMP	3	21.96	1200	2	149	65	215							
233	CV-59-4a	Cut	S	CV-59-4		PERM	Rail	New	Yes; CV-70-3 bridge	No	527329	7926595	No	NFB	No	NFB	0	NA	NA	n/a								698	-	698
234	CV-59-5	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	527272	7926457	No	NFB	No	NFB	1	12.2	900	n/a										
235	CV-60-1	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	527202	7926246	No	NFB	No	NFB	1	9.76	900	n/a										
236	CV-60-2	Culvert/encroachment	S/P			PERM	Rail	New	Yes; CV-70-3 bridge	No	527214	7926070	No	NFB	No	NFB	1	17.08	900	n/a										
237	CV-60-3	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	527225	7925961	Probable	MAR - IMP	Probable	MAR - IMP	1	24.4	900	2	166	49	215							
238	CV-60-4	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	527243	7925782	Unlikely	MAR	Unlikely	MAR	1	9.76	900	2	66	49	115							
239	CV-60-4a	Cut	S	CV-60-5		PERM	Rail	New	Yes; CV-70-3 bridge	No	527252	7925685	No	NFB	No	NFB	0	NA	NA	n/a								277	1,518	1,795
240	CV-60-5	Culvert	S		CV-60-4a	PERM	Rail	New	Yes; CV-70-3 bridge	No	527273	7925480	Potential	MAR - IMP	Potential	MAR - IMP	1	26.84	1200	2	183	65	248							
241	CV-60-6	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	527283	7925381	Unlikely	MAR	Unlikely	MAR	1	26.84	900	1	75	20	95							
242	CV-61-1	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	527296	7925237	Probable	MAR - IMP	Probable	MAR - IMP	1	31.72	900	1	89	20	109							
243	CV-61-2	Culvert	S		CV-61-3	PERM	Rail	New	Yes; CV-70-3 bridge	No	527181	7925009	Probable	MAR - IMP	Probable	MAR - IMP	1	9.76	900	1	27	20	47							
244	CV-61-3	Cut	S	CV-61-2		PERM	Rail	New	Yes; CV-70-3 bridge	No	527023	7924876	Potential	MAR - IMP	Potential	MAR - IMP	NA	NA	NA	1								2,097	3,965	6,062
245	CV-62-1	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	526868	7924453	Yes	IMP	Yes	IMP	7	51.24	1800	3+	835	235	1070							
246	CV-62-2	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	526897	7924167	Probable	MAR - IMP	Probable	MAR - IMP	1	12.2	900	2	83	49	132							
247	CV-62-3	Cut	S	CV-62-4		PERM	Rail	New	Yes; CV-70-3 bridge	No	526951	7923938	Unlikely	MAR	Unlikely	MAR	NA	NA	NA	1								1,405	-	1,405
248	CV-62-4	Culvert	S		CV-62-3	PERM	Rail	New	Yes; CV-70-3 bridge	No	526975	7923621	No	NFB	No	NFB	1	9.76	900	n/a										
249	CV-62-5	Culvert	LP		CV-62-6 and CV-62-6b	PERM	Rail	New	Yes; CV-70-3 bridge	No	526982	7923557	No	NFB	No	NFB	1	12.2	900	n/a										
250	CV-62-6	Cut	S	CV-62-5		PERM	Rail	New	Yes; CV-70-3 bridge	No	527016	7923383	Unlikely	MAR	Unlikely	MAR	NA	NA	NA	1								6,191	-	6,191
251	CV-62-6b	Cut	S	CV-62-5		PERM	Rail	New	Yes; CV-70-3 bridge	No	527011	7923411	Unlikely	MAR	Unlikely	MAR	NA	NA	NA	1								350	-	350
252	CV-63-1	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	527058	7923177	Potential	MAR	Potential	MAR	1	14.64	900	1	41	20	61							
253	CV-63-2	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	527100	7923086	Potential	MAR	Potential	MAR	1	12.2	900	2	83	49	132							
254	CV-63-3	Culvert	S		CV-63-3a	PERM	Rail	New	Yes; CV-70-3 bridge	No	527162	7922964	Potential	MAR - IMP	Potential	MAR - IMP	1	14.64	900	1	41	20	61							
255	CV-63-3a	Cut	LP	CV-63-3		PERM	Rail	New	Yes; CV-70-3 bridge	No	527179	7922796	No	NFB	No	NFB	0	NA	NA	n/a										
256	CV-63-4	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	527204	7922667	Probable	MAR - IMP	Probable	MAR - IMP	1	12.2	900	2	83	49	132							
257	CV-63-4a	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	527229	7922619	Potential	MAR	Potential	MAR	1	12.2	900	1	34	20	54							
258	CV-63-5	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	527241	7922603	Potential	MAR	Potential	MAR	1	12.2	900	1	34	20	54							

DFO IR 3.1.1. **List of stream crossings (culverts), bridges, cuts/diversions, and lake/pond encroachments/infills along the north rail alignment and Tote Road realignment and fish habitat summary.**

Number	Site ID	Description	Waterbody Type	Diversion to	Receives Diversion From	Permanent/Temporary	Rail/Road	New/Replacement /Extension /Modification	Other Crossings/Bridges/Encroachments/Cuts on Same Waterbody [1]		Current UTM Coordinates		Arctic Char		Ninespine Stickleback		No. Barrels	Culvert Length (m)	Culvert Diameter (mm)	Stream Order at Crossing/Cut /Bridge	Stream Crossings			Bridges			Lake/Pond Encroachment /Infilling	Cuts		
									Rail Crossing	Road Crossing	Easting	Northing	Fish Bearing	Habitat Quality (MAR/IMP/NFB)	Fish Bearing	Habitat Quality (MAR/IMP/NFB)					Lost Habitat (m^2)	Altered Habitat (m^2)	Total (m^2)	Lost Habitat (m^2)	Altered Habitat (m^2)	Total (m^2)	Lost Habitat (m^2)	Lost Habitat (m^2)	Altered Habitat (m^2)	Total (m^2)
259	CV-64-1	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	527295	7922538	Unlikely	MAR	Unlikely	MAR	1	9.76	900	1	27	20	47								
260	CV-64-2	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	527414	7922399	Unlikely	MAR	Unlikely	MAR	1	12.2	900	1	34	20	54								
261	CV-64-3	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	527482	7922239	No	NFB	No	NFB	1	12.2	900	n/a											
262	CV-64-4	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	527625	7921956	Yes	MAR - IMP	Yes	MAR - IMP	1	19.52	900	1	55	20	75								
263	CV-64-5a	Cut	LP	CV-64-5		PERM	Rail	New	Yes; CV-70-3 bridge	No	527688	7921835	No	NFB	No	NFB	0	NA	NA	n/a											
264	CV-64-5	Culvert	S		CV-64-5a	PERM	Rail	New	Yes; CV-70-3 bridge	No	527743	7921726	No	NFB	No	NFB	1	12.2	900	n/a											
265	CV-64-6	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	527757	7921691	No	NFB	No	NFB	1	12.2	900	n/a											
266	CV-65-1	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	527793	7921396	Probable	MAR - IMP	Probable	MAR - IMP	1	17.08	900	3	278	117	396								
267	CV-65-2a	Cut	LP	CV-65-2		PERM	Rail	New	Yes; CV-70-3 bridge	No	527803	7921140	Unlikely	MAR	No	NFB	0	NA	NA	n/a									537	-	537
268	CV-65-2	Pond Infilling/Culvert	P		CV-65-2a	PERM	Rail	New	Yes; CV-70-3 bridge	No	527828	7920934	Potential	MAR	Potential	MAR	1	21.96	900	1							541				
269	CV-66-1	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	527959	7920627	Unlikely	MAR	Unlikely	MAR	1	12.2	900	2	83	49	132								
270	CV-66-2a	Cut	LP	CV-66-2		PERM	Rail	New	Yes; CV-70-3 bridge	No	528013	7920571	No	NFB	No	NFB	0	NA	NA	n/a											
271	CV-66-2	Culvert	S		CV-66-2a	PERM	Rail	New	Yes; CV-70-3 bridge	No	528063	7920532	No	NFB	No	NFB	1	14.64	900	n/a											
272	CV-66-3	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	528328	7920342	Probable	MAR - IMP	Probable	MAR - IMP	1	19.52	900	1	55	20	75								
273	CV-66-4	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	528359	7920292	No	NFB	No	NFB	1	12.2	900	n/a											
274	CV-66-5	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	528389	7920187	No	NFB	No	NFB	1	14.64	900	n/a											
275	CV-66-6	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	528390	7920161	No	NFB	No	NFB	1	9.76	900	n/a											
276	CV-66-7	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	528378	7920014	No	NFB	No	NFB	1	9.76	900	n/a											
277	CV-66-8	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	528376	7919987	Probable	MAR - IMP	Probable	MAR - IMP	1	9.76	900	1	27	20	47								
278	CV-67-1	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	528299	7919743	Probable	MAR - IMP	Probable	MAR - IMP	1	14.64	900	1	41	20	61								
279	CV-67-2	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	528226	7918995	No	NFB	No	NFB	1	9.76	900	n/a											
280	CV-68-1a	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	528200	7918864	Yes	MAR - IMP	Yes	MAR - IMP	1	33	900	2	224	49	273								
281	CV-68-1	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	528199	7918838	Yes	IMP	Yes	IMP	3	31.72	1400	2	216	76	292								
282	CV-68-2	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	528194	7918768	No	NFB	No	NFB	1	21.96	900	n/a											
283	CV-68-3	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	528059	7918496	Probable	MAR - IMP	Probable	MAR - IMP	1	21.96	1200	2	149	65	215								
284	CV-68-4	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	528055	7918461	No	NFB	No	NFB	1	12.2	900	n/a											
285	CV-68-5	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	528081	7918334	Potential	MAR - IMP	Potential	MAR - IMP	1	26.84	900	2	183	49	231								
286	CV-69-1	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	528322	7917862	No	NFB	No	NFB	1	12.2	900	n/a											
287	CV-69-2	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	528438	7917517	Yes	MAR - IMP	Yes	MAR - IMP	1	14.64	900	2	100	49	149								
288	CV-69-3	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	528458	7917456	Yes	MAR - IMP	Yes	MAR - IMP	1	14.64	900	1	41	20	61								
289	CV-69-4	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	528474	7917407	Potential	MAR - IMP	Potential	MAR - IMP	1	12.2	900	1	34	20	54								
290	CV-70-1	Encroachment	P			PERM	Rail	New	Yes; CV-70-3 bridge	No	528704	7916939	No	NFB	Unlikely	MAR	1	12.2	900	n/a (LE)											
291	CV-70-2	Culvert	S			PERM	Rail	New	Yes; CV-70-3 bridge	No	529030	7916745	Yes	IMP	Yes	IMP	1	17.08	900	2	116	49	165								
292	CV-70-3	Bridge	S			PERM	Rail	New	No	No	529120	7916693	Yes	IMP	Yes	IMP	0	NA	NA	3+				10.50	677	688					
293	CV-71-1	Pond Infilling	S/P			PERM	Rail	New	Yes; CV-70-3 bridge	No	529451	7916535	Yes	IMP	Yes	IMP	4	17.08	1800	3							1,214				
294	CV-71-2a	Encroachment	S/P			PERM	Rail	New	No	No	529708	7916558	Probable	MAR	Probable	MAR	NA	NA	NA	1							72				
295	CV-71-3	Culvert	S			PERM	Rail	New	No	No	529965	7916706	No	NFB	Unlikely	MAR	1	12.2	900	1											
296	CV-71-4	Culvert	S			PERM	Rail	New	No	No	530214	7916862	No	NFB	Unlikely	MAR	1	9.76	900	1											
297	CV-72-1	Culvert	S			PERM	Rail	New	No	No	530370	7916951	No	NFB	Unlikely	MAR	1	17.08	1200	3											
298	CV-72-1a	Culvert	S			PERM	Rail	New	No	No	530587	7917015	No	NFB	Unlikely	MAR	1	12.2	1200	1											
299	CV-72-2	Culvert	S			PERM	Rail	New	No	No	530784	7917069	No	NFB	Unlikely	MAR	1	12.2	900	1											
300	CV-72-3	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	531048	7917142	Potential	MAR	Potential	MAR	1	12.2	900	1	34	20	54								
301	CV-72-3a	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	531130	7917165	Potential	MAR	Potential	MAR	1	12.2	900	1	34	20	54								
302	CV-72-4	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	531160	7917173	Potential	MAR	Potential	MAR	2	9.76	900	2	66	49	115								
303	CV-73-1	Culvert	S			PERM	Rail	New	No	No	531795	7917555	Unlikely	MAR	Unlikely	MAR	1	9.76	900	1	27	20	47								
304	CV-73-2	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	532007	7918051	Potential	MAR	Potential	MAR	1	16.1	900	2	109	49	158								
305	CV-73-3	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	532156	7918212	Potential	MAR	Potential	MAR	1	16.1	900	2	109	49	158								
306	CV-73-4	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	532303	7918244	Potential	MAR	Potential	MAR	1	13.6	900	1	38	20	58								
307	CV-74-1	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	532376	7918246	Probable	MAR - IMP	Probable	MAR - IMP	2	20.6	1200	3	336	156	492								
308	CV-74-2	Culvert	S			PERM	Rail	New	No	No	532406	7918246	Yes	MAR - IMP	Yes	MAR - IMP	2	20.6	1200	3	336	156	492								
309	CV-74-3	Culvert	S			PERM	Rail	New	No	No	532735	7918374	Potential	MAR	Potential	MAR	1	14.64	1800	1	41	40	81								
310	CV-74-4	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	532888	7918494	Potential	MAR	Potential	MAR	1	14.64	1800	1	41	40	81								
311	CV-74-6	Culvert	S		CV-74-7	PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	532988	7918553	Potential	MAR - IMP	Potential	MAR - IMP	1	9.76	900	1	27	20	47								
312	CV-74-7	Cut	S	CV-74-6		PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	533258	7918549	Potential	MAR - IMP	Potential	MAR - IMP	NA	NA	NA	1									3,718	-	3,718
313	CV-75-1	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	533398	7918521	Potential	MAR	Potential	MAR	1	12.2	1200	1	34	27	61								
314	CV-75-1a	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	533444	7918512	Potential	MAR	Potential	MAR	1	12.2	1200	3	199	156	355								
315	CV-75-2	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	533559	7918501	Potential	MAR	Potential	MAR	1	17.08	900	1	48	20	68								
316	CV-76-1	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	533900	7918535	Probable	MAR	Probable	MAR	1	19.52	1200	2	133	65	198								
317	CV-76-1a	Culvert	S			PERM	Rail	New	No	No	534333	7918581	Potential	MAR	Potential	MAR	1	19.52	1200	1	55	27	82								
318	CV-76-2	Culvert	LP			PERM	Rail	New	No	No	534506	7918563	No	NFB	No	NFB	1	9.76	900	n/a											
319	CV-76-3	Culvert	S			PERM	Rail	New	No	No	534825	7918511	Potential	MAR	Potential	MAR	1	19.52	900	1	55	20	75								
320	CV-77-1	Culvert	S			PERM	Rail	New	No	No	534992	7918491	Potential	MAR	Potential	MAR	1	19.52	900	1	55	20	75								
321	CV-77-2	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	535267	7918560	Yes	MAR - IMP	Yes	MAR - IMP	3	39.04	1400	3	636	183	819								
322	CV-77-3	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	535497	7918521	Probable	MAR	Probable	MAR	1	9.76	900	2	66	49	115								
323	CV-78-1	Culvert	LP			PERM	Rail	New	No	No	535691	7918488	No	NFB	No	NFB	1	14.64	900	n/a											
324	CV-78-2	Culvert	S			PERM	Rail	New	No	No	535890	7918531	Unlikely	MAR	Unlikely	MAR	1	14.64	900	1	41	20	61								
325	CV-78-3	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	536006	7918599	Yes	MAR - IMP	Yes	MAR - IMP	1	29.28	900	3	477	117	595								
326	CV-78-4	Culvert	LP			PERM	Rail	New	No	No	536163	7918706	No	NFB	No	NFB	1	9.76	900	n/a											
327	CV-78-5	Culvert	S			PERM	Rail	New	No	No	536237	7918756	Unlikely	MAR	Unlikely	MAR	1	9.76	900	1	27	20	47								
328	CV-78-6	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	536450	7918866	Probable	MAR - IMP	Probable	MAR - IMP	1	10	900	1	28	20	48								
329	CV-79-0	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	537243	7919138	Probable	MAR - IMP	Probable	MAR - IMP	1	10	900	2	68	49	117								
330	CV-79-1	Culvert	S			PERM	Rail	New	No	No	537418	7919175	Unlikely	MAR	Unlikely	MAR	1	17.08	900	1	48	20	68								
331	CV-80-1	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	537461	7919180	Yes	MAR - IMP	Yes	MAR - IMP	2	24.4	1200	3	398	156	554								
332	CV-80-1a	Culvert	S			PERM	Rail	New	No	No	537487	7919182	Unlikely	MAR	Unlikely	MAR	1	No **12.2**	1200	1	34	27	61								
333	CV-80-2	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	538320	7919565	Unlikely	MAR	Unlikely	MAR	1	10	900	1	28	20	48								
334	CV-80-2a	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	538307	7919556	Unlikely	MAR	Unlikely	MAR	1	10	900	1	28	20	48								
335	CV-80-2b	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	538334	7919573	Unlikely	MAR	Unlikely	MAR	1	10	900	2	68	49	117								
336	CV-80-3	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	538453	7919642	Unlikely	MAR	Unlikely	MAR	1	10	900	1	28	20	48								
337	CV-80-4	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	538510	7919675	Unlikely	MAR	Unlikely	MAR	1	10	900	1	28	20	48								
338	CV-80-5	Culvert	S			PERM	Rail	New	No	No	538604	7919729	Unlikely	MAR	Unlikely	MAR	1	10	900	2	68	49	117								
339	CV-81-1	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	538691	7919779	No	NFB	No	NFB	2	9.76	900	n/a											
340	CV-81-2	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	538879	7919924	Probable	MAR - IMP	Probable	MAR - IMP	1	12.2	900	1	34	20	54								
341	CV-81-3	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	538942	7920004	Probable	MAR - IMP	Probable	MAR - IMP	1	12.2	900	2	83	49	132								
342	CV-81-4	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	539077	7920175	Unlikely	MAR	Unlikely	MAR	1	12.2	900	1	34	20	54								
343	CV-82-1	Culvert	S		CV-82-1a	PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	539131	7920244	Unlikely	MAR	Unlikely	MAR	2	12.2	900	2	83	49	132								
344	CV-82-1a	Cut	LP	CV-82-1		PERM	Rail	New	No	No	539242	7920376	No	NFB	No	NFB	0	NA	NA	n/a											
345	CV-82-2	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	539376	7920489	Unlikely	MAR	Unlikely	MAR	1	9.76	900	1	27	20	47								
346	CV-82-3	Culvert	S			PERM	Rail	New	No	No	539508	7920599	Unlikely	MAR	Unlikely	MAR	1	12.2	900	1	34	20	54								
347	CV-82-4	Culvert	S			PERM	Rail	New	No	No	539729	7920783	Probable	MAR - IMP	Probable	MAR - IMP	1	13.2	1200	1	37	27	64								
348	CV-83-1	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	539835	7920871	Probable	MAR - IMP	Probable	MAR - IMP	1	12.2	1200	2	83	65	148								
349	CV-83-1a	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	539887	7920915	Potential	MAR - IMP	Potential	MAR - IMP	1	12.2	1200	1	34	27	61								
350	CV-83-2	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	540162	7921134	Yes	MAR	Yes	MAR	4	12.2	1800	3	199	235	434								
351	CV-84-1	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	540842	7921510	Yes	IMP	Yes	IMP	1	17.08	1200	3+	96	54	149								

DFO IR 3.1.1. **List of stream crossings (culverts), bridges, cuts/diversions, and lake/pond encroachments/infills along the north rail alignment and Tote Road realignment and fish habitat summary.**

Number	Site ID	Description	Waterbody Type	Diversion to	Receives Diversion From	Permanent/Temporary	Rail/Road	New/Replacement /Extension /Modification	Other Crossings/Bridges/Encroachments/Cuts on Same Waterbody [1]		Current UTM Coordinates		Arctic Char		Ninespine Stickleback		No. Barrels	Culvert Length (m)	Culvert Diameter (mm)	Stream Order at Crossing/Cut /Bridge	Stream Crossings			Bridges			Lake/Pond Encroachment /Infilling	Cuts		
									Rail Crossing	Road Crossing	Easting	Northing	Fish Bearing	Habitat Quality (MAR/IMP/NFB)	Fish Bearing	Habitat Quality (MAR/IMP/NFB)					Lost Habitat (m^2)	Altered Habitat (m^2)	Total (m^2)	Lost Habitat (m^2)	Altered Habitat (m^2)	Total (m^2)	Lost Habitat (m^2)	Lost Habitat (m^2)	Altered Habitat (m^2)	Total (m^2)
352	CV-84-2	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-217 bridge	541030	7921642	Unlikely	MAR	Unlikely	MAR	1	12.2	900	2	83	49	132								
353	CV-84-3	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-214, CV-217 bridge	541294	7921948	No	NFB	No	NFB	1	14.64	1200	n/a										
354	CV-85-1	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; Unnamed Tote Road, CV-217 bridge	541514	7922054	No	NFB	No	NFB	1	12.2	900	n/a										
355	CV-85-2	Culvert	S			PERM	Rail	New	Yes; CV-85-4 bridge	Yes; CV-215, CV-217 bridge	541921	7922236	No	NFB	No	NFB	2	17.08	1800	n/a										
356	CV-85-3	Bridge	S			PERM	Rail	New	No	Yes; CV-217 bridge	542213	7922215	Yes	IMP	Yes	IMP		NA	NA	3+				10.50	677	688				
357	CV-85-4	Culvert	S			PERM	Rail	New	No	Yes; CV-217 bridge	542288	7922156	Yes	IMP	Yes	IMP	1	17.08	1800	3+	427	360	787								
358	CV-86-1	Encroachment	P			PERM	Rail	New	No	No	542671	7921780	No	NFB	Potential	MAR	6	9.76	900	n/a (LE)										
359	CV-86-2	Culvert	S			PERM	Rail	New	No	Yes; CV-216	542753	7921708	Yes	MAR	Yes	MAR	2	19.52	1800	3	1171	864	2035								
360	CV-87-1	Culvert	LP			PERM	Rail	New	No	No	543078	7921473	No	NFB	No	NFB	1	9.76	900	n/a										
361	CV-87-2	Culvert	LP			PERM	Rail	New	No	No	543392	7921247	No	NFB	No	NFB	1	12.2	900	n/a										
362	CV-87-3	Culvert	LP			PERM	Rail	New	No	No	543532	7921170	No	NFB	No	NFB	1	9.76	900	n/a										
363	CV-87-4	Culvert	S			PERM	Rail	New	No	No	543736	7921141	Yes	MAR	Yes	MAR	1	9.76	900	2	66	49	115								
364	CV-88-1	Culvert	LP			PERM	Rail	New	No	No	543976	7921204	No	NFB	No	NFB	1	9.76	900	n/a										
365	CV-88-2	Culvert	S			PERM	Rail	New	No	No	544209	7921282	Yes	MAR	Yes	MAR	1	14.64	900	2	100	49	149								
366	CV-88-3	Culvert	S			PERM	Rail	New	No	No	544259	7921299	Yes	MAR	Yes	MAR	1	12.2	900	2	83	49	132								
367	CV-88-4	Culvert	LP			PERM	Rail	New	No	No	545151	7921245	No	NFB	No	NFB	1	15	900	n/a										
368	CV-89-1	Culvert	S			PERM	Rail	New	No	Yes; BG-29 US though fish at this crossing may come from DS Muriel Lake instead	545492	7921173	Yes	IMP	Yes	IMP	1	24.4	900	3	398	117	515								
369	CV-89-2	Pond Infilling	P			PERM	Rail	New	No	No	545729	7921121	No	NFB	Unlikely	MAR	1	12.2	1400	n/a (LE)										
370	CV-90-1	Culvert	LP			PERM	Rail	New	No	No	545902	7921048	No	NFB	No	NFB	1	12.2	900	n/a										
371	CV-90-2	Cut	S	CV-90-3		PERM	Rail	New	No	Yes; BG-29	546181	7920409	No	NFB	Unlikely	MAR	NA	NA	NA	1									639	-	639
372	CV-90-3	Culvert	S		CV-90-2 and CV-90-4	PERM	Rail	New	No	Yes; BG-29	546240	7920244	No	NFB	No	NFB	0	12.2	0	n/a										
373	CV-90-4	Cut	S	CV-90-3		PERM	Rail	New	No	Yes; CV-022	546459	7920041	No	NFB	No	NFB	0	NA	NA	n/a										
374	CV-91-0	Culvert	S			PERM	Rail	New	No	Yes; CV-021	546858	7919853	No	NFB	No	NFB	1	12.2	900	n/a										
375	CV-91-1	Culvert	S			PERM	Rail	New	Yes; CV-91-0	Yes; CV-021	546928	7919820	No	NFB	No	NFB	1	12.2	900	n/a										
376	CV-91-2	Culvert	S			PERM	Rail	New	Yes; CV-91-0	Yes; CV-021	547012	7919781	No	NFB	No	NFB	1	9.76	900	n/a										
377	CV-92-1b	Cut	S	CV-92-1		PERM	Rail	New	No	No	547125	7919725	No	NFB	No	NFB	0	NA	NA	n/a										
378	CV-92-1	Culvert/encroachment	S/P		CV-92-1b	PERM	Rail	New	Yes; CV-91-0	Yes; CV-021	547173	7919694	No	NFB	Unlikely	MAR	1	9.76	1200	n/a (LE)										
379	CV-92-2	Culvert	LP			PERM	Rail	New	No	No	547416	7919506	No	NFB	No	NFB	1	9.76	900	n/a										
380	CV-92-3	Culvert	S			PERM	Rail	New	No	Yes; BG-28	547521	7919456	No	NFB	No	NFB	1	9.76	900	n/a										
381	CV-92-4	Culvert	S			PERM	Rail	New	No	No	547721	7919363	No	NFB	No	NFB	1	12.2	900	n/a										
382	CV-92-5	Culvert	S			PERM	Rail	New	No	Yes; BG-27	547879	7919262	Yes	MAR	Yes	MAR	1	14.64	900	2	100	49	149								
383	CV-92-6	Culvert	S			PERM	Rail	New	No	No	547927	7919241	No	NFB	No	NFB	1	9.76	900	n/a										
384	CV-92-7	Culvert	S			PERM	Rail	New	No	Yes; CV-015	548001	7919220	No	NFB	No	NFB	1	14.64	900	n/a										
385	CV-92-8	Culvert	LP			PERM	Rail	New	No	Yes; CV-015	548033	7919215	No	NFB	No	NFB	1	12.2	900	n/a										
386	CV-92-9	Culvert	S			PERM	Rail	New	No	Yes; CV-014	548062	7919211	No	NFB	No	NFB	1	12.2	900	n/a										
387	CV-93-1	Culvert	LP			PERM	Rail	New	No	Yes; BG-26	548228	7919188	No	NFB	No	NFB	1	14.64	900	n/a										
388	CV-93-2	Culvert	LP			PERM	Rail	New	No	No	548355	7919148	No	NFB	No	NFB	1	17.08	900	n/a										
389	CV-93-3	Culvert	LP			PERM	Rail	New	No	No	548601	7918857	No	NFB	No	NFB	1	12.2	900	n/a										
390	CV-93-3a	Culvert	S			PERM	Rail	New	No	Yes; CV-218	548670	7918765	No	NFB	No	NFB	1	24.4	1200	n/a										
391	CV-93-4a	Culvert	S			PERM	Rail	New	No	Yes; BG-24	548749	7918703	Probable	MAR	Probable	MAR	1	12.2	900	1	34	20	54								
392	CV-93-4b	Culvert	S			PERM	Rail	New	No	Yes; BG-24	548701	7918736	Probable	MAR	Probable	MAR	1	24.2	1200	1	68	27	95								
393	CV-93-4	Culvert	S			PERM	Rail	New	No	Yes; BG-24	548770	7918691	Yes	IMP	Yes	IMP	3	24.4	1400	3	398	183	580								
394	CV-94-1	Culvert	LP			PERM	Rail	New	No	No	548899	7918649	No	NFB	No	NFB	1	12.2	900	n/a										
395	CV-94-2	Culvert	S		CV-95-1	PERM	Rail	New	No	No	549840	7918391	No	NFB	No	NFB	1	12	900	n/a										
396	CV-95-1	Cut	LP	CV-94-2		PERM	Rail	New	No	No	550005	7918257	No	NFB	No	NFB		NA	NA	n/a										
397	CV-95-2	Culvert	S			PERM	Rail	New	No	Yes; BG-21	550144	7918111	No	NFB	No	NFB	1	9.76	900	n/a										
398	CV-95-3	Culvert	S			PERM	Rail	New	Yes; CV-96-1	Yes; BG-18, BG-17, BG-13-1, BG-14-1	550483	7917613	Probable	MAR - IMP	Probable	MAR - IMP	1	12.2	900	1	34	20	54								
399	CV-95-4	Culvert	S			PERM	Rail	New	Yes; CV-96-1	Yes; BG-17; BG-13-1, BG 14-1	550630	7917484	Probable	MAR	Probable	MAR	1	12.2	900	1	34	20	54								
400	CV-95-5	Culvert	S			PERM	Rail	New	No	No	550708	7917426	No	NFB	No	NFB	1	12.2	900	n/a										
401	CV-95-5a	Culvert	S			PERM	Rail	New	Yes; CV-96-1	Yes; BG-17; BG-13-1, BG 14-1	550781	7917371	No	NFB	No	NFB	1	12.2	900	n/a										
402	CV-95-6	Culvert	S			PERM	Rail	New	Yes; CV-96-1	Yes; BG-17; BG-13-1, BG 14-1	550832	7917333	No	NFB	No	NFB	1	12.2	900	n/a										
403	CV-95-7	Culvert	S			PERM	Rail	New	No	No	550885	7917294	No	NFB	No	NFB	1	12.2	900	n/a										
404	CV-96-1	Culvert	S			PERM	Rail	New	No	Yes; BG-17; BG-13-1, BG 14-1	550924	7917265	Yes	IMP	Yes	IMP	1	26.84	900	3	142	38	180								
405	CV-96-2	Culvert	S			PERM	Rail	New	Yes; CV-96-1	Yes; BG-17; BG-13-1, BG 14-1	550964	7917235	No	NFB	No	NFB	1	26.84	900	n/a										
406	CV-96-3	Culvert	LP			PERM	Rail	New	No	No	551117	7917101	No	NFB	No	NFB	1	26.84	900	n/a										
407	CV-97-1	Culvert	LP			PERM	Rail	New	Yes; CV-96-1	Yes; BG-17; BG-13-1, BG 14-1	551191	7917013	No	NFB	No	NFB	1	12.2	900	n/a										
408	CV-97-2	Culvert	S			PERM	Rail	New	Yes; CV-96-1	Yes; BG-17; , BG-13, BG-13-1, BG-14-1	551226	7916972	No	NFB	No	NFB	1	21.96	900	n/a										
409	CV-97-3	Culvert	S			PERM	Rail	New	Yes; CV-96-1	Yes; BG-17; , BG-13, BG-13-1, BG-14-1	551254	7916940	No	NFB	No	NFB	1	9.76	900	n/a										
410	CV-97-4	Culvert	S			PERM	Rail	New	No	Yes; CV-006	551292	7916898	No	NFB	No	NFB	1	19.52	900	n/a										
411	CV-97-5	Culvert	S		CV-97-6	PERM	Rail	New	No	Yes; CV-006	551351	7916843	No	NFB	No	NFB	1	12.2	900	n/a										
412	CV-97-5b	Culvert	S			PERM	Rail	New	No	Yes; CV-006	551326	7916865	No	NFB	No	NFB	1	12.2	900	n/a										
413	CV-97-6	Cut	LP	CV-97-5		PERM	Rail	New	No	Yes; BG-12	551457	7916754	No	NFB	No	NFB		NA	NA	n/a										
414	CV-97-7	Culvert	S			PERM	Rail	New	No	Yes; CV-005	551576	7916658	No	NFB	No	NFB	1	12	900	n/a										
415	CV-97-7a	Culvert	S			PERM	Rail	New	No	Yes; CV-005	551560	7916671	No	NFB	No	NFB	1	12.2	900	n/a										
416	CV-97-9	Culvert	S			PERM	Rail	New	No	Yes; BG-11	551629	7916614	No	NFB	No	NFB	1	19.52	900	n/a										
417	CV-97-10	Culvert	S			PERM	Rail	New	No	Yes; BG-09	551781	7916475	No	NFB	No	NFB	1	19.52	900	n/a										
418	CV-97-11	Culvert	LP			PERM	Rail	New	No	No	551823	7916434	No	NFB	No	NFB	1	12.2	900	n/a										
419	CV-97-12	Culvert	LP			PERM	Rail	New	No	No	551891	7916370	No	NFB	No	NFB	1	14.64	900	n/a										
420	CV-98-0	Culvert	LP			PERM	Rail	New	No	No	552001	7916266	No	NFB	No	NFB	1	19.52	900	n/a										
421	CV-98-1	Culvert	LP			PERM	Rail	New	No	No	552043	7916226	No	NFB	No	NFB	1	19.52	900	n/a										
422	CV-99-1	Culvert/Encroachment	S/P			PERM	Rail	New	No	No	552464	7915930	No	NFB	Potential	MAR	1	12.2	900	1										
423	CV-99-2	Culvert	S			PERM	Rail	New	No	No	552958	7915502	No	NFB	Potential	MAR	5	12.2	900	1										
424	CV-99-3	Culvert	S			PERM	Rail	New	No	Yes; BG-04	553253	7915414	Yes	MAR - IMP	Yes	MAR - IMP	5	12.2	900	3	199	117	316								
425	CV-100-1	Culvert	LP			PERM	Rail	New	No	No	553579	7915319	No	NFB	No	NFB	5	7.32	900	n/a										
426	CV-100-2	Culvert	LP			PERM	Rail	New	No	No	553862	7915292	No	NFB	No	NFB	1	9.76	900	n/a										
427	CV-100-3	Culvert	LP			PERM	Rail	New	No	No	554050	7915379	No	NFB	No	NFB	1	9.76	900	1										

DFO IR 3.1.1. **List of stream crossings (culverts), bridges, cuts/diversions, and lake/pond encroachments/infills along the north rail alignment and Tote Road realignment and fish habitat summary.**

Number	Site ID	Description	Waterbody Type	Diversion to	Receives Diversion From	Permanent/Temporary	Rail/Road	New/Replacement /Extension /Modification	Other Crossings/Bridges/Encroachments/Cuts on Same Waterbody [1]		Current UTM Coordinates		Arctic Char		Ninespine Stickleback		No. Barrels	Culvert Length (m)	Culvert Diameter (mm)	Stream Order at Crossing/Cut /Bridge	Stream Crossings			Bridges			Lake/Pond Encroachment /Infilling	Cuts		
									Rail Crossing	Road Crossing	Easting	Northing	Fish Bearing	Habitat Quality (MAR/IMP/NFB)	Fish Bearing	Habitat Quality (MAR/IMP/NFB)					Lost Habitat (m^2)	Altered Habitat (m^2)	Total (m^2)	Lost Habitat (m^2)	Altered Habitat (m^2)	Total (m^2)	Lost Habitat (m^2)	Lost Habitat (m^2)	Altered Habitat (m^2)	Total (m^2)
428	CV-100-4	Culvert	S			PERM	Rail	New	No	Yes; CV-001	554185	7915443	Probable	MAR	Probable	MAR	2	12.2	1200	3	199	156	355							
429	CV-101-1	Culvert	S		CV-101-1a and CV-101-	PERM	Rail	New	No	Yes; CV-001	554664	7915456	Probable	MAR	Probable	MAR	1	9.76	900	3	159	117	276							
430	CV-101-1a	Cut	S	CV-101-1		PERM	Rail	New	No	Yes; CV-001	554772	7915455	No	NFB	No	NFB		NA	NA	2									
431	CV-101-1b	Cut	S	CV-101-1		PERM	Rail	New	No	Yes; CV-001	554885	7915454	No	NFB	No	NFB		NA	NA	2									
432	CV-101-2	Culvert	S			PERM	Rail	New	No	Yes; BG-03	555200	7915449	No	NFB	Unlikely	MAR	5	9.76	1400	1									
433	CV-102-1	Bridge	S			PERM	Rail	New	No	Yes; CV-223 bridge	555728	7915442	Yes	IMP	Yes	IMP	0	NA	NA	3+				14.00	242	256				
434	CV-102-1a	Cut	S	CV-102-2		PERM	Rail	New	No	No	555891	7915441	No	NFB	No	NFB	0	NA	NA	n/a										
435	CV-102-2	Culvert	S		CV-102-1a	PERM	Rail	New	No	Yes; CV-224	556019	7915438	Yes	IMP	Yes	IMP	1	21.96	1200	3	358	156	514							
436	CV-102-3	Culvert	S			PERM	Rail	New	No	Yes; CV-224	556373	7915485	Probable	MAR - IMP	Probable	MAR - IMP	1	14.64	900	1	41	20	61							
437	CV-102-4	Culvert	S			PERM	Rail	New	No	Yes; CV-224	556461	7915488	Yes	MAR - IMP	Yes	MAR - IMP	3	9.76	900	1	27	20	47							
438	CV-102-5	Cut	S	CV-103-1		PERM	Rail	New	No	Yes; CV-225	557111	7915356	No	NFB	No	NFB	NA	NA	NA	1										
439	CV-103-1	Culvert	S		CV-102-5	PERM	Rail	New	No	Yes; CV-225	557447	7915244	Yes	IMP	Yes	IMP	1	41.48	1800	3	369	128	497							
440	CV-104-1	Culvert	S			PERM	Rail	New	No	Yes; CV-225	557574	7915202	Probable	MAR	Probable	MAR	1	17.08	900	1	48	20	68							
441	CV-104-2	Culvert	S			PERM	Rail	New	No	Yes; BG-01	557882	7915099	Yes	MAR - IMP	Yes	MAR - IMP	1	21.96	1200	2	149	65	215							
442	CV-104-3	Culvert	S			PERM	Rail	New	No	Yes; BG-01	557996	7915052	Yes	IMP	Yes	IMP	3	26.84	1400	1	75	31	107							
443	CV-104-4	Culvert	LP			PERM	Rail	New	No	No	558154	7914976	No	NFB	No	NFB	1	12.2	900	n/a										
444	CV-104-5	Culvert	S			PERM	Rail	New	No	Yes; BG-01	558340	7914885	Yes	IMP	Yes	IMP	1	21.96	1800	3	123	81	204							
445	CV-105-1	Culvert	S			PERM	Rail	New	Yes; CV-104-5	Yes; BG-01	558521	7914785	Probable	MAR	Probable	MAR	1	9.76	900	1	27	20	47							
446	CV-105-2	Culvert	S			PERM	Rail	New	Yes; CV-104-5 (CV-105-1 is a separate tributary)	Yes; BG-01	558750	7914656	Yes	MAR	Yes	MAR	1	9.76	900	3	159	117	276							
447	CV-105-3	Pond Infilling	P			PERM	Rail	New	Yes; CV-105-2, CV-104-5	Yes; BG-01	558875	7914578	Yes	MAR	Yes	IMP	1	9.76	900	n/a (LE)							1,090			
448	CV-105-4	Culvert	S			PERM	Rail	New	Yes; CV-105-3, CV-105-2, CV-104-5	Yes; BG-01	559196	7914375	Yes	MAR	Yes	MAR	1	14.64	900	3	239	117	356							
449	CV-106-1	Pond Infilling	P			PERM	Rail	New	Yes; CV-105-4, CV-105-3, CV-105-2, CV-104-5	Yes; BG-01	559334	7914281	Yes	MAR	Yes	IMP	1	12.2	900	n/a (LE)							375			
450	CV-106-2	Pond Infilling	P			PERM	Rail	New	Yes; CV-106-1, CV-105-4, CV-105-3, CV-105-2, CV-104-5	Yes; BG-01	559615	7914085	Yes	MAR	Yes	IMP	1	12.2	900	n/a (LE)							1,310			
451	CV-106-3	Encroachment	P			PERM	Rail	New	Yes; CV-106-1, CV-105-4, CV-105-3, CV-105-2, CV-104-5	Yes; BG-01	559980	7913834	Yes	MAR	Yes	IMP	1	14.64	900	n/a (LE)							281			
452	CV-107-1	Encroachment	P			PERM	Rail	New	Yes; CV-106-3, CV-106-1, CV-105-4, CV-105-3, CV-105-2, CV-104-5	Yes; BG-01	560409	7913682	Probable	MAR - IMP	Probable	MAR - IMP	1	19.52	900	n/a (LE)							585			
453	CV-107-2	Encroachment	P			PERM	Rail	New	No	No	560529	7913655	Potential	MAR	Potential	MAR	1	19.52	900	n/a (LE)							27			
454	CV-107-3	Encroachment	P			PERM	Rail	New	No	No	560660	7913555	No	NFB	No	NFB	1	24.4	900	n/a										
455	CV-107-4	Culvert	S			PERM	Rail	New	No	Yes; CV-186	560706	7913502	Yes	IMP	Yes	IMP	1	26.84	1400	3	437	183	620							
456	CV-108-1	Culvert	S			PERM	Rail	New	No	No	560926	7913247	No	NFB	No	NFB	1	17.08	900	n/a										
457	CV-108-2	Culvert	S			PERM	Rail	New	No	No	560963	7913204	No	NFB	No	NFB	1	17.08	900	n/a										
458	CV-108-3	Culvert	S			PERM	Rail	New	Yes; CV-110-1	Yes; Landfill Road	561364	7912739	No	NFB	No	NFB	1	9.76	900	n/a										
459	CV-109-1	Cut	S	CV-109-2		PERM	Rail	New	No	No	561856	7912346	Unlikely	MAR	Unlikely	MAR	NA	NA	NA	1								2,395	-	2,395
460	CV-109-2	Culvert	S		CV-109-1	PERM	Rail	New	No	No	561973	7912254	No	NFB	No	NFB	TBD	TBD	TBD	n/a										
461	CV-109-3	Culvert	LP			PERM	Rail	New	No	No	562024	7912215	No	NFB	No	NFB	TBD	TBD	TBD	n/a										
462	CV-110-1	Culvert	S			PERM	Rail	New	No	Yes; Landfill Road	561084	7912910	No	NFB	No	NFB	TBD	TBD	TBD	n/a										
463	CV-110-2	Culvert/Encroachment	P			PERM	Rail	New	No	No	561266	7912241	No	NFB	No	NFB	TBD	TBD	TBD	n/a										
464	CV-110-3	Pond Infilling	P			PERM	Rail	New	Yes; CV-110-2	No	561445	7912240	No	NFB	No	NFB	TBD	TBD	TBD	n/a										
465	CV-110-4	Culvert	S			PERM	Rail	New	No	No	561546	7912425	No	NFB	No	NFB	TBD	TBD	TBD	n/a										
466	CV-169-1	Culvert	S			PERM	Road	New	No	No	505149	7972688	Probable	MAR	Probable	MAR	TBD	TBD	TBD	3	TBD	TBD	TBD							
467	CV-146-1	Culvert	S			PERM	Road	Relocation	Yes; CV-9-1	Yes; CV-146, CV-146-2, CV-146-3	508928	7968816	Unlikely	APR	Unlikely	APR	TBD	TBD	TBD	3	TBD	TBD	TBD							
468	CV-146-2	Culvert	S			PERM	Road	Relocation	No	Yes; CV-146-3	508726	7968858	Unlikely	MAY	Unlikely	MAY	TBD	TBD	TBD	3	TBD	TBD	TBD							
469	CV-146-3	Culvert	S			PERM	Road	Relocation	No	Yes; CV-146-2	508721	7968887	Unlikely	JUN	Unlikely	JUN	TBD	TBD	TBD	3	TBD	TBD	TBD							
470	CV-131-1	Culvert	S			PERM	Road	New	No	No	511333	7967096	Unlikely	JUL	Unlikely	JUL	TBD	TBD	TBD	2	TBD	TBD	TBD							
471	CV-060-1	Culvert	S			PERM	Road	New	No	No	527517	7930366	Yes	IMP	Unlikely	MAR	TBD	TBD	TBD	3	TBD	TBD	TBD							
472	CV-060-2	Culvert	S			PERM	Road	New	Yes; CV-55-3	Yes; CV-060, CV-060-1	527756	7930278	Yes	IMP	Yes	MAR	TBD	TBD	TBD	3	TBD	TBD	TBD							
473	CV-059-1	Culvert	S			PERM	Road	New	No	No	528033	7929251	Yes	MAR	Unlikely	MAR	TBD	TBD	TBD	3	TBD	TBD	TBD							
474	CV-214-1	Culvert	S			PERM	Road	Relocation	Yes; CV-84-3	Yes; CV-214, CV-217	541273	7921956	No	NFB	No	NFB	TBD	TBD	TBD											
475	CV-214-2	Culvert	S			PERM	Road	New	Yes; CV-85-1	Yes; Unnamed Tote Road, CV-217	541507	7922071	No	NFB	No	NFB	TBD	TBD	TBD											
476	CV-215-1	Culvert	S			PERM	Road	Relocation	Yes; CV-85-2	Yes; CV-215, CV-217	541909	7922250	No	NFB	No	NFB	TBD	TBD	TBD											
477	CV-216-1	Culvert	LP			PERM	Road	New	No	No	543381	7921181	No	NFB	No	NFB	TBD	TBD	TBD											
478	CV-216-2	Culvert	LP			PERM	Road	New	No	No	543524	7921151	No	NFB	No	NFB	TBD	TBD	TBD											
479	CV-020-2	Culvert	S			PERM	Road	New	Yes; CV-91-0	Yes; CV-020-2, CV-021	546893	7919846	No	NFB	No	NFB	TBD	TBD	TBD											
480	CV-020-1	Culvert	S			PERM	Road	New	Yes; CV-91-0	Yes; CV-021	547094	7919813	No	NFB	No	NFB	TBD	TBD	TBD											
481	BG-14-1	Culvert	S			PERM	Road	New	Yes; CV-96-1	Yes; BG-17; BG-14-1	550839	7917414	Yes	IMP	Yes	IMP	TBD	TBD	TBD	3+	TBD	TBD	TBD							
482	BG-13-1	Culvert	S			PERM	Road	New	Yes; CV-96-1	Yes; BG-17; BG-13-1	551001	7917116	Probable	IMP	Probable	IMP	TBD	TBD	TBD	2	TBD	TBD	TBD							

S = stream; P = pond; LP = Low point; L = Lake; PERM = Permanent; TEMP = Temporary; IMP = Important; MAR = Marginal; and NFB = Not fish bearing

1 For each site on a stream, where stream is defined as terminating at either a large watercourse or a lake, all downstream road and rail crossings and cuts are identified.
For lakes, the number of encroachments/infilling sites are identified.
For bridges the number of bridges on the same river are identified.
For cuts, the number of crossings and cutes on the stream are identified (where stream is defined as above).

APPENDIX 5
ECCC IR ATTACHMENTS

ECCC WL 02: ATTACHMENT 1: MINE SITE LAYOUT AND MDMER/WATER LICENCE MONITORING LOCATIONS

WASTE ROCK STOCKPILE FACILITY

TRANSFER PUMP
VALVE
WATER TREATMENT SYSTEM
MS-08 FDP
MS-08 DISCHARGE LINE OUTFLOW
GEOTUBE POND
CURRENT DITCH

560 000 E
561 500 E
563 000 E
564 500 E
7 914 500 N
7 913 000 N
7 911 500 N

WASTE ROCK SEDIMENTATION POND
WASTE ROCK FACILITY (ERP)
MS-08 FDP
TRANSFER PUMP
MS-08 DISCHARGE LINE OUTFLOW
WASTE ROCK DUMP BOUNDARY AT THE END OF OPERATION (RAIL PHASE)
PROPOSED FINAL OPEN PIT OUTLINE
110 KM LAYDOWN AREA
MRTTF-1
MINE HAUL ROAD
QUARRY D1Q1
OPEN PIT DEVELOPMENT
NON-FISH BEARING
WASTE MANAGEMENT FACILITY
EXISTING LAYDOWN AREA
SITE SERVICES GARAGE
KM 97 BORROW LOCATIONS
RAW WATER INTAKE
RAW WATER PUMP HOUSE
MS-HWB-6
MS-HWB-5
MS-HWB-3
MS-HWB-4
MS-HWB-2
MS-HWB-1
BULK FUEL STORAGE FACILITY (BLADDER FARM)
AERODROME APRON
QUARRY QMR2
PWSP No. 2
PWSP No. 3
PWSP No. 1
EXPLORATION CAMP FACILITIES
WASTE WATER TREATMENT FACILITY
HELIPAD
POLISHING WASTE STABILIZATION PONDS (PWSPs)
CONSTRUCTION LAYDOWN AREA
CAMP INFRASTRUCTURE
QUARRY D1Q2
AERODROME RUNWAY
NEW ACCOMMODATIONS CAMP
NEW ACCOMMODATIONS CAMP PAD
TRUCK WEIGH SCALE
ORE CRUSHING AND LOADING
MINE OPERATIONS OFFICE
FISH BEARING
E0-10
FO-01
G0-01
MS-08-US
MS-08-DS
MS-06 FDP
ORE CRUSHING SEDIMENTATION POND
EXISTING LANDFILL ROAD
EXISTING LANDFILL
E0-03
EFFLUENT DISCHARGE POINT
EXPLOSIVE MAGAZINE
EMULSION PLANT
MS-06-DS
E0-21
E0-20

UTILITIES, INCLUDED:
- POWER GENERATION MODULE
- FUEL TANK FARM & DYKE
- SEWAGE TREATMENT PLANT
- POTABLE WATER TREATMENT PLANT

POLISHING WASTE STABILIZATION PONDS TREATED WATER DISCHARGE POINT

SITE SERVICE FACILITIES, INCLUDING:
- MAINTENANCE BUILDING
- WELDING WORKSHOP
- TRUCK WASH STATION
- TOROMONT SHOP
- EMERGENCY RESPONSE OFFICE

LEGEND:
- INUIT OWNED LAND - SURFACE ONLY EXCLUDING MINERALS
- INUIT OWNED LAND - SURFACE AND SUBSURFACE INCLUDING MINERALS
- WATER
- BORROW AREAS (2013 UNDER Q10C3001)
- QUARRY AREA (EXISTING UNDER Q13C301)
- RIVER/STREAM/DRAINAGE
- ROAD
- QIA SURFACE COMMERCIAL LEASE BOUNDARY
- LAY FLAT HOSE
- FISH BEARING WATER
- NON-FISH BEARING WATER
- HDPE PIPE
- OVERLAND SURFACE WATER FLOW
- WATER QUALITY MONITORING LOCATION
- PUMP
- DRAINAGE DIRECTION

NOTES:
1. COORDINATE GRID IS UTM NAD83 ZONE 17N.
2. TOPOGRAPHY PROVIDED BY EAGLE MAPPING (2005).
3. PLAN BASED ON INFORMATION PROVIDED BY HATCH, DATED (JAN 13, 2015).
4. CONTOUR INTERVAL IS 2.5 METRES.

SCALE A: 300 150 0 500 1000 1500 m

Baffinland

MARY RIVER PROJECT

MINE SITE LAYOUT AND MDMER / WATER LICENCE MONITORING LOCATIONS

Knight Piésold CONSULTING

PIA NO: NB102-181/45
REF NO: NB18-00875
FIGURE 1
REV: 0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	17DEC'18	ISSUED WITH TRANSMITTAL	CB	AS	AV

SAVED: I:\1\02\00181\45\A\acad\FIGS\BOD R0_12\17\2018 3:50:47 PM_ASIMPSON PRINTED: 12\17\2018 3:52:44 PM_ASIMPSON
XREF FILE(S): QMR2 QMR1 - BOUNDARY LIMIT AND MINING LIMIT Contours-2.5m_Intermediate_to_Mine_Site-EC.dwg; MDN_CGC2018_X-N-TOPO-BASE-LANDUSE---CLAS IMAGE FILE(S): GIS Baffinland Logo many_rtwe_wo3073_wv2_wv3_wv1_title26 many_rtwe_wo3073_wv2_wv3_wv1_title27

APPENDIX 6
HEALTH CANADA

THERE ARE NO ATTACHMENTS IDENTIFIED FOR THIS GROUP OF RESPONSES, AT THIS TIME

APPENDIX 7
NATURAL RESOURCES CANADA

THERE ARE NO ATTACHMENTS IDENTIFIED FOR THIS GROUP OF RESPONSES, AT THIS TIME.

APPENDIX 8
PARKS CANADA AGENCY IR ATTACHMENTS

THERE ARE NO ATTACHMENTS IDENTIFIED FOR THIS GROUP OF RESPONSES, AT THIS TIME

APPENDIX 9
OCEANS NORTH

THERE ARE NO ATTACHMENTS IDENTIFIED FOR THIS GROUP OF RESPONSES, AT THIS TIME

APPENDIX 10
WORLD WILDLIFE FUND IR ATTACHMENTS

WWF 04 ATTACHMENT 1: TABLES

Table 1 Consequence Severity and Risk Rating (cont'd)

Consequence Severity	Risk Rating	Description
(1) Insignificant ***Minor incident or inefficiency of little or no consequence.*** **Health and Safety:** No injury or lost time. **Production**: One to two weeks production loss or expenditure. **Cost:** <$100,000 damage or additional costs. **Environmental Impact/Compliance:** No lasting impacts. Low-level effects on biological or physical environment. Limited damage to minimal area of low significance. **Corporate Image or Utility:** Corporate image not affected or verbal complaint dealt with internally. **Community Affairs:** No community concern.	NEGLIGIBLE (N) (<$100,000)	Issues represents an **insignificant** control weakness.

Table 2 Frequency of Occurrence – Likelihood

Likelihood		
Likelihood	Description in context of full operating life of the facility.	Frequency
Almost Certain	Consequence expected to occur in most circumstances.	High frequency of occurrence – occurs more than once per year.
Likely	Consequence will probably occur in most circumstances.	Event does occur, has a history, occurs once every 1 to 10 years.
Possible	Consequence could occur at some time.	Occurs once every 10 to 100 years.
Unlikely	Consequence could occur at some time.	Occurs once every 100 to 1000 years.
Rare	Consequence might occur at some time.	Occurs once every 1000 to 10,000 years.

Table 3 Risk Rating Matrix

	Likelihood				
Impact	**Rare**	**Unlikely**	**Possible**	**Likely**	**Almost certain**
Catastrophic	moderate	moderate	high	critical	critical
Major	Low	moderate	moderate	high	critical
Moderate	Low	moderate	moderate	moderate	high
Minor	very low	low	moderate	moderate	moderate
Insignificant	very low	very low	low	low	moderate

4.3 STEP 3: EVALUATE EXISTING CONTROLS

Once a risk rating has been determined for areas, departments, and processes, significant EHS hazards, management ownership, and recommended controls will be identified and actions determined using the guides described in the sections following.

Note: Assigning a risk classification to each EHS hazard determines the relative risk ranking of each hazard identified for the purpose of establishing priorities for risk control action. It is not a quantitative risk assessment.

4.4 STEP 4: IMPLEMENT ADDITIONAL RISK CONTROLS

All hazards must be managed before the environment is harmed or people are injured, become ill, or there is damage to plant, machinery, or property. Assessed hazards that must be dealt with in order of priority in one or more of the following hierarchy of controls:

1. **Remove hazard** from the workplace or environment.
2. **Substitute the hazard**: substitute a substance, material, or method to reduce the risk of the hazard.
3. **Isolate or enclose the hazard**: separate the hazard from the workplace or environment, e.g.:
   - Engineered and lined bulk fuel hazardous chemical storage areas
   - lockout procedures on faulty equipment
   - appropriate guarding of machinery and equipment
4. **Use engineering controls**: modify existing machinery or plant or purchase different machinery or equipment:
   - administrative procedures
5. **Develop work methods** to reduce the conditions of risks, e.g.:
   - written safe operating procedures
   - job rotation to restrict hours worked on difficult jobs
   - employees trained in the correct operating procedures

WWF 05 ATTACHMENT 1: FUEL SPILL MODELLING: NORTHERN SHIPPING ROUTE OPEN WATER SEASON

FINAL

Mary River Project

Fuel Spill Modelling: Northern Shipping Route Open Water Season

Milne Inlet, Eclipse Sound, Pond Inlet

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18 February 201518 February 2015
Amec Foster Wheeler Project No. TA1475302

IMPORTANT NOTICE

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EXECUTIVE SUMMARY

Under contract to Baffinland Iron Mines Corporation, Amec Foster Wheeler Environment & Infrastructure, a Division of Amec Foster Wheeler Americas Limited (Amec Foster Wheeler), has completed an open water fuel spill modelling assessment for fuel shipment to Milne Inlet, Nunavut in the Canadian Arctic. As part of the Baffinland Mary River Project, Early Revenue Phase, two fuels will be transported along "the Northern Shipping Route" from Baffin Bay through Pond Inlet, Eclipse Sound, and Milne Inlet to the port site at the head of Milne Inlet. Arctic diesel cargo will be shipped with fuel tanker and unloaded by means of flexible hoses to shore; intermediate fuel oil (IFO) will be carried for powering of the iron ore carriers. At this time, shipping will occur only during the open water season, from approximately mid-July to mid-October.

The purpose of fuel spill trajectory modelling is to inform spill response and preparedness stakeholders. Key information sought includes estimation of the marine and coastal areas potentially affected as a result of a spill, together with the initial weathering fate of the fuel.

A set of spill scenarios are presented to address the Nunavut Impact Review Board (NIRB) requirements for the Mary River Early Revenue Phase. From discussions with Transport Canada and the Canadian Coast Guard at a fuel spill preparedness workshop it was established that credible spill scenarios could amount to: a) a loss of two compartments of a double-hull, multi-compartment fuel tanker, or 4,000 m^3 (4 ML) of arctic diesel; and b) a loss of half the IFO fuel remaining on board an iron ore carrier entering Milne Inlet, or approximately 2,000 m^3 (2 ML). The spill assessment considers open water season; shipping does not commence until the sea ice has retreated and melted from the shipping route. The month of September has been selected to be representative of the open water season. Five scenario locations were selected to provide good geographic coverage of potential spill locations along the project shipping route: at Bruce Head and at the Mouth of Milne Inlet, in Eclipse Sound, and at two locations west and east of Pond Inlet.

Two spill models were employed. The Amec Foster Wheeler in-house software, OST, was used to produce spill distribution probability plots to indicate which regions along the shipping route might be affected, how frequently, and how soon. The RPS ASA OILMAP software was used for estimation of spill fate including amounts of fuel weathered due to evaporation or dispersion into the water column by wave action, as well as amounts brought ashore. The spill modelling scenarios completed in this study assume no intervention, response or containment efforts.

Wind, ocean tide and current, and sea temperature which might affect the trajectory and fate of a fuel spill, were assessed for use in the spill models. Winds for input to the spill models were selected following comparison of a number of sources. These included: the met station at the

Milne port camp site, Environment Canada climate stations at Pond Inlet, Meteorological Service of Canada (MSC) North Atlantic wind and wave hindcast winds in Baffin Bay just east of the entrance to Pond Inlet, and reanalysis winds from the European Centre for Medium-Range Weather Forecasts (ECMWF), ERA Interim (ERAI) class, Atmospheric Model gridded over the study area. Wind speeds, in September, from these sources, are just under 6 m/s (12 knots) on average with maximum wind speeds ranging from about 11 m/s at Pond Inlet to 28 m/s at the head of Milne Inlet. While the ERAI wind speeds were judged to be a bit low compared to measurements from the Milne camp site, and at times, also at Pond Inlet, they provide a long 30 year time series record over the entire study area and were selected to provide reasonable wind inputs for the spill model.

The high resolution HYbrid Coordinate Ocean Model (HYCOM) ocean circulation model was used to derive both a grid of September mean near-surface ocean currents, and an estimate of sea water temperature. September current speeds average about 0.15 cm/s (0.3 knots) with maximum speeds of about 60 to 90 cm/s (1.2 to 1.75 knots). Mean sea surface temperatures are about 2°C in September.

For each of the five spill scenario locations, the OST spill model predicts the path of all possible trajectories for each day in September for each of 30 years, 1984-2013. Trajectories are followed until they reach shore, the fuel weathers below 5%, or the trajectory reaches a boundary of the spill model domain. The location, time to shore and amount of fuel loss for each trajectory is logged, from which overall statistics of the percent trajectories ashore, the time to shore, and amount of weathering can be tabulated; these statistics are derived for each of 13 geographical regions defined to cover the spill model domain.

A spill probability map for each of the five spill scenario locations is presented, each showing the probability that fuel would reach any particular location on the map. With the shipping route scenario locations being as close as 6 to 10 km to shore, or for Bruce Head as close as 2 km to shore, it is not surprising nearly all the simulated trajectories are modelled to reach shore before weathering below 5% or leaving the model domain. A total of 99 to 100% of trajectories reach shore for the four western spill scenario locations. Only for the scenario at Pond Inlet: East do 6% of trajectories travel east out into Baffin Bay; the other 94% reach shore.

Earliest times to shore for spill trajectories are as soon as 2 h for the scenario at Bruce Head in Milne Inlet and typically 5 to 9 h for the other scenarios. Predicted mean times range from about 18 h at Bruce Head in Milne Inlet to almost 12 days for a trajectory simulation from Eclipse Sound ultimately reaching land on the southeast portion of Bylot Island. The average of the mean times to shore for shoreline regions seeing trajectories is about 86 h. For about one third of the shoreline regions seeing trajectories, for all five scenarios, the mean time to shore is four days or longer.

For the arctic diesel spill scenarios, the mean percent of fuel remaining ranges from 39% - for trajectories from Pond Inlet: West to shorelines to the southwest of Eclipse Sound – to 80% for Bruce Head scenario trajectories reaching the head of Milne Inlet. The average of the mean percent of fuel remaining for shoreline regions seeing trajectories is 58%, that is, 42% fuel lost due to evaporation or dispersion in the water column.

For the more persistent IFO 180 spill scenarios, the mean percent of fuel remaining ranges from 91% - again, for trajectories from Pond Inlet: West to shorelines to the southwest of Eclipse Sound – to 98% for Bruce Head scenario trajectories reaching the head of Milne Inlet. The average of the mean percent of fuel remaining for shoreline regions seeing trajectories is 95%.

Eleven additional spill fate simulations with the OILMAP software were completed. At each of the five spill scenario locations the two spill amounts of 4 ML of arctic diesel and 2 ML of IFO 180 fuel were modelled with a constant September 'P50' wind condition defined as the average wind speed and the associated most frequent wind direction. For four of the locations this condition was winds of 4 m/s from the northeast; for the Pond Inlet: East location, the 'P50' condition was winds of 5 m/s from the northwest.

For the arctic diesel spill, after five days, 41 to 55% of the fuel remains on the sea surface, 44 to 48% has evaporated, about 1% has come ashore (assuming a sheltered rock shore type), and less than 1% has been dispersed into the water column – with the larger 5 m/s wind speed 7% is lost to the water column. For the IFO 180 spill, after five days, 82 to 92% of the fuel remains on the sea surface, 8 to 9% has evaporated, about 1 to 2% has come ashore (assuming a sheltered rock shore type), and less than 0.01% has been dispersed into the water column. Times to shore, for both fuel types range from half a day for the Milne Inlet: Bruce Head location to four days for Pond Inlet: West.

Finally, a 10 day sensitivity run considering a hypothetical full fuel tanker loss of 15 ML arctic diesel cargo at the Eclipse Sound spill scenario location was also prepared with variable September winds of 1 to 11 m/s (2 to 21 knots). A short time of 1 h was used for the simulated spill duration.

The amount of fuel on the sea surface decreases from 13.7 ML after one day to 5.7 ML after two days. The amount of fuel lost both due to evaporation and dispersion in the water column increases noticeably with stronger winds. This is particularly evident in the simulation midway through day two with winds of 11 m/s and then on day three with winds of 8 m/s. On day three the amounts of fuel on the sea surface fall below 30,000 L, and then with slightly calmer conditions some of the fuel resurfaces: subsequent to a period of increased winds, amounts on the sea surface return to about 2 ML and remain near that level for the duration of the simulation out to 10 days. Amounts of fuel in the water column reach about 1 ML after 36 h, at which time about

2.7 ML of the fuel has evaporated. After five days about 80% of the fuel has weathered: 6.4 ML to evaporation and 5.9 ML due to water column loss. The total area covered by the slick of thicknesses 0.001 mm (dull colours seen on calm water) or greater is about 16 km^2 after one day and reaches a maximum area of 83 km^2 after six days; the area of the slick at thicknesses greater than 0.1 mm (light brown or black sheen easily seen from aircraft) is 14 km^2 after one day and reaches a maximum of 17 km^2 within the next 12 hours.

The spill modelling results highlight the importance of spill prevention and fuel spill response plan preparedness to minimize any adverse effects in the unlikely event of a fuel release of any size during vessel traffic into Milne Inlet.

TABLE OF CONTENTS

EXECUTIVE SUMMARY III

1.0 INTRODUCTION 10
1.1 Objectives 10
1.2 Spill Scenario Selection 10

2.0 SPILL TRAJECTORY MODELLING: OST 13
2.1 Model Setup 13
2.1.1 Model Theory Overview 13
2.1.2 Model Geometry 14
2.1.3 Transport (Advection) 16
2.1.4 Weathering 17
2.2 Model Input 27
2.2.1 Wind 27
2.2.2 Ocean Currents 29
2.3 Model Output 31
2.3.1 Individual Day Spill Trajectory Plots 31
2.3.2 Shoreline Zone Definitions 31
2.3.3 Composite Monthly Fuel Distribution Probability Maps 33
2.4 Presentation and Interpretation of Results 33
2.4.1 Milne Inlet: Bruce Head 35
2.4.2 Milne Inlet: Mouth 36
2.4.3 Eclipse Sound 37
2.4.4 Pond Inlet: West 38
2.4.5 Pond Inlet: East 39
2.5 Shoreline Statistics 40

3.0 SPILL FATE MODELLING: OILMAP 45
3.1 Model Implementation 45
3.2 September ‘P50’ Wind Scenarios 47
3.3 Fuel Tanker Cargo Spill: 15 ML Arctic Diesel 55

4.0 CLOSURE 61

5.0 REFERENCES 62

LIST OF TABLES

Table 1-1: Spill Scenario Locations 12
Table 2-1: OST Spill Model Grid Setup 15
Table 2-2: Diesel Fuel Oil (Alaska) Weathering: Evaporation Loss as a Function of Wind Speed 26
Table 2-3: Diesel Fuel Oil (Alaska) Weathering: Water Column Loss as a Function of Wind Speed 26
Table 2-4: IFO 180 Weathering: Evaporation Loss as a Function of Wind Speed 27



Table 2-5: IFO 180 Weathering: Water Column Loss as a Function of Wind Speed 27
Table 3-1: September 'P50' Winds 47
Table 3-2: September, P50 Winds, Arctic Diesel Spill Fate after 5 days 51
Table 3-3: September, P50 Winds, IFO 180 Spill Fate after 5 days 54

LIST OF FIGURES

Figure 1-1: Spill Scenario Locations 12
Figure 2-1: OST Spill Model Grid 16
Figure 2-2: Diesel Fuel Oil (Alaska) Physical Parameters (Source: ASA Updated Oil Database, OILMAP v 6.10.2.0) 18
Figure 2-3: Intermediate Fuel Oil 180 Physical Parameters (Source: ASA Updated Oil Database, OILMAP v 6.10.2.0) 19
Figure 2-4: Diesel Fuel Oil (Alaska) Weathering: Evaporation Loss as a Function of Sea Temperature (Source: OILMAP) 21
Figure 2-5: IFO 180 Weathering: Evaporation Loss as a Function of Sea Temperature (Source: OILMAP) 22
Figure 2-6: Sea Temperature, September (Source: HYCOM) 23
Figure 2-7: Diesel Fuel Oil (Alaska) Weathering: Evaporation Loss as a Function of Wind Speed (Source: OILMAP) 24
Figure 2-8: Diesel Fuel Oil (Alaska) Weathering: Water Column Loss as a Function of Wind Speed (Source: OILMAP) 24
Figure 2-9: IFO 180 Weathering: Evaporation Loss as a Function of Wind Speed (Source: OILMAP) 25
Figure 2-10: IFO 180 Weathering: Water Column Loss as a Function of Wind Speed (Source: OILMAP) 25
Figure 2-11: Wind Comparison, September 2007 28
Figure 2-12: Wind Data Source Locations (ERAI grid points denoted with blue squares) 29
Figure 2-13: Milne Inlet, HYCOM Surface Mean Currents, September 30
Figure 2-14: Definition of Geographical Regions for Interpretation of Shoreline Statistics 32
Figure 2-15: Spill Distribution Probability Plot, Milne Inlet, Bruce Head, September, Base Case 35
Figure 2-16: Spill Distribution Probability Plot, Milne Inlet, Mouth, September, Base Case 36
Figure 2-17: Spill Distribution Probability Plot, Eclipse Sound, September, Base Case 37
Figure 2-18: Spill Distribution Probability Plot, Pond Inlet, West, September, Base Case 38
Figure 2-19: Spill Distribution Probability Plot, Pond Inlet, East, September, Base Case 39
Figure 2-20: September, Arctic Diesel, Percentage of Trajectories Reaching Shore 41
Figure 2-21: September, Arctic Diesel, Mean Times to Shore 42
Figure 2-22: September, Arctic Diesel, Fuel Weathering 43
Figure 2-23: September, IFO 180, Fuel Weathering 44
Figure 3-1: Milne Inlet: OILMAP Land/Water Grid 46
Figure 3-2: September, IFO spill durations of 1h, 24 h 48
Figure 3-3: Wind Roses, September, 1984-2012 49
Figure 3-4: September, P50 Winds, Arctic Diesel Spill Scenarios after 1 day 50

Figure 3-5: September, P50 Winds, Arctic Diesel Spill Scenarios after 5 days 50
Figure 3-6: Areal Coverage of Spilled Fuel for Different Thicknesses (Source: CCG, 1995) 52
Figure 3-7: September, P50 Winds, IFO 180 Spill Scenarios after 1 day 53
Figure 3-8: September, P50 Winds, IFO 180 Spill Scenarios after 5 days 53
Figure 3-9: Winds for September 2013 55
Figure 3-10: 15 ML Arctic Diesel Spill after 24 hours 56
Figure 3-11: 15 ML Arctic Diesel Spill after 36 hours 56
Figure 3-12: 15 ML Arctic Diesel Spill after 5 days 57
Figure 3-13: 15 ML Arctic Diesel Spill after 10 days 57
Figure 3-14: 15 ML Arctic Diesel Spill, Percent of Fuel Mass Balance 58
Figure 3-15: 15 ML Arctic Diesel Spill, Viscosity 58
Figure 3-16: 15 ML Arctic Diesel Spill, Thickness 59
Figure 3-17: 15 ML Arctic Diesel Spill, Total Area 59
Figure 3-18: 15 ML Arctic Diesel Spill, Total Volume, Fuel & Water 60

1.0 INTRODUCTION

1.1 Objectives

In response to project planning and stakeholder input for the Baffinland Mary River Iron Ore Project, Amec Foster Wheeler Environment & Infrastructure, a Division of Amec Foster Wheeler Americas Limited (Amec Foster Wheeler), has undertaken an open water fuel spill modelling assessment for Milne Inlet in the Canadian Arctic. The purpose of fuel spill trajectory modelling is to inform spill response. Specific information sought for spill response agencies and other stakeholders includes estimation of the marine and any shoreline areas potentially affected together with the initial weathering fate of the spilled fuel.

As part of the Baffinland Mary River Trucking Feasibility Option activities, two fuels will be transported along a shipping route through Pond Inlet, Eclipse Sound, and Milne Inlet to the port site at the head of Milne Inlet: arctic diesel cargo will be shipped with fuel tanker and unloaded by means of flexible hoses to shore; IFO fuel will be carried for powering of the iron ore carriers. At this time, shipping will occur only during the open water season, from mid-July to mid-October.

1.2 Spill Scenario Selection

A set of model spill scenarios are presented to address the Nunavut Impact Review Board (NIRB) requirements for the Mary River Early Revenue Phase.

The two fuel types of interest include arctic diesel and IFO fuel. During discussions with Transport Canada and the Canadian Coast Guard at a fuel spill preparedness workshop (Baffinland, 2014) it was established that credible spill scenarios could amount to:

- For arctic diesel - two compartments of a double-hull, multi-compartment fuel tanker, which amounts to 4,000 m^3 (4 ML). The expected maximum size of the fuel tanker is 15 ML.
- For IFO – half of the IFO fuel remaining in the ship when sailing into Milne Inlet which amounts to 2,000 m^3 (2 ML) of IFO.

The spill assessment considers open water season; shipping does not commence until the sea ice has retreated and melted from the shipping route. The month of September has been selected to be representative of the open water season.

The NIRB requirement is for three open sea spill scenario locations; in addition to stakeholder community recommendations for five locations, it is felt that five locations would indeed provide a more complete (geographic) coverage of potential spill locations along the project shipping route.

The five spill scenario locations selected along the shipping route are listed in Table 1-1, and are shown in Figure 1-1.

Two sets of scenarios: a fuel tanker spill of 4 ML of arctic diesel, and an ore carrier spill of 2 ML of IFO, are completed for each of the five locations, using the Amec Foster Wheeler software, OST. OST computes spill probability distributions to indicate geographical regions (e.g., Pond Inlet, Eclipse Sound, Navy Board Inlet and Milne Inlet) which might be affected as a result of a spill, how frequently and how soon. These results are presented in Section 2.0.

In addition, 10 (two fuel types x five locations) simulations are run with a September 'P50' wind condition defined as the average wind speed conditions and the associated most frequent wind direction. Finally, a sensitivity run considering a full fuel tanker loss of 15 ML arctic diesel cargo at a location in Eclipse Sound was also prepared. For these scenarios, RPS ASA's OILMAP (RPS 2014) was used to provide additional estimation of spill weathering and fate. This includes slick characteristics, estimate of fuel concentrations in the surface layer, amounts evaporated and that have reached shore, and remaining amounts of fuel, and fuel and water (mousse) volume. These results are presented in Section 3.0.

The spill modelling completed in this study assumes no intervention, response or containment and that the slick is assumed to freely discharge (during a very short duration) from the damaged vessel.

Baffinland Iron Mines Corporation, Mary River Project
Fuel Spill Modelling: Northern Shipping Route Open Water Season
Amec Foster Wheeler Project TA1475302
18 February 2015

Table 1-1: Spill Scenario Locations

Spill ID	Location	Latitude (N)	Longitude (W)
MR1	Milne Inlet: Bruce Head	72° 02.83'	80° 30.79'
MR2	Milne Inlet: Mouth	72° 32.86'	80° 18.33'
MR3	Eclipse Sound	72° 41.27'	79° 20.18'
MR4	Pond Inlet: West	72° 47.89'	77° 57.41'
MR5	Pond Inlet: East	72° 45.22'	76° 09.61'

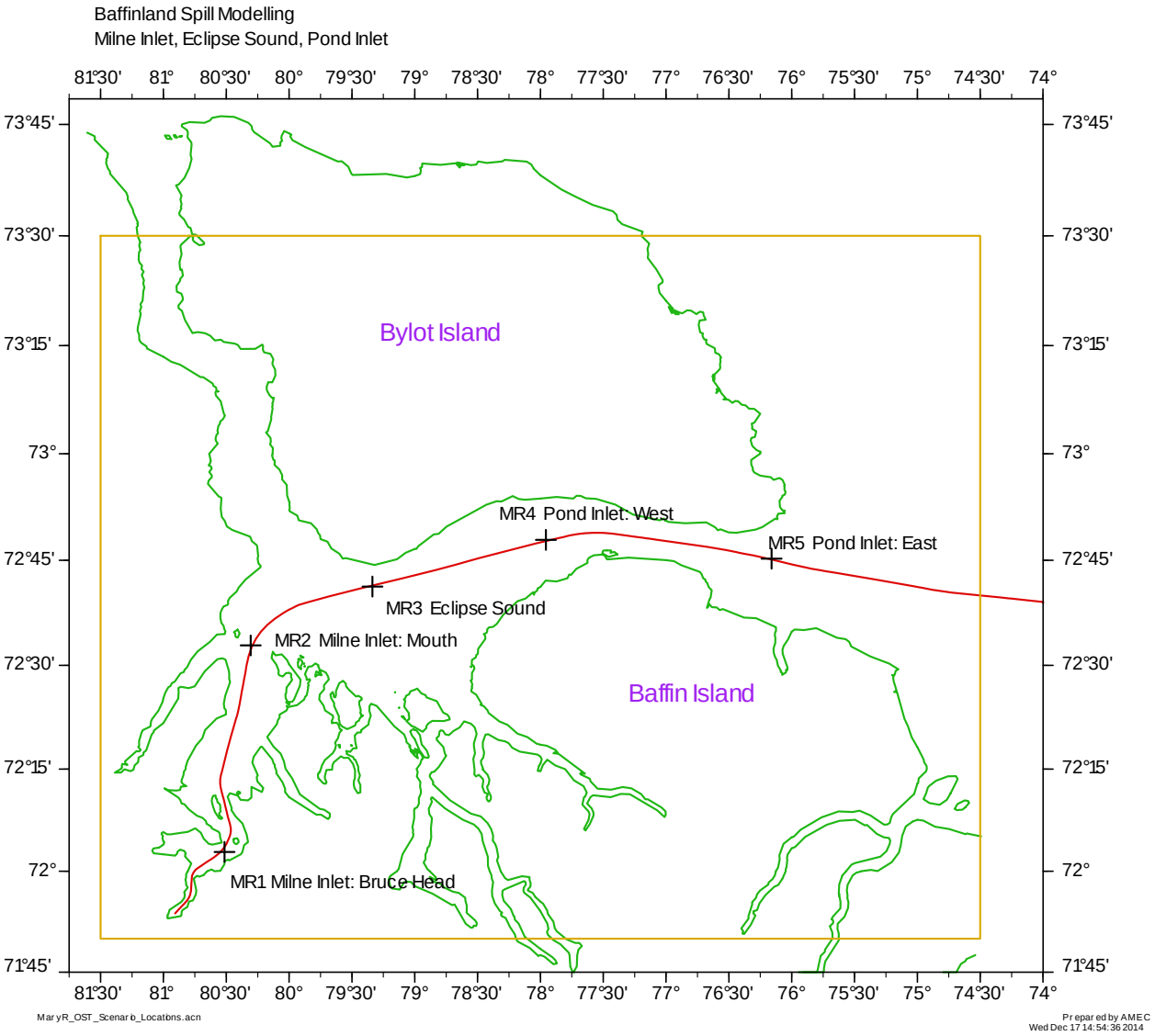


Figure 1-1: Spill Scenario Locations

2.0 SPILL TRAJECTORY MODELLING: OST

The analysis of the open water scenarios was accomplished by making use of the numerical computer model OST developed by Amec Foster Wheeler to determine probabilistic spill trajectories. To accompany the delivery of the fuel spill trajectory results, a description of the model and techniques used, and observations based on the modelling activity are presented.

2.1 Model Setup

2.1.1 Model Theory Overview

A fuel spill trajectory model is defined for purposes of the present discussion as a computerized sequence of calculations designed to predict some aspects of the behaviour of fuel spilled on the surface of water. Such behavioural aspects may include the transport (advection), and/or the spreading, and/or the weathering of spills. Attention is generally restricted to the behaviour of fuel on the sea surface.

Fuel spill trajectory scenario models (as distinguished from real-time models) are typically employed to provide a prediction of potential spill behaviour. Scenario models attempt to predict typical (or most probable) and extreme answers, for a given spill site, to such questions as:

- What is the likely speed and direction of slick motion?
- What combination of environmental (wind and current) conditions generates the most severe spill scenario?
- How frequently do such conditions occur?

A distinction is drawn between the two basic types of scenario models: deterministic and statistical. The differences relate not so much to the mechanics of the model but to the nature of wind and current data input to the model. A deterministic scenario model employs actual or hindcast data as input to the advection aspect of its calculations. These data may possibly be modified to be made more representative of the site under consideration, but the root of the input is a measured or hindcast time-series of values. Deterministic scenario model mechanics are such that input of a given data series will always yield the identical predicted output. Thus, to gain statistical significance in the interpretation of output, deterministic models must be run on a variety of input data sets or must group predictions by some appropriate time average (such as monthly). Thirty years of conditions for each of 30 days in a month yields 900 individual trajectories, a large number, which yields good confidence in the overall resultant statistics.

In contrast, the statistical variety of scenario model employs some volume of measured data as a standard or guide to creating a synthetic input data set. This approach is most commonly encountered with wind input. The synthetic data, generated by some statistical process (Monte Carlo simulation, Markov chain) employing a random number generator, are the input to the

scenario model. Each iteration of the model, commencing with a specific set of fixed parameters except for the random number seed used in the synthesis, which changes each time, will generate a distinctly different predicted output. Such models must also be run a sufficient number of times to assure statistical significance in the interpretation of the output data.

2.1.2 Model Geometry

The transport (and spatial extent) and fate of a spill is modelled as a function of time. A spill time step is assigned which is appropriate for the geographic scale and model grid of the study area and the wind and current conditions which will be used in the model to transport the spill. At each time step in the model a new location and spill volume is calculated. Selection of too large a time step may yield to inaccurate results. Too small a time step makes for overly intensive computations in the model. For the Milne Inlet domain, a time step of 15 minutes is appropriate (using winds for the given hour over each of those four time steps).

A grid is employed in the model to track the spatial extent of the spill. The grid serves three simultaneous purposes, these being: (i) it serves as the gridded coordinate system for the computation of successive displacements of the slick over each time step; (ii) it is the spatial grid upon which the winds and surface current vectors are mapped; and (iii) it provides a coordinate system for summarizing the predicted first contacts with the shorelines. This single grid is therefore referenced at various times as the model or computational grid, the wind or current grid, and the external grid.

The model grid is a Cartesian grid which includes the northern portion of Baffin Island, Bylot Island, Pond Inlet, Eclipse Sound, and Milne Inlet. The model grid has its origin at 73° 30' N latitude, 81° 30' W longitude, and extends eastward to 74° 30' W longitude and southward to 71° 50' N latitude.

Grid element dimensions are defined as 24” latitude, or 740 m in the north-south (Y) direction and 80” longitude, or 735 m in the east-west direction, i.e., on the order of 740 m x 740 m. The choice of a Cartesian grid requires the specification of a fixed east-west (X) grid scale, and consequently demands the Mercator projection of land elements on the grid. The computational grid is of minimal consequence to the model user who is simply interested in viewing printed and plotted model output. All results appearing as printed output refer to geographical coordinates and distances which are exactly computed and are independent of grid dimensions. Model output plots of fuel distribution probabilities represent all computational grid elements as appropriately scaled rectangles and thus are valid as representing correct relative positions.

Along with the geographical (longitude, latitude) coordinates and the Cartesian (X, Y) coordinates employed with the computational grid, a column (J) and row (I) coordinate system is also imposed to identify grid elements. In the present case, with the grid spanning 7° of longitude and 1° 40’ of

latitude, and with 24” row by 80” column grid element definitions, these latter coordinates range as follows:

Column (J) 1 - 315

Row (I) 1 - 250

The model grid is summarized in Table 2-1 and illustrated in Figure 2-1 where lines for every second row and column are drawn. The computational grid boundaries are shown as a gold rectangle in the spill probability figures in Section 2.4.

Table 2-1: OST Spill Model Grid Setup

	Grid Size						**Cell Size (latitude x longitude)**	
Domain	*latitude*	*longitude*	*# rows*	*# columns*	*latitude (km)*	*longitude (km)*	*latitude*	*longitude*
Milne Inlet Eclipse Sound, Pond Inlet	1° 40’ 71° 50' to 73° 30' N	7° 74° 30' to 81° 30' W	250	315	185	231.5 (at 72° 40’ N)	24” or 740 m	80” or 735 m
	grid mid-latitude is at 72° 40’N							

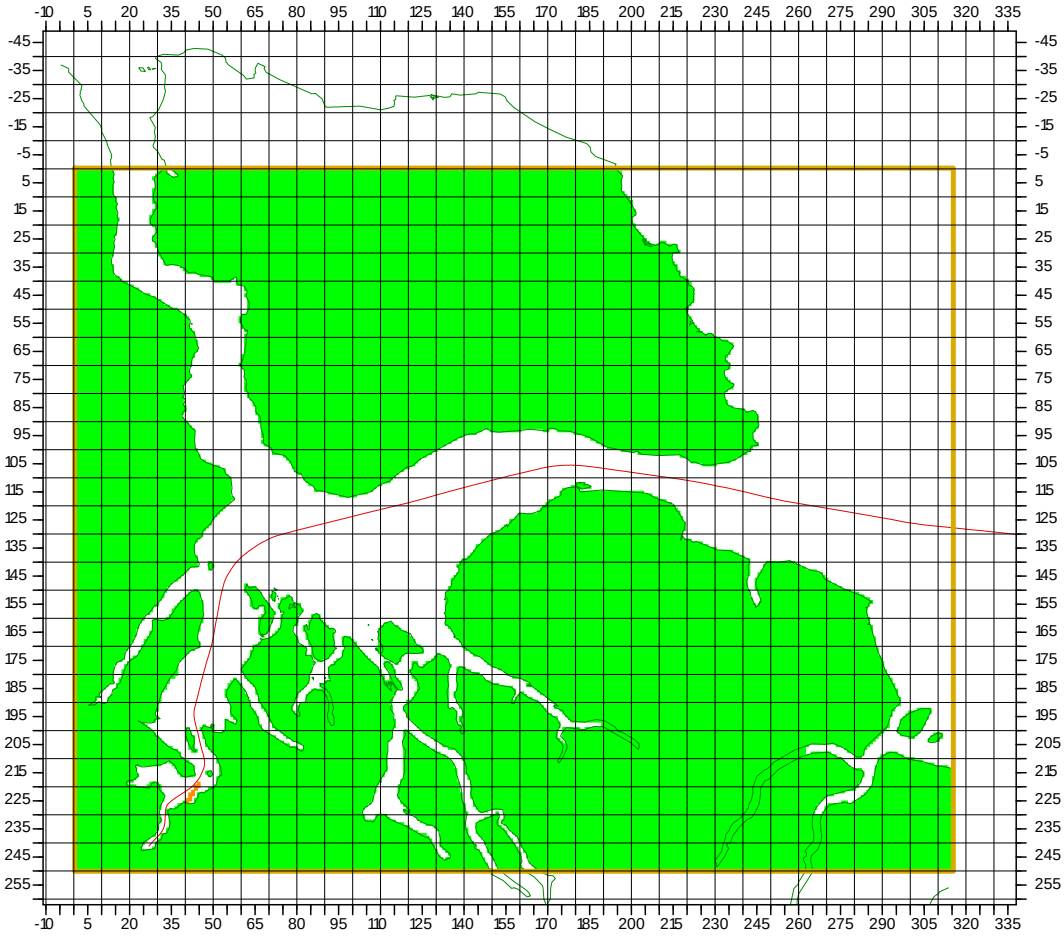


Figure 2-1: OST Spill Model Grid

2.1.3 Transport (Advection)

A simple transport computation is employed to simulate the advection of a point (assumed to represent the centroid of a slick) through two-dimensional space (representing the sea surface).

At any given time the point is assumed to be subject to two independent displacing forces. The presence of an ocean surface current is assumed to displace the point (centroid) in the direction of the current at 100% of the current speed. Simultaneously, but independently, the presence of wind is assumed to generate an instantaneous surface current directed 10° (Westeng, et al., 1977) to the right of the wind (in the northern hemisphere) and having a magnitude of 3.0 to 3.5% of the wind speed. A value of 3.5% is used in the model. This current is also assumed to directly transport the slick. Over the time-step of the available wind data the displacements due to surface

current and due to wind-driven surface currents are vectorially added to yield a new slick position. Sequential vector additions are computed over each successive time-step until the simulation terminates on one of two endpoint conditions:

- a coastal boundary is reached, or
- an external grid boundary is reached

A third possibility for ending a trajectory in the model is if the percent fuel weathered rises above 95%. The selection of the current vector and the wind vector to be employed in the transport computation at any given time during the simulation is determined strictly by the present location of the slick centroid.

For the present model implementation, the wind velocity is available hourly. Due to the generally short distances to shore in most of the study area, a sub-interval of 15 minutes is employed, where the winds and currents for a given hour are used at each of the four sub-steps in that hour.

2.1.4 Weathering

The scenario trajectory model is provided with a switch to globally control the use of weathering routines. If weathering routines are enabled, a series of subroutines are executed after the displacement computation (described above) is completed in each time step. The processes of evaporation and vertical dispersion or loss into the water column, are simulated to yield estimates of the total volume of fuel remaining. This is expressed as a percentage of initial spill volume. If weathering is switched off, these calculations are omitted.

Two fuel types were modelled: arctic diesel fuel for powering of site equipment and IFO 180 carried for ship propulsion. Based on fuel specification sheets for the project and use of the OILMAP updated oil database corresponding oil types were selected as follows: Diesel Fuel Oil (Alaska) for arctic diesel (Figure 2-2) and IFO 180 for the ore carrier's IFO fuel (Figure 2-3).

Upon release in the marine environment, fuel oil is subject to weathering processes, including spreading, evaporation, dissolution, dispersion of fuel droplets into the water column, photochemical oxidation, emulsification, microbial degradation, adsorption onto particulate matter, ingestion by aquatic organisms, sinking and sedimentation (Payne et al., 1991). Immediately after the fuel is spilled, it starts spreading over the sea surface, at a rate that is largely dependent on the viscosity (resistance to flow) of the fuel. The rate of spreading also depends on the wind speed, significant wave height, as well as the presence of tidal and mean currents. The dynamic viscosity of diesel fuel changes drastically with temperature from 2 mPa·s at 25°C to 4 mPa·s at 0°C (ESTD, Environment Canada, 2010).

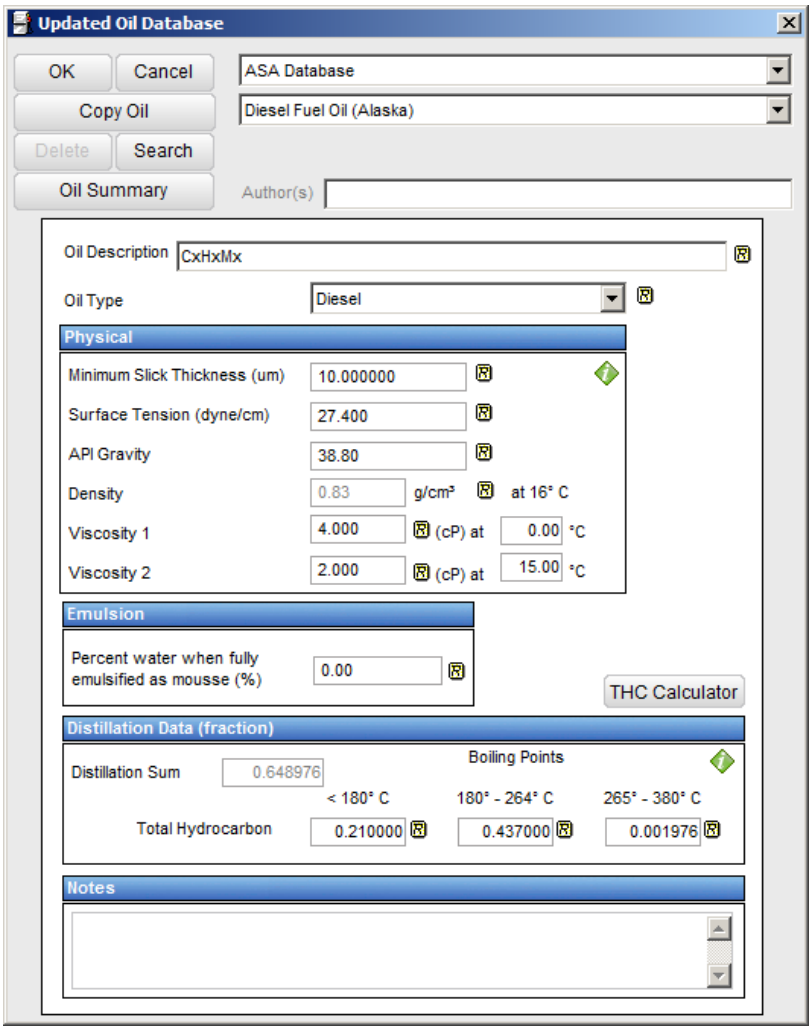


Figure 2-2: Diesel Fuel Oil (Alaska) Physical Parameters (Source: ASA Updated Oil Database, OILMAP v 6.10.2.0)

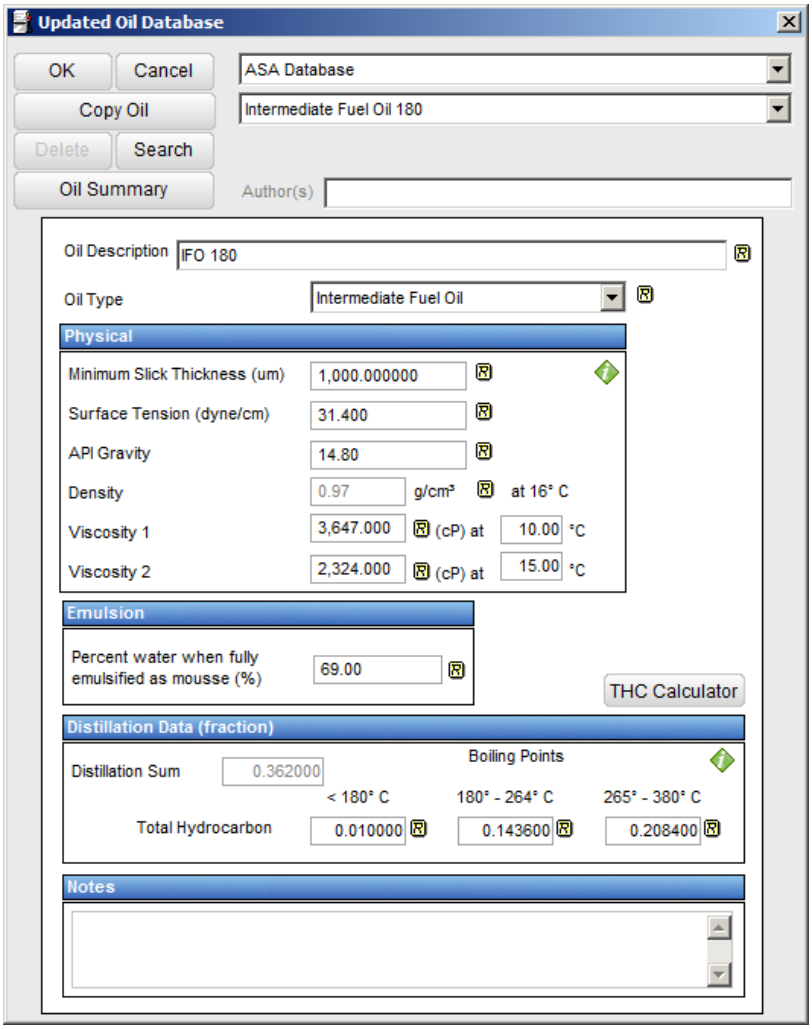


Figure 2-3: Intermediate Fuel Oil 180 Physical Parameters (Source: ASA Updated Oil Database, OILMAP v 6.10.2.0)

Another property of fuel that is especially significant in Arctic conditions is the pour point, which is the lowest temperature at which the fuel will flow, typically at -30°C (ESTD, Environment Canada, 2010). At temperatures below the pour point, the fuel solidifies rapidly and the spreading is minimized.

During periods of high winds and waves, the fuel can form narrow bands that are aligned with the wind direction, a state in which the slick movement is controlled by the sea state rather than the fuel properties (ITOPF, 2010).

Another major weathering process within the first days of a spill is evaporation. According to ITOPF (2010), most of the fuel components with a boiling point under 200°C tend to evaporate within the first few days. For diesel fuel, these components represent 34% of the weight (ESTD, Environment Canada, 2010). Therefore, due to the higher volatility of diesel fuel compared to a crude oil, a comparatively higher fraction of the amount of spilled fuel would evaporate. Evaporation is facilitated by the ambient temperature and the presence of wind.

The fuel fraction that is not lost to evaporation or dilution in water is eventually broken up into droplets of varying sizes which are subject to dispersion. The process of dispersion, often accelerated by the application of dispersants, contributes towards faster biodegradation, dissolution and sedimentation of the spilled fuel. Dispersion can be hindered by emulsification of the fuel under the action of waves, which is a common cause for the persistence of spilled fuel in the marine environment. On a time scale longer than a week, the dominant weathering processes become biodegradation by microorganisms and sedimentation and sinking processes (ITOPF 2010).

Primary environmental parameters that effect the weathering of spilled fuel include sea temperature and winds.

Model Implementation

For weathering algorithm development for the OST model, scenarios of both arctic diesel and IFO 180 fuel were simulated with the OILMAP software which calculates the evaporation, dispersion, and remaining percentage for a given spill scenario where the user defines a fuel product type, weather conditions, properties of the receiving water, and the amount of fuel released.

Illustration of the weathering of arctic diesel and IFO 180 fuels for a range of sea temperatures, and constant wind speed of 5 m/s, is presented in Figure 2-4 and Figure 2-5.

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Fuel Spill Modelling: Northern Shipping Route Open Water Season
Amec Foster Wheeler Project TA1475302
18 February 2015

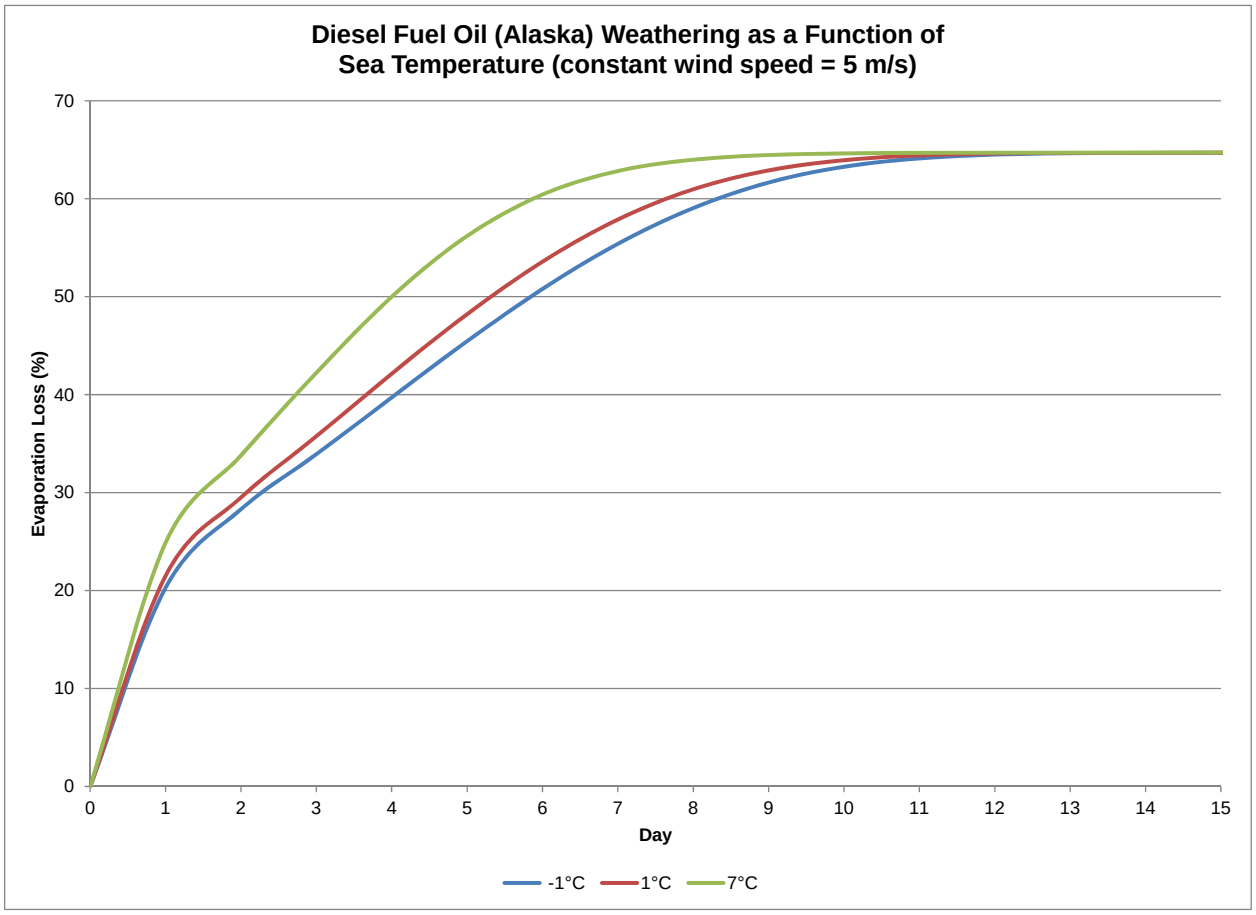


Figure 2-4: Diesel Fuel Oil (Alaska) Weathering: Evaporation Loss as a Function of Sea Temperature (Source: OILMAP)

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Amec Foster Wheeler Project TA1475302
18 February 2015

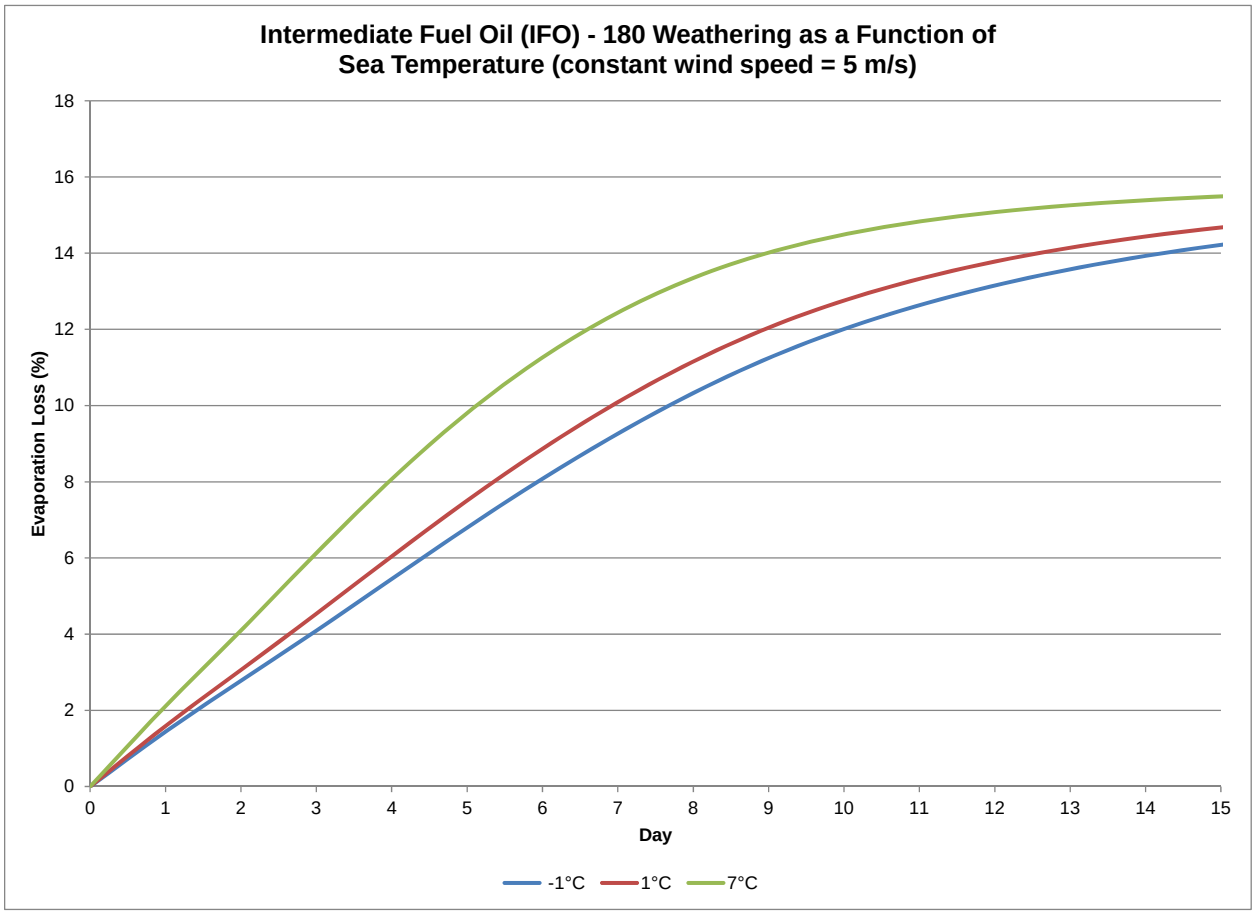


Figure 2-5: IFO 180 Weathering: Evaporation Loss as a Function of Sea Temperature (Source: OILMAP)

Modelled values for sea temperature are available from the HYbrid Coordinate Ocean Model (HYCOM), implemented as part of the global Real-Time Ocean Forecast System (Atlantic) model of the National Oceanic & Atmospheric Administration (NOAA) (National Weather Service, 2014). September values, near-surface – as the average of the 0 and 10 m depths - over the study area, average about 2°C (Figure 2-6). From a conservative view, for less evaporation loss, 1°C is selected for the spill weathering.

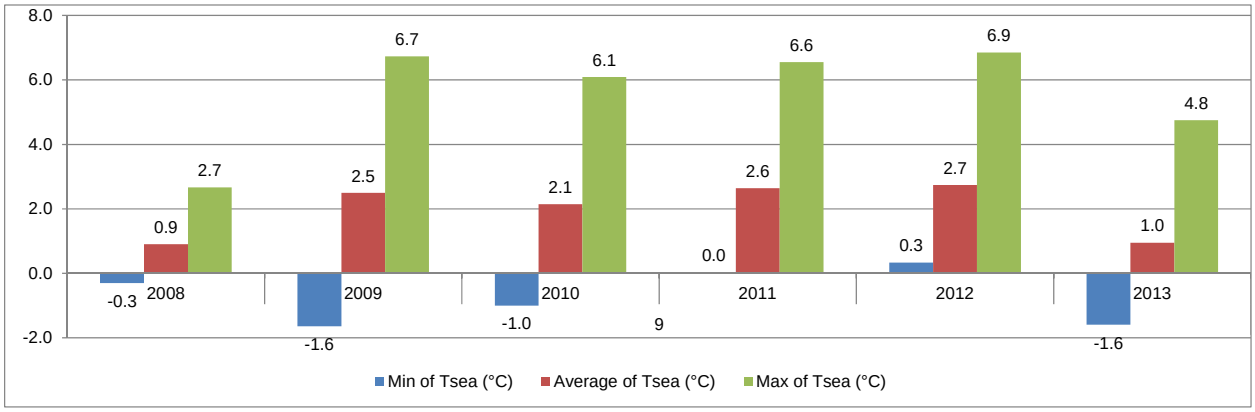


Figure 2-6: Sea Temperature, September (Source: HYCOM)

With an assumed 1°C sea temperature in hand, estimates of the likely weather losses due to evaporation and to dispersion into the water column were prepared again using OILMAP. These results are shown in Figure 2-7 to Figure 2-10 for a range of wind speeds for both fuel types. These results are also tabulated in Table 2-2 and Table 2-3 for arctic diesel fuel and Table 2-4 and Table 2-5 for IFO 180 fuel.

These tables were in turn implemented in the OST weathering routine; with the appropriate fuel type lookup applied. The lookup is simply based on time into the spill, and wind speed, and was used to calculate the percentage weathering losses, at each time step in the trajectory simulations. The spill modelling does not treat a specific volume of fuel, rather the percentage fuel remaining – less what is lost due to evaporation and water column dispersion - is estimated, and provided in the OST outputs; in this way one can apply the percentages to any chosen volume.

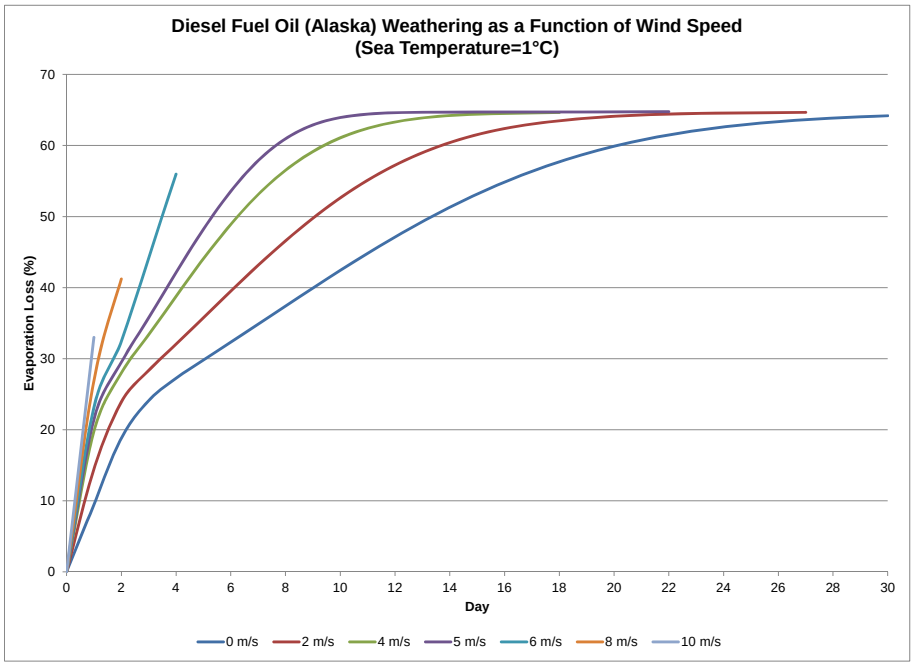


Figure 2-7: Diesel Fuel Oil (Alaska) Weathering: Evaporation Loss as a Function of Wind Speed (Source: OILMAP)

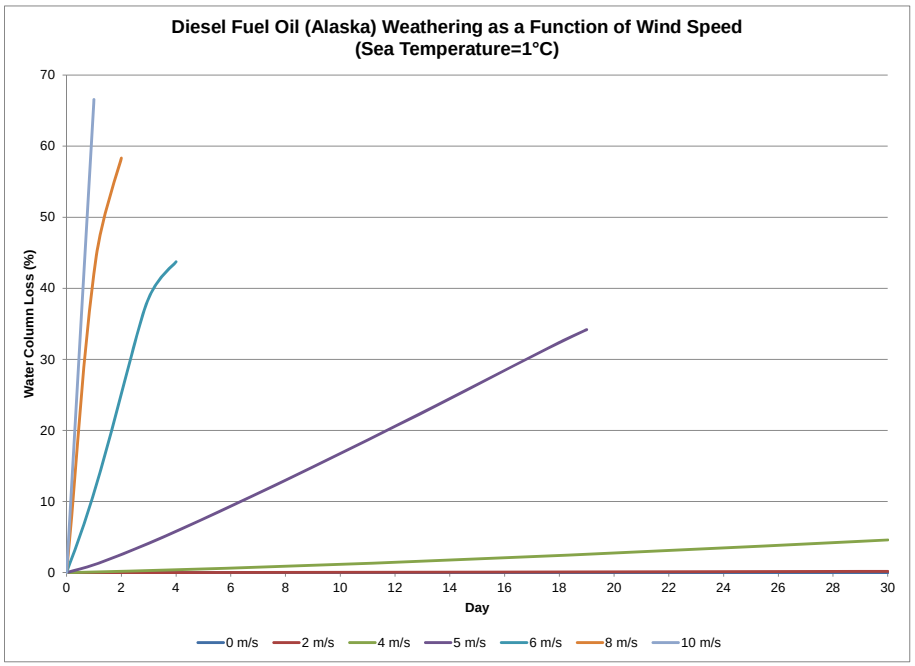


Figure 2-8: Diesel Fuel Oil (Alaska) Weathering: Water Column Loss as a Function of Wind Speed (Source: OILMAP)

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Fuel Spill Modelling: Northern Shipping Route Open Water Season
Amec Foster Wheeler Project TA1475302
18 February 2015

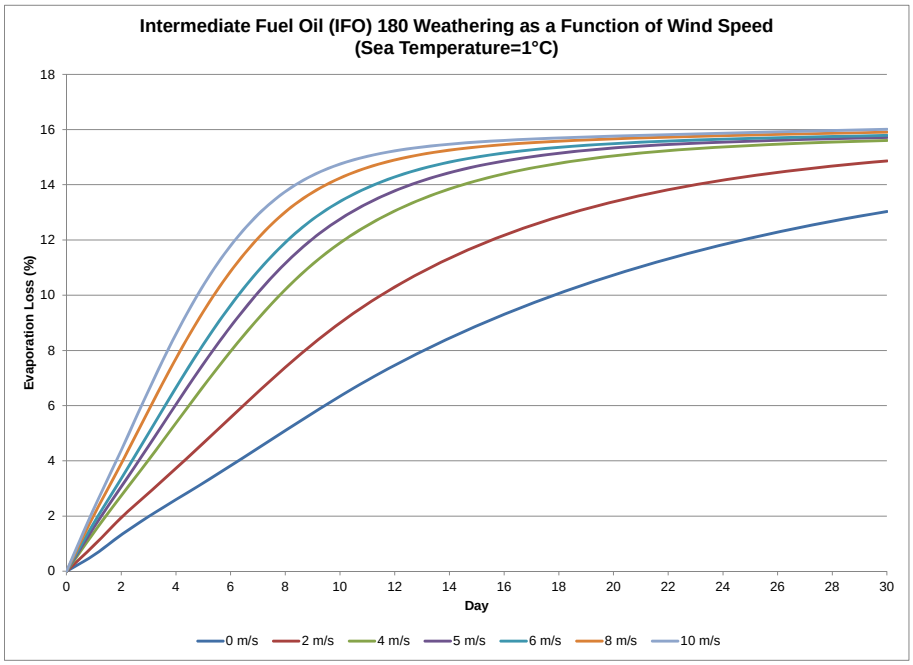


Figure 2-9: IFO 180 Weathering: Evaporation Loss as a Function of Wind Speed (Source: OILMAP)

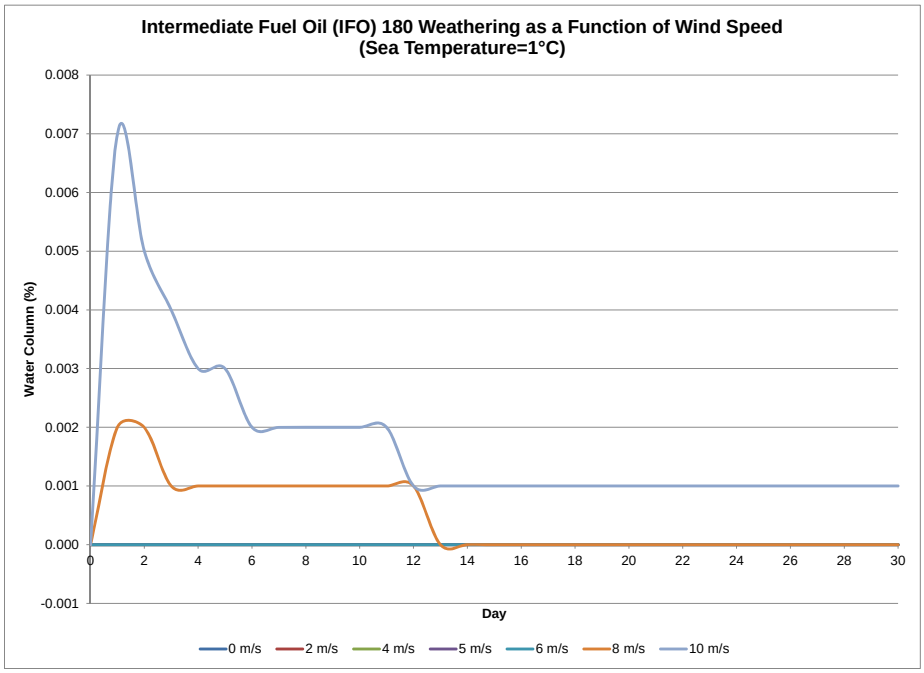


Figure 2-10: IFO 180 Weathering: Water Column Loss as a Function of Wind Speed (Source: OILMAP)

Table 2-2: Diesel Fuel Oil (Alaska) Weathering: Evaporation Loss as a Function of Wind Speed

Wind Speed (m/s)	Evaporation Loss Rate (% per day) for time into Spill (days)				
	0-1 days	2	3-4	5-9	10+
0-1	9.5	9.3	4.2	2.5	1.2
1-3	14.5	9.4	4.1	3.5	1.0
3-4.5	19.8	8.2	5.4	4.1	0.7
4.5-5.5	21.5	8.0	6.3	4.2	0.4
5.5-7	23.2	9.2	11.8	0.0	0.0
7-9	27.0	14.2	0.0	0.0	0.0
9+	33.0	0.0	0.0	0.0	0.0

Table 2-3: Diesel Fuel Oil (Alaska) Weathering: Water Column Loss as a Function of Wind Speed

Wind Speed (m/s)	Water Column Loss Rate (% per day) for time into Spill (days)				
	0-1 days	2	3-4	5-9	10+
0-1	0.0	0.0	0.0	0.0	0.0
1-3	0.1	0.1	0.1	0.1	0.1
3-4.5	0.1	0.1	0.1	0.1	0.2
4.5-5.5	1.1	1.5	1.6	1.8	1.9
5.5-7	11.1	14.0	9.3	0.0	0.0
7-9	42.4	16.0	0.0	0.0	0.0
9+	66.0	0.0	0.0	0.0	0.0

Values are rounded to nearest 0.1%; values greater than 0.0 but less than 0.1 are rounded to 0.1%

Table 2-4: IFO 180 Weathering: Evaporation Loss as a Function of Wind Speed

Wind Speed (m/s)	Evaporation Loss Rate (% per day) for time into Spill (days)				
	0-1 days	2	3-4	5-9	10+
0-1	0.6	0.7	0.6	0.6	0.3
1-3	0.9	1.0	0.9	0.9	0.3
3-4.5	1.4	1.3	1.3	1.2	0.2
4.5-5.5	1.6	1.5	1.5	1.2	0.2
5.5-7	1.8	1.6	1.6	1.2	0.1
7-9	2.0	1.9	1.9	1.2	0.1
9+	2.3	2.1	2.1	1.2	0.1

Table 2-5: IFO 180 Weathering: Water Column Loss as a Function of Wind Speed

Wind Speed (m/s)	Water Column Loss Rate (% per day) for time into Spill (days)		
	0-2 days	3-9	10+
0-7	0.0	0.0	0.0
7-9	0.002	0.001	0.0
9+	0.006	0.002	0.001

2.2 Model Input

2.2.1 Wind

Winds for input to the spill models were selected following comparison of a number of sources. These included:

- the met station at the Milne port site
- Environment Canada climate stations at Pond Inlet
- MSC North Atlantic wind and wave hindcast winds just east of the entrance to Pond Inlet
- European Centre for Medium-Range Weather Forecasts (ECMWF), ERA Interim (ERAI) class, Atmospheric Model winds at 10 m, gridded over the study area[1]

[1] abbreviations ERI YYy XXx are used to denote ERA Interim winds at latitude YY.y N, XX.x W, e.g., ERAI 725 790 is for the location at 72.5°N, 79.0°W in Eclipse Sound.

While the ERAI wind speeds were judged to be a bit low compared to measurements from the Milne camp site, and at times, also at Pond Inlet, they provide long time-series records over the entire study area and were selected to provide reasonable wind inputs for the spill model.

The winds from Pond Inlet, three ERAI locations - two in Eclipse Sound and one at the MSC50 location east of Bylot Island are illustrated in Figure 2-11.

Four ERAI grid points were selected for the OST spill model as shown in Figure 2-12: winds at the grid point nearest a given scenario location were selected for each scenario's model input.

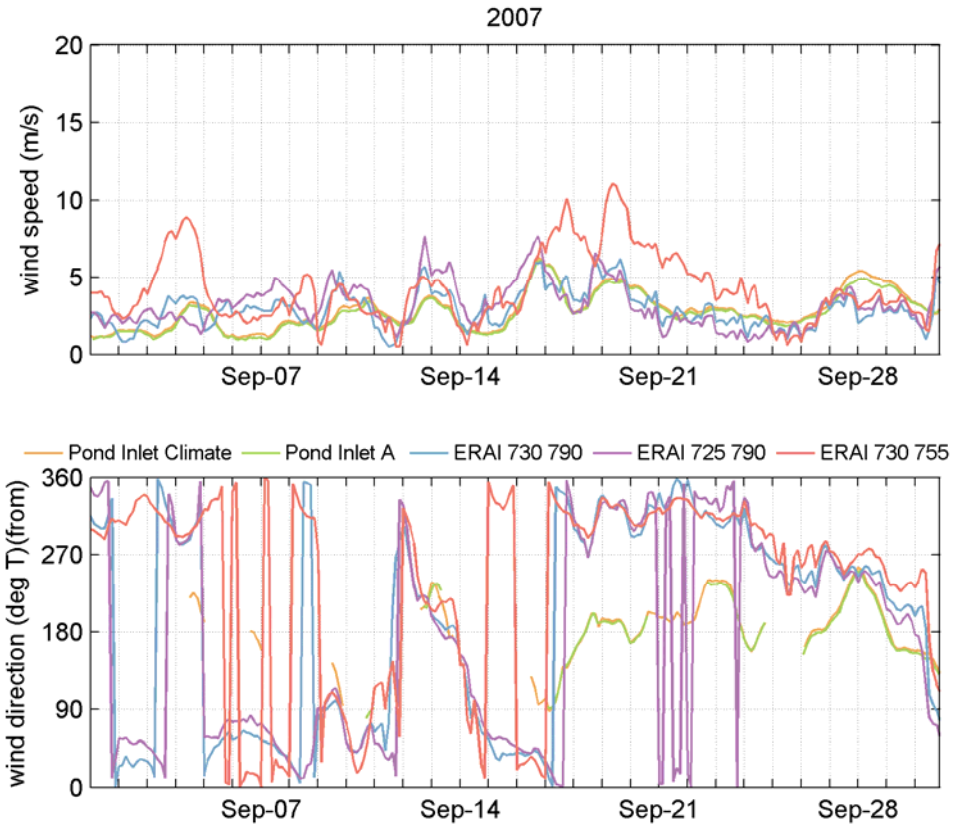


Figure 2-11: Wind Comparison, September 2007

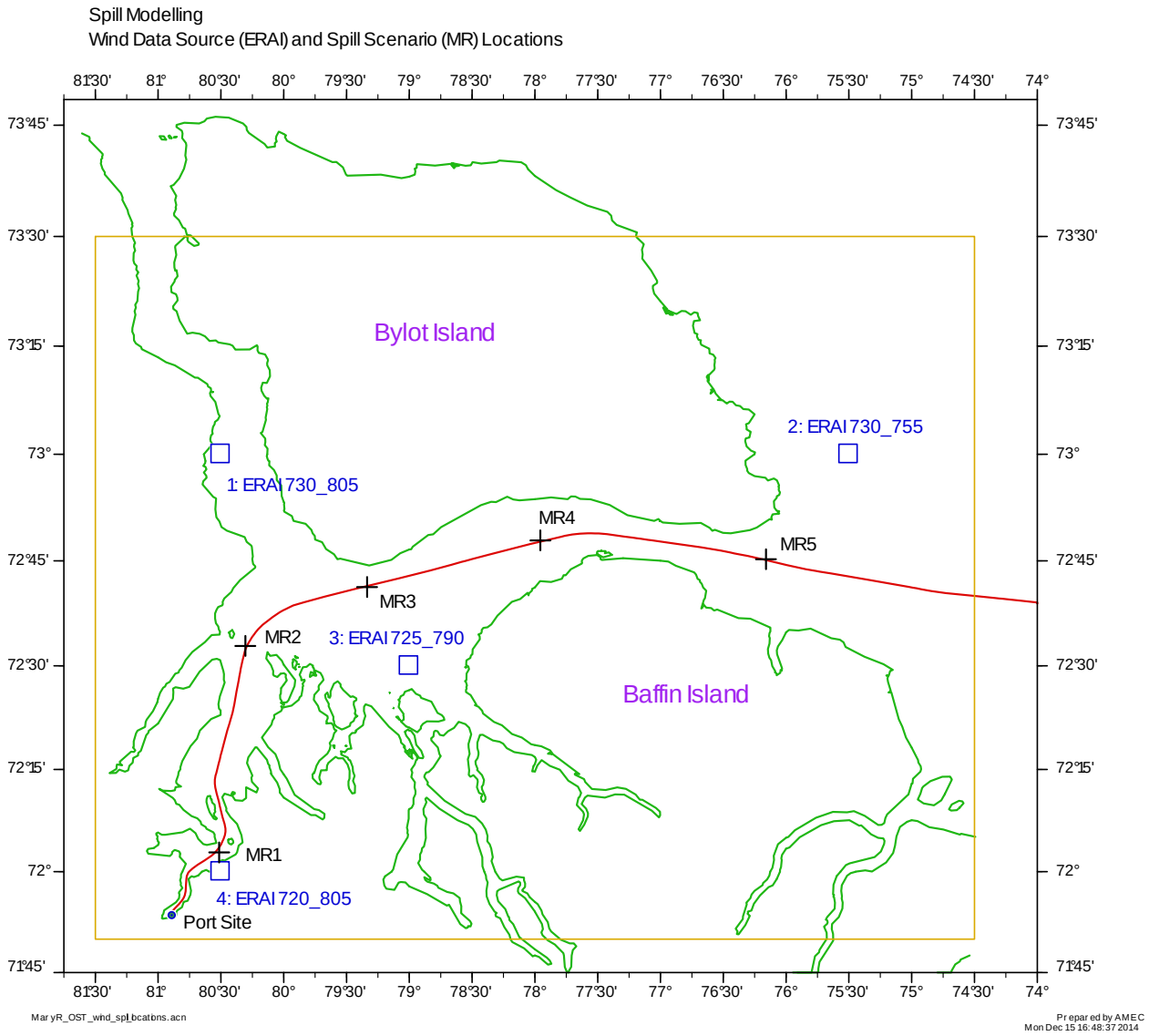


Figure 2-12: Wind Data Source Locations (ERAI grid points denoted with blue squares)

2.2.2 Ocean Currents

The high resolution ocean circulation model, the HYbrid Coordinate Ocean Model (HYCOM), is implemented as part of the Real-Time Ocean Forecast System (Atlantic) HYCOM model of the National Oceanic & Atmospheric Administration (NOAA) (National Weather Service, 2014). HYCOM current model experiments for September month from 2008 to 2013 were downloaded for an area near Baffin Island encompassing the spill model domain. The model yields one value

per day at depth levels of 0, 10, 20, 30, 50, 75, 100, 125, 150, 200, 250, 300, 400, 500, ..., 1400, 1500 m. The grid spatial resolution is. For the spill model, mean current velocities were calculated for the average of the 0 and 10 m depths to yield an estimate of near-surface ocean current (Figure 2-13).

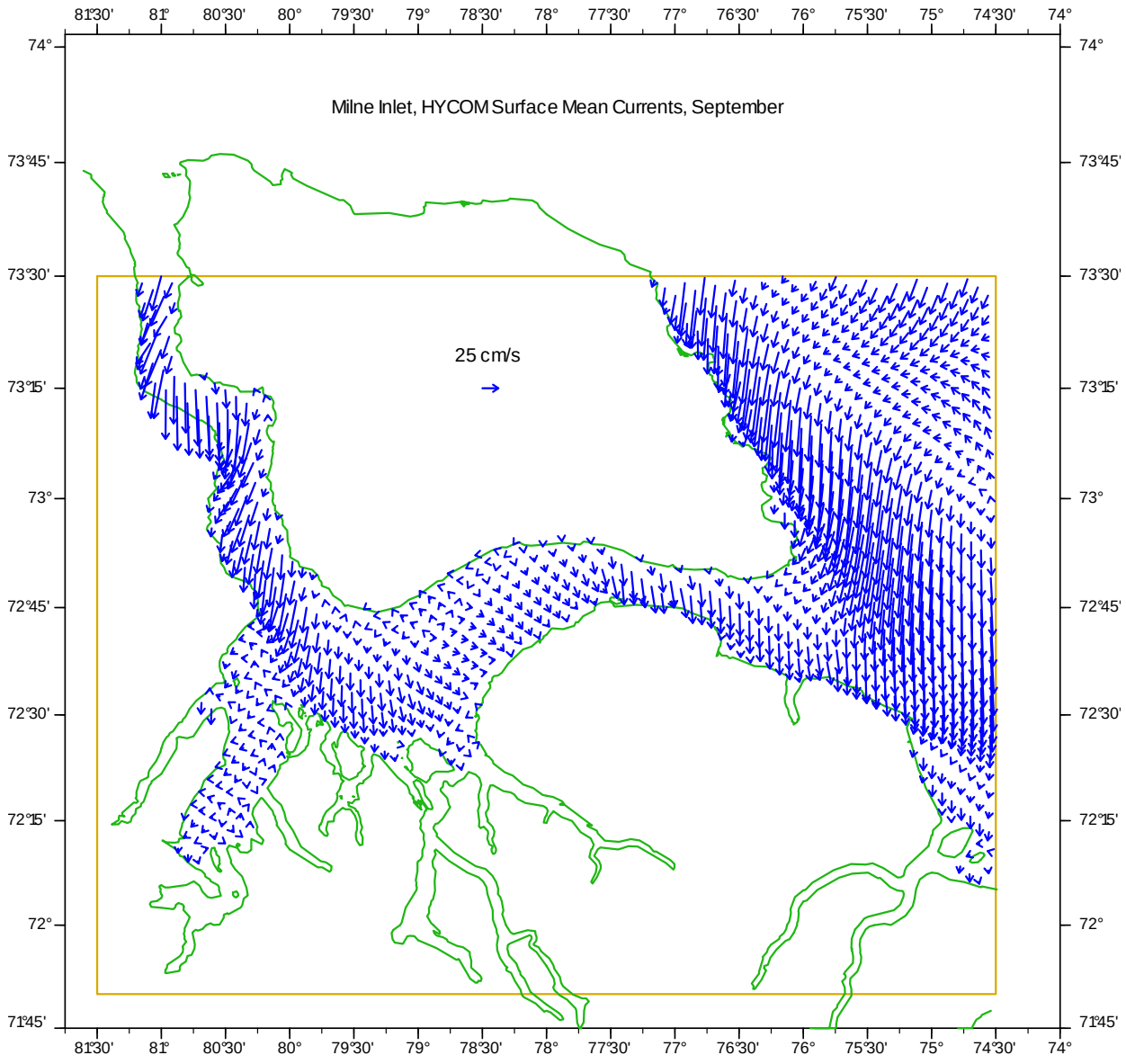


Figure 2-13: Milne Inlet, HYCOM Surface Mean Currents, September

2.3 Model Output

2.3.1 Individual Day Spill Trajectory Plots

The basic spill modelling result is generated by introducing a spill on any given day of a given month, e.g., September, of any year, at the scenario location. The trajectory of the spill is computed over an ensuing time interval until the trajectory eventually terminates on a coastline or on an external boundary (e.g., latitude 73° 30'N at the north of the model grid) or until a maximum duration of thirty days is reached. For example, a spill initiated on 1 September 1984 would take as input the portion of the 1984-2013 wind time-series that commences on 1 September 1984 (thirty years is taken as a representative period to characterize the wind climate for this study). The model trajectory then traces out the path the spill would take over the subsequent thirty days: 1 September, 2 September ..., 30 September or until, as noted above, the trajectory terminates on a coastline or model grid boundary. (Any spill that continues into October uses the corresponding October winds.) This trajectory is one "representative case" and illustrates the possible geographical distribution of fuel which could have evolved for a spill originating on that day in the given month and year (e.g., 1 September 1984).

2.3.2 Shoreline Zone Definitions

For a scenario in which at least one trajectory terminates ashore, the fuel distribution probability calculations yield an accompanying set of shoreline summary statistics. These statistics identify, by geographical region, the percentage of trajectories that reach shore, and the earliest, mean, and latest times to shore. For the Milne Inlet study area 13 regions are defined to cover the model domain. These regions are illustrated in Figure 2-14.

Companion model output listings report statistics for each day/year trajectory as follows:

- row and column of the grid cell where the trajectory ended
- "ORI" land ('I') or water ('O') designation of the end point
- range, bearing, and latitude and longitude or the end point
- whether the trajectory reached shore or a model boundary
- elapsed time of the trajectory, until it ended
- path length and mean speed
- percent of original fuel volume remaining after weathering

By introducing a spill at the beginning of each day of September for each of the 30 years of wind data, and superimposing the resulting 900 daily trajectories on a single plot, a representative indication of possible slick motion for that month is achieved. This is quantified through a count of the number of individual trajectories that travel through a given square, e.g., 18 is 2% of the

900 trajectories so that one can estimate a 2% probability of fuel reaching that grid square. This is described further in Section 2.3.3.

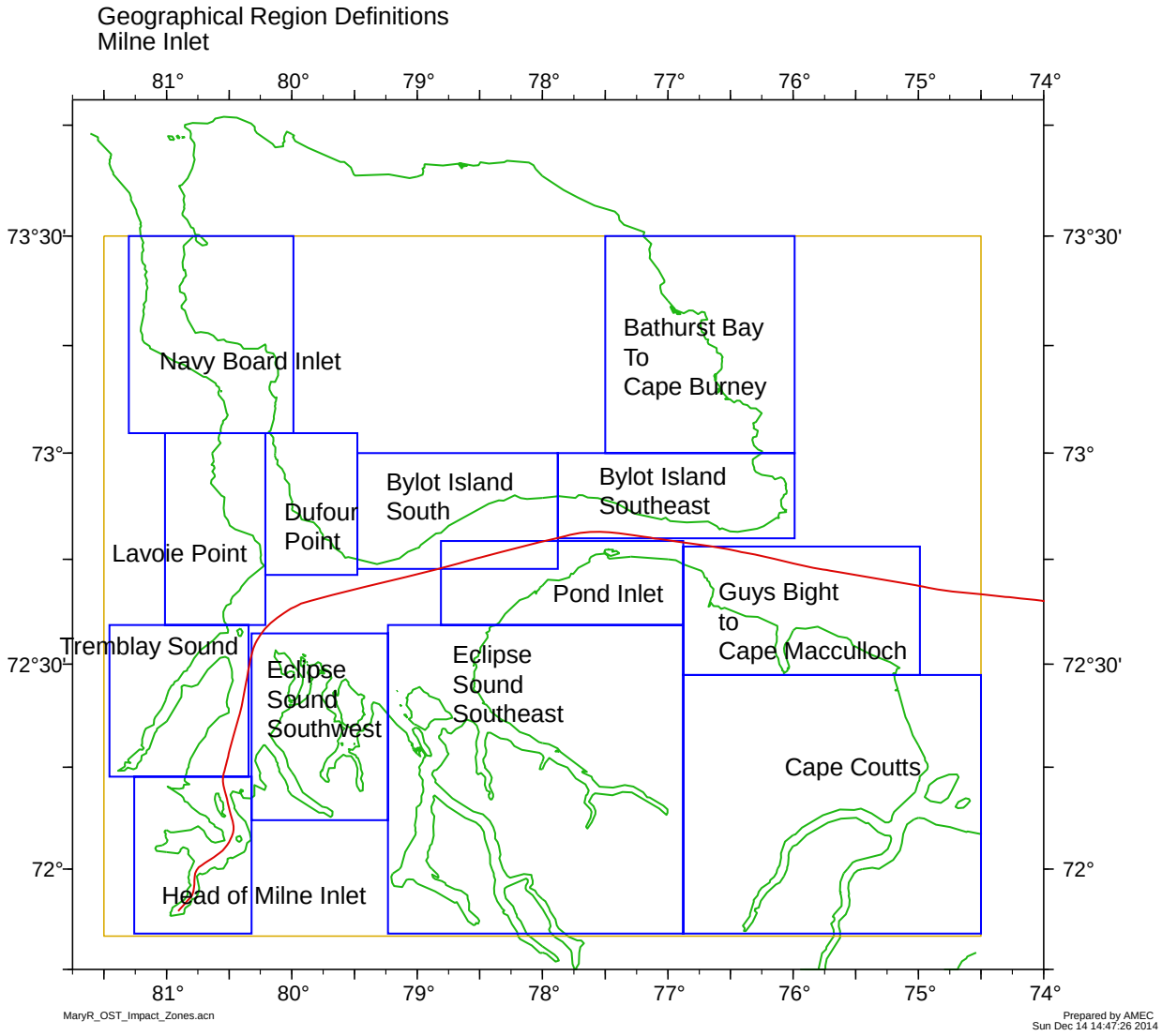


Figure 2-14: Definition of Geographical Regions for Interpretation of Shoreline Statistics

2.3.3 Composite Monthly Fuel Distribution Probability Maps

To define the probability of fuel distribution by month, every possible spill originating each day over the 30 year duration of the wind record is considered. That is, all possible trajectories (up to 30 days at 30 per day) for the month of September are simulated. Note that any month may be modelled. Thus, for September there are a total of 900 trajectories. For each element or cell of the computational grid (350 columns by 250 rows) a record of the number of (monthly) trajectories passing through that element is maintained. By knowing the total number of trajectories simulated for a given month, it is thus possible to identify the percentage of those trajectories which passed through any particular grid element. Due to the large number of trajectories simulated for a given month this percentage can be interpreted as the probability that fuel released at the spill site in the given month, would reach the particular grid element. Grid elements having similar levels of probability can be grouped to present a contoured display of fuel distribution probabilities.

The probable directions of slick motion and probable spill destinations are now more precisely defined by the probability plots than by a representative case, or individual day, scenarios (will be described in next draft). The basic probability plots have been developed from simulations of every possible day spill over the duration of the available 30-year wind record.

2.4 Presentation and Interpretation of Results

The spill probability maps employ the following colour code.

Probability Range	**Colour**
25% < P < 100%	Orange
15% < P < 25%	Red
5% < P < 15%	Pink
2% < P < 5%	Yellow
1% < P < 2%	Light Blue
0% < P < 1%	Grey

Land is shown in green. The shipping route is shown in red.

The percentages can be interpreted as presenting the probability that fuel would reach any particular location on the map, given a spill originating on any day of the particular calendar month. In this instance, the 25%, 15%, 5%, 2%, 1%, and 0% contours of probability are illustrated.

Orange contours indicate that 25 to 100% of all trajectories (in the case of 900 simulations, 225 to 900 trajectories) will pass through that location (grid cell in the model). Grey contours indicate that 1% or less of all trajectories (in the case of 900 simulations, 1 to 9 of 900 trajectories) will pass through that location.

There is no implication that a spill could cover the entire zone enclosed by a contour, only that the fuel would drift through or be located at some position within this zone. The contours represent the maximum possible affected zone and in reality any spill would be likely to affect only some modest subset of the region, depending on wind and current conditions over the duration of the spill, and the weathered fate of the spill slick.

These probabilities are derived from scenarios in which the hypothetical spills are both uncontained and unmanaged, conditions that would be limited given an appropriate fuel spill emergency contingency planning and response plan in place.

The set of fuel distribution probability maps for the arctic diesel fuel scenarios are presented in Sections 2.4.1 to 2.4.5. The set of IFO 180 fuel scenarios were also completed: the trajectory paths and fuel distribution probability maps were virtually identical to those for arctic diesel. Time to shore for IFO 180 were also virtually the same as those for arctic diesel; therefore, the IFO 180 fuel distribution probability maps are not presented.

Different weathering fates were estimated for the two fuel types, as presented in Section 2.5.

2.4.1 Milne Inlet: Bruce Head

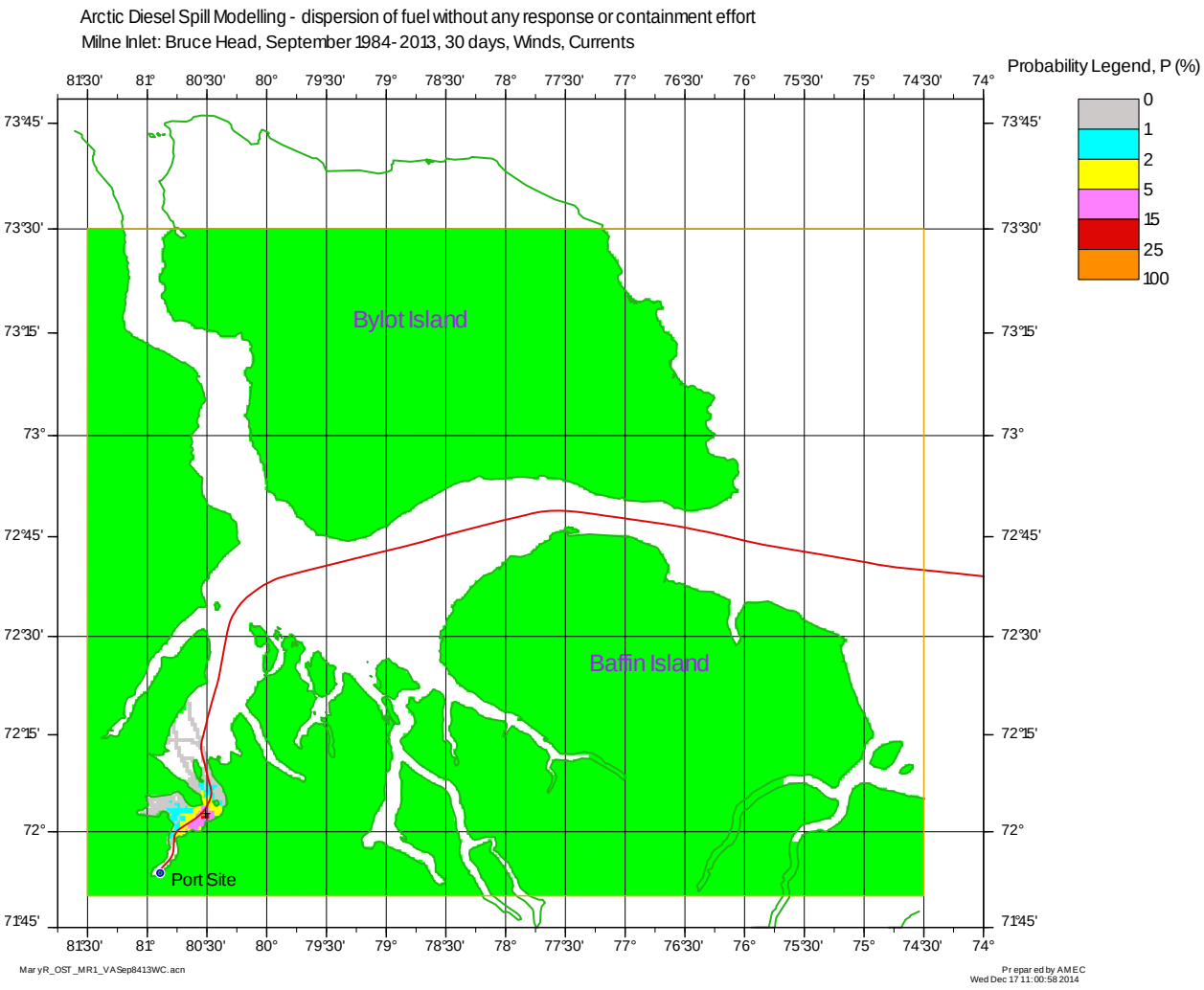


Figure 2-15: Spill Distribution Probability Plot, Milne Inlet, Bruce Head, September, Base Case

2.4.2 Milne Inlet: Mouth

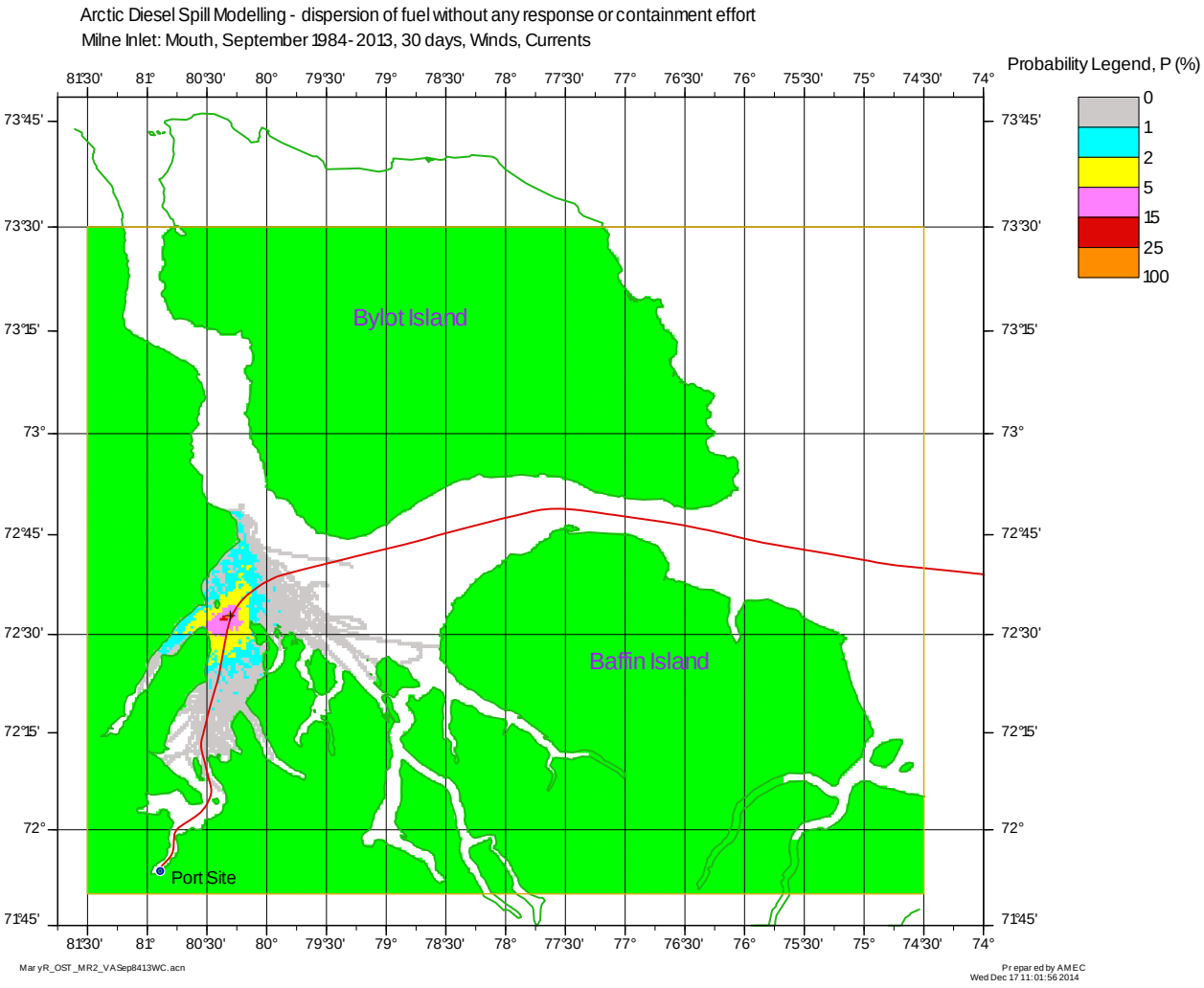


Figure 2-16: Spill Distribution Probability Plot, Milne Inlet, Mouth, September, Base Case

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Fuel Spill Modelling: Northern Shipping Route Open Water Season
Amec Foster Wheeler Project TA1475302
18 February 2015

2.4.3 Eclipse Sound

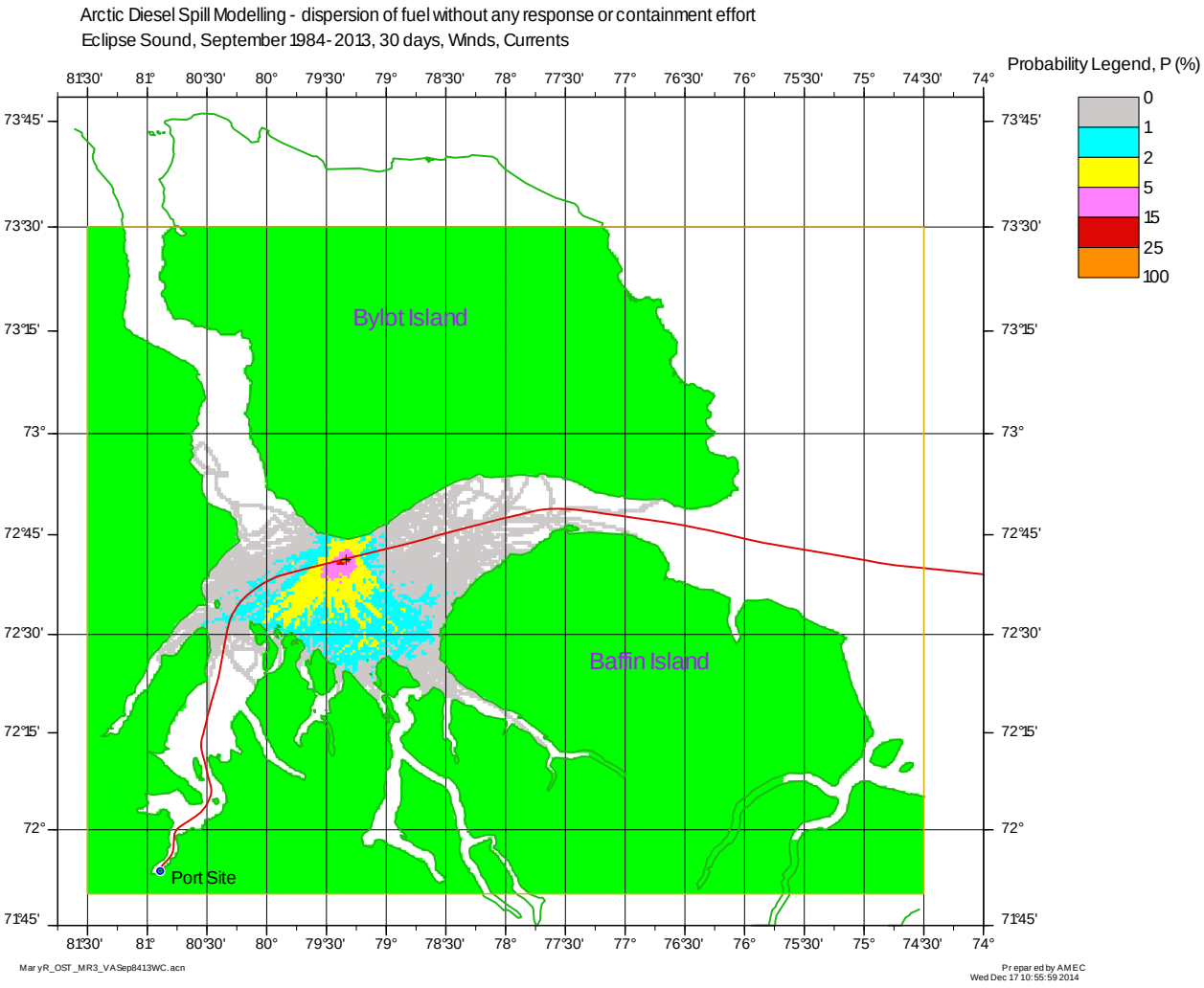


Figure 2-17: Spill Distribution Probability Plot, Eclipse Sound, September, Base Case

2.4.4 Pond Inlet: West

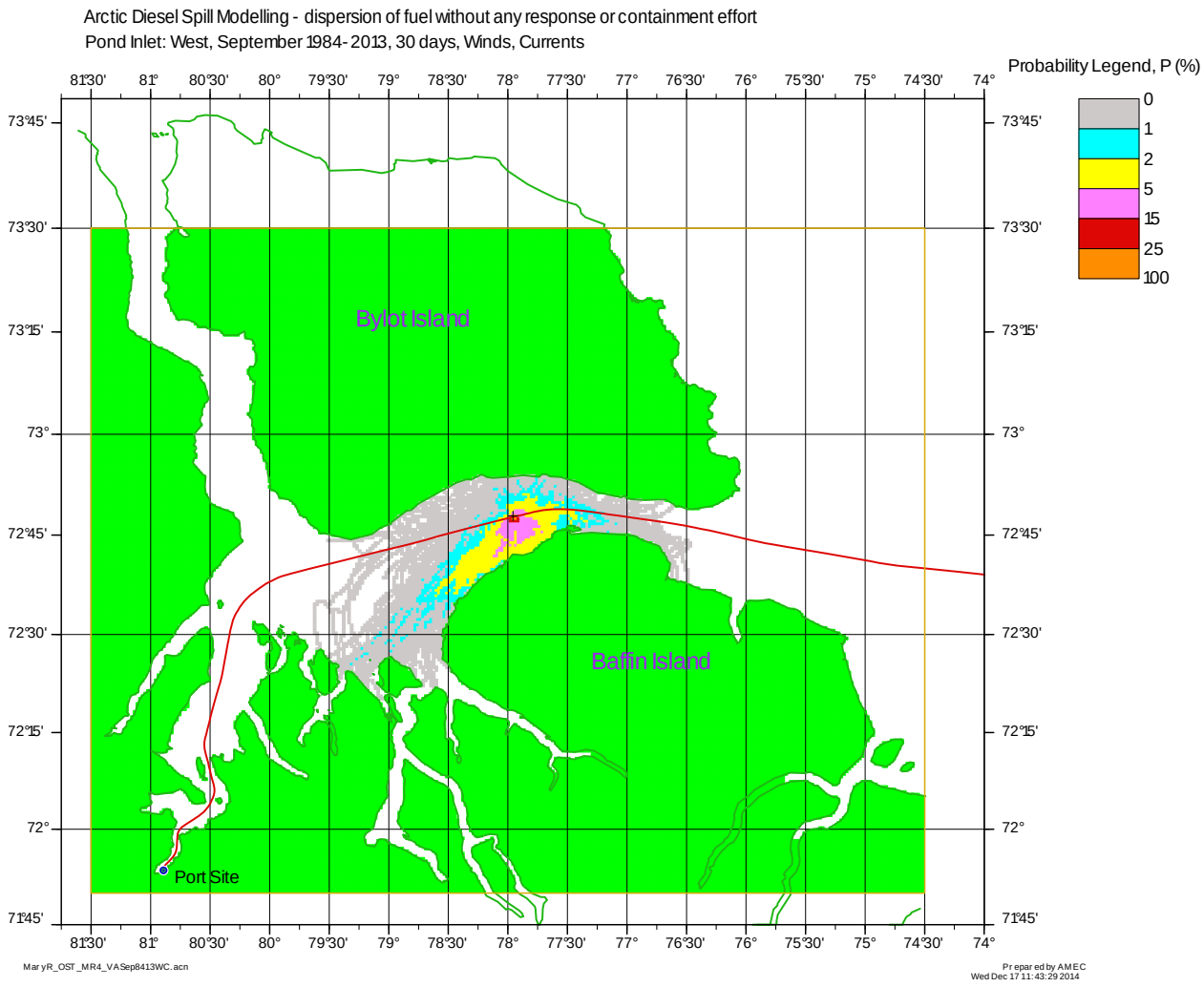


Figure 2-18: Spill Distribution Probability Plot, Pond Inlet, West, September, Base Case

2.4.5 Pond Inlet: East

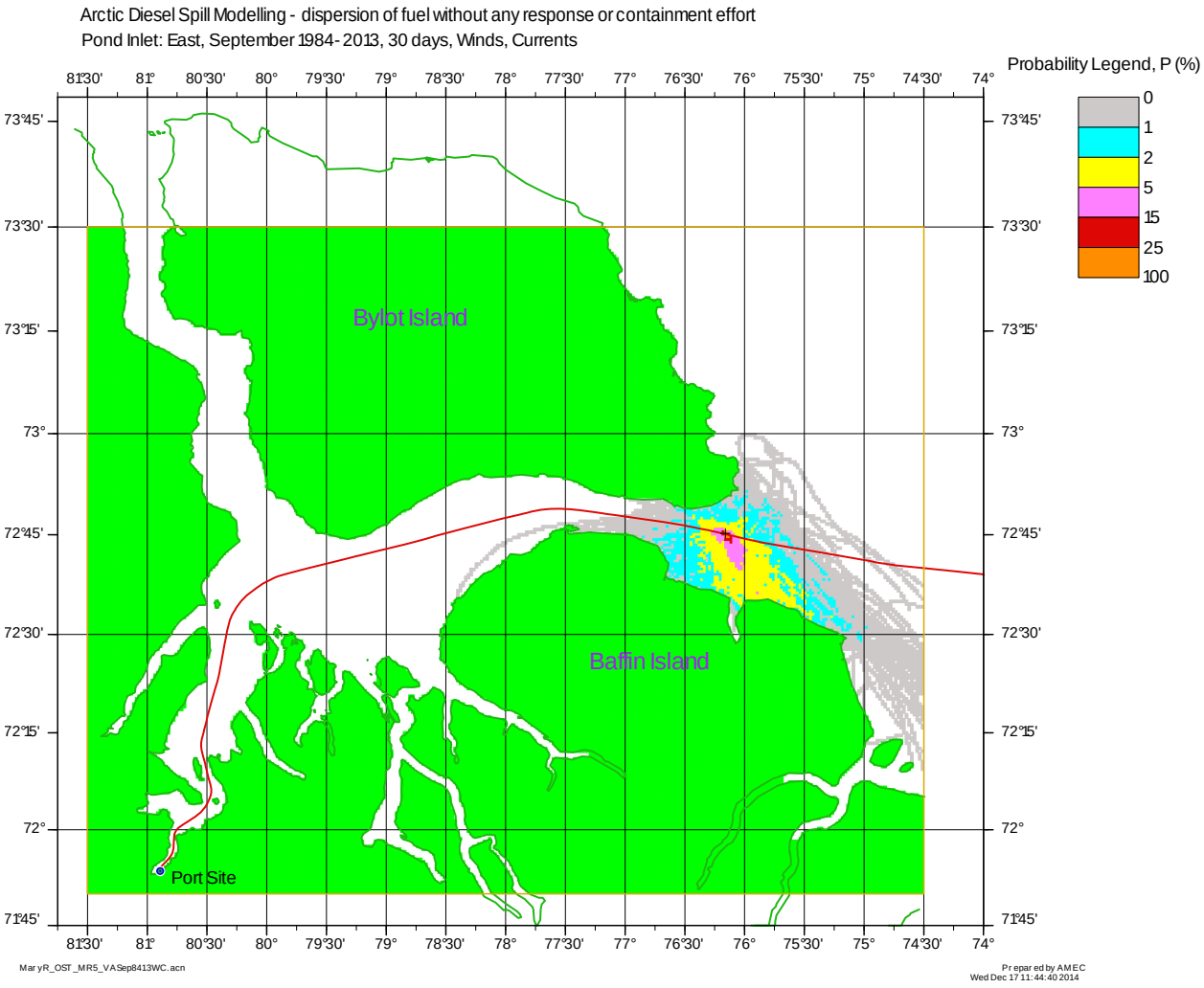


Figure 2-19: Spill Distribution Probability Plot, Pond Inlet, East, September, Base Case

2.5 Shoreline Statistics

Figure 2-20 reports the percentage of trajectories reaching shore. Figure 2-21 reports the mean time to shore for each region. Figure 2-22 and Figure 2-23 show statistics for the mean percent of fuel remaining at the end of each trajectory; for both Arctic diesel and IFO 180 fuel types.

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Fuel Spill Modelling: Northern Shipping Route Open Water Season
Amec Foster Wheeler Project TA1475302
18 February 2015

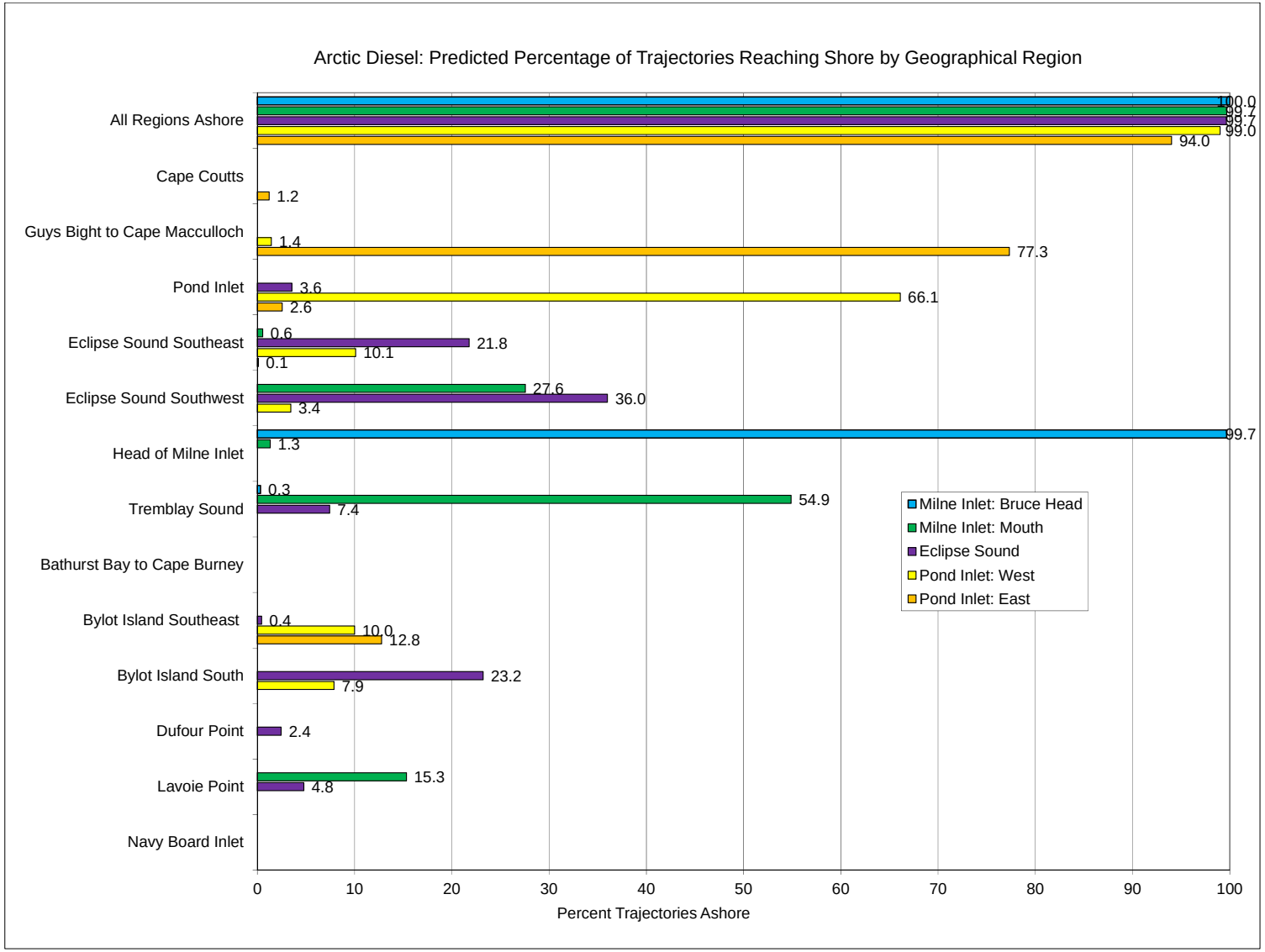


Figure 2-20: September, Arctic Diesel, Percentage of Trajectories Reaching Shore

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Amec Foster Wheeler Project TA1475302
18 February 2015

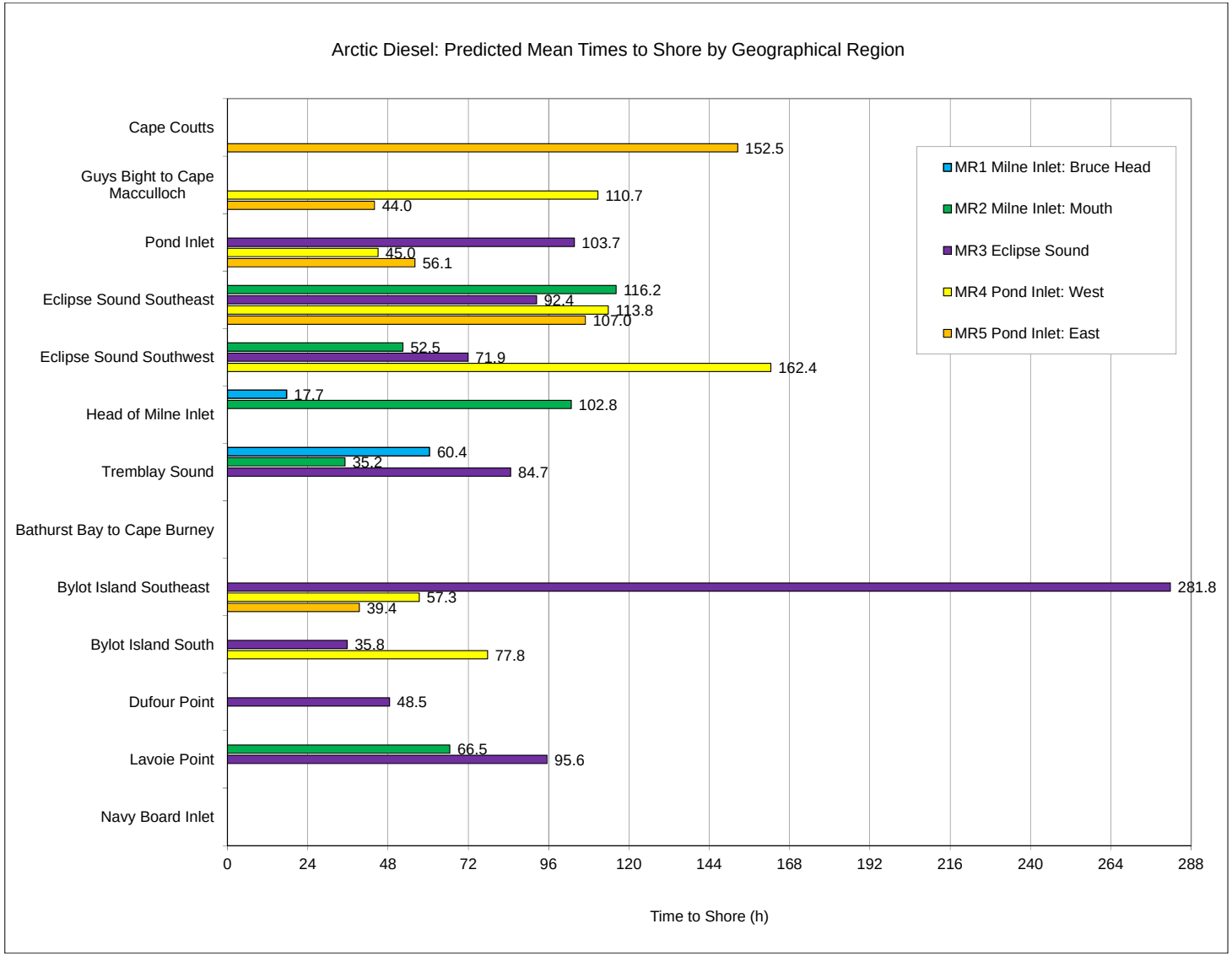


Figure 2-21: September, Arctic Diesel, Mean Times to Shore

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18 February 2015

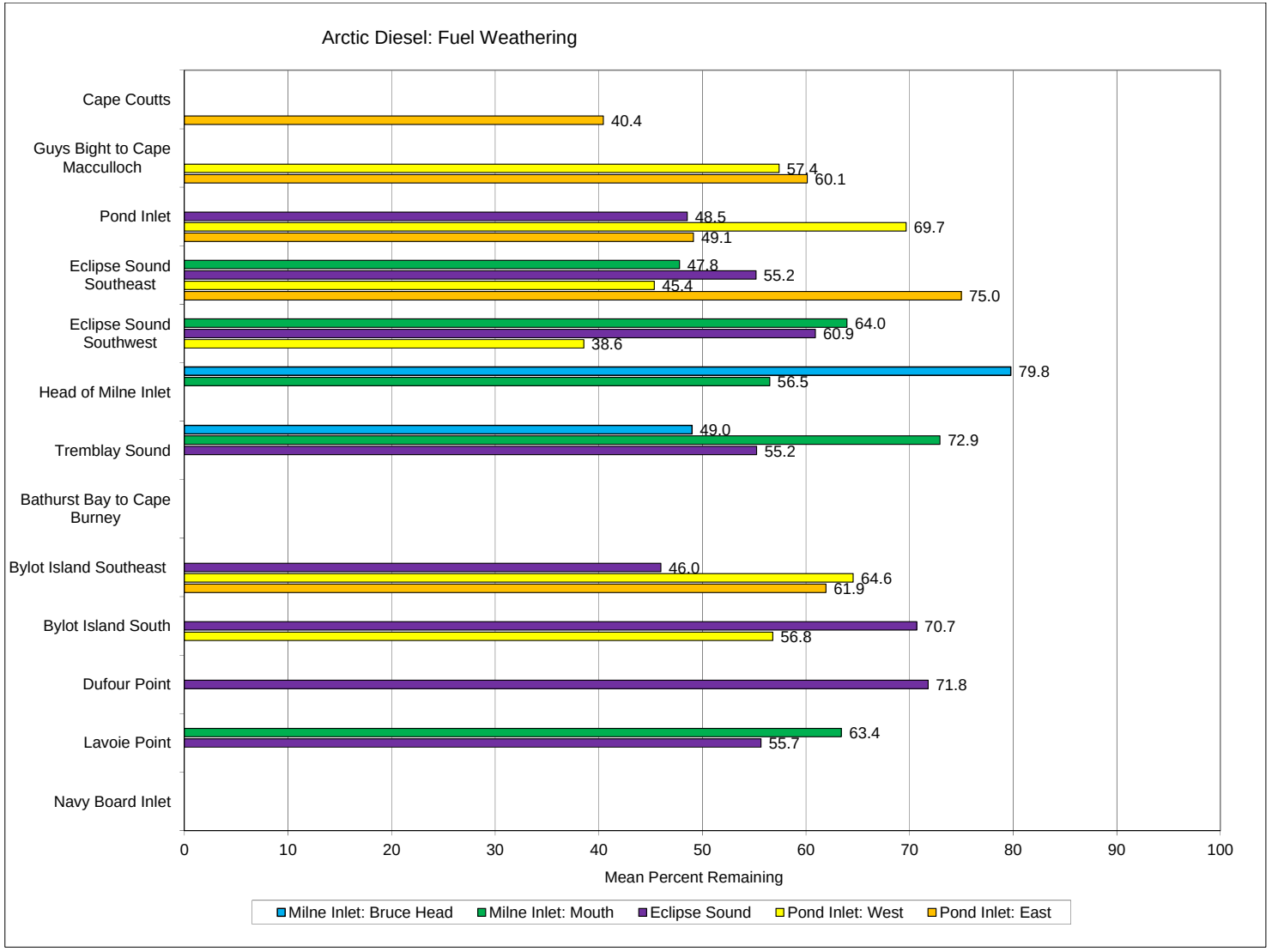


Figure 2-22: September, Arctic Diesel, Fuel Weathering

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Amec Foster Wheeler Project TA1475302
18 February 2015

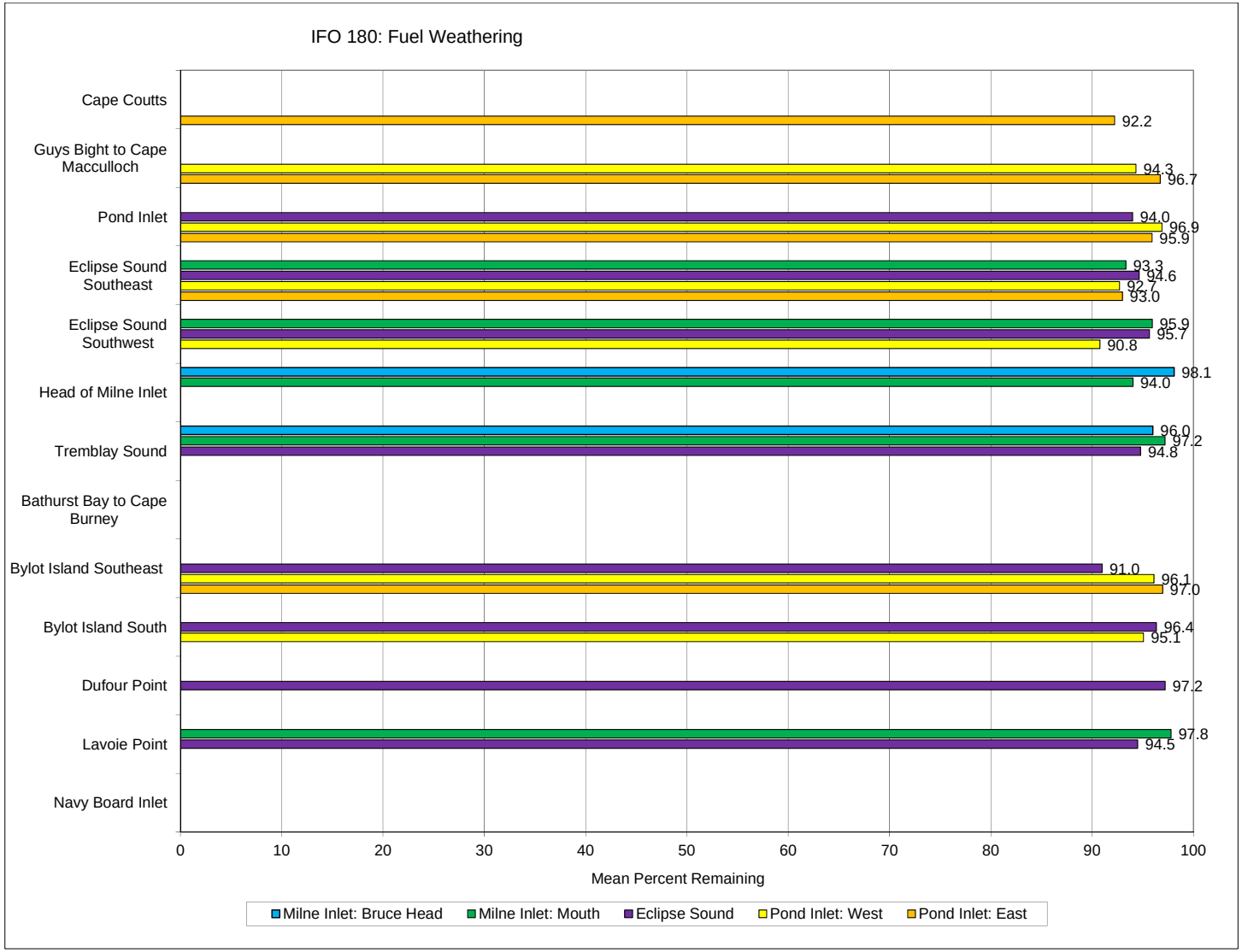


Figure 2-23: September, IFO 180, Fuel Weathering

3.0 SPILL FATE MODELLING: OILMAP

The OILMAP oil spill model and reponse system introduced above was used to provide additional estimates of spilled fuel fate, in particular, slick characteristics and weathering. OILMAP will calculate the evaporation, dispersion and remaining percentage for a given spill scenario where the user defines a fuel product type, weather conditions, properties of the receiving water, and the amount of fuel released.

The fate or weathering processes considered were evaporation, the conversion of liquid fuel into a gaseous component, and natural dispersion, the breakup of a fuel slick into small droplets that are mixed into the sea by wave action. These are two important weathering processes that typically occur over the first five days following a spill and act to remove fuel from the sea surface. Fuel will also be brought to shore depending on the prevailing currents and winds at the time as well as the type and amount of fuel, and type of shoreline. Consideration of the amounts lost due to these processes yields an estimate of the remaining amount of fuel on the surface at any time. These are the key fates modeled and tracked by OILMAP. No containment or recovery of spilled fuel is assumed in the simulations considered here.

3.1 Model Implementation

A 185 x 221 cell land/water grid of cell size ~1 km^2 was created as shown in Figure 3-1.

OILMAP's ability to characterize shore types was employed. An oil, or fuel, handling capacity based on oil type, and beach or shore type is calculated (ASA, 2004). Each shore type has an associated maximum oil thickness. Wind or current may bring fuel ashore depositing it on the shoreline. Deposition ceases when the holding capacity for the shoreline surface is reached. Any subsequent fuel brought ashore to that shoreline cell will remain offshore on the water surface.

The OILMAP Sheltered Rock shore type was selected to be representative for the model domain. This corresponds to an approximate beach width of 3 m with associated maximum surface fuel thicknesses of 1 mm for light oils (< 30 cSt, e.g., gasoline or diesel fuel), 5 mm for medium oils (30-2000 cSt, e.g., medium to light crude oils), and 10 mm for heavy oils (> 2000 cSt, e.g., heavy bunker or weathered crude).

Baffinland Iron Mines Corporation, Mary River Project
Fuel Spill Modelling: Northern Shipping Route Open Water Season
Amec Foster Wheeler Project TA1475302
18 February 2015

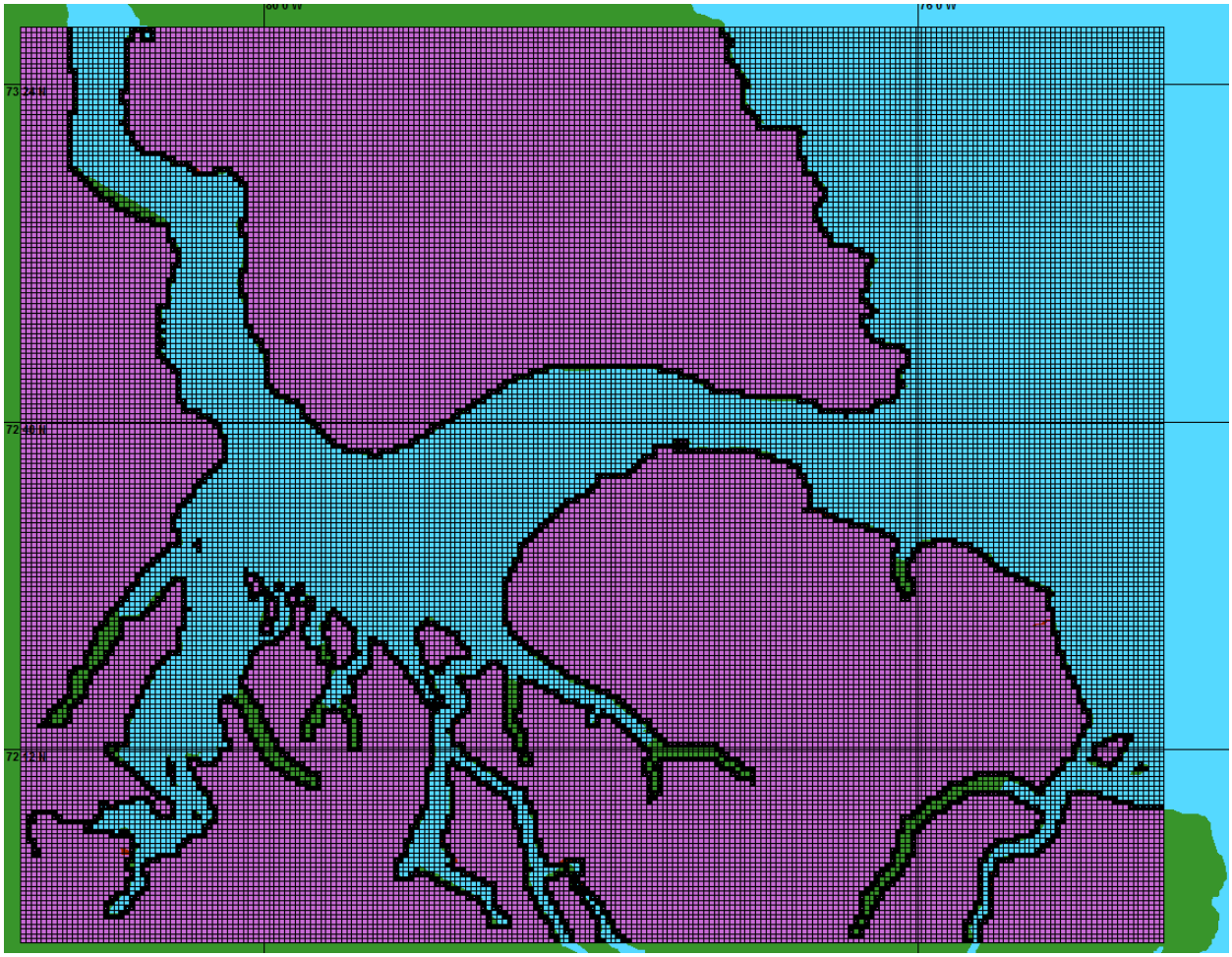


Figure 3-1: Milne Inlet: OILMAP Land/Water Grid

3.2 September 'P50' Wind Scenarios

Ten OILMAP simulations (Table 3-1) were run with a September 'P50' wind condition defined as the average wind speed conditions and the associated most frequent wind direction (Figure 3-3).

Table 3-1: September 'P50' Winds

			September 'P50' Winds	
Spill ID	**Location**	**Wind Source**	**Mean Wind Speed (m/s)**	**Most Frequent Wind Direction (from)**
MR1	Milne Inlet: Bruce Head	ERAI 720_805	4	NE
MR2	Milne Inlet: Mouth	ERAI 725_790	4	NE
MR3	Eclipse Sound	ERAI 725_790	4	NE
MR4	Pond Inlet: West	ERAI 725_790	4	NE
MR5	Pond Inlet: East	ERAI 730_755	5	NW

Wind sources: abbreviations ERI YYy XXx denotes ERA Interim winds at latitude YY.y N, XX.x W

Mean wind speeds: rounded to nearest m/s

Two sets of simulations considering release at each of the five spill scenario locations were completed: one set releasing 4 ML of arctic diesel cargo and one set releasing 2 ML of IFO 180 fuel.

The spill amounts were modelled to be released to the sea surface over a 1 h duration. For an actual spill, the duration of release would depend on several factors which could include location and orientation of the ship, nature of the any hull damage and marine weather conditions. The total fuel volume lost would also affect initial slick size. Figure 3-2 illustrates the scenario of a 2 ML IFO spill after 36 h at the Eclipse Sound scenario location. Two trajectories are shown: one for a 1 h duration on the right, and one for a 24 h duration on the left. Wind conditions simulated are those of Figure 3-9. As can be seen, the longer release time has the effect of creating a larger slick, whereas, with a 1 h release, the slick is more confined. In practice, time to mobilize and reach the slick and respond would also affect the slick size and fate.

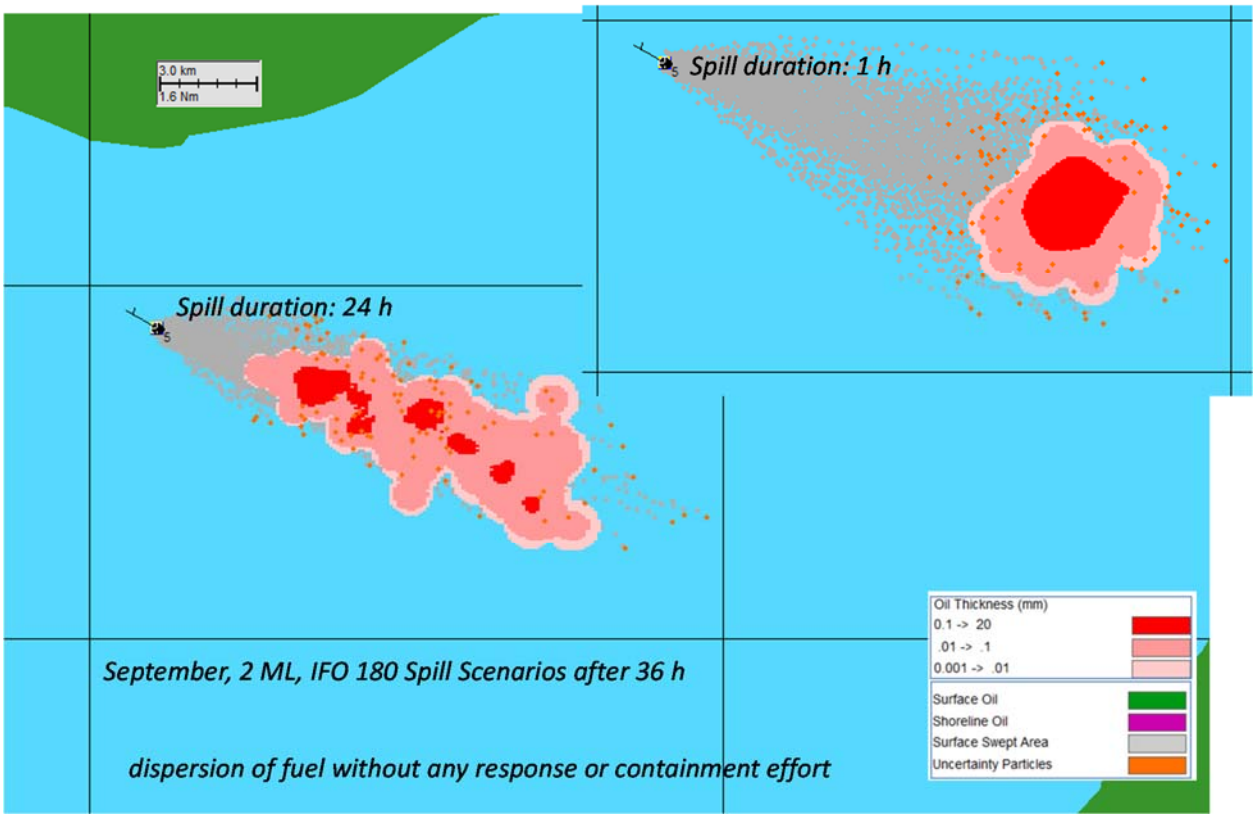


Figure 3-2: September, IFO spill durations of 1h, 24 h

OILMAP maps showing spatial extent and shorelines affected are shown at two times during the simulation, after one day, and after five days. These maps are presented in Figure 3-4 and Figure 3-5 for arctic diesel and Figure 3-7 and Figure 3-8 for IFO 180 fuel. The spill volume is apportioned to a number of 'spillets', in this simulation, 100, which are each modeled separately; spillets with volume less than 10% are not tracked further. In addition, the slick thicknesses (Figure 3-6) are shown for three levels as follows:

- red 0.1 to 20 mm
- rose 0.01 to 0.1 mm
- light pink 0.001 to 0.01 mm

Slick swept area is shown in grey; surface fuel spillets are shown in green; spillets ashore are shown in magenta. Uncertainty particles are shown in orange: the results of an uncertainty analysis whereby the wind speed and current speed are varied by 30% and wind direction and current direction are varied by 30°. A summary of the spill fates after five days are presented in Table 3-2 and Table 3-3 for the two sets of simulations.

Baffinland Iron Mines Corporation, Mary River Project
Fuel Spill Modelling: Northern Shipping Route Open Water Season
Amec Foster Wheeler Project TA1475302
18 February 2015

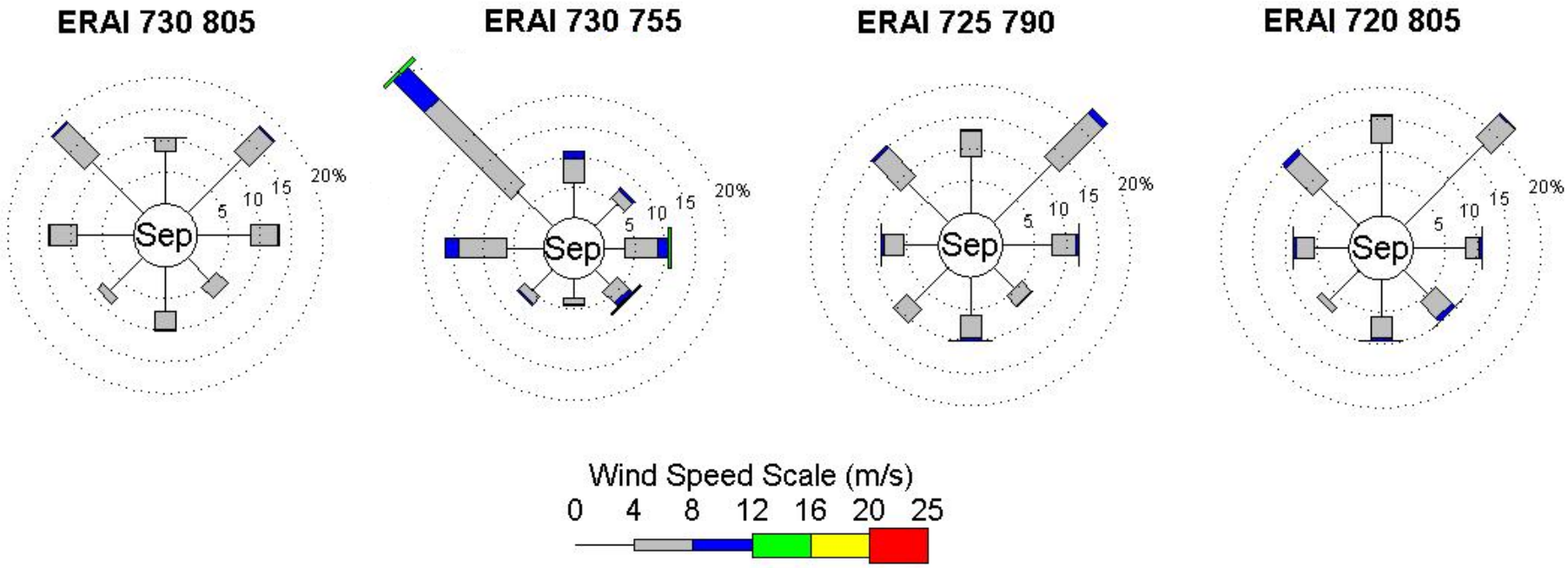


Figure 3-3: Wind Roses, September, 1984-2012

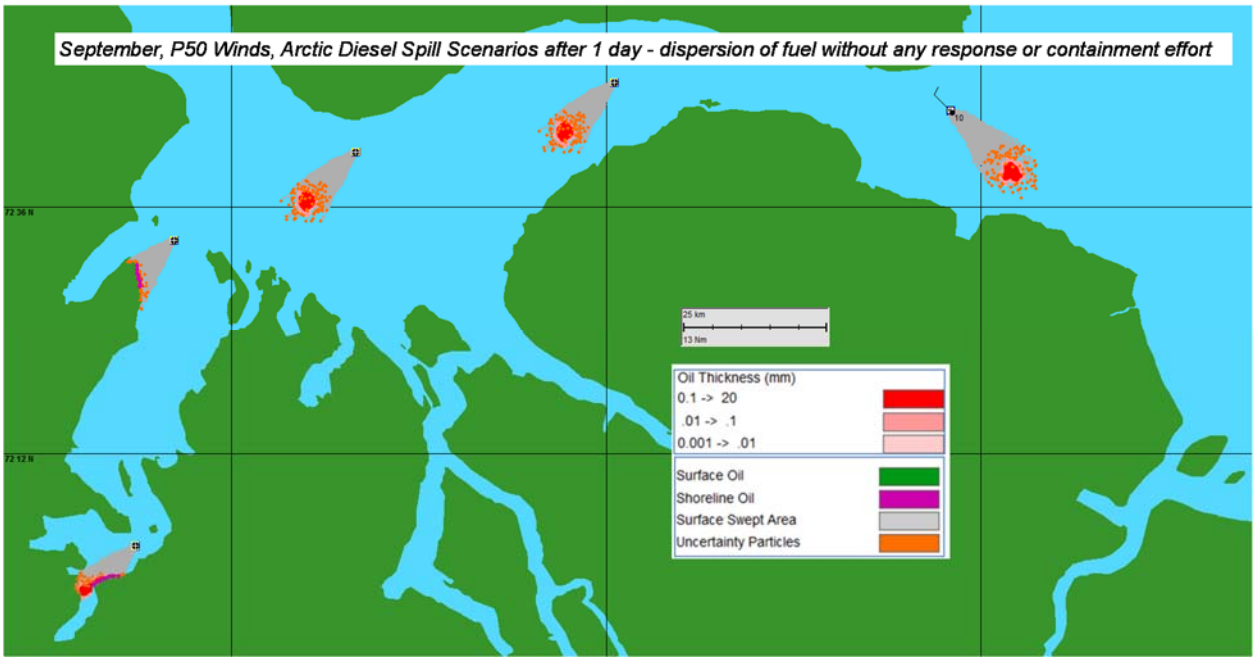


Figure 3-4: September, P50 Winds, Arctic Diesel Spill Scenarios after 1 day

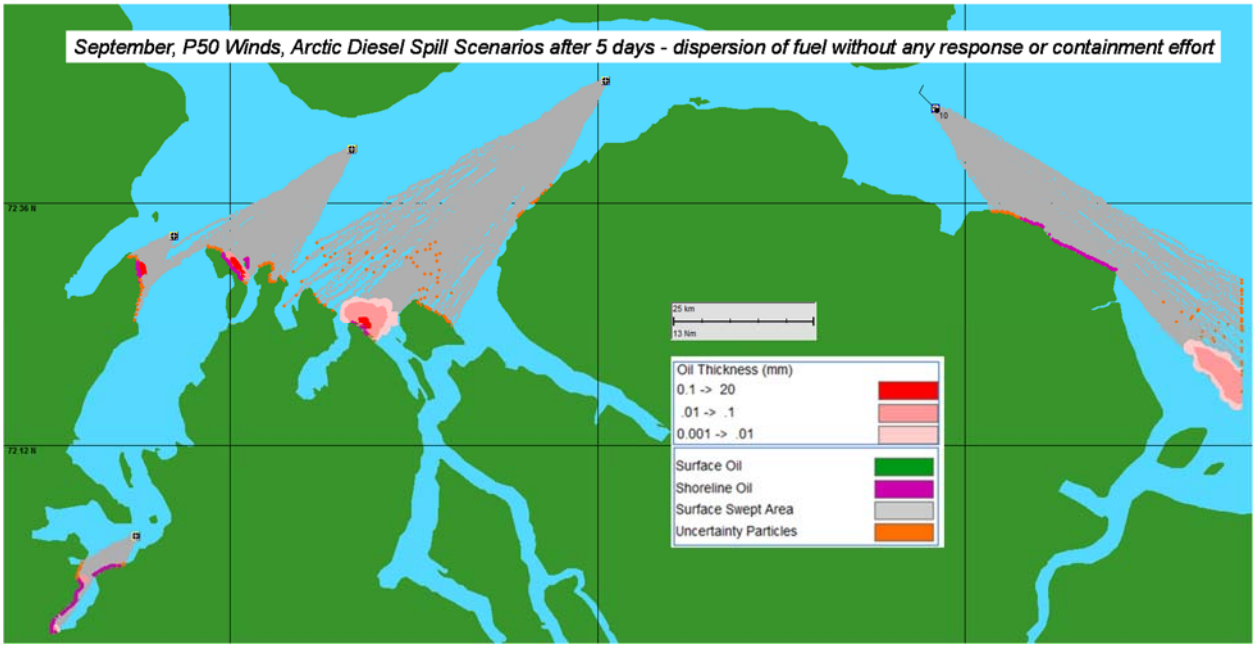


Figure 3-5: September, P50 Winds, Arctic Diesel Spill Scenarios after 5 days

Table 3-2: September, P50 Winds, Arctic Diesel Spill Fate after 5 days

Scenario	On Surface (%)	Ashore (%)	Evaporated (%)	Water Column (%)	Time to shore (days)	Comments
MR1	54.0	1.2	44.4	0.5	0.5	After 12 hours the slick reaches Cape Kwaunang and within 24 hours the spill has reached the head of Milne Inlet bay particularly along the western shores. After five days about half of the spilled fuel is on the surface and half evaporated.
MR2	55.1	0.4	44.1	0.5	0.5	After 12 hours the slick reaches Athole Point and start spreading along the western shore south into Milne Inlet. After five days about half of the spilled fuel is on the surface and half evaporated.
MR3	54.6	0.9	44.1	0.5	2	It takes about 48 hours for the fuel to reach Cape Hatt close to Ragged Island. The eastern part of Ragged Island is filled with fuel in less than three days, and after five days about 55% remains on the surface, the rest having evaporated.
MR4	55.1	0.5	44.0	0.5	4	A few traces of fuel reach the Tunulaqtaiik Point, south of Pond Inlet within 48 hours. The slick reaches Emmerson Island in four days and moves towards Curry Island along Cape Knud Jorgensen in five days.
MR5	40.7	1.0	48.3	7.0	1.5	The fuel slick reaches Cape Weld after 36 hours and spreads along the coast towards Cape Bowen and Cape Macculloch. The slick leaves the coast after three days and continues offshore to the southeast.

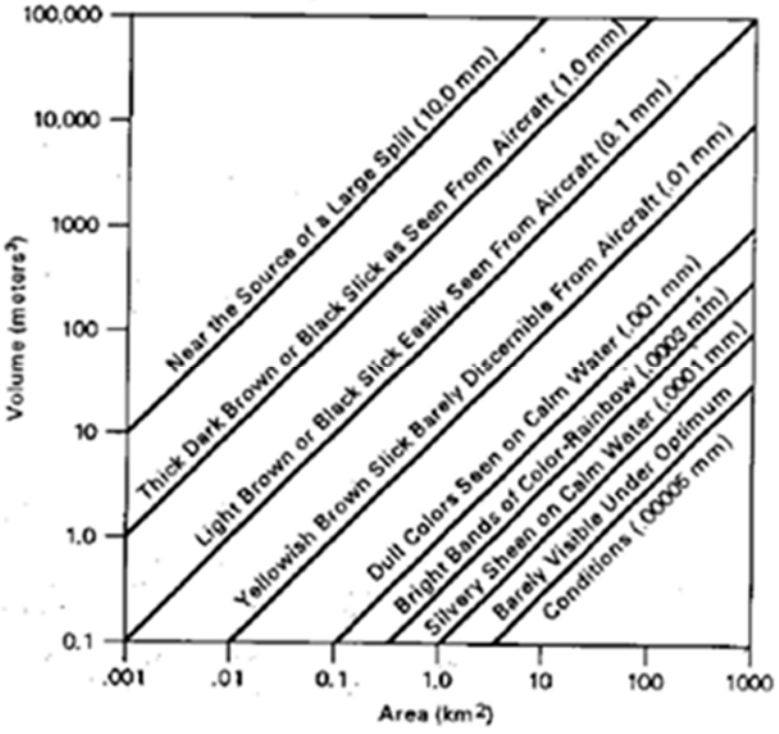


Figure 3-6: Areal Coverage of Spilled Fuel for Different Thicknesses (Source: CCG, 1995)

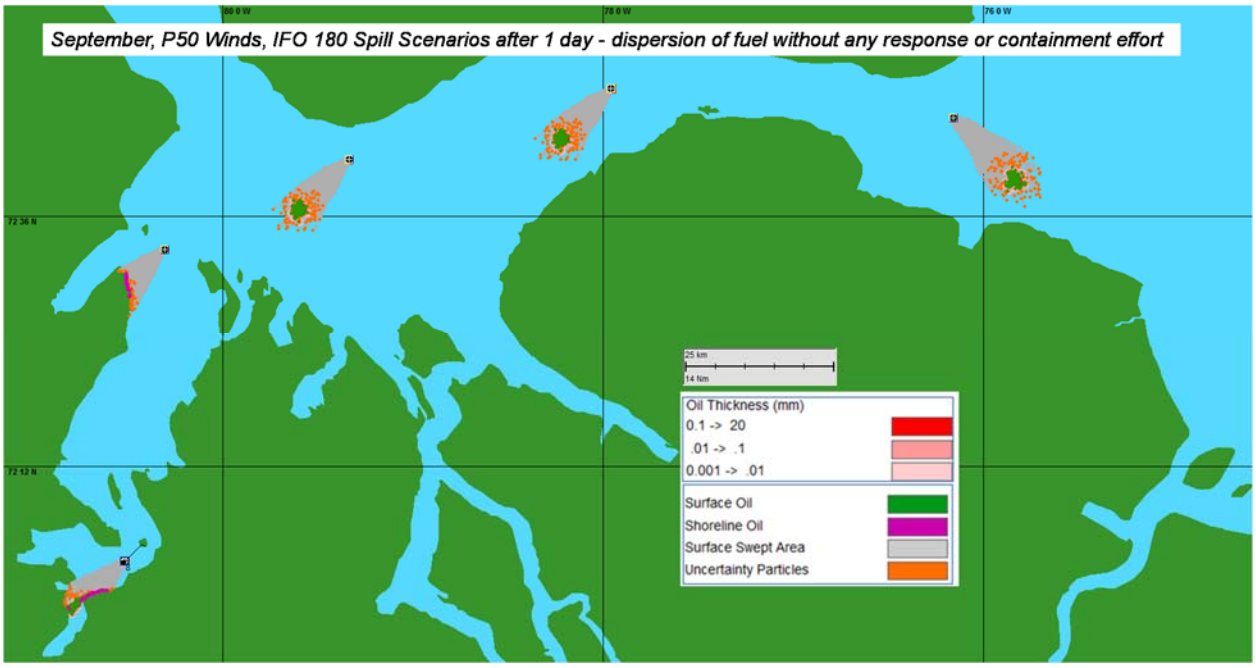


Figure 3-7: September, P50 Winds, IFO 180 Spill Scenarios after 1 day

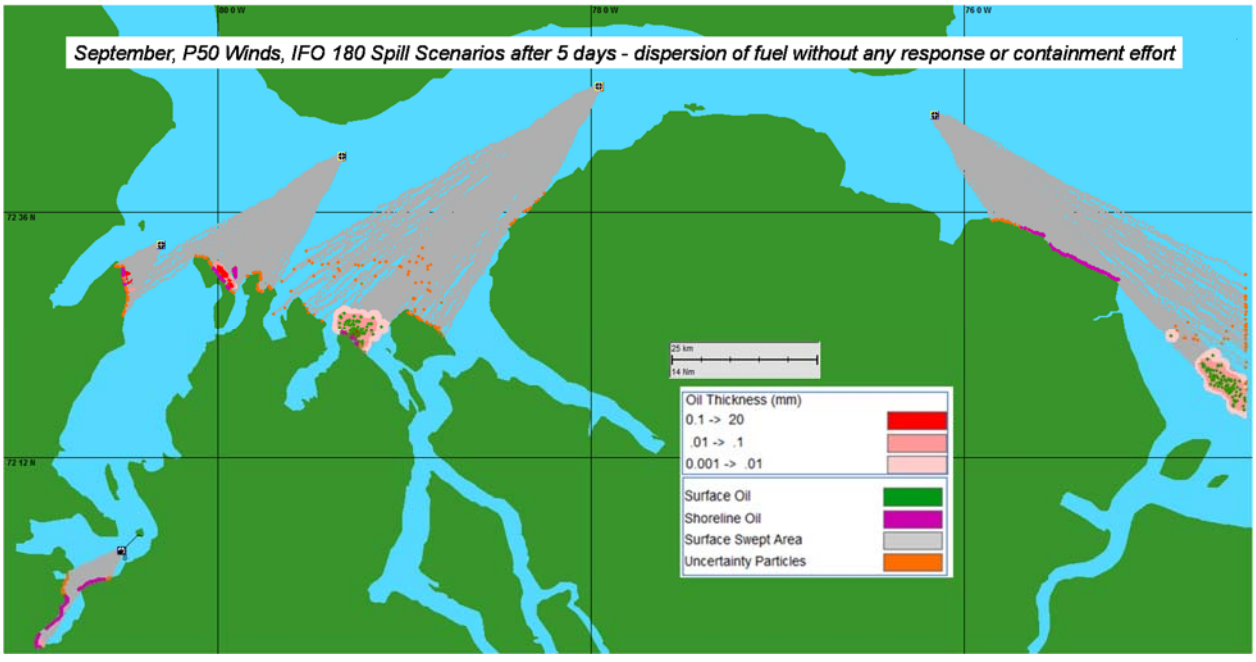


Figure 3-8: September, P50 Winds, IFO 180 Spill Scenarios after 5 days

Table 3-3: September, P50 Winds, IFO 180 Spill Fate after 5 days

Scenario	On Surface (%)	Ashore (%)	Evaporated (%)	Water Column (%)	Time to shore (days)	Comments
MR1	89.7	2.3	8.0	< 0.01	0.5	Within 12 hours the slick reaches Cape Kwaunang and moves towards the head of Milne Inlet filling the head of the inlet within two days. After five days about 90% remains on surface, 2% is ashore, and 8% has evaporated.
MR2	91.5	0.6	7.9	< 0.01	0.5	After 12 hours the slick reaches east of Athole Point and starts spreading along the coast, south, toward Milne Inlet. Five days into the spill, about 90% remains on the surface, less than 1% has reached shore and 8% has evaporated.
MR3	91.1	1.0	7.9	< 0.01	2	It takes about 48 hours for the fuel to reach Cape Hatt close to Ragged Island. Curry Island is fully engulfed with fuel within 72 hours. Five days into the spill, about 90% remains on the surface, the remainder having evaporated. Very little amounts of IFO fuel are dispersed in the water column.
MR4	91.5	0.6	7.9	< 0.01	4	A few traces of fuel reach the Tunulaqtaiik point, south of Pond Inlet after 48 hours. The slick reaches Emmerson Island in four days and is at Curry Island in five days.
MR5	82.4	1.8	8.8	< 0.01	1.5	Fuel reaches Cape Weld after 36 hours and spreads along the coast towards Cape Macculloch. The slick leaves the coast after three days moving offshore to the southeast.

3.3 Fuel Tanker Cargo Spill: 15 ML Arctic Diesel

A scenario was completed for the release in Eclipse Sound of 15 ML of arctic diesel cargo. A wind record from September 2013 was used to provide a more 'realistic' input (compared with the constant wind P50 scenarios) for the simulation (Figure 3-9).

A series of snapshots of the trajectory are presented in Figure 3-10 to Figure 3-13 for time periods of 24 and 36 h and five and 10 days.

The fuel slick initially moves east and turns north, reaching the coast along Dufour Point after 36 h. The fuel spreads along on the shore and stays for about three days, kept there by the wind. Subsequently the slick moves south and after six days most of the spill has reached Emmerson Island. A small amount reaches the Eqeperiaqtalik Point to the east. After 10 days, 10.6% of the fuel remains on the surface, 43% has evaporated, and less than 1% has dispersed into the water column.

Weathering charts that show the percent of fuel on the surface, in the water column, ashore, or evaporated, and viscosity, thickness, total area and fuel and water volume are presented in Figure 3-14 to Figure 3-18.

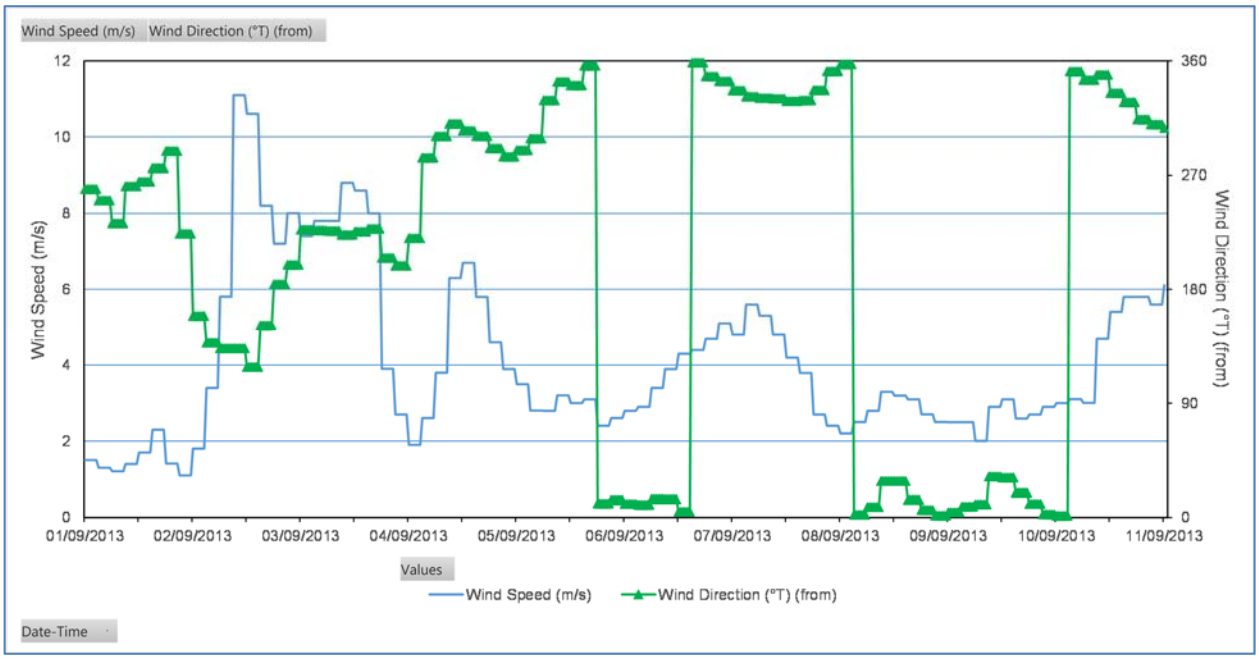


Figure 3-9: Winds for September 2013

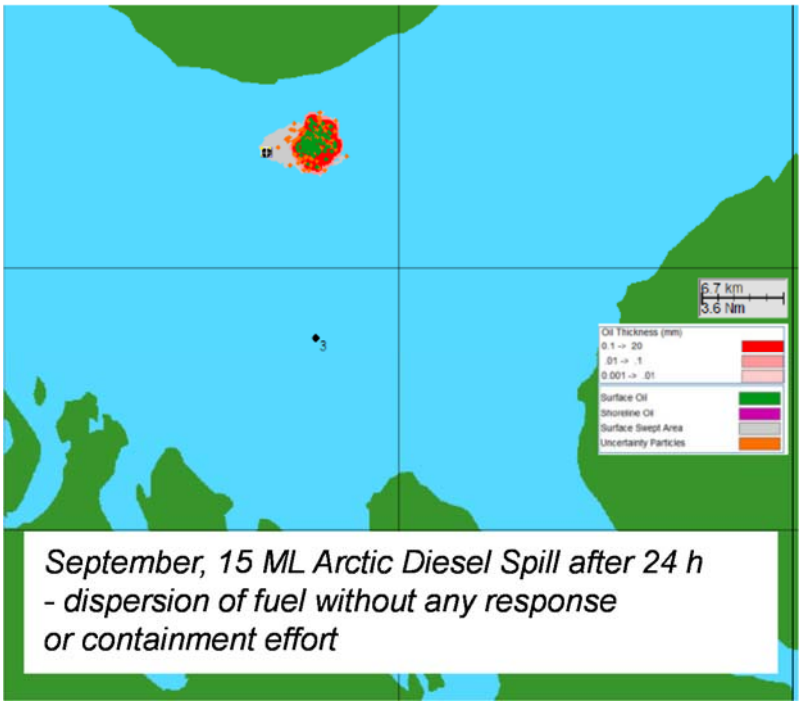


Figure 3-10: 15 ML Arctic Diesel Spill after 24 hours

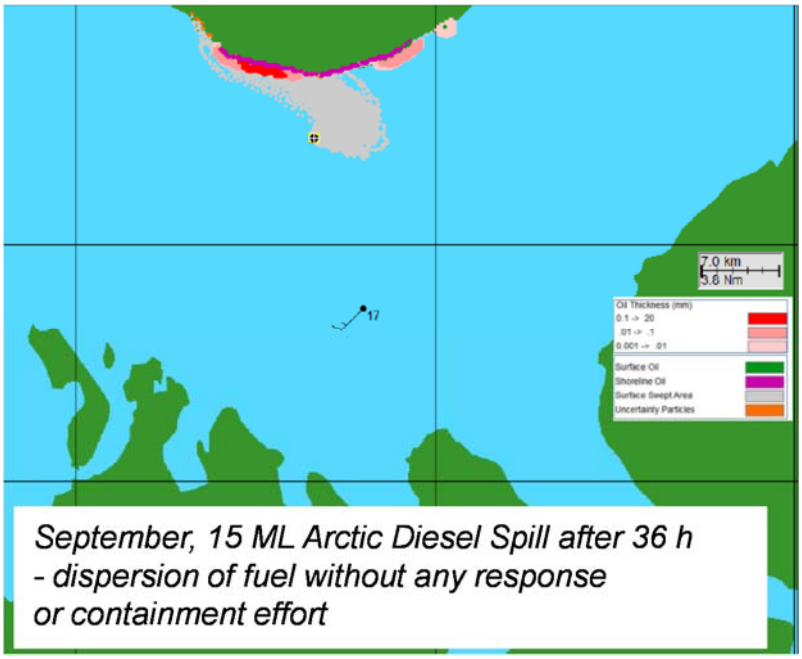


Figure 3-11: 15 ML Arctic Diesel Spill after 36 hours

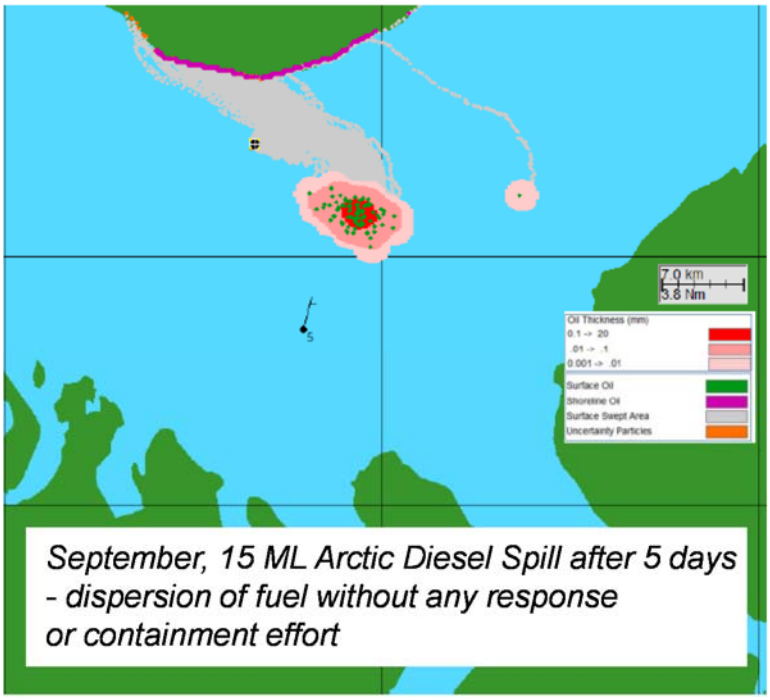


Figure 3-12: 15 ML Arctic Diesel Spill after 5 days

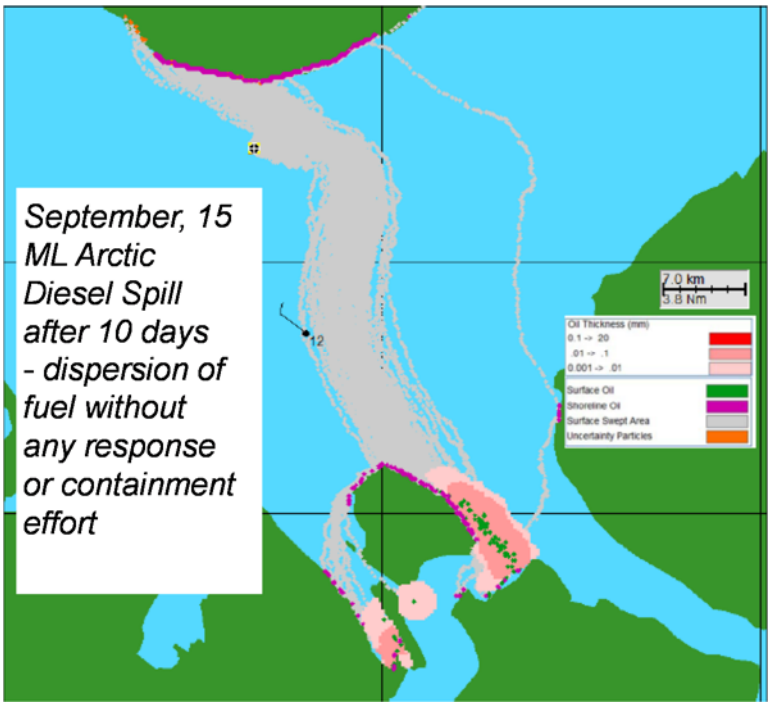


Figure 3-13: 15 ML Arctic Diesel Spill after 10 days

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Fuel Spill Modelling: Northern Shipping Route Open Water Season
Amec Foster Wheeler Project TA1475302
18 February 2015

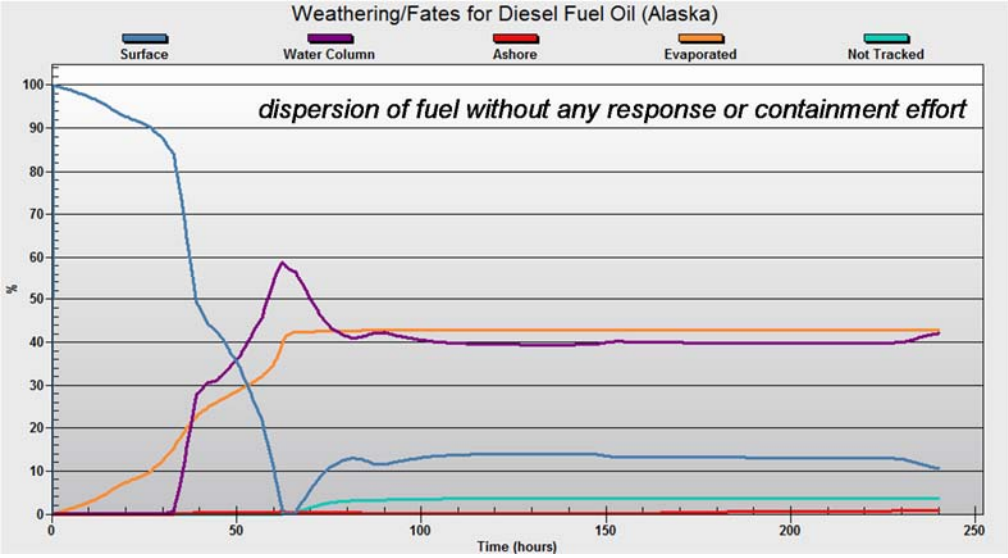


Figure 3-14: 15 ML Arctic Diesel Spill, Percent of Fuel Mass Balance

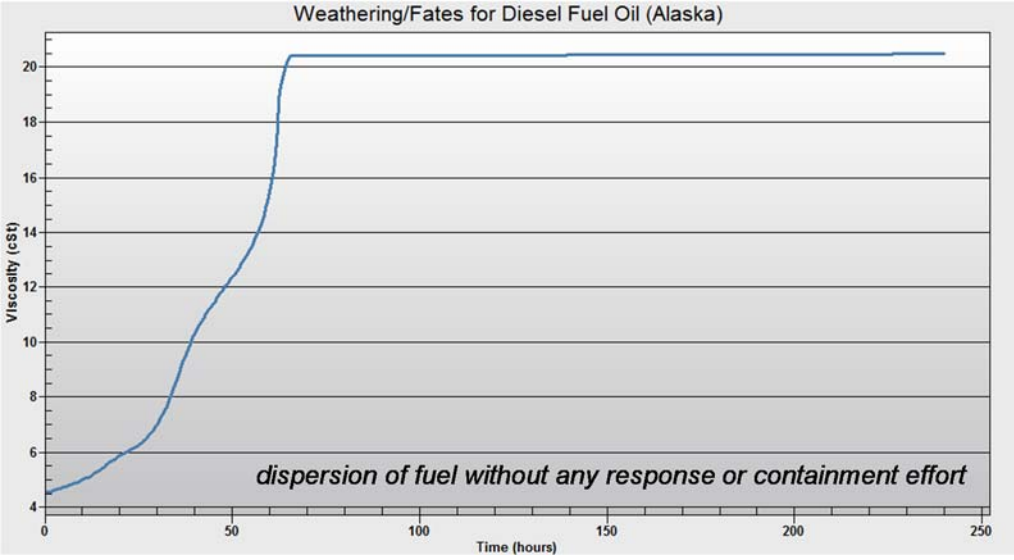


Figure 3-15: 15 ML Arctic Diesel Spill, Viscosity

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Fuel Spill Modelling: Northern Shipping Route Open Water Season
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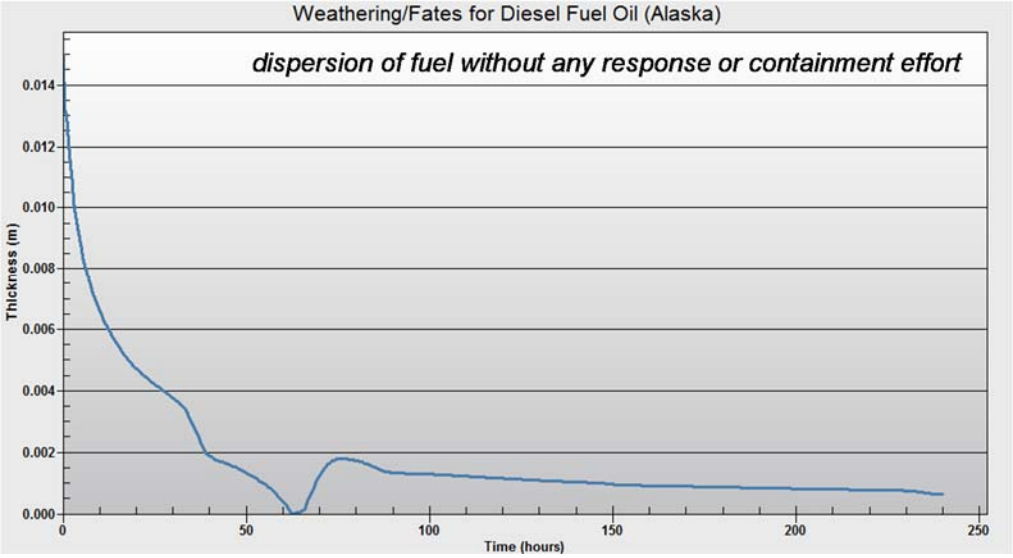


Figure 3-16: 15 ML Arctic Diesel Spill, Thickness

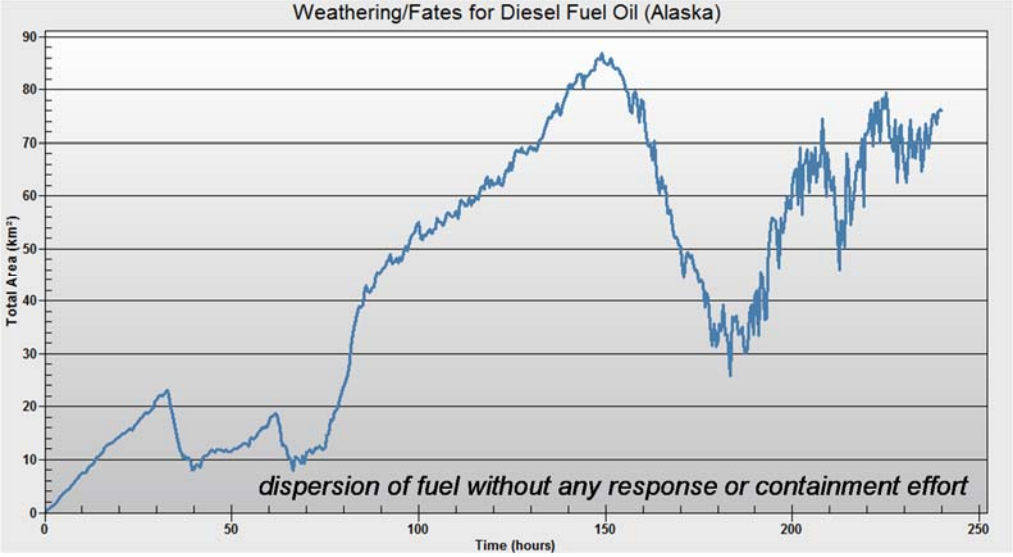


Figure 3-17: 15 ML Arctic Diesel Spill, Total Area

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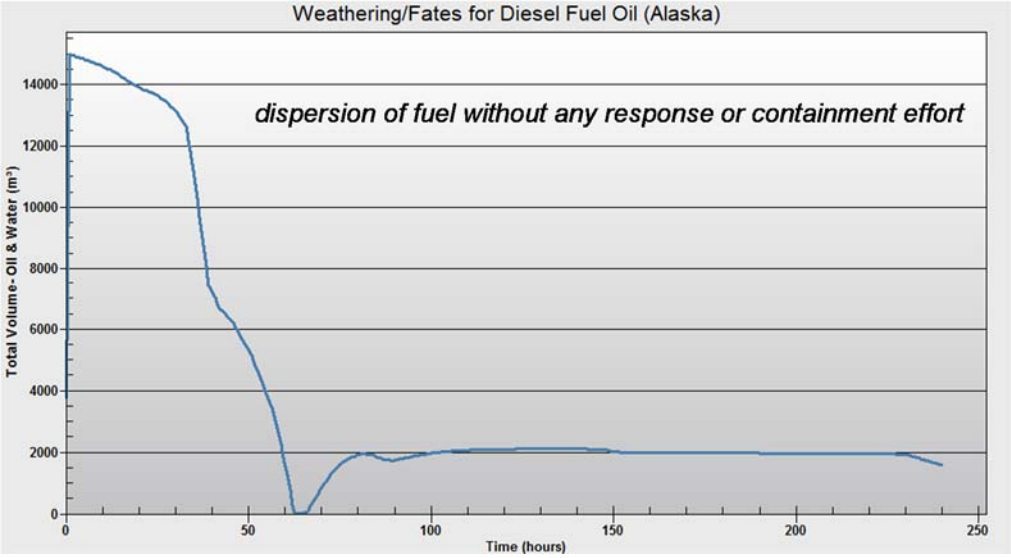


Figure 3-18: 15 ML Arctic Diesel Spill, Total Volume, Fuel & Water

4.0 CLOSURE

This report presents results of an open water fuel spill modelling assessment for the Mary River Project Northern Shipping Route in the Canadian Arctic. The purpose of fuel spill trajectory modelling is to provide support for spill response agencies and other stakeholders for simulated exercise or actual emergency spill events. Support information includes estimation of the marine and any shoreline areas potentially affected together with the initial weathering fate of the spilled fuel.

This report has been prepared for the exclusive use of Baffinland Iron Mines Corporation to support spill response planning and preparedness. The scenarios modelled assume no spill response or containment efforts. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibility of such third parties. Amec Foster Wheeler accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. The report has been prepared in accordance with generally accepted scientific practices. No other warranty, expressed or implied, is made.

Yours truly,

Amec Foster Wheeler Environment & Infrastructure,
a Division of Amec Foster Wheeler Americas Limited

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APPENDIX 11
COMMITMENT REGISTER

Baffinland

Memo

TO:	Nunavut Impact Review Board	From:	Baffinland Iron Mines Corporation
File:	Phase 2 Proposal Updates to Environmental Management and Monitoring Plans and Commitment Registry	Date:	December 17, 2018

REFERENCE: PHASE 2 PROPOSAL – COMMITMENT REGISTRY

Introduction

Baffinland Iron Mines Corporation (Baffinland) developed environmental management, mitigation and monitoring documents to support the Final Environmental Impact Statement (FEIS) and Early Revenue Phase and has continued to create and update its plans throughout operations. As an operational mine, it is important to recognize that all management plans are living documents, where regular updates are tracked through a formal versioning process. It is recognized that the Phase 2 Proposal requires a consolidated update to many of Baffinland's management plans and that some of these management plans will require further update(s) once Phase 2 is approved by the Nunavut Impact Review Board (NIRB) and Nunavut Water Board (NWB), and, revisions to the Project Certificate No. 005 and Type A Water License No. 2AM-MRY1325, respectively, are granted.

As part of the regulatory review and consultation process, including the technical review period, it is anticipated that new mitigation, monitoring and commitments will be identified, and that some existing commitments may change. Therefore, the attached Commitment Register is intended to be a living document that will be updated throughout the review process and provides a tool for all reviewers to easily identify any track changes. After the technical review is complete, based on the final consolidated Commitment Register, the management, mitigation and monitoring plans will then be updated according to the schedule below.

Management, Mitigation and Monitoring Plan Update Schedule

Required changes to plans will be tracked, and the Commitment Register will be updated for circulation at various milestones through the regulatory process, including but not necessarily limited to the following: with submission of information request responses (version submitted with this memo); with submission of technical question responses; immediately following the technical meetings; and in advance of any formalized engagement activities as neccessary. It is anticipated that the final draft plans reflecting all changes identified will be distributed after the technical meetings and before final written submissions are due, with some reasonable exceptions. These exceptions include plans that are specific to a separate approval or permitting process and include the following:

- Ore Dock Construction Management Plan: to be developed during the permitting phase
- Interim Closure and Reclamation Plan: to be developed in accordance with regulatory timelines as established for the ICRP
- Oil Pollution Emergency Plan – Milne Inlet: to be developed in accordance with regulatory timelines associated with the OPEP
- Landfill Maintenance and Operations Manual: to be developed when appropriate detailed engineering information is available (after the closure of Quarry 1)

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Baffinland Phase 2 Commitment Register

Commitment ID#	Management Plan	Section to be Updated	Required Update	Description of Update/ Commitment
1	EPP	2.2	Operation of North Railway	The construction and operation of the railway will require updates related to local land use
2	EPP	2.3	Operation of North Railway	The construction and operation of the railway will require updates related to land disturbance.
3	EPP	2.12	Operation of North Railway	The construction and operation of the railway will require updates related to caribou protection measures.
4	EPP	2.19	Operation of North Railway	The construction and operation of the railway will require updates related to lo traffic management.
5	EPP	2.20	Operation of North Railway	The construction and operation of the railway will require updates related to local land use, and drilling, blasting, and crushing.
6	EPP	2.3	Land Disturbance Mitigation	Mitigation to be added:Slopes will be flattened as necessary when being constructed in ice-rich or thaw sensitive materials, and will be protected with thermal and erosion protection material, if required.Excavations will be minimized, especially in areas of known ice-rich permafrost. Prior to embankment construction, ground disturbance will be minimized and vegetative or organic cover left in place to provide the maximum protection of the thermal regime. In areas where excavation is required, the foundations will be over excavated and backfilled with 0.8 m of non-freeze/thaw susceptible fill to minimize frost heaving and settlement. Slopes will be flattened as necessary when being constructed in ice-rich or thaw sensitive materials, and will be protected with erosion protection material, if required. This will include a geotextile layer as well as an engineered backfill. For high embankment fills on ice-rich materials, the side slopes may be flattened significantly or stabilization berms constructed to reduce the creep deformation potential. For construction during the summer, woven geotextile may be required over unstable ground.Proper runoff collection and diversions drainage systems will be used to control runoff and erosion from affecting the modified thermal regime. As part of basic design, thermal modeling will be conducted for each typical embankment condition and configuration to identify the actual permafrost protection measures required and to predict the nature of the active layer and the effect that construction will have on the thermal regime over the life of the Project. The thermal modeling will incorporate potential warming trends resulting from climate change based on world-recognized global warming scenarios.Thaw settlements and surface sloughing of cut slopes is expected, particularly during the thaw seasons immediately following construction. The behaviour of both cut slopes and embankment fills will be monitored throughout these thaw seasons and remedial measures will be implemented as necessary. For example, it is expected that many of the cut slopes will need to be monitored as thaw settlements occur. Silt fences and

Commitment ID#	Management Plan	Section to be Updated	Required Update	Description of Update/ Commitment
				other erosion protection measures will be installed as necessary to prevent siltation of adjacent drainage courses and water bodies.
7	EPP	2.9	Drainage Patterns	Add measures to minimize changes to the hydrologic drainage patterns.
8	EPP	2.17	Drainage Patterns	Add measures to minimize changes to the hydrologic drainage patterns.
9	EPP	2.25	Drainage Patterns	Add measures to minimize changes to the hydrologic drainage patterns.
10	EPP	2.27	Drainage Patterns	Add measures to minimize changes to the hydrologic drainage patterns.
11	EPP	2.29	Drainage Patterns	Add measures to minimize changes to the hydrologic drainage patterns.
12	EPP	2.18	Culvert Design	Add the following design considerations for culvert installation/replacement: •Install culverts at the same slope as the existing stream, where feasible. •Minimize culvert lengths. •Culverts with lengths that exceed 50 m may be considered barriers to fish passage due to darkness. Examine and consider methods to provide light inside culverts, where applicable. •Compare culvert velocities to the velocity in the existing watercourse to determine fish passage potential. This information can be used to reassess design velocities under proposed conditions with the culvert installed. With the channelization of flows and conveyance in culverts, the velocity of the flows may increase. This may be mitigated by placing rocks and boulders inside the culverts (stream replication) to provide greater friction, thereby reducing velocities and increasing the flow depth and to provide resting locations for fish. Boulders may be bolted into place. In culverts on steep slopes, high velocities may result in the movement of rocks inside the culvert. At these locations, install baffles, baffle inserts or weirs to: •assist in keeping rocks inside the culvert; •maintain and increase roughness in order to reduce velocities; and •provide additional resting locations for fish as they move through the culvert.
13	EPP	2.2	Railway and Road Safety Features	The following safety features will increase the visibility of the crossings and increase safe use of the road: • Early warning signs will warn road users of an approaching railway crossing and stop sign ahead. • A combined stop and railway crossing sign will be located on either side of the crossings. • Crossing timbers will ease vehicle, ATV, and snowmobile crossing. • Instructional bulletins regarding the rail crossings will be posted in English and Inuktitut at each end of the Tote Road.
14	EPP	2.3	Thaw Settlements from Construction	Thaw settlements and surface sloughing of cut slopes is expected, particularly during the thaw seasons immediately following construction. The behaviour of both cut slopes and embankment fills will be monitored throughout these thaw seasons and remedial measures will be implemented as necessary. For example, it is expected that many of the cut slopes will need to be

Commitment ID#	Management Plan	Section to be Updated	Required Update	Description of Update/ Commitment
				monitored as thaw settlements occur. Silt fences and other erosion protection measures will be installed as necessary to prevent siltation of adjacent drainage courses and water bodies.
15	EPP	2.3	Permafrost Protection	Excavations will be reduced, especially in areas of known ice-rich permafrost.
16	EPP	2.3	Embankment Construction	In areas where excavation is required, the foundations will be over excavated and backfilled with 1.5 m of non-freeze/thaw susceptible fill to reduce frost heaving and settlement. For high embankment fills on ice-rich materials, the side slopes may be flattened substantially or stabilization berms constructed to reduce the creep deformation potential. To reduce the rate of creep settlement, embankments thicker than three metres should be constructed with side slopes no steeper than 5H:1V or with toe buttresses. For construction during the summer, woven geotextile may be required over unstable ground.
17	EPP	2.3	Thermal Regime	Proper runoff collection and diversion drainage systems will be used to control runoff and erosion from affecting the modified thermal regime.
18	EPP	New Section 'Ore Dock Construction'	Ore Dock Construction	An Ore Dock Construction Environmental Plan will be prepared to meet Fisheries Act Authorization requirements and implemented during construction of marine facilities in Milne Inlet. Silt curtains will be installed around localized construction areas during the ice break-up period and around the full perimeter of construction including removed sediment disposal area during the open-water season.Silt curtains will be installed prior to any in-water work in order to encapsulate the entire construction footprint and to reduce disturbance to the marine environment in the surrounding area.Construction of concrete components of the dock will consist of installation of prefabricated concrete elements whenever possible. If in-situ concrete production is required, works will be conducted in the way to avoid contact of cement and uncured concrete with surrounding water.The majority of construction work, particularly in shallow water (e.g., access causeway), will take place in winter as land-fast ice is formed. It is expected that, as construction gradually moves offshore, ice will thicken and become grounded. Therefore, ice surrounding construction areas will act as a barrier limiting particulate deposition and spills in surrounding water.To reduce disturbance to the marine environment, the ore dock components will be constructed sequentially, moving from onshore to offshore; the causeway will be constructed in small sections, placing protective layers and armoring immediately after core material is placed to minimize erosion.Backfilling of the birth will only occur after a sufficient length of quay is installed so the fill remains within the structure footprint and no material is dispersed. Machine operation in water will be reduced, e.g., piling and filling equipment will operate on the constructed sections of the ore dock and will not enter the water. Use of a suction pump for localized removal of soft sediment layer will reduce dispersal of re-suspended sediment in water. Disposal of removed sediment will be conducted in accordance in a way to minimize effects on water and sediment quality. The material will be removed using a suction pump, which will reduce dispersal of re-suspended sediment in water. Most acoustically sensitive fish will avoid

Commitment ID#	Management Plan	Section to be Updated	Required Update	Description of Update/ Commitment
				the immediate impact area once impact pile driving is underway. Operators are encouraged to take advantage of this behaviour by adopting a ramp-up / soft-start procedure when operating the impact hammer, when this is technically feasible. A ramp-up procedure consists of initial activation of the equipment using the lowest energy source / pulse and gradually increasing the intensity of the sound until it reaches the required intensity, thus allowing time and incentive for acoustically sensitive fish to leave the area prior to operating the impact driver at full power.
19	EPP	New Section 'Ore Dock Construction'	Ore Dock Construction	Concurrent impact pile driving activities will be minimized when practicable (e.g., avoiding multiple pile driving activities at the same time). Where multiple underwater noise generating activities are planned, they will be sequenced where possible to minimize acoustic impacts.Underwater noise generated during impact pile driving will not exceed 207 dB re 1µPa2·s (SPLPk) at a distance of 200 m from the source. If the sound level exceeds 30 kPa at a distance of 10 m from the source, measures will be undertaken to reduce either the intensity of the sound generated or the level of sound propagation through the water column. The appropriate measure will be chosen based on practicality and effectiveness and may include: The placement of bubble curtains around the wetted pile during impact driving. Bubble curtains are proven to be an effective mitigation measure for dampening underwater noise generated by pile driving, and are reported to reduce peak pressures by up to 30 dB (Buehler et al. 2015).The use of a vibratory hammer in place of an impact hammer for pile driving.Impact pile driving activities will be temporarily suspended if aggregations of fish are spotted within the immediate work area or if any fish spawn is observed attached to equipment or structures in the water.Impact pile driving will be scheduled when practical to avoid sensitive fish periods such as fish spawning and migratory periods.During in water construction, a silt curtain will be installed in order to isolate the footprint of the proposed ore dock. The curtain will be designed and procured in sections which relate to the water depth in order to remain buoyant and extend to the ocean floor with sufficient slack. Prior to construction work within the silt curtain area, efforts will be made to salvage fish and release them alive outside of the work area. The silt curtain will also serve as a deterrent to fish re-entering the isolated work area.Construction activities will be managed through development of the Environmental Protection and Monitoring Plan, outlining specific procedures to avoid or reduce effects on the marine environment. Proposed mitigation measures during construction will include the installation of silt curtains around in-water works to minimize disturbance to the surrounding marine environment, turbidity monitoring and underwater noise monitoring during pile installation and dredging, and environmental monitoring with regular inspection audits to verify effectiveness of mitigation measures and compliance of Project activities with existing permits and authorizations.Proposed mitigation measures included the use of a bubble curtain to reduce peak sound pressure levels emitted from the pile (during pile driving).

Commitment ID#	Management Plan	Section to be Updated	Required Update	Description of Update/ Commitment
20	EPP	New Section 'Ore Dock Construction'	Ore Dock Construction	The proposed ore dock will be constructed in succession to limit disturbance to the natural marine environment, with a focus on in-water activities and producing an effective structure for long term, low maintenance operation.The dock face will be oriented parallel to the existing seabed contours to minimize dredging activities.The proposed ore dock will be constructed during the ice-covered season, when ringed seal would be the only marine mammal species present in Southern Milne Inlet.A ramp-up procedure consists of initial activation of the equipment using the lowest energy source / pulse and gradually increasing the intensity of the sound until it reaches the required intensity, thus allowing time and incentive for marine mammals to leave the immediate zone of potential injury before the pile driver is operating at full power.Installation of a bubble curtain around the wetted pile to dampen sound transmission through water during active pile driving.During all pile driving activities, marine mammal monitoring will be undertaken by a qualified and experienced Marine Mammal Observer (MMO), with all sightings communicated to the piling contractor.Implementation of a 1-km Marine Mammal Exclusion Zone – defined as the zone within which MM may be potentially exposed to sound levels above the injury threshold criteria (180 dB re 1 µPa SPLrms for cetaceans and 190 dB re 1 µPa SPLrms for pinnipeds). The occurrence of a marine mammal within the exclusion zone will trigger specific mitigation actions (e.g., shut-downs) such to avoid potential for physical injury to animals from pile driving noise.Shut-down procedures –pile driving will be temporarily suspended when a marine mammal enters within the exclusion zone until which time it moves outside the safety zone.Implementation of a 30 minute pre-operational (pre-ops) search for marine mammals prior to start-up of pile driving. This would consist of a visual scan of the water by the MMO to determine that no marine mammals are present within the exclusion zone. If an animal is spotted within the exclusion zone during the pre-ops search, the ramp-up procedure will be delayed 20 minutes from the time the marine mammal has left the exclusion zone, or was last sighted in this zone.The MMO will periodically verify underwater sound levels in the field using a hydrophone and a real-time sound monitor to confirm that sound levels at the modeled exclusion zone radius are below the established injury thresholds for marine mammals. If sound levels are shown to exceed the injury thresholds at the exclusion zone radius, the exclusion zone boundary will be adjusted accordingly.Vessels will reduce speeds to a maximum of 9 knots when transiting along the established shipping corridor, and 5 knots when operating in Milne Port, thus reducing the overall noise output generated by ship propulsion and the potential for ship strikes.
21	Borrow Pit and Quarry Management Plan	Appendix E	Identify New Quarry Sites	Update tables and figures with new quarry site information.
22	Interim Closure and	3.2	Project Description	Update to include new Project components and infrastructure.

Commitment ID#	Management Plan	Section to be Updated	Required Update	Description of Update/ Commitment
	Reclamation Plan			
23	Interim Closure and Reclamation Plan	6	Closure and Objectives	Update to include North Rail, consistent with the Closure Objectives and Criteria for the South Rail already considered.
24	Interim Closure and Reclamation Plan	13.3.2	Post-closure Monitoring	Update to include new Project components and infrastructure.
25	Interim Closure and Reclamation Plan	13.3.7	Post-closure Monitoring	Update to include new Project components and infrastructure.
26	Interim Closure and Reclamation Plan	14	Annual Security Requirements	Baffinland will submit a revised version of the ICRP within 60 days following approval of the requested water licence amendment, in accordance to Part J, Item 2 of the Licence. In accordance to Part C of the Licence, Baffinland will update the security requirements for the Project annually, with necessary adjustments accounted for in the results of the Annual Security Review process.
27	Interim Closure and Reclamation Plan	Appendix A	Mine Closure and Reclamation Plan Drawings	Update to include new Project components and infrastructure.
28	Explosives Management Plan	2.1	Project Timelines	Update to incorporate the project timelines and applicable activities from the Phase 2 Proposal.
29	Explosives Management Plan	2.3	Quantity of Ammonium Nitrate	Update to incorporate the new quantity of ammonium nitrate required for Phase 2.
30	Explosives Management Plan	2.4	Quantity of Ammonium Nitrate	Update to incorporate the new quantity of ammonium nitrate required for Phase 2.

Commitment ID#	Management Plan	Section to be Updated	Required Update	Description of Update/ Commitment
31	Explosives Management Plan	2.4	Expansion of Explosives Area	Update to incorporate the expansion of the explosives area to accommodate increases in volume of ammonium nitrate and storage of pre-packaged explosives required for Phase 2
32	Fresh Water Supply, Sewage and Wastewater Management Plan	4.3	Water Supply for Temporary Camps	Describe water supply to temporary camps.
33	Fresh Water Supply, Sewage and Wastewater Management Plan	5.4	Sewage Disposal for Temporary Camps	Describe sewage disposal plans for temporary camps.
34	Fresh Water Supply, Sewage and Wastewater Management Plan	Table 4-2	Additional Water Sources for Dust Suppression	Add the additional dust suppression water sources within the Northern Transportation Corridor.
35	Fresh Water Supply, Sewage and Wastewater Management Plan	4.2	Additional Water Supply Mitigation	Add that monthly cumulative withdrawals from lakes represent less than 10% of the monthly outflow, unless site-specific conditions indicate that a greater water withdrawal will not be significant in the context of fish habitat (i.e., Camp Lake).
36	Fresh Water Supply, Sewage and Wastewater Management Plan	4.2	Additional Water Supply Mitigation	Add that stream water take stations are selected to be sufficiently large such that the instantaneous water withdrawal rate does not exceed 20% of the 10-year monthly low flow condition if a stream is fish-bearing, or 40% of the 10-year monthly low flow condition if the stream is not fish-bearing.

Commitment ID#	Management Plan	Section to be Updated	Required Update	Description of Update/ Commitment
37	Fresh Water Supply, Sewage and Wastewater Management Plan	4.2	Additional Water Supply Mitigation	Add mitigation that at select streams where the water take exceeds than the applicable threshold under mean flow conditions but not under the 10-year low flow, water withdrawals are permitted only during the months of June and July.
38	Fresh Water Supply, Sewage and Wastewater Management Plan	7	Address Water Management Changes with New Ore Stockpiles	Update to reflect the changes in water management associated with ore and product stockpiles, including the use of the temporary ore transfer stormwater pond as a water source for dust suppression.
39	Fresh Water Supply, Sewage and Wastewater Management Plan	8	Update to Include New Water Monitoring Locations for Milne Landfill	Update to include the addition of the Milne Port Landfill and associated water quality monitoring locations.
40	Fresh Water Supply, Sewage and Wastewater Management Plan	Appendix B	Updates to Figures and Block Diagrams	Update to reflect new infrastructure and water quality monitoring locations.
41	Fresh Water Supply, Sewage and Wastewater Management Plan	Appendix C	Updates to Figures and Block Diagrams	Update to reflect new infrastructure and water quality monitoring locations.
42	Snow Management Plan	4.3	Snow Stockpile Locations	Revise snow stockpile locations based on site layout changes arising from the Phase 2 Proposal.

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43	Snow Management Plan	Attachment A	Project Camp Sites Snow Management Guidelines	Update to reflect camp infrastructure.
44	Snow Management Plan	Attachment B	Milne Port Ore Stockpile Snow Management Guidelines	Update to reflect revised ore stockpile infrastructure.
45	Snow Management Plan	Attachment D	Tote Road Snow Management Guidelines	Expand scope of section to include North Railway Snow Management Guidelines.
46	Waste Management Plan	3.7	Milne Port Landfill	Update to include new landfill facility at Milne Port
47	Hazardous Materials and Hazardous Waste Management Plan	Appendix B	Hazardous Waste Storage Facilities Locations	Provide updated site layout figures identifying hazardous waste storage facilities.
48	Hazardous Materials and Hazardous Waste Management Plan	3.1.2	Explosives Quantities	Update to reflect new quantities of ammonium nitrate and explosives.
49	Hazardous Materials and Hazardous Waste Management Plan	5	Roles and Responsibilities	Update roles and responsibilities for Project departments and personnel related to Phase 2.
50	Hazardous Materials and Hazardous Waste	Appendix A	Concordance Tables for Relevant Terms and Conditions	Update to reflect terms and conditions in amended Type 'A' Water Licence and Project Certificate.

Commitment ID#	Management Plan	Section to be Updated	Required Update	Description of Update/ Commitment
	Management Plan			
51	Hazardous Materials and Hazardous Waste Management Plan	Appendix B	Site Layouts	Update to reflect new Project facilities and infrastructure.
52	Life of Mine Waste Rock Management Plan	3	Waste Rock Production Schedule	Quantities of waste rock generated over the mine life and the phasing of waste rock deposition over time will be updated to reflect the higher production rate associated with the Phase 2 Proposal.
53	Life of Mine Waste Rock Management Plan	4	Waste Rock Production Schedule	Quantities of waste rock generated over the mine life and the phasing of waste rock deposition over time will be updated to reflect the higher production rate associated with the Phase 2 Proposal.
54	Landfill Maintenance and Operations Manual	Throughout	New Non-hazardous Waste Landfill at Milne Port	Update to include reference to the new non-hazardous waste landfill at Milne Port.
55	Health and Safety Management Plan	2.4	Consistency with Emergency Response Plan	Update section to ensure it is consistent with the detailed information provided in the Emergency Response Plan.
56	Health and Safety Management Plan	8	References	Change reference to reporting and documentation requirements so it is not referencing Appendices of the FEIS.
57	Health and Safety Management Plan	9	References	Change reference to reporting and documentation requirements so it is not referencing Appendices of the FEIS.

Commitment ID#	Management Plan	Section to be Updated	Required Update	Description of Update/ Commitment
58	Health and Safety Management Plan	11	References	Change reference to reporting and documentation requirements so it is not referencing Appendices of the FEIS.
59	Health and Safety Management Plan	12	References	Provide Canadian reference for indicators (Recordable incident rate, lost time injury rate) rather than OSHA (United States).
60	Health and Safety Management Plan	Annex 1	Update Out-of-date Annex 1 Document	Provide updated Annex or reference other more recent safety plans.
61	Emergency Response Plan	Appendix B	New Risks due to Updated Site Layouts (Part of Water Licence Amendment Application)	New risks to be considered including: collisions along road/rail, stranding due to rail accident.
62	Emergency Response Plan	Foreword	Railway Emergency Plan	Remove 'Future revisions to the Emergency Response Plan will include references to the Railway Emergency Plan' and add reference to the Railway Emergency Plan.
63	Emergency Response Plan	2.2	Reference to Railway Emergency Response Plan	Add Railway Emergency Response Plan to Baffinland Emergency Response figure. Add Section 2.2.6 which will describe Railway Emergency Response Plan.
64	Emergency Response Plan	4.2	Add Probable Emergencies Related to Rail	Add sections on probable emergencies that may occur with the railway (e.g., derailments).
65	Emergency Response Plan	8.1	Emergency Response Equipment for Railway Incidents	Add additional emergency response equipment that will be available for incidents on the railway.
66	Emergency Response Plan	9	Reporting Requirements for Railway Occurrences	Add information on how railway occurrences must be reported as per Transportation Safety Board Regulations Section 5(1).

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67	Emergency Response Plan	Appendix A.1	New Project Certificate Conditions	Add any new Project Certificate conditions applicable to Emergency Response that have been added to the amended Project Certificate.
68	Emergency Response Plan	Appendix A.2	Reference Regulatory Documents Related to railway	Add reference to regulatory documents related to railway.
69	Spill Contingency Plan	7	New Fuel Storage and Handling Facilities	Update to include the location and details of new fuel storage and new spill response equipment.
70	Spill Contingency Plan	Appendix A	Site Layouts	Update to reflect new Project facilities and infrastructure.
71	Spill Contingency Plan	6.4	Rail-based Emergency Response Vehicles	Update to include rail-based emergency response.
72	Spill Contingency Plan	Table 7-1	Fuel Storage Capacity	Update to include updated fuel storage capacities.
73	Spill Contingency Plan	Table 7-2	Explosives Storage Quantities	Update to include current explosives storage quantities.
74	Spill Contingency Plan	7.4.1	Potential Spill Scenario	Add detail on potential scenario: Railway Lubricants/Oil Spill.
75	Spill Contingency Plan	8	Reporting Requirements	Update reporting requirements to include Transportation Safety Board reporting requirements.
76	Spill Contingency Plan	Appendix B	Inventory	Add rail-based emergency response vehicles and spill kit supplies to inventory.

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77	Spill Contingency Plan	Appendix C	Railway Specific Chemicals to MSDS Inventory Appendix	Add any additional chemicals that will be used for railway operations to the MSDS inventory.
78	Oil Pollution Emergency Plan – Milne Inlet	4.1	Bulk Oil Transfer, Ship to Shore	Update section to reflect increased volumes of fuel to be transferred (110ML+) and relocation of fuel transfer manifold.
79	Oil Pollution Emergency Plan – Milne Inlet	Appendix A	Site Layout	Update to reflect new Project facilities and infrastructure.
80	Spill at Sea Response Plan	General Overview	Project Description	Update description of project to change mode of ore transport to railway, increase tonnage from 3.5 to 12 Mtpa.
81	Spill at Sea Response Plan	General Overview	Shipping Route	Change shipping route description/figure to indicate final destination is not necessarily Rotterdam.
82	Spill at Sea Response Plan	Figure 1-1	Shipping Route	Change shipping route description/figure to indicate final destination is not necessarily Rotterdam.
83	Spill at Sea Response Plan	Context for the SSRP	Number of Tugs in Use	Increase number of tugs from 2, to 6-10.
84	Spill at Sea Response Plan	Context for the SSRP	List of Vessel Types	Remove reference to Rotterdam, add capsize vessels to list of vessels.
85	Spill at Sea Response Plan	Context for the SSRP	Number of Fuel Tanker Deliveries	Increase number of fuel tanker deliveries per year.
86	Spill at Sea Response Plan	Section 11	Fuel Volume due to Capesize Vessels	Confirm maximum volume of fuel on capesize vessels and update Table 11-1 Fuel Inventory if greater than 3000 m^3.
87	Spill at Sea Response Plan	Table 15	Update to Fuel Volumes in Risk Register due to Capesize Vessels	Update table with increased spill volume due to increased fuel volume on capesize vessels.
88	MMER Emergency Response Plan	Appendix A	Site Plans	Update to reflect the new water management infrastructure at the primary crusher pad (Mine Site) and secondary crusher pad (Milne Port).

Commitment ID#	Management Plan	Section to be Updated	Required Update	Description of Update/ Commitment
89	MMER Emergency Response Plan	Appendix B	Drainage Plan	Update to describe the Phase 2 components and activities that interact with surface water.
90	Surface Water and Aquatic Ecosystems Management Plan	1.4	Incorporate Scope of Phase 2 Proposal	Update to describe the Phase 2 Proposal components and activities that interact with surface water quantity and water quality including mitigation measures to address the effects on streams receiving diverted flows, and mitigation measures to address fish passage at select culvert crossings along the railway.
91	Surface Water and Aquatic Ecosystems Management Plan	4	Mitigation Measures for Surface Water	Update mitigation measures for exposed soils, sedimentation, erosion, dust suppression, stream crossings, flow diversions, and fish habitat based on activities and components in the Phase 2 Proposal. Mitigation measures to be updated/added include: •In-stream work will not be conducted during the restricted activity window, September 1 through June 30, where applicable (i.e., where spawning habitat is present or at sites where fall spawning movements are occurring such as at the bridge crossing sites CV-15-5, CV-70-3, and CV-85-3) to avoid effects on Arctic Char spawning and egg incubation. •Work in watercourses will be conducted in isolation of surface waters, if flow is present. •If dewatering is required, salvage fish prior to dewatering and release to adjacent surface waters; if water is pumped from within a cofferdam prior to fish salvage, screens meeting criteria set out by DFO will be used. •Preserve low vegetative cover within 100 metres (m) of the crossing unless effective erosion and sediment control are in place to protect water quality. •Implement measures as soon as possible to stabilize banks disturbed by construction to avoid erosion or sediment releases to the water. Re-vegetation with natural vegetation is the preferred approach. •Implement measures for managing water flowing onto the site, as well as water being pumped/diverted from the site, such that sediment is filtered out prior to the water entering the waterbody (e.g., by discharging water to a vegetated area). •Deposit all dredged material in a manner to prevent its re-entry into the watercourse. •Stabilize slopes with rocks, geotextiles, and/or hydraulic seed and mulch.
92	Surface Water and Aquatic Ecosystems Management Plan	4	Mitigation Measures for Surface Water	Update mitigation measures for exposed soils, sedimentation, erosion, dust suppression, stream crossings, flow diversions, and fish habitat based on activities and components in the Phase 2 Proposal.Mitigation measures to be updated/added include•Fill material placed below the high water level within the waterbody's flood plain will be either erosion resistant or protected from erosion and only clean fill will be used.•No waste material resulting from work activities will be left in a manner such that it can enter the water (e.g., by being left on the ice).•Machinery will be washed, refueled and serviced, and fuel and other materials will be stored in such a way as to

Commitment ID#	Management Plan	Section to be Updated	Required Update	Description of Update/ Commitment
				prevent any deleterious substances from entering the water. Such activities typically occur at least 50 m from the high water mark.-machinery will arrive at site in a clean condition and be maintained free of fluid leaks, invasive species and noxious weeds.•Limit fording of the watercourse by machinery to a one-time event (i.e., over and back), and only if no alternative crossing method is available. If repeated crossings of the watercourse are required, a temporary crossing structure will be constructed.-design mitigation for potential effects of increased flows on fish habitat include channel widening; regrading, construction of habitat features (in fish bearing streams); and channel stabilization.•Install culverts at the same slope as the existing stream, where feasible.•Minimize culvert lengths.•Culverts with lengths that exceed 50 m may be considered barriers to fish passage due to darkness. Examine and consider methods to provide light inside culverts, where applicable.•Compare culvert velocities to the velocity in the existing watercourse to determine fish passage potential. This information can be used to reassess design velocities under proposed conditions with the culvert installed.With the channelization of flows and conveyance in culverts, the velocity of the flows may increase. This may be mitigated by placing rocks and boulders inside the culverts (stream replication) to provide greater friction, thereby reducing velocities and increasing the flow depth and to provide resting locations for fish. Boulders may be bolted into place.
93	Surface Water and Aquatic Ecosystems Management Plan	5.3	Description of Hydrology	Update regional hydrology and peak flow estimates.
94	Surface Water and Aquatic Ecosystems Management Plan	6.1	Water Management Plans for Milne Port, Tote Road, and Mine Site	Update water management plans for site drainage, laydowns, soil stockpiles, rock cuts, quarries, mine effluent, and dust suppression. Key issues include management of contact water from construction and operations.
95	Surface Water and Aquatic Ecosystems Management Plan	6.2	Water Management Plans for Milne Port, Tote Road, and Mine Site	Update water management plans for site drainage, laydowns, soil stockpiles, rock cuts, quarries, mine effluent, and dust suppression. Key issues include management of contact water from construction and operations.
96	Surface Water and Aquatic Ecosystems Management Plan	6.3	Water Management Plans for Milne Port, Tote Road, and Mine Site	Update water management plans for site drainage, laydowns, soil stockpiles, rock cuts, quarries, mine effluent, and dust suppression. Key issues include management of contact water from construction and operations.

Commitment ID#	Management Plan	Section to be Updated	Required Update	Description of Update/ Commitment
97	Surface Water and Aquatic Ecosystems Management Plan	7	Water Management Plans for Milne Port, Tote Road, and Mine Site	Update water management plans for site drainage, laydowns, soil stockpiles, rock cuts, quarries, mine effluent, and dust suppression. Key issues include management of contact water from construction and operations.
98	Surface Water and Aquatic Ecosystems Management Plan	New Section	Water Management Plan for North Railway	Add water management plans for laydowns, soil stockpiles, soil disposal areas, rock cuts, quarries, flow diversions, watercourse crossings, and water takes for dust suppression. Key issues include maintaining minimum flows for fish, fish passage at culverts, and management of contact water and dust from construction and operations. Includes mitigation measures to address the effects on streams receiving diverted flows, and mitigation measures to address fish passage at select culvert crossings along the railway.
99	Surface Water and Aquatic Ecosystems Management Plan	9	Monitoring Plan for Fish Passage Along North Railway	Add monitoring during construction and operation of the North Railway, and where applicable, at new or relocated stream crossings along the Tote Road, to assess fish passage at fish-bearing stream crossings.
100	Surface Water and Aquatic Ecosystems Management Plan	New Section	Pre-Construction Survey Request	A survey of the Camp Lake outflow and at water withdrawal site BG32 is recommended in the first year following Project approval in late summer/fall when water withdrawals occur and during a low flow event to ensure there is no stranding of Arctic Char. In the event that stranding is observed, a fish salvage would be undertaken to relocate stranded fish to a local waterbody.
101	Surface Water and Aquatic Ecosystems Management Plan	9	Monitoring Plan for Flow Diversions	Update monitoring plan to include post-construction monitoring for low risk flow diversions.
102	Terrestrial Environment Mitigation and Monitoring Plan	Table 1-1	Commitments relevant to Phase 2 Proposal	Update, post approval, to include commitments made (if any) relevant to monitoring Phase 2 Project impacts.
103	Terrestrial Environment Mitigation and	Table 1-2	Terms and Conditions relevant to Phase 2	Update, post-approval, to include new or revised Project Terms and Conditions relevant to monitoring Phase 2 Project impacts.

Commitment ID#	Management Plan	Section to be Updated	Required Update	Description of Update/ Commitment
	Monitoring Plan			
104	Terrestrial Environment Mitigation and Monitoring Plan	1.5	Relationship to Other Management Plans	Update management plan references and describe the relevance of those management plans to the mitigations identified in the TEMMP.
105	Terrestrial Environment Mitigation and Monitoring Plan	2	Key Indicators for Follow-up Monitoring	Post-approval text editing to cross-reference to Phase 2 impact assessment and updated status report.
106	Terrestrial Environment Mitigation and Monitoring Plan	3	Mitigation Measures	Post-approval updates to include any mitigations that may be agreed to during technical review and Project Terms and Conditions requirements. Update all cross-references to any updated or new Terms and Conditions. This will include mitigation measures for-wind turbine operations, should wind turbines be approved as part of the Phase 2 Proposal. Specific mitigation measures to be added include: •seasonal avoidance of construction near nests during the breeding season; and •temporarily making raptor nest sites potentially affected by construction inaccessible during the nesting seasons and hazing nesting pairs to discourage nesting at an affected nest site.
107	Terrestrial Environment Mitigation and Monitoring Plan	4.3	Vegetation Monitoring	Programs identified in Tables 4-3 (Vegetation Monitoring: Vegetation Health) and 4-4 (Vegetation Monitoring: Dust) may be adjusted pending comments and direction received during the technical review and Project Terms and Commitments post project approval.
108	Terrestrial Environment Mitigation and Monitoring Plan	4.5.1	Caribou Monitoring	May be updated to address any MoUs that Baffinland may have in place with the Government of Nunavut or other parties to support broader regional research/monitoring to better understand north Baffin Island population recovery and ecology.

Commitment ID#	Management Plan	Section to be Updated	Required Update	Description of Update/ Commitment
109	Terrestrial Environment Mitigation and Monitoring Plan	4.5.2	Caribou Monitoring	May be updated to address any MoUs that Baffinland may have in place with the Government of Nunavut or other parties to support broader regional research/monitoring to better understand north Baffin Island population recovery and ecology.
110	Terrestrial Environment Mitigation and Monitoring Plan	Appendix B	Monitoring Details and Methods	As part of ongoing "living" document, the methods are updated regularly as part of annual report and review/critique by the TEWG and the Nunavut Impact Review Board (NIRB). Portions of these methods may be updated to identify changes in spatial scope of plots, frequency of sampling, or analytical methods pending technical review and final project terms and conditions, post project approval.
111	Shipping and Marine Wildlife Management Plan	All	New Shipping Scenario	Update to reflect new shipping scenario included in the Phase 2 Proposal.
112	Shipping and Marine Wildlife Management Plan	1.3	Commitments Relevant to Phase 2	Update (post-approval) to include commitments made (if any) relevant to monitoring Phase 2 Project impacts.
113	Shipping and Marine Wildlife Management Plan	1.3	Terms and Conditions Relevant to Phase 2	Update (post-approval) to include new or revised Project Terms and Conditions relevant to monitoring Phase 2 Project impacts, including revisions to the Table of Concordance in Appendix G.
114	Shipping and Marine Wildlife Management Plan	Appendix G	Terms and Conditions Relevant to Phase 2	Update (post-approval) to include new or revised Project Terms and Conditions relevant to monitoring Phase 2 Project impacts, including revisions to the Table of Concordance in Appendix G.
115	Shipping and Marine Wildlife	1.5	Relationship to Other Management Plans	Update references in document and describe the relevance of those management plans to the mitigations identified in the SMWMP.

Commitment ID#	Management Plan	Section to be Updated	Required Update	Description of Update/ Commitment
	Management Plan			
116	Shipping and Marine Wildlife Management Plan	3	Updated Project Description for Shipping relevant to Phase 2 shipping operations	Update to reflect current Project Description for shipping operations, including vessel specifications, schedule, ship loading and unloading, safety, navigation, insurance and compensation.
117	Shipping and Marine Wildlife Management Plan	5	Environmental Management Practices Relevant to Phase 2 Shipping Operations	Document will be updated to include additional mitigation measures to minimize impacts on marine mammals and fish and fish habitat due to increased frequency of shipping, extended shipping season, and updated berth design relevant to Phase 2 operationsMitigation to be added to Section 5.3 include:•When marine mammals appear to be trapped or disturbed by vessel movements, the vessel will implement appropriate measures to mitigate disturbance, including stoppage of movement until wildlife move away from the immediate area.•Project vessels shall not approach within 300 m of a walrus or polar bear observed on sea ice.•All Project vessels will not be operated in such a way as to separate an individual member(s) of a group of marine mammals from other members of the group.
118	Shipping and Marine Wildlife Management Plan	5.5.1	Detailed Ballast Water Management Plan	A stand-alone ballast water management plan will be developed (to be included as a separate Appendix in the SMWMP) to address the increased risk from invasive species and D-2 requirements of the International Convention for the Control and Management of Ships' Ballast Water and Sediments, to prescribe ballast water monitoring and reporting requirements specific to the Project, and to identify management procedures in the event of any non-compliance events.
119	Shipping and Marine Wildlife Management Plan	6	Environmental Monitoring Relevant to Phase 2 shipping Operations	Update to reflect environmental monitoring and Environmental Effects Monitoring (EEM) commitments relevant to Phase 2 shipping operations.
120	Shipping and Marine Wildlife Management Plan	7	Roles and Responsibilities Relevant to Phase 2 Shipping Operations	Update to identify Project-specific roles and responsibilities related to environmental issues for Phase 2 shipping operations.
121	Shipping and Marine Wildlife	8	Environmental Reporting	Update to reflect environmental reporting requirements relevant to Phase 2 shipping operations.

Commitment ID#	Management Plan	Section to be Updated	Required Update	Description of Update/ Commitment
	Management Plan			
122	Marine Environmental Effects Monitoring Plan	1	Commitments Relevant to Phase 2	Update (post-approval) to include commitments made (if any) relevant to monitoring Phase 2 Project effects.
123	Marine Environmental Effects Monitoring Plan	1	Terms and Conditions Relevant to Phase 2	Update (post-approval) to include new or revised Project Terms and Conditions relevant to monitoring Phase 2 Project impacts.
124	Marine Environmental Effects Monitoring Plan	New subsection of Section 1	Relationship to Other Management Plans	Add new sub-section in Section 1.0 identifying relationship of MEEMP to other management plans. Update management plan references and describe the relevance of those management plans to the mitigations identified in the MEEMP.
125	Marine Environmental Effects Monitoring Plan	Table 1.1	Effect Pathway Linkages Relevant to Phase 2	Update to include impact predictions made in the FEIS Addendum for the Phase 2 Proposal.
126	Marine Environmental Effects Monitoring Plan	3	Study Design for EEM Program - Marine Ecosystem Relevant to Phase 2	Update to identify EEM study design changes required to monitor for Project effects on Marine Ecosystem related to Phase 2 construction (new ore dock) and operations (e.g., increased shipping, expansion of ore stockpiles, fugitive dust emissions, increase in wastewater discharge). Revised study design will be based on results from EEM studies conducted to date and Phase 2 modelling.
127	Marine Environmental Effects Monitoring Plan	3.4.7	Update Study Design for Aquatic Invasive Species Monitoring Program Relevant to Phase 2	Update to identify study design changes required to monitor for potential aquatic invasive species introduction related to increases in the overall ballast water discharge volume and new discharge locations. Revised study design will be based on results from aquatic invasive species monitoring study conducted to date and Phase 2 modelling.
128	Marine Environmental Effects	6	Update Study Design for EEM Program -	Update to identify EEM study design changes required to monitor for Project effects on Marine Mammals related to Phase 2 construction (e.g., new ore dock) and operations (e.g., increased

Commitment ID#	Management Plan	Section to be Updated	Required Update	Description of Update/ Commitment
	Monitoring Plan		Marine Mammals relevant to Phase 2	shipping, extended shipping season). Revised study design will be based on results from EEM studies conducted to date,
129	Air Quality and Noise Abatement Management Plan	2.3	Wind Power	Update for potential addition of wind power as an offset to diesel power generation.
130	Air Quality and Noise Abatement Management Plan	3.4	Noise Modelling	Add noise modelling results from TSD 07.
131	Air Quality and Noise Abatement Management Plan	3	Dustfall Mitigation	Update mitigation measures to reduce dustfall, including additional water takes and applications, as well as the continued examination of viable alternatives.
132	Air Quality and Noise Abatement Management Plan	3	Dustfall Monitoring	Update dustfall monitoring program to account for new and modified emission sources during construction and operations.
133	Air Quality and Noise Abatement Management Plan	3.4.1	Noise Mitigation	Add mitigation to use acoustical screening from existing on-site buildings to shield dwellings from construction equipment noise.
134	Air Quality and Noise Abatement Management Plan	3.4.1	Noise Mitigation	Add mitigation that local topography will be taken advantage of to screen noise emissions, where possible.
135	Air Quality and Noise Abatement	3.4.1	Noise Mitigation	Add mitigation that discussions with the HTO will determine if it would be preferred to move the existing HTO cabin to an area outside of the area of disturbance for noise.

Commitment ID#	Management Plan	Section to be Updated	Required Update	Description of Update/ Commitment
	Management Plan			
136	Air Quality and Noise Abatement Management Plan	5.3	New Mitigation and Monitoring Measures for Underwater Noise	Add mitigation and monitoring measures for marine underwater noise, including bubble curtains and marine mammal monitoring.
137	Air Quality and Noise Abatement Management Plan	4	Roles and Responsibilities	Update roles and responsibilities for Project departments and personnel.
138	Air Quality and Noise Abatement Management Plan	Attachment 2	Concordance Tables for Relevant Terms and Conditions	Update to reflect terms and conditions in amended Project Certificate.
139	Cultural Heritage Resource Protection Plan	1.1.1	Incorporate the scope of the Phase 2 Proposal	Update to remove reference to the FEIS and 2012 Archaeology Mitigation Plan, as that plan has already been implemented.
140	Cultural Heritage Resource Protection Plan	3.2	Annual Reporting Requirements	Section 3.2 incorrectly discusses annual reporting to NIRB on archaeology. Update this section to reflect Baffinland's commitment to provide the Government of Nunavut with an annual archaeology status report by February 28, in addition to the requirement for any licensed archaeologists on the project to provide an archaeology permit report by March 31.
141	Cultural Heritage Resource Protection Plan	4	Annual Reporting Requirements	Commitment #11 in Section 4 incorrectly discusses annual reporting to NIRB on archaeology. Update this section to reflect Baffinland's commitment to providing the Government of Nunavut with an annual archaeology status report by February 28, in addition to the requirement for any licensed archaeologists on the project to provide an archaeology permit report by March 31.
142	Roads Management Plan	4	Operational Mitigation Measures	Update operational measures to mitigate erosion, sedimentation, and fish passage at culvert crossings associated with the Phase 2 Proposal.

Commitment ID#	Management Plan	Section to be Updated	Required Update	Description of Update/ Commitment
143	Human Resource Management Plan	5.3	Education and Training Partnerships	Baffinland will include both the GN Department of Family Services and the GN Department of Education in Section 5.3 of a revised future version of the Human Resource Management Plan.
144	Snow Management Plan	4.3	Snow Stockpile Locations	Details on the physical delineation of 31 m boundary from water body.
145	Metal Mining Effluent Regulations Emergency Response Plan	Throughout	References to MMER	References to the Metal Mining Effluent Regulations (MMER) under the *Fisheries Act* will be updated to refer to the current Metal and Diamond Mining Effluent Regulations (MDMER)
146	Aquatic Effects Monitoring Plan.	Throughout	References to MMER	References to the Metal Mining Effluent Regulations (MMER) under the *Fisheries Act* will be updated to refer to the current Metal and Diamond Mining Effluent Regulations (MDMER)
147	Life of Mine Waste Rock Management Plan	Throughout	References to MMER	References to the Metal Mining Effluent Regulations (MMER) under the *Fisheries Act* will be updated to refer to the current Metal and Diamond Mining Effluent Regulations (MDMER)
148	Interim Waste Rock Management Plan	Throughout	References to MMER	References to the Metal Mining Effluent Regulations (MMER) under the *Fisheries Act* will be updated to refer to the current Metal and Diamond Mining Effluent Regulations (MDMER)
149	Interim Closure and Reclamation Plan	Throughout	References to MMER	References to the Metal Mining Effluent Regulations (MMER) under the *Fisheries Act* will be updated to refer to the current Metal and Diamond Mining Effluent Regulations (MDMER)
150	Marine Environmental Effects Monitoring Plan	Throughout	References to MMER	References to the Metal Mining Effluent Regulations (MMER) under the *Fisheries Act* will be updated to refer to the current Metal and Diamond Mining Effluent Regulations (MDMER)

Commitment ID#	Management Plan	Section to be Updated	Required Update	Description of Update/ Commitment
151	Phase 1 Waste Rock Management Plan	Throughout	References to MMER	References to the Metal Mining Effluent Regulations (MMER) under the *Fisheries Act* will be updated to refer to the current Metal and Diamond Mining Effluent Regulations (MDMER)
152	Explosives Management Plan	1.2	Explosives Storage Areas	Add information related to four new explosives storage areas for the storage of pre-packaged explosives (for use in rail construction) that are planned along the Northern Transportation Corridor (as shown on Figure B.2 and in Figure B.2 sheets in Appendix B of TSD 02 [Project Description]).
153	Other Commitment	N/A	N/A	Specific design parameters for the Wind Energy Project will be developed at the preliminary engineering phase. Specific locations and lengths of collector lines, number of poles, and placement above and/or below ground will depend on site-specific factors and will also be assessed during preliminary design work, but fully determined at detailed design in consultation with turbine vendor.
154	Other Commitment	N/A	N/A	Dedicated crossing locations of the railway for land users will be determined through consultation with local community members and elders.
155	Other Commitment	N/A	N/A	New mitigation and monitoring that arises during the technical review will be added to the applicable management plans if required.
156	Other Commitment	N/A	N/A	Baffinland will undertake an additional stand-alone assessment of icebreaking effects that addresses icebreaking effects during the shoulder season hich will include underwater noise modelling of icebreaker transits along the Northern Shipping Route. The acoustic modelling will be based on a conservative scenario for icebreaking noise based on thickest seasonal ice conditions in the RSA and maximum acoustic propagation potential. The stand-alone acoustic modelling report and icebreaking assessment will be submitted to the NIRB in 2019 once reporting is completed.
157	Other Commitment	N/A	N/A	Baffinland plans to engage "Operation Lifesaver" (Operation Lifesaver Canada 2017). Baffinland believes that this organization has the experience and knowledge that can help the company ensure Nunavummiut are educated about rail safety through rail safety presentations to schools, and community groups such as Hunter and Trapper Organizations.
158	Other Commitment	N/A	N/A	An update to the water quality predictions for the Waste Rock Facility that incorporates data collected will be provided in 2019.
159	Other Commitment	N/A	N/A	Results from the 2018 Geochemical Evaluation will be provided in 2019.
160	Other Commitment	N/A	N/A	Baffinland is currently reviewing the required water crossings to identify a short-list of crossings that are better suited to alternatives to CSP culverts and will be prepared to discuss this with DFO.

Commitment ID#	Management Plan	Section to be Updated	Required Update	Description of Update/ Commitment
161	Other Commitment	N/A	N/A	Upon selection of the specific site(s) for wind turbine(s), Baffinland will conduct a risk assessment including any surveys required for informing site sensitivity, consistent with Environment and Climate Change Canada's Environmental Assessment Guidance Document on Wind Turbines and Birds.
162	Other Commitment	N/A	N/A	Baffinland will conduct the required pre-construction phase surveys for migratory birds and species at risk surveys, consistent with ECCC guidance prior to construction of the wind energy project .
163	Other Commitment	N/A	N/A	Baffinland will identify mitigation and monitoring requirements from the pre-construction phase surveys and incorpoate them into into the wind energy project design, consistent with Environment and Climate Change Canada's Guidance Document on Recommended Protocols for Monitoring Impacts of Wind Turbines and Birds
164	Other Commitment	N/A	N/A	Prior to use for dust suppression, water quality monitoring of contact water will be completed to ensure that the water meets the appropriate effluent discharge limits. Monitoring will be undertaken through sampling of water prior to discharge.
165	Other Commitment	N/A	N/A	Reclamation research plans are expected to be developed in consultation with IQ. Where practical, IQ will be incorporated into research plans for revegetation.
166	Other Commitment	N/A	N/A	Before final siting of the wind turbines is confirmed, Baffinland will carry out specific engagements with local land users to identify optimal and/or preferable locations.
167	Other Commitment	N/A	N/A	Exact coordinates for the Proposed additional SNP stations to address the Phase 2 Proposal will be provided to the NWB for approval prior to the commissioning of the associated Phase 2 infrastructure.
168	Other Commitment	N/A	N/A	Roads used in operation will be constructed to appropriate design criteria, as presented in TSD 02.
169	Air Quality and Noise Abatement Management Plan	Attachment 7	Dust Monitoring Locations	The Dustfall Monitoring Program will be expanded to include additional monitoring locations as required for the Northern Transportation Corridor.
170	Surface Water and Aquatic Ecosystems Management Plan	5.3.1	Surfface Water Runoff Estimation	Provide mean flows for streamflow record (not just 2015 flows)

Commitment ID#	Management Plan	Section to be Updated	Required Update	Description of Update/ Commitment
171	Surface Water and Aquatic Ecosystems Management Plan	6	Stormwater Management	Update stormwater management to reflect Phase 2 and the addition of the, North Railway
172	Surface Water and Aquatic Ecosystems Management Plan	9.1	Rpi	Add routine inspections for railway.
173	Surface Water and Aquatic Ecosystems Management Plan	9.2.1	Water Monitoring	Add new water monitoring stations.
174	Surface Water and Aquatic Ecosystems Management Plan	Appendix B	2016 Work Plan	Remove 2016 work plan details.
175	Surface Water and Aquatic Ecosystems Management Plan	Appendix C	Water Balance	Update with water balance PFDs.
176	Surface Water and Aquatic Ecosystems Management Plan	Appendix D	Site Layouts	Update site layouts showing SNP stations.
177	Other Commitment	N/A	N/A	Follow-up and Adaptive Management Plans will be updated to indicate the criteria and thresholds to trigger mitigation measures.
178	Other Commitment	N/A	N/A	Quality Assurance and Quality Control measures to be applied to each monitoring program will be included in relevant plans, where warranted.

Commitment ID#	Management Plan	Section to be Updated	Required Update	Description of Update/ Commitment
179	Other Commitment	N/A	N/A	A detailed fish salvage plan will be developed and included in an Environmental Management Plan (EMP), which will form part of the application for the Fisheries Act Authorization (FAA).

APPENDIX 12
OVERVIEW OF MARINE OPERATIONS

Phase 2 Proposal Information Request Supporting Document:
Overview of Marine Operations

Baffinland Iron Mines Corporation
Mary River Project
NIRB File No. 08MN053



TABLE OF CONTENTS

Table of Contents ..... **i**

List of Tables ..... **i**

1 Shipping Season - Addresses: (GN-IR-66 (2); GN-IR-66 (3); GN-IR-66 (4); PCA-4 ..... **3**

2 Example Handling Times - Addresses: (GN-IR-66 (4)) **2.1**

3* Vessel Communication (Shipping Instructions to Masters) - *Addresses: (GN-IR-66 (4); QIA 64; PCA-1(c)) **3.1**

4 Ice-Management vs. Ice-Breaking **4.2**

LIST OF TABLES

Table 1: Predicted voyage and vessel numbers 4
Table 2: Example Shipping Schedule 1 6
Table 3: Example Shipping Schedule 2 6
Table 4: Example Shipping Schedule 3 7

1 SHIPPING SEASON - ADDRESSES: (GN-IR-66 (2); GN-IR-66 (3); GN-IR-66 (4); PCA-4

Baffinland is proposing a shipping window that potentially commences in early July and ends in the middle of November, the exact duration of the annual shipping season will be dictated by the ice conditions for that year. Accordingly, any dates provided in the Phase 2 FEIS Addendum are nominal and intended to aid reviewers in conceptualizing what is being proposed only.

The dates provided in the FEIS addendum reference a period of **July 1 – November 15**. The operative limit of the proposed shipping window is the commitment ***to not break land fast ice***. As demonstrated in Tables 2 and 4 from TSD-16, there is significant variability in the timing of break up (July 18 average; 21 days of variability) and freeze-up (November 14 average; 29 days variability) along the northern shipping route for the recorded 20 year period between 1997 and 2016.

The date range of July 1 – November 15 has been selected as the nominal shipping season to provide Baffinland and land-users certainty in expectations of when operations may begin and end. This date range provides for contingency in unexpected weather patterns (e.g. early ice break-up) and contingency for unexpected operational delays through the open water season. The actual operational season will vary from year to year, however history and experience has shown that an average operational timeline starting in the third week of July to the third week of October is realistic with assistance from ice breakers and ice management vessels.

To open and close each season, Baffinland will rely on a combination of technical factors and known land use, both of which are tied to ice conditions:

Technical – The Arctic Ice Regime Shipping System (AIRSS) is used by a ship's captain to validate access in each area according to current ice conditions. The AIRSS uses a four-step process that includes defining the ice regime, obtaining ice multipliers, calculating ice numerals, and obtaining permission (NORDREG). This process is described in more detail in Section 3 of TSD 16. This system, along with input from contractors, allows all vessels to assess the current and predicted ice conditions to allow for safe navigation.

Land Use – Making sure Baffinland's shipping activities are safe for employees and land users is always the first priority. Before Baffinland commences its shipping season each year it will rely on a protocol with the community of Pond Inlet to inform Baffinland that residents are no longer using the sea ice. The protocol will be jointly developed and finalized with the community of Pond Inlet.

Use of 'as required' throughout the FEIS addendum when referring to shipping during periods of ice break and ice formation refers to the prevailing ice conditions and the shipping operations that will commence after landfast ice has fractured. Transport Canada regulations, Polar Water Operations Manual, availability of ice-breaker escort, vessel ice class design capabilities and Inuit land-use are all factors (but not limited to this list) that will be taken into consideration when starting and ending the annual shipping operations.

Vessel Information and Shipping Schedule

Addresses: (GN-IR-66 (2); QIA 65; QIA 66; DFO 3.2.1; PCA-1(a); PCA-1(b); WWF-03

a. Vessel Information

The suite of vessels for the shipping season will be a function of vessel commercial availability and ice conditions. As such, an exact shipping schedule which outlines the number of vessels during each period of the shipping season

year over year is not possible to provide. The shipping season will be maximized each year based on commercial availability of vessels and weather conditions.

The shipping class and types of ore carriers proposed for use are provided below:

a) Ice class designs for ore carriers include (not an exhaustive list, but based on current knowledge of market availability):
   i) Non Ice Class (Type E)
   ii) Ice Class 1C (Type D)
   iii) Ice Class 1B (Type C)
   iv) Ice Class 1A (Type B)
   v) Ice Class 1A Super (PC 7)
b) Types of ore carriers include (not an exhaustive list, but based on current knowledge of market availability):
   i) Supramax
   ii) Panamax
   iii) Kamsarmax
   iv) Capesize

For assessment purposes assumptions have been made to ensure a conservative ship management approach has been used. Baffinland recognizes the FEIS addendum for the Phase 2 proposal has discrepancies in the values provided for vessel numbers.

For clarification the following information is provided and should be referred to as the definitive numbers that were used for assessment purposes.

a) Total number of ore carrier voyages is 176. 176 ore carriers have been used in the marine effects assessment. This number does not include tanker related voyages, re-supply related voyages, tug related voyages and/or ice breaker/management related voyages.
b) An estimate of 24 voyages for other vessels (e.g. wet/dry re-supply) has been considered. For re-supply vessels, efforts are currently underway to increase the cubic capacity of vessels employed by BIM, meaning number of voyages might be reduced.
c) For tugs, a range of between 6 to 10 tugs will be operating for the same period of time that ore carriers are loading in Milne Inlet. As tugs operate predominantly within Milne Port an estimate of 10 voyages has been included for assessment purposes.
d) For Ice Breakers, operations could require one to two assets operating for the first 15 – 20 or more days of the shoulder season, weather dependent, and then again for the same duration at the end of the season.
e) For sake of clarification, a voyage constitutes a round trip between a load port (Milne Inlet) and the designated discharge port for that vessel. Trips/year throughout the document refers to a voyage. A transit is considered to be a one-way track either to or from Milne Inlet by any of the vessels. A voyage represents two transits through the Northern Transportation Corridor.

Table 1: Predicted voyage and vessel numbers

Vessel Type	Upper Bound # of voyages per annum	# of Vessels considered in the Marine Assessment
Ore-Carriers	176	176 or carriers
Tugs	10	10

Ice-Breakers	Variable based on prevailing ice conditions	Up to 1-2 ice breakers could be needed (not included in assessment)
Wet/dry re-supply	24	24

b. Shipping Schedule

Example shipping models have been provided to demonstrate the feasibility of transporting ore using a two dock system, currently commercially available vessels and using expected dates that ice breaking would start and end in order to meet the required quantity of ore shipped in a season. The example schedules use the highest probability of dates that will allow for positive ice numerals for the ore carriers with currently available information. An exact shipping schedule over the period of 2019-2035 cannot be provided and is not required for assessment purposes. See Table 2-4 below. All three schedules use the same number of vessels and start and end dates. The difference in the three schedules is how the number of vessels is displayed over various time periods which reflect specific reviewer requests on how an example schedule should be presented.

The shipping model demonstrates 176 voyages to ship approximately 12 million tonnes between July 20 and October 16. It is understood that yearly ice conditions will dictate the start and end dates of the Shipping Season at Baffinland. If ice conditions allow (the break-up of land fast ice, positive ice numerals, available ice breaker and ice management assets, etc.), Baffinland would endeavor to begin shipping operations as early as July 1st and end as late as November 15th. The models shown assumes that the average ice conditions of the past will continue in the short-term, hence the reason we have shown a theoretical model that begins loading ore vessels on July 20th and completing on October 16th.

The model was built utilizing vessel tonnage that is currently available for charter with the current loading, transit times and discharge times experienced since 2015. It does not allow for any delays on site, delays discharging in Europe, weather delays or any downtime between vessels. The model assumes a consistent flow of vessels to the port and that all of these vessels will be available for charter during these periods of time. Any contingency required would be best served by starting the year earlier and/or ending later in the season. The model also assumes that at least one icebreaker (and possibly two) would be required at the beginning and at the end of the season in order to allow the ore carriers for safe transiting.

The example schedule was created utilizing a large number of the total ice class tonnage vessels available in the market at this time, however additional tonnage is currently under construction and could be called upon to assist with the Project.

A schedule for re-supply vessels and fuel tankers has not been provided as they would be scheduled to arrive on an annual and as-needed basis. Given that re-supply vessels are similar class vessels to ore carriers, the shipping season would mimic that for ore carriers.

Table 2: Example Shipping Schedule 1

Assumes Start Date of July 20th and Completion Date of October 16th	July 1 - August 4		August 5 - October 15*		October 16 - November 15		
	Dock #1	Dock #2	Dock #1	Dock #2	Dock #1	Dock #2	Totals
Number of Voyages	*15*	*15*	*72*	*72*	*1*	*1*	*176*
Ice Class Supramax	11		54		1		*66*
Ice Class Ultramax	4	4	12	4			*24*
Ice Class Panamax		11		54		1	*66*
Non-ice Class Panamax			5				*5*
Non-ice Class Kamsarmax			1				*1*
Non-ice Class Cape				14			*14*

*Baffinland recognizes that non-ice class tonnage would only be used August 16-September 20th as represented in Table 4.

Table 3: Example Shipping Schedule 2

Assumes Start Date of July 20th and Completion Date of October 16th	July		August		September		October		
	Dock #1	Dock #2	Dock #1	Dock #2	Dock #1	Dock #2	Dock #1	Dock #2	Totals
Number of Voyages	11	11	31	31	30	30	16	16	*176*
Ice Class Supramax	7		23		20		16		*66*
Ice Class Ultramax	4	4	8		4	4			*24*
Ice Class Panamax		7		25		18		16	*66*
Non-ice Class Panamax					5				*5*
Non-ice Class Kamsarmax					1				*1*
Non-ice Class Cape				6		8			*14*

Table 4: Example Shipping Schedule 3

Assumes Start Date of July 20th and Completion Date of October 16th	July 20 - August 15		August 16 - September 20		September 21 - October 16		
	Dock #1	Dock #2	Dock #1	Dock #2	Dock #1	Dock #2	Totals
Number of Voyages	*26*	*26*	*36*	*36*	*26*	*26*	*176*
Ice Class Supramax	22		22		22		*66*
Ice Class Ultramax	4	4	8		4	4	*24*
Ice Class Panamax		22		22		22	*66*
Non-ice Class Panamax			5				*5*
Non-ice Class Kamsarmax			1				*1*
Non-ice Class Cape				14			*14*

2 EXAMPLE HANDLING TIMES - ADDRESSES: (GN-IR-66 (4))

Using data from the current Approved Project, the below provides estimates for the average expected handling time (hour or days) of an ore, freight and fuel vessel using the Milne docking facilities:

a) Berthing / Unberthing time for Kamsarmax, Panamax to Supramax vessels is about 1.5 hrs per movement.
b) Berthing / unberthing time for Capesize vessels will be slightly longer given the larger dimensions associated with said vessels.
c) Load rate for an ore carrier (ie Supramax, Panamax, Kamsarmax, Baby Cape, Capesize) is about 1 day (+/- 15%).
d) Discharge rate for re-supply vessels depends on discharge method. Current methods via tug and barge, then fully loaded vessel requires about 4 – 5 days to discharge.
e) Similar to re-supply vessels, discharge rate for tankers depends on method. Current methods via floating hose and OHF Tier at Level 1, then rate is 150 M3 per hour, or about 6 – 7 days assuming QTY of ULSD to be discharged is 20,000 M3.

3 VESSEL COMMUNICATION (SHIPPING INSTRUCTIONS TO MASTERS) -

ADDRESSES: (GN-IR-66 (4); QIA 64; PCA-1(C))

The Standing Instructions to Master (SITM) address matters pertaining to speed limitations approved anchorage locations, locations where vessels can perform a controlled drift as well as other vessel traffic management practices. Baffinland also employs an on-site Port Captain who is responsible for, among other duties, communicating with vessels to ensure the flow of traffic.

1) Vessel speed (regardless of vessel type) has been assessed at max of 9 knots through Eclipse Sound and 5 knots in Milne Port.
2) 24 hours of operation can be expected. Decisions as to when a vessel can/should or cannot/should not proceed are influenced by day light hours; and this is taken into consideration when Captains look to transit to and from Milne Inlet. Please note that decisions are made on a case by case basis and take into account the prevailing ice, weather, etc. conditions at the time of transit.
3) Communication with vessel operators is provided via SITM as well as regular email communication as vessels arrive near the Northern Shipping Corridor. The on-site Port Captain coordinates with all vessels entering and exiting Eclipse Sound to and from Milne Inlet. Directions from the Port Captain include, but are not limited to, speed constraints, local marine traffic, anchoring/drifting positons and potential loading date.
4) The SITM provides all vessels with the waypoints for the approved ship track from the entrance of Eclipse Sound to Milne Inlet. Vessels are requested to maintain that track when feasible. The only times when the track is not followed is when a navigational hazard exists (ice berg, another vessel, etc.) or during the period of ice infested waters. During ice breaker operations, the vessel track is normally performed and dictated by the ice concentration. Ice breaker(s) and the following vessels will normally take a track through the least amount of ice as is possible to ensure the safety of the vessels. This track may or may not be the shortest route, but rather the safest path.
5) SITM is a live document and is updated on an annual basis as well as during the actual shipping season.
6) Compliance related matters are managed via direct electronic communication with vessel owner / operators and verbal communications from Port Captain to each vessel

4 ICE-MANAGEMENT VS. ICE-BREAKING

Addresses: (PCA-5; WWF-03)

There is a distinction between Ice Management and Ice Breaker operators. The former envisions the use of Ice Class Tugs, or another asset with similar dimensions, to prevent large ice floes or ice bergs from making contact with vessels in Milne Inlet, port infrastructure or other objects. Ice Breaker operations involves the use of an ice breaker to facilitate the passage of ice class vessels through prevailing ice conditions.

1) Ice breakers are used to facilitate the safe passage of vessels through prevailing ice conditions which are predominantly expected during the shoulder seasons (i.e both the start and end of the shipping season). More precisely, ice breaking operations create a safe track for ore carriers to transit. The Ice Breaker operations will be performed when prevailing ice conditions require Ice Class 1A – 1C ore carriers to operate under escort. Generally speaking, the Ice Breaker(s) will operate from the time of break-up to freeze-up within the nominal shipping window (July 1-November 15) – As demonstrated in Tables 2 and 4 from TSD-16, there is significant variability in the timing of break up (July 18 average; 21 days of variability) and freeze-up (November 14 average; 29 days variability).

2) Ice management operations are more focused on preventing floes of ice or ice bergs from making contact with vessel(s), port infrastructure or other. Ice management operations will be performed when ice bergs or floes make their way down to Milne Inlet. This type of operation, unlike the ice breaker operations, could occur throughout the entire duration of shipping season. This is due to the fact that ice bergs or large floes can make their way along Lancaster Sound, south via Navy Board and then down to Milne Inlet.

Ice breaker and ice management operations are one of the measures used to ensure human and vessel safety. To ensure safe operations, communication between Captain of the ice breaker and Captain of vessels under escort are live and vessels are in direct communication throughout the course of the escort operations. Further, ice breaker, ice management and all vessels are in constant communication with the on-site Port Captain to ensure communications are always maintained.

Specific Information Requests Related to Ice-Breaking

1) Will ice breaking be undertaken regardless of Inuit use of ice within Eclipse Sound, Pond Inlet and Milne Inlet?

No. Communication between BIM and relevant personnel will be maintained so as to ensure that such operations do not hinder use of land fast ice.

2) At what threshold of use will Baffinland cease ice breaking/ice management activities?

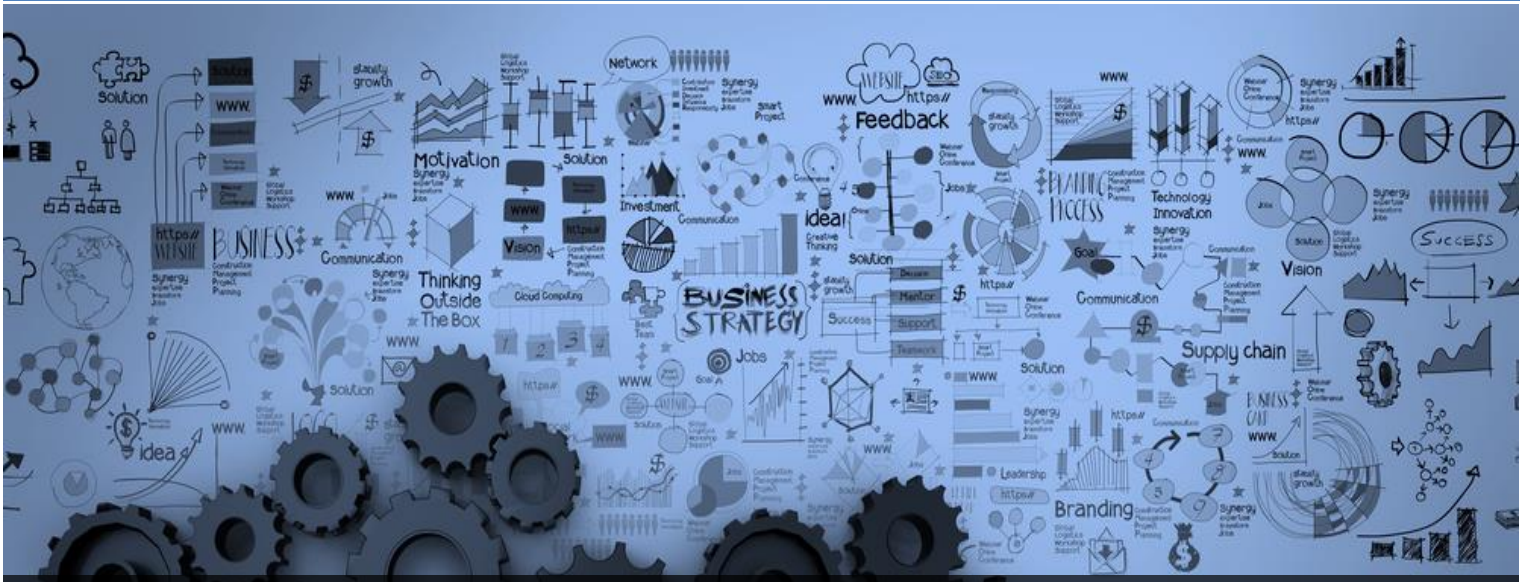
Several factors will determine when operations could come to a close, including:

i) Prevailing ice conditions prevent ore carriers from rendering a positive ice numeral;
ii) Annual shipping requirements have been achieved;
iii) Presence of landfast ice has been identified.

3) Please clarify what the shipping frequency will be during the shoulder seasons when landfast ice is present and/or when ice management and/or breaking activities are being carried out.
   a) Operations will not be executed when landfast ice is present and prevents ore carriers from rendering a positive ice numeral. Current operations do not require use of Polar Class 4 vessel or operations in landfast ice.
   b) Assuming landfast ice is no longer present, then ore carriers will operate under ice breaker escort. A prerequisite for said operations is the need to submit ice numerals to NORDREG.

c) Frequency of shipping will be assessed on a day to day basis, taking into consideration prevailing ice conditions and operational requirements at the two ore docks.

APPENDIX 13
UPDATED LABOUR MARKET ANALYSIS



Baffinland Iron Mines Corporation
Mary River Project—Phase 2 Proposal

Labour Market Analysis

Prepared by Impact Economics

Technical Supporting Document No. 26

2018

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Summary of Key Findings

The 2018 Labour Market Analysis describes the labour force demand created by the Mary River Project (the Project). It also describes the labour supply in Nunavut and details regarding how this supply might change over time. A key finding of this report is that there are not enough available, interested, and qualified Inuit in the Local Study Area (LSA) and Secondary Labour Market communities to fill all the jobs created by the Project; this is true today and will be true for the entire life of the project.

Labour Demand

The Project will require a sizeable workforce throughout its 21-year operational life span that will include two significant construction projects and stepped increase in operations. A 3-year closure and reclamation project will follow that will have its own labour requirements.

Using full-time equivalency (FTE) terms[1], the Project created 933 FTE jobs in 2016 and Baffinland is reporting 1,180 FTE jobs were created in 2017. As a point of comparison, Statistics Canada reports that total employment for the entire territory was 13,400 that year, which includes full-time and part-time employment.

Moving forward, Baffinland expects labour demand to grow even higher. From 2018 to 2020, the Early Revenue Phase that is currently underway will need a larger workforce than what exists today, averaging 1,360 FTE jobs annually over this time frame. At the same time, the proposed Phase 2 North Railway construction project will need its own workforce, estimated to be approximately 550 FTE jobs from 2019 to 2021, with a peak employment of more than 1,000 in 2020.

The new transportation system will allow Baffinland to expand its ore production to 12 million tonnes per annum (Mtpa) from the current 4.2 Mtpa production rate. This larger operation is expected to continue until 2035 and will require a workforce of approximately 1,000 people on average on a FTE basis.

Baffinland will begin construction of the already approved South Railway and Steensby Inlet port facility in 2021. This is a larger project than the North Railway needing four years to complete and a labour force in excess of 4,500 person years, which is equal to an average of 1,145 FTE jobs annually. This infrastructure will facilitate further expansions in production that will result in the creation of another 950 FTE jobs. From 2025 to 2035, the Mary River Project is expected to produce 30 Mt of ore annually and employ an average of 1,960 people on a FTE basis.

The 3-year closure and reclamation project will take place from 2036 to 2038 and will employ approximately 300 people on a FTE basis each year.

Labour Supply

In 2017, there were approximately 10,500 Inuit living in the LSA communities, which include Arctic Bay, Clyde River, Hall Beach, Igloolik, Pond Inlet, and Iqaluit.[2] This is a small population when compared to the labour force needs of the Project. The main purpose of this research is to determine a reasonable estimate of the potential Inuit labour supply that could be available to work at the Project.

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[1] Full-time equivalency is a method of normalizing employment data. A full time job at the mine site was made equal to working 2,016 hours, based on working 12 hours per day for 14 days and with 12 shifts per year (which is based on the assumption that there are 13 shifts per year and one is taken as holiday). An employee who works for less time would be reported as working a smaller percentage of one FTE job, while an employee that works additional shifts or overtime would be reported as a percentage greater than one FTE job.

[2] These communities are the focal point of the analysis because they are the points of hire within Nunavut for the Project. However, Baffinland will also seek Inuit employees from communities through the Qikiqtaaluk region. Communities outside the Local Study Area are referred to as the Secondary Labour Market throughout this report.

It's fair to assume that not everyone living in the LSA should be included in this estimate of *potential* labour. For example, almost half of the population is too young to be in the workforce—they're not ready for work. If one were to only count the Inuit population in the 19 to 59 age cohort, the potential workforce number drops from 10,500 to approximately 5,000.[3]

These people are old enough but can all of them work at the Project? The abilities of this potential labour must be considered. The vast majority of jobs created by the Project require a high school diploma or its equivalency and some training as a minimum qualification, however, fewer than 50% of Nunavut's Inuit population aged 25 to 64 have graduated from high school.[4] Taking education into consideration lowers the potential pool of Inuit workers in the LSA to approximately 2,270.[5]

Using the estimated 2,270 Inuit who are old enough and have a high school diploma or its equivalency is a realistic starting point in the assessment of the Project's future Inuit workforce—this group is ready (they are old enough) and able (they have the basic education requirements). However, there are other factors that might prevent someone from taking a job there. These factors are not easily quantified because they represent an individual's willingness to work at the Project. For example

- Employment status—Being employed does not disqualify someone from applying for a job with the Project, but an individual's current job satisfaction (including extrinsic and intrinsic rewards) would influence the decision whether or not to apply for work at the Project.
- Aptitudes—Not everyone possesses the mental and physical abilities to do the work required. This goes beyond education, training, or experience, and is more focussed on other factors that are more difficult to quantify but are nonetheless critical when determining a realistic labour pool.
- Interest—Working at a fly-in/fly-out (FIFO) mining project is not for everyone; some are simply not interested and would prefer other types of full-time wage employment.
- Familiarity with wage employment—For some Inuit, a job at the Project will be their first experience in the workforce and it can take some time before becoming accustomed to the requirements of employment.
- Family responsibilities—Many Inuit have large families (three or more children) and they may care for elder parents or other dependents. For some Inuit, taking a job that would have them leave their families for two weeks is simply not possible. This is particularly true for single-parent families or if a partner is already employed by the Project.
- Language—English can be a barrier (perceived or otherwise) for some Inuit who would otherwise choose to work. Although the IIBA clearly states that lack of fluency in English will not necessarily be a barrier to employment, linguistic issues may affect participation in the training necessary to take up a position in the Project workforce.
- Criminal record— A criminal record may disqualify someone from employment with the Project depending on the frequency and severity of their criminal activities.
- Dependencies—There is a wide range of dependencies that deter potential employees from seeking employment at the Project, for example
    - addictions can create a dependency that prevents a potential employee from working in a camp setting for two weeks at a time,

[3] The 19 to 59 age cohort is the mostly likely age range for employees at the Project. Throughout this report, the 25 to 64 age cohort is used as a proxy for this slightly younger age cohort. This is because the latter age range is used by Statistics Canada when it disaggregates data by age, and therefore, it is more readily available. Because of Nunavut's low median age, it can be assumed that the 25 to 64 age cohort is biased—it underrepresents the 19 to 59 age cohort.
[4] The percentage of Inuit with a high school diploma living in Iqaluit is higher.
[5] It should be noted that there are jobs available that do not require a high school education. In 2016, there were 94 of these jobs representing 10% of the Project's labour requirements.

    - potential employees dependent on public housing might perceive their rent will rise as a result of their higher income and do not believe the increased cost is affordable.[6]
- Competition for Inuit Labour—It must be emphasized that there are other demands for Inuit labour from throughout the Nunavut economy. Government, education, health, Inuit organisations, as well as other industries (construction, fishing, etc.) are keen to increase their Inuit employment record, and in some cases, are legally obliged to do so. Therefore, there is competition for Inuit labour.

These are all factors that could prevent someone from applying for work at the Project and should be accounted for in the assessment of potential labour supply. Some are easily quantified such as age, employment status, and education, while other factors are more qualitative in nature such as aptitudes, interest, and family responsibilities, but are no less critical when determining the potential workforce.

It is also important to recognize that many of these challenges will be in place throughout the entire life of the Project. For example:

- Even the most optimistic assumption for improving high school graduation rates would still see them below 50% for the majority of the Project's life span;
- Demand for Inuit labour from other employers throughout the Nunavut economy, especially those with post-secondary education or training, will not go away and could very well intensify over time; and,
- Other challenges such as family constraints, aptitudes, and interest will always exist and are not necessarily unique to the jobs being created by the Project.

Labour Force Participation

Nevertheless, there is evidence that the Project's potential labour supply will grow over time and that the Inuit employment record will improve accordingly. For one thing, labour markets are not static. Every year, there will be more Inuit entering the workforce adding to the supply of potential labour for the Project. The Mary River Project is still a relatively new phenomenon within the Baffin economy. One should expect the Project to increase its penetration into the regional labour market over the next few years through increased awareness of the employment opportunities and benefits and through ongoing investments in recruitment and training.

One can also look to the employment record at Agnico Eagle Mines Ltd.'s Meadowbank Mine for evidence for what is possible. Inuit participation in that project has grown to 25% of its operations' workforce after 6 years of operations.

Increasing Inuit participation is a long-term commitment for Baffinland. It should be understood that success cannot be achieved overnight and that progress will be slow at times. Establishing realistic annual targets where there are improvements each and every year can be a productive approach. Baffinland is investing in its Inuit workforce and will continue to do so, but lowering or eliminating many of the constraints to employment will be the responsibility of others, including individuals, families, communities, Inuit organisations, and government departments and agencies. And, while all parties are genuinely interested in improving the workforce participation of Inuit in the Project, it must be acknowledged that some factors that prevent an otherwise eligible person from working cannot be eliminated.

[6] Baffinland arranges and pays for all travel costs for Inuit employees living in a non-point of hire community to a point of hire community. This should mitigate the challenges associated with public housing that prevented potential labour from relocating to a LSA community.

Table of Contents

Summary of Key Findings i

1 Introduction 1

2 Project Labour Demand 7

2.1 Early Revenue Phase 8
2.2 Proposed Phase 2 Construction 8
2.3 12 Mtpa Operation Phase 9
2.4 South Railway and Steensby Port Construction 9
2.5 18 Mtpa Operation Phase 9
2.6 Closure and Reclamation 10
2.7 Summary 10

3 Potential Inuit Labour Supply 11

3.1 What is the Potential Inuit Labour Supply and how is it determined? 11
3.2 Population Demographics 15
3.3 Education Levels 21
3.4 Employment Status of Potential LSA Labour Supply 23
3.5 Estimating the Future Labour Supply 26
3.6 Summary of Labour Force Estimation 30

4 Conclusion 33

Appendix 1: Participation of Indigenous Labour at Other Northern Mining Operations 34

Meadowbank Mine 34
NWT Diamond Mines (Ekati, Diavik, and Snap Lake) 38
Important Takeaways from Other Northern Mine Employment 41

Tables

Table 2.1: Mary River Project Labour Demand—Early Revenue Phase 7
Table 2.2: Mary River Project Labour Demand—North Rail Construction Project 7
Table 2.3: Mary River Project Labour Demand—12 Mt/a Operation Phase 8
Table 2.4: Mary River Project Labour Demand— Steensby Port and Rail Construction 8
Table 2.5: Mary River Project Labour Demand—18 Mt/a Operations 9
Table 2.6: Mary River Project Labour Demand—Closure and Reclamation 9
Table 2.7: Mary River Project Cumulative Labour Demand, 2016 to 2040 9
Table 3.1: Median Age in Nunavut, 2016 15
Table 3.2: 2017 Population Estimates 15
Table 3.3: Population Estimates by Age Cohort and Gender, 2017 16
Table 3.4 Regional Population Estimates, 2017 16
Table 3.5(a): Projected Population of North Baffin LSA, 20-year outlook 17
Table 3.5(b): Projected Population of Iqaluit, 20-year outlook 17
Table 3.5(c): Projected Population of the Secondary Labour Market, 20-year outlook 18
Table 3.6: Nunavut Secondary School Graduates, 2011 to 2016 21
Table 3.7: LSA Population by Education, 2016 22
Table 3.8: Labour Force Characteristics, 2017 23
Table 3.9(a): Qikiqtaaluk Labour Markets, 2016 24
Table 3.9(b): North Baffin Labour Markets, 2016 24
Table A.1: Meadowbank Mine Employment 33
Table A.2: Employee Turnover, 2010 to 2015 34
Table A.3: Employment by Gender, 2010 to 2015 34
Table A.4: Inuit Employees by Job Classification, 2014 and 2015 35
Table A.5: Kivalliq Population, 2016 35
Table A.6: Kivalliq Population by Age Cohort, 2016 35
Table A.7: Agnico Eagle Mine Limited's Cash and In-Kind Support for Training 36
Table A.8: Indigenous Workforce by Job Classification, 2015 39
Table A.9: Indigenous Labour Force Participation in NWT mining, 2014 39

Figures

Figure 1.1: Phase 2 Proposal Schedule including the Phase 2 Proosal 1
Figure 1.2: Mary River Project Workforce Requirements, by phase..... 3
Figure 2.1 Labour Force Requirements, by job classification 6
Figure 3.1 Representation of How the Labour Supply Criteria Helps in Determining the Potential Labour Force 13
Figure 3.2: Nunavut's Population Pyramid, 2017..... 14
Figure 3.3(a): Ready Labour Supply, Qikiqtaaluk Region..... 19
Figure 3.3(b): Ready Inuit Labour Supply, Qikiqtaaluk Region..... 20
Figure 3.4: Graduation Rates, 1999 to 2016..... 21
Figure 3.5: Ready and Able Inuit Labour Supply in North Baffin and Iqaluit 26
Figure 3.6: Ready and Able Inuit Labour Supply in the LSA and Secondary Labour Market 26
Figure 3.7: Employment and Unemployment rates by education, Inuit, 25 to 64 age cohort..... 27
Figure 3.8 Employment Status of Ready and Able Inuit Labour Supply 28
Figure 3.9: Ready, Able, and Willing Inuit Labour Supply 31
Figure A.1: Job Creation in NWT's Diamond Mining Industry, 1999 to 2015 37
Figure A.2: NWT Resident Employment in Diamond Mining, 1999 to 2015 38
Figure 5.3: Relative Contribution to Mine Employment by NWT Indigenous residents, 1997 to 2015 . 38

1 Introduction

This labour market analysis is an objective assessment of the current and future labour supply conditions in the Local Study Area, which is defined as the North Baffin communities of Arctic Bay, Clyde River, Hall Beach, Igloolik, and Pond Inlet, and Iqaluit set against the labour demand of Mary River Project (the Project).

As agreed to in the Inuit Impact Benefit Agreement (IIBA), the Project proponent, Baffinland Iron Mines Corporation (Baffinland) includes all communities in the Qikiqtaaluk region in its labour force catchment area. This includes the communities of Cape Dorset, Grise Fiord, Kimmirut, Pangnirtung, Qikiqtarjuaq, Resolute, and Sanikiluaq. For the purpose of this Labour Market Analysis report, these seven communities are referred to as the Secondary Labour Market.

Baffinland arranges and pays for all travel costs (including accommodations, meals, etc.) for Inuit employees living in a non-point of hire community to a point of hire community. This logistical challenge will likely mean that the effect of this labour market expansion will be minimal though still positive overall.

Baffinland is planning (upon regulatory approval) an expansion of its operations (the Phase 2 Proposal) through the construction of a railway to the port at Milne Inlet that will facilitate an increased rate of production from 4.2 million tonnes per annum (Mtpa) to 12 Mtpa. An already approved, but not yet built, railway heading south from the Mine Site to a port at Steensby Inlet will add an 18 Mtpa mining operation to the existing mine production.

The schedule of the Phase 2 Proposal is presented in Figure 1.1 alongside the existing Early Revenue Phase (ERP), and the already approved South Railway and Steensby Inlet port construction and 18 Mtpa operation. According to this schedule, the mine will operate through 2035, with mine closure from 2036 to 2038.

Area	2018	2019-2020	2021	2022-2023	2024	2025-2035
Mine	5.5 Mtpa	6 Mtpa	12 Mtpa	12 Mtpa	21 Mtpa	30 Mtpa
Tote Road/Trucking	5.5 Mtpa	6 Mtpa	12 Mtpa*	NA	NA	NA
North Rail	NA	NA	12 Mtpa*	12 Mtpa	12 Mtpa	12 Mtpa
South Rail	NA	NA	NA	NA	9 Mtpa	18 Mtpa
Milne Port	5.5 Mtpa	6 Mtpa	12 Mtpa	12 Mtpa	12 Mtpa	12 Mtpa
South/Steensby Port	NA	NA	NA	NA	9 Mtpa	18 Mtpa

* during commissioning, both rail and trucking will be used

Figure 1.1: Mary River Project Schedule including the Phase 2 Proposal

Source: Baffinland Iron Mines Corporation

A larger workforce is an important component of the expanded operations and construction projects. The labour demand of the current mine operations has grown from 933 in 2016 in full-time equivalent (FTE) terms to 1,181 in 2017 and will grow again to 1,360 in 2018 and remain at that level for two more years.[7] The three-year North Railway construction phase will start, upon regulatory approval, in 2019. It requires an estimated 1,660 person years of labour, averaging 550 FTE jobs per year with a peak employment of 1,050.[8] The overlap of these two activities (ERP operations and the North Railway construction) will push labour demand over 2,000 FTE jobs by 2020.

The railway will facilitate an increase in iron production to 12 Mtpa while the efficiencies granted by the railway will result in an operational workforce of 1,010 that will remain in place until the mine closes in 2035.

With the North Railway construction project completed, attention will turn to the South Railway and Steensby Inlet port. This is a four-year project starting in 2021. This is a much more substantive endeavour than the North Railway, requiring an average labour force of 1,145 per year, peaking in 2022 at 2,680. Again, these construction-related jobs are in addition to the operations jobs.

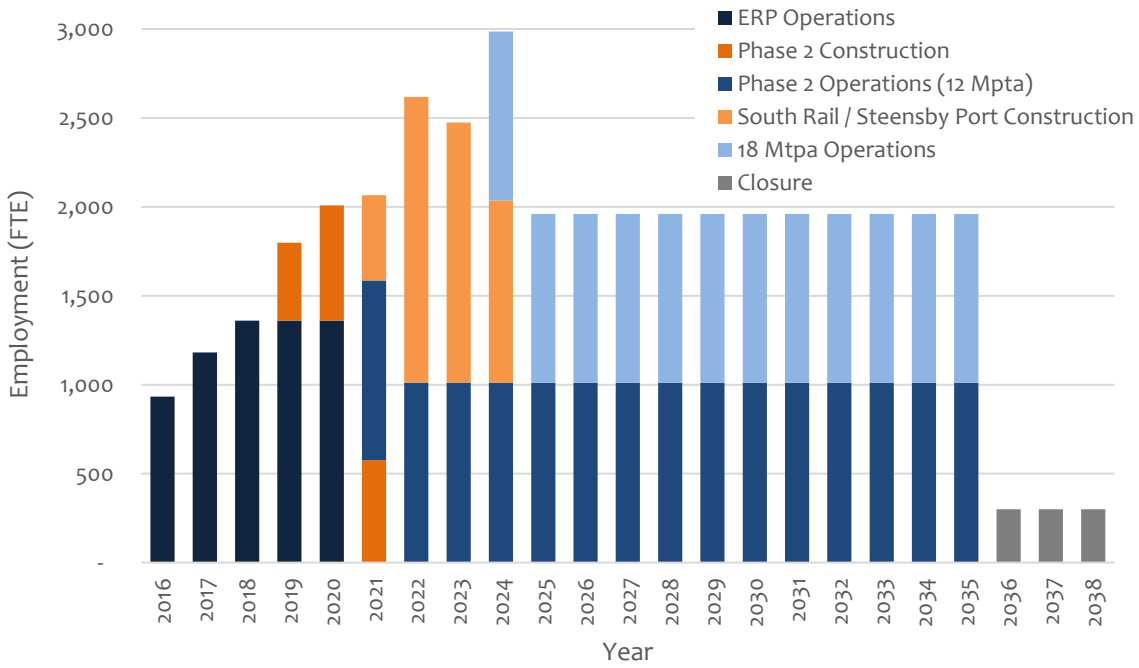
The final operational phase of the Project will see dual mining operations with a combined production of 30 Mtpa, rail service to ports at Milne and Steensby Inlets, seasonal shipping from Milne Port, and year-round shipping from Steensby Port. Labour demand is expected to settle at 1,960 in FTE terms for the remaining 11 years of operations, from 2025 to 2035. Reclamation and closure is the final phase of the Project. It will span three years, requiring an estimated 300 employees.

The Project's labour force needs can be separated into the different operation and construction phases. These phases include:

- Early Revenue Phase (ERP) or Current Phase (present to 2020)
- Phase 2 Construction Phase (2019 to 2021)
- Phase 2 (12 Mtpa) Operation Phase (2021 to 2035)
- Steensby Port and South Railway Construction Phase (2021 to 2024)
- 18 Mtpa Operations Phase (2024 to 2035)
- Closure and Reclamation (2036 to 2038)

[7] All employment data are presented in FTE terms unless otherwise noted.
[8] Employment numbers have been rounded and therefore may not add up.

Figure 1.2: Mary River Project Workforce Requirements, by phase



Source: Baffinland Iron Mines Corporation.

Labour from the LSA communities cannot supply the Project with all of its labour force needs. This statement holds true even after adding potential labour from the Secondary Labour Market communities. Baffinland reported its 2017 workforce was 1,181 (in FTE terms). That same year, Statistics Canada reported total employment for the entire territory was 13,400 jobs—a figure that includes full-time and part-time employment. Inuit employees represented 13.5% of the workforce, equal to 159 FTE jobs. The 2017 record of employment is the starting point for understanding the labour supply issues facing the LSA.

Included in this analysis are:

- A review of the 2016 and 2017 employment record
- A look at the Project's future labour demand
- A review of the current population and demographics of the primary and secondary labour markets
- An investigation into the future labour supply in the Qikiqtaaluk communities
- An examination of the Indigenous workforce of other northern mining districts, including the employment record of Agnico-Eagle Mine's Meadowbank Mine and the diamond mines in the Northwest Territories

Before proceeding, it is important to clarify some important points. First, when investigating a labour market—and especially when attempting to determine the number of employees that will work in a particular industry for a particular employer—one must remember that Canadians are free to pursue any work they choose. Simply being unemployed and qualified are not sufficient conditions to assume an individual will work at the Project. This simply means they are a part of the *potential* workforce. An individual might choose to work elsewhere for any number of reasons.

Second, there are other demands for Inuit labour within the Baffin region. This will be described later in the report, but it is an important point to introduce now. The Government of Nunavut is the largest employer in the territory with a broad range of staffing needs in public administration, education, and health. Under Article 23 of the Nunavut Agreement, the territory's public government should be representative of the population, which implies 84% of GN staff should be Inuit. To meet this requirement, the Government of Nunavut is actively pursuing increased employment of ready, willing, and able Inuit labour. The federal government, Inuit organisations, other industries, and businesses have Inuit hiring mandates or policies as well. In other words, there is competition amongst employers to attract qualified Inuit employees. Given the relatively low number of Inuit labour with the necessary qualifications, an employer that meets its Inuit employment targets likely does so to the detriment of other employers that have their own Inuit employment targets.

Third, the analysis includes an investigation into the participation of Inuit in the mining industry in the Kivalliq Region and Indigenous people in the diamond mines in the Northwest Territories. These examples help demonstrate the levels of Indigenous employment achieved elsewhere and the investments or mitigation measures taken to improve this employment. These examples offer a useful comparison, but one should not assume the social, economic, and cultural conditions are identical across the different jurisdictions and therefore they are not perfect comparisons. This analysis is presented as an Appendix to the report.

Fourth, the labour market analysis will concern itself exclusively with direct employment effects, including employment with the Project's contractors (it is more accurate to describe the latter group of employees as indirect employment or direct endogenous employment). However, the Project will also have indirect and induced effects on job creation. The numbers will be small relative to the number of direct jobs, but not insignificant to the region. These jobs tend to be located in communities, often with more traditional 9 AM to 5 PM, Monday to Friday, work schedules that are desirable for people who are less inclined or unable to meet the rotational work requirements of the

Project. These indirect and induced jobs represent additional competition for Inuit labour and therefore represent a risk to Baffinland's Inuit employment targets.

As a final point, this report can be read in the context of the Inuit Impact and Benefit Agreement (IIBA) concluded between Baffinland Iron Mines Corporation (Baffinland) and the Qikiqtani Inuit Association (QIA) in 2013 and later amended in October, 2018. The IIBA includes a number of provisions respecting Inuit employment, training, and education, and in particular, requires Baffinland and QIA to establish an annual Minimum Inuit Employment Goal (MIEG), which stipulates the prescribed percentage of Inuit Project employment on a yearly basis. To that end, this report provides evidence for Baffinland and the QIA to establish realistic employment targets and to develop a process for determining these targets in future years.

2 Project Labour Demand

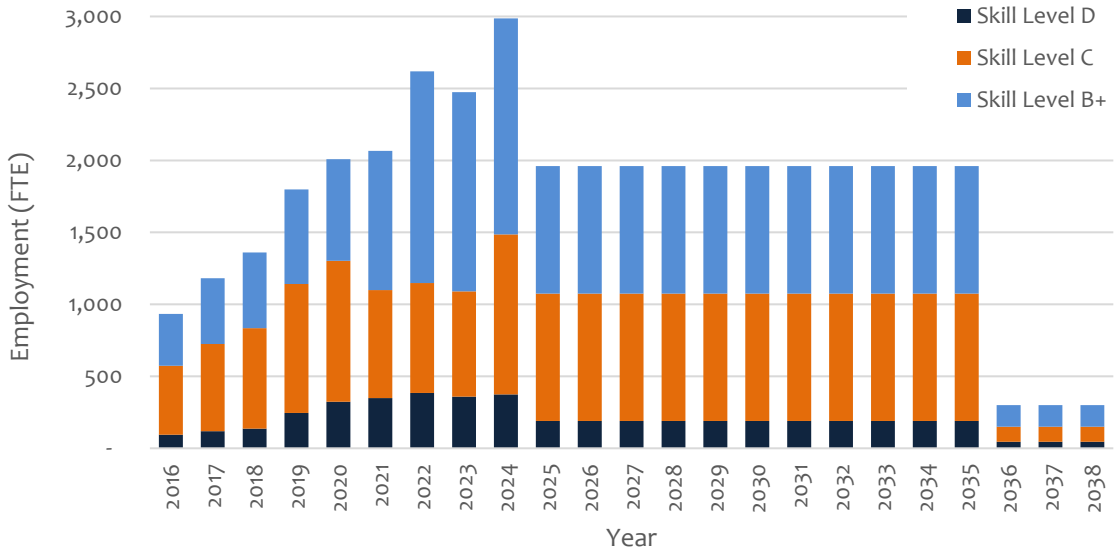
Baffinland has estimated its future workforce requirements for the Project. These estimates include the labour needs of its contractors, but do not include any indirect or induced effects that would create additional labour demand.

All jobs have been assessed according to the level of education and/or experience they require. The National Occupational Classification matrix was used during the regulatory process for the approved Mary River Project to assign jobs a classification according to the skill levels needed in that job. The original five levels were condensed into three levels for the purpose of estimating future labour requirements where levels O, A, and B category jobs were grouped together into a single category B+ and where levels C and D were left unchanged.

- Level B and higher occupations are jobs that usually require apprenticeship training or college/university education. This level includes industrial trades, drillers, blasters, supervisors, technical occupations, managers and professional occupations. This category also includes Level O jobs, which are defined as all management-level employment.
- Level C occupations usually require secondary school and/or occupation-specific training. This level includes jobs such as heavy equipment operators, administrative support, scheduling jobs, and occupations in food and beverage services.
- Level D jobs are those where on-the-job training is usually provided. These may include kitchen helpers, cleaners, security guards, trades helpers and labourers.

The Project's overall workforce requirements presented in Chapter 1 can be shown in terms of skill levels. The vast majority of jobs created by the Project are classified as Level C or Level B+. Over the entire 21-year operation (2015 to 2035), the three years of reclamation, and including all construction phases, Level C and Level B+ jobs represent 43% and 46% of the workforce, respectively, while Level D jobs account for approximately 12% of the total.

Figure 2.1 Labour Force Requirements, by job classification



Source: Baffinland Iron Mines Corporation.

2.1 Early Revenue Phase

The Early Revenue Phase (ERP) is underway and will continue until the North Railway is operational. Employment during this phase has grown to 1,181 in 2017 and will expand to 1,360 in 2018 and remain at that level until 2020.

Jobs requiring minimal education (Level D classification) represent 10% of the total, averaging 125 jobs over the five-year period 2016 to 2020. Level C is the largest skill category with 636 positions, on average. Jobs classified as Level B and higher will average 478 (Table 2.1).

Table 2.1: Mary River Project Labour Demand—Early Revenue Phase (Current) Operations

	2016	2017	2018	2019	2020	Total	Annual Average
Skill Level B and Higher Workforce	360	456	525	525	525	2,391	478
Skill Level C Workforce	479	606	698	698	698	3,179	636
Skill Level D Workforce	94	119	137	137	137	624	125
Total Workforce	933	1,181	1,360	1,360	1,360	6,194	1,239

2.2 Proposed Phase 2 Construction

The proposed Phase 2 construction project will have a separate workforce from the ERP.

Work rotations are often longer for construction projects, with the majority of work crews adopting a 4 and 2 schedule (4 weeks in and 2 weeks out), and some using a 6 and 2 schedule. With that said, many employees from the LSA were able to work a 2 and 2 schedule during the mine's initial construction project.

It is the nature of construction projects that the size of workforce can undergo large fluctuations. It is not uncommon that workers with highly specialized skills are on site for short periods of time, after which they are no longer required. This can cause the total workforce to swell at times.

The combination of longer work rotations and the coming and going of specialized work crews results in a notable difference between the estimated workforce in person years (FTE) and the estimated peak workforce. Both are provided in the construction phase employment tables.

The proposed Phase 2 construction project requires a workforce of 1,662 person years of labour over a three-year project timeframe, equal to an annual average of 554 FTE jobs. From this average, an estimated 28% (257 FTE jobs) will be classified as Level D jobs, while 43% will be Level C jobs and 29% will be Level B+ jobs (Table 2.2). The workforce will peak in 2020, when an estimated 1,050 will be working on the project.

Table 2.2: Mary River Project Labour Demand—North Railway Construction Phase

	2019	2020	2021	Total	Annual Average
Skill Level B and Higher Workforce	132	180	174	486	162
Skill Level C Workforce	198	282	234	714	238
Skill Level D Workforce	108	186	168	462	154
Total Workforce (FTE)	426	648	576	1,662	554
Estimated Peak Workforce	710	1,050	950		

2.3 12 Mtpa Operation Phase

The opening of the North Railway will allow production at the mine to grow to 12 Mtpa. It will also bring greater efficiencies to the mine's operations. In particular, fewer road maintenance and transportation-related jobs will be needed. The decline in these types of jobs will outnumber any additional production-related jobs.

The demand for unskilled (Level D) labour will fall from 137 in the final year of the ERP (2020) to an annual average of 95 from 2021 to 2035. Demand for Level C labour will fall from 698 to 410. Level B+ jobs will remain relatively stable during the transition into the larger operation, averaging 505 FTE jobs over the 15-year timeframe (Table 2.3).

Table 2.3: Mary River Project Labour Demand—12 Mtpa Operation Phase

	Total	2021 to 2035 (annual average)
Skill Level B and Higher Workforce	7,577	505
Skill Level C Workforce	6,153	410
Skill Level D Workforce	1,422	95
Total Workforce	16,160	1,010

2.4 South Railway and Steensby Port Construction

The final construction phase is based on estimates provided in the *2012 Final Environmental Impact Statement* for Mary River. It includes the construction of a railroad south from Mary River to Steensby Inlet where a new port facility will be built. This project is expected to commence in 2021 after the North Railway has been built. This is a much larger project requiring a much larger workforce, in part because it includes the construction of a port, but also because the southern rail link is longer and there isn't a tote road in place to facilitate the movement of construction materials or to improve the logistics of the project. This phase will span four years.

These factors combine to raise the estimated workforce to just under 4,600 person-years over the four years of port and rail construction activities, averaging 1,145 person-years annually. It is estimated that 18% of these jobs will be classified as Level D work, meaning there will be an average of 206 jobs created that do not require specialized training or trade certification. The workforce is expected to peak in the second year of construction at 2,680 jobs.

Table 2.4: Mary River Project Labour Demand— Steensby Port and South Railway Construction

	2021	2022	2023	2024	Total	Annual Average
Skill Level B and Higher Workforce	288	965	878	616	2,747	687
Skill Level C Workforce	106	354	322	226	1,007	252
Skill Level D Workforce	86	289	264	185	824	206
Total Workforce (FTE)	480	1,608	1,464	1,026	4,578	1,145
Estimated Peak Workforce	800	2,680	2,440	1,710		

2.5 18 Mtpa Operation Phase

The second rail and port facility will allow Baffinland to expand its mining operation by an additional 18 Mtpa for the final 12 years of production, from 2024 to 2035. This expanded operation will bring about the need for a much larger workforce when compared to the 1,010 needed for the 12 Mpta phase. The

new production will add 380 Level B+ jobs, 475 Level C jobs, and 95 Level D jobs to the existing operations workforce, bringing the total labour demand to an estimated 1,960 FTE jobs.

Table 2.5: Mary River Project Labour Demand—18 Mtpa Operation

	Total	2024 to 2035 (annual average)
Skill Level B and Higher Workforce	4,560	380
Skill Level C Workforce	5,700	475
Skill Level D Workforce	1,140	95
Total Workforce	8,550	950

2.6 Closure and Reclamation

Closure and Reclamation will span three years after production has ended and will include reclaiming the mine site, railways, and port facilities. Baffinland estimates it will require 300 employees annually to complete these tasks.

Table 2.6: Mary River Project Labour Demand—Closure and Reclamation

	Total	2036 to 2038 (annual average)
Skill Level B and Higher Workforce	450	150
Skill Level C Workforce	315	105
Skill Level D Workforce	135	45
Total Workforce	900	300

2.7 Summary

Table 2.7 contains the estimated labour force requirements by skill level for the entire life of the Project. Note that operations do not stop during the construction phases. The proposed Phase 2 construction will combine with the ongoing ERP operations, followed by a second construction phase (Steensby Port and South Railway) that will combine with the Phase 2 12 Mpta operations. Labour demand will stabilize in 2025 until operations wrap up in 2035, and the 3-year reclamation and closure phase takes over.

Table 2.7: Mary River Project Cumulative Labour Demand, 2016 to 2040

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Level B and Higher	360	456	525	657	705	967	1,470	1,384	1,501	885	885	885	885
Level C	479	606	698	896	980	750	764	732	1,111	885	885	885	885
Level D	94	119	137	245	323	349	384	358	374	190	190	190	190
Total Workforce (FTE)	933	1,181	1,360	1,798	2,008	2,066	2,618	2,474	2,986	1,960	1,960	1,960	1,960
Estimate Peak Workforce	933	1,181	1,360	2,070	2,410	2,760	3,690	3,450	3,670	1,960	1,960	1,960	1,960

	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	Total	Annual Average
Level B and Higher	885	885	885	885	885	885	885	150	150	150	**18,211**	**792**
Level C	885	885	885	885	885	885	885	105	105	105	**17,068**	**745**
Level D	190	190	190	190	190	190	190	45	45	45	**4,607**	**200**
Total Workforce	1,960	1,960	1,960	1,960	1,960	1,960	1,960	300	300	300	**39,886**	**1,734**
Estimate Peak Workforce	1,960	1,960	1,960	1,960	1,960	1,960	1,960	300	300	300		

3 Potential Inuit Labour Supply

3.1 What is the Potential Inuit Labour Supply and how is it determined?

The potential Inuit labour supply can be defined simply as Inuit who are ready, able, and willing to work at the Project.

Readiness implies an individual is old enough to work and is not otherwise unavailable to work.[9,10]

Ability implies the individual has the right education and training, and is mentally and physically able to complete the tasks required of the job.

Willingness implies that an individual wants a job and will make whatever changes in their life necessary to take the job. As an example, a majority of the Project's jobs require employees to work in a camp with a 2-week work rotation. This rotation is an insurmountable barrier for some individuals who are otherwise ready and able to work. Willingness also includes people who are currently employed but who are willing to leave their job for one with the Project.

The first step in establishing an estimate of the potential Inuit labour supply is to examine the regional population to determine who is ready to work. The region is referred to as the Local Study Area, which is the primary labour market, and includes the communities of Arctic Bay, Clyde River, Hall Beach, Igloolik, Pond Inlet, and Iqaluit. This LSA is sometimes divided between the North Baffin communities and Iqaluit as part of the analysis.

Baffinland also arranges and pays for all travel costs (including accommodations, meals, etc.) for Inuit employees living in a non-point of hire community to a point of hire community. This includes the communities of Cape Dorset, Grise Fiord, Kimmirut, Pangnirtung, Qikiqtarjuaq, Resolute, and Sanikiluaq, and for the purpose of this Labour Market Analysis report, these seven communities are referred to as the Secondary Labour Market.

Estimating the ready workforce is relatively straightforward. The median age of North Baffin LSA community residents was approximately 21 at the time of the last Census meaning the number of Inuit residents meeting the age requirements is a little more than half of the regional population. This subset of the region's total population is considered the ready workforce—they live in the right region and they meet the minimum age requirement.

While technically correct, it is not accurate to assume everyone within this working-age population is a potential employee. As proof of this, the majority of jobs created by the Project require the employee have at least a high school diploma or its equivalency and some training or work experience. Many of the jobs require a professional designation, years of experience, or a university education. So, at a minimum, the ready workforce should be separated according to their general qualifications for the types of jobs being created.

- Ready workers without a high school diploma or its equivalency qualify for entry-level jobs. These types of jobs represent approximately 10% of the operations workforce and about 20% of construction jobs. It is important to note that Inuit currently fill the majority of the Level D jobs associated with the ERP, so in terms of increasing Inuit employment, there are not a lot of gains to be made in this area.

[9] Workers' Safety and Compensation Commission regulations preclude Baffinland from hiring anyone under the age of 18.
[10] Individuals who are incarcerated, serving in the Canadian Armed Forces, or are medically unable to work are a part of this group of people who are old enough but not available to work. Statistics Canada defines this ready group as the labour force's source population.

- Ready workers with a high school diploma or its equivalency qualify for a wider variety and larger number of jobs, and have the prerequisite education to participate in training needed for advancement.

The most recent Census has found that approximately 47% of Nunavut's Inuit adult population aged 25 to 64 have acquired a high school diploma. This lowers the potential Inuit labour force by 53% from those who are ready for work.

Inuit who are ready and able to work represent, at least theoretically, the potential labour supply. These individuals live in the North Baffin region, Iqaluit, or in a Secondary Labour Market community, they are of the right age, and they have the basic education required for employment and job-related training.

The difference between this theoretical supply and the actual or realistic supply is the willingness of individuals to work at the Project. Not everyone wants a job at a mine. Others are unwilling to make changes in their lives that would enable them to work a mine. There are numerous reasons or circumstances for this. Some of the more common reasons are cited below:

- *Employment status*—Being employed does not exclude anyone from applying for work at the Project, but it does mean that the individual doesn't need the job. Changing jobs would likely be based on a comparison of benefits (intrinsic and extrinsic) and be conditional on the other potential constraints.
- *Aptitudes*—Not everyone possesses the mental and physical abilities to do the work that is required. As examples, some jobs include strenuous physical activities, while others require long periods of constant careful attention.
- *Interest*—Working at a mining project is not for everyone, some are simply not interested in the jobs available and would prefer other types of employment. Others are simply not interested in working 12 hours a day for 14 consecutive days in a remote setting. For example, Agnico Eagle Mines Ltd reported that some of its younger, unmarried Inuit employees left their jobs because they missed their girlfriend/boyfriend.
- *Familiarity with wage employment*—For some Inuit, work at the Project will be their first job and it can take time before becoming accustomed to the requirements of employment.
- *Family responsibilities*— Many Inuit have large families (three or more children) and they may care for elder parents or other dependents. For some Inuit, taking a job that would have them leave their families for two weeks is simply not possible. This is particularly true for single-parent families or in families where one partner is already working at a job that has them away from home for extended periods—this would include employment at the Project or any other job that requires regular travel away from home.
- *Language*—English can be a barrier (perceived or otherwise) for some Inuit who are otherwise ready, able, and willing to work. For example, while the IIBA clearly states that lack of fluency in English will not necessarily be a barrier to employment, linguistic issues may affect participation in the training necessary to take up a position in the Project workforce.
- *Criminal record*—Crime rates are extremely high in Nunavut, and particularly so for young Inuit. A criminal record may disqualify someone from employment with the Project depending on the number and severity of criminal activities.
- *Dependencies*—Different dependencies can deter someone from seeking employment in a camp setting. Addictions are an example that would make working in a camp setting for 2 weeks difficult if not impossible. Another example is public housing, where residents might be concerned

the cost of their public housing unit will rise as a result of their higher income and do not believe the increased cost is affordable.[11]

The biggest challenge in assessing the implications of these willingness factors is that a majority of them are not easily quantified. The absence of data should not be interpreted as meaning these reasons are any less important in the assessment. However, it does mean that other methods are needed to help inform their significance.

One such method is to look at examples of Inuit or Indigenous workforce participation in the mining industry in other regions of Nunavut and the Northwest Territories. For example, in the Kivalliq Region, approximately 7% of the Inuit population that can be deemed "ready for work" is employed at the Meadowbank Mine. Their experience can be used as a comparison to the experience of the Mary River Project and the estimation of potential labour supply in the LSA.

Other factors were considered in estimating the ready, able, and willing labour force. These factors are not often found in a standard labour market analysis, but were relevant in the context of Nunavut and the Project. For example:

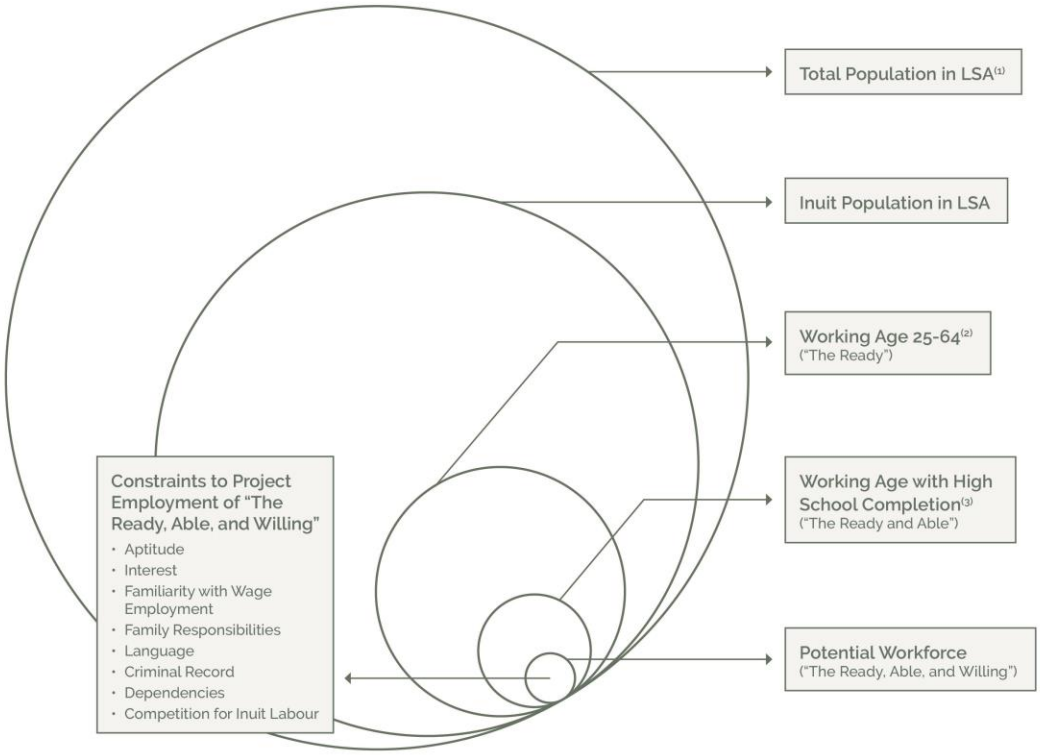
- The Labour Market Analysis is concerned primarily with Inuit labour in the LSA and Secondary Labour Market communities. Inuit from other regions and non-Inuit in the LSA are both potential sources of labour and it is important to point out that the MIEG treats all Nunavut Agreement Inuit equal regardless of residency. However, it is also true that the Inuit labour from the LSA has been given priority status and Baffinland has established the six communities as pick-up points for employment.
- The employment status of ready, able, and willing Inuit is not included in the initial calculations to determine the potential Inuit labour supply, however, if one were to view the goal of maximizing Inuit employment more holistically, unemployed labour would be the primary target. To this end, Baffinland has not made a practice of recruiting from within other industries and from other employers, but inevitably, its workforce will include at least some individuals who choose to leave their current job to take up a new one with the Project.
- Another variable to consider is gender. Baffinland is actively promoting employment amongst women and the IIBA establishes access to employment opportunities for women as a priority. However, examples from other mining projects in Nunavut and the NWT suggest women tend to fill 15% or 20% of the workforce, and rarely much more. Baffinland might be able to improve upon this, but there is a downside risk in assuming it will. This doesn't mean women should not be considered a part of the potential labour supply, but it does mean the probability of filling mining positions with women is likely low in comparison to men.
- It is also useful to add further refinements to the ready workforce estimates; that is, there are good reasons to narrow this group from all individuals aged 18 to 99 to something more reasonable. For example, any position requiring education or training beyond a high school diploma likely excludes individuals who are 18 years of age. Similarly, being 60 years of age or older does not exclude someone from working at the Project, however, for the purpose of this exercise, old age might be a legitimate factor in affecting the abilities or willingness to work—especially in the case of new hires. For these reasons, the age range that most accurately reflects the ready workforce was assumed to be 19 to 59.[12]
- Inuit who are ready and able to work at the Project, but have chosen to concentrate the majority of their productive efforts in the traditional or subsistence economy are an important

[11] Baffinland arranges and pays for all travel costs for Inuit employees living outside the LSA. This should mitigate the challenges associated with public housing that prevented potential labour from relocating to a designated point-of-hire community.
[12] To repeat an earlier footnote, the 25 to 64 age cohort is used as a proxy for the 19 to 59 age cohort. The 25 to 64 age cohort is often used by Statistics Canada when reporting socio-economic cross-sectional data (e.g. employment, education, income).

consideration. These individuals are difficult to capture using standard survey methods. It is not uncommon for these people to participate in the wage economy from time to time, sometimes on a part-time or seasonal basis, so they can appear to be available for work according to survey methods such as Statistics Canada's *Labour Force Survey*. Other times, they will be recorded as "Not in the Labour Force" but might meet the ready and able conditions. Regardless, these people are not likely candidates for work at the Project, but could be inadvertently included in the potential labour supply estimates.

A realistic estimate of the potential Inuit labour supply is determined by combining the ready, able, and willing factors. The key point is that one cannot simply look at the entire Nunavut population when studying labour force participation. The actual pool of potential workers is a small fraction of this larger number. Figure 3.1 provides an illustration of what this process looks like.

Figure 3.1 Representation of How the Labour Supply Criteria Helps in Determining the Potential Labour Force

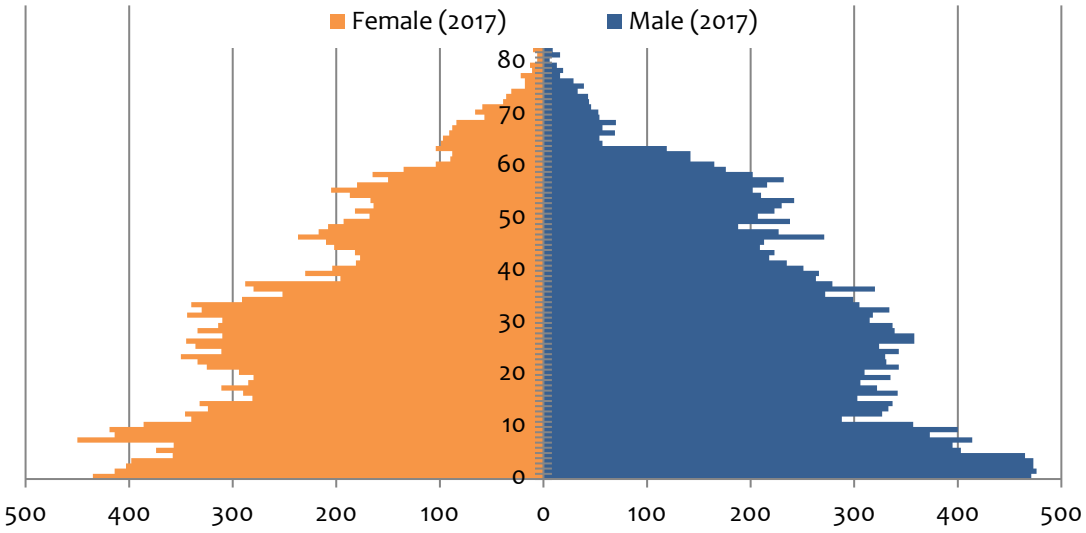


NOTES:
1. Total population refers to that of the Project's socio-economic local study area.
2. While the minimum legal working age is 18, the working age of 25 to 64 years old from Statistics Canada has been used.
3. While high school education is not mandatory, candidates for employments with a high school diploma have a better chance at employment.
4. Circle sizes are relative to population size.

3.2 Population Demographics

Nunavut's 2017 population estimate was 37,996 where approximately 84% of that population were Inuit.[13,14] The population is young, with the median age of 26.4 compared to 40.6 for Canada.[15] Figure 3.2 shows the demographic structure of the territory, which highlights the large percentage of residents under the age of 19 and the low percentage of residents over the age of 60.

Figure 3.2: Nunavut's Population Pyramid, 2017



Source: Statistics Canada, *Table 17-10-0005-01*, Population estimates on July 1st, by age and sex.

It is worth noting the contrast between Iqaluit and the rest of the territory, and between the primary and secondary labour markets. Iqaluit's population is still young by Canadian standards with a median age of 31.1, but is significantly older than the North Baffin communities (Table 3.1). The median age in the secondary labour market communities fall between the two extremes, being lower than Iqaluit but higher than the North Baffin communities. A median age that is close to 20 implies almost half of the population are currently not eligible (i.e. not ready) for work at the Project, but that over the next 20 years, there will be a sharp rise in the number of eligible workers.

The Local Study Area's population represents approximately 38% of the territory's total population. Estimates published by the Nunavut Bureau of Statistics (the Bureau) show the combined population of Arctic Bay, Clyde River, Hall Beach, Igloolik, and Pond Inlet (i.e. the North Baffin PLM) was 6,383 in 2017 while Iqaluit's population was estimated to equal 8,011 (Table 3.2). The vast majority (94.6%) of residents in the North Baffin communities are Inuit compared to 55.4% in Iqaluit. A similar Inuit majority (92.6%) can be found in the Secondary Labour Market communities.

[13] Statistics Canada, *Table 17-10-0005-01*, Population estimates on July 1st, by age and sex. Accessed October 23, 2018.
[14] Nunavut Bureau of Statistics, Population Estimates, by Inuit and non-Inuit, December 1, 2016.
[15] Statistics Canada, *Table 17-10-0005-01*.

Table 3.1: Median Age, 2016	
	Median Age
Nunavut	25.1
Primary Labour Market	26.3
Arctic Bay	22.3
Clyde River	22.0
Hall Beach	20.3
Igloolik	20.5
Pond Inlet	22.5
Iqaluit	31.1
Secondary Labour Market	23.7
Cape Dorset	23.3
Grise Fiord	26.4
Kimmirut	23.9
Pangnirtung	23.9
Qikiqtarjuaq	24.8
Resolute	25.8
Sanikiluaq	22.8

Source: Statistics Canada. *2016 Census*. Catalogue no. 98-316-X2016001. November 29, 2017.

Table 3.2: 2017 Population Estimates					
	Total Population	Inuit	%	Non-Inuit	%
Nunavut	37,996	32,004	84.2%	5,992	15.8%
Qikiqtaaluk Region	20,150	15,898	78.9%	4,252	21.1%
Primary Labour Market	14,394	10,478	72.8%	3,916	27.2%
North Baffin Communities	6,383	6,036	94.6%	347	5.4%
Arctic Bay	973	920	94.5%	53	5.5%
Clyde River	1,088	1,047	96.3%	41	3.7%
Hall Beach	855	818	95.7%	37	4.3%
Igloolik	1,677	1,562	93.2%	115	6.8%
Pond Inlet	1,790	1,689	94.3%	101	5.7%
Iqaluit	8,011	4,441	55.4%	3,570	44.6%
Secondary Labour Market	5,749	5,321	92.6%	428	7.4%
Cape Dorset	1,623	1,511	93.1%	112	6.9%
Grise Fiord	142	128	89.8%	14	10.2%
Kimmirut	514	474	92.2%	40	7.8%
Pangnirtung	1,678	1,555	92.7%	123	7.3%
Qikiqtarjuaq	631	587	93.0%	44	7.0%
Resolute	247	212	85.7%	35	14.3%
Sanikiluaq	914	855	93.6%	59	6.4%

Source: Nunavut Bureau of Statistics, Population Estimates.
Note that the Inuit and non-Inuit figures are based on 2016 estimates, whereas the total population figures are based on 2018 estimates that incorporate Statistics Canada's *2016 Census*.

Table 3.3 further illustrates the age distribution and gender of the population. Table 3.4 contains estimates of community populations by age-cohort and ethnicity.

Table 3.3: Population Estimates by Age Cohort and Gender, 2017

	North Baffin		Iqaluit		Secondary Labour Market	
	Female	Male	Female	Male	Female	Male
Total	3,008	3,375	3,912	4,099	2,790	2,959
0 to 4	448	500	314	391	272	361
5 to 14	653	674	588	525	644	563
15 to 24	518	595	551	570	501	499
25 to 44	839	957	1,402	1,447	743	817
45 to 64	403	533	921	1,053	457	557
65 and over	147	116	136	113	164	149

Source: Nunavut Bureau of Statistics, Population Estimates.

Table 3.4 Regional Population Estimates, 2017

	Total	0 to 4	5 to 14	15 to 24	25 to 44	45 to 64	65 and over
				(by age cohort)			
Qikiqtaaluk*	**20,150**	**2,304**	**3,647**	**3,234**	**6,205**	**3,930**	**830**
Inuit	15,898	1,956	3,188	2,715	4,543	2,637	712
non-Inuit	4,252	296	459	519	1,662	1,287	118
Local Study Area	**14,394**	**1,653**	**2,440**	**2,234**	**4,645**	**2,910**	**512**
Inuit	10,477	1,386	2,039	1,773	3,127	1,740	412
non-Inuit	3,917	267	401	461	1,518	1,170	100
North Baffin	**6,383**	**948**	**1,327**	**1,113**	**1,796**	**936**	**263**
Inuit	6,036	913	1,280	1,065	1,671	854	252
non-Inuit	347	35	47	48	125	82	11
Iqaluit	**8,011**	**705**	**1,113**	**1,121**	**2,849**	**1,974**	**249**
Inuit	4,441	473	758	708	1,455	886	160
non-Inuit	3,570	232	355	413	1,394	1,088	89
				(percentage of population)			
Qikiqtaaluk*	**100%**	**11%**	**18%**	**16%**	**31%**	**20%**	**4%**
Inuit	100%	12%	20%	17%	29%	17%	4%
non-Inuit	100%	7%	11%	12%	39%	30%	3%
Local Study Area	**100%**	**11%**	**17%**	**16%**	**32%**	**20%**	**4%**
Inuit	100%	13%	19%	17%	30%	17%	4%
non-Inuit	100%	7%	10%	12%	39%	30%	3%
North Baffin	**100%**	**15%**	**21%**	**17%**	**28%**	**15%**	**4%**
Inuit	100%	15%	21%	18%	28%	14%	4%
non-Inuit	100%	10%	13%	14%	36%	24%	3%
Iqaluit	**100%**	**9%**	**14%**	**14%**	**36%**	**25%**	**3%**
Inuit	100%	11%	17%	16%	33%	20%	4%
non-Inuit	100%	6%	10%	12%	39%	30%	2%
				(percentage of Inuit)			
Qikiqtaaluk*	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Inuit	79%	85%	87%	84%	73%	67%	86%
non-Inuit	21%	13%	13%	16%	27%	33%	14%
Local Study Area	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Inuit	73%	84%	84%	79%	67%	60%	80%
non-Inuit	27%	16%	16%	21%	33%	40%	20%
North Baffin	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Inuit	95%	96%	96%	96%	93%	91%	96%
non-Inuit	5%	4%	4%	4%	7%	9%	4%
Iqaluit	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Inuit	55%	67%	68%	63%	51%	45%	64%
non-Inuit	45%	33%	32%	37%	49%	55%	36%

Note: * figures may not add up due to rounding error, supressed data, and/or population living in unorganised areas. In these cases, the data error was assigned to the Qikiqtaaluk summations.
The shaded area highlights published population data. Unshaded areas are estimates based on published data.

3.2.1 Population Projections

Nunavut's total population was projected forward 20 years using the *Nunavut Demographics Model* developed by Impact Economics. Nunavut has the highest fertility rates in the country and the youngest population. Together, the two variables combine to generate a high natural rate of population growth. Net migration was assumed to follow historical trends, which means the territory loses as many as 200 more residents through migration each year, though the average is closer to 100 and in the most recent year (2016-2017) Nunavut's population actually expanded through net migration by 113. Highlights from this population forecast include:

- Nunavut's total population is predicted to grow to more than 47,000 by 2037.
- Nunavummiut aged 19 to 59 will grow by approximately 4,600 over the 20-year time period.
- The median age will climb to 29.

It is possible to estimate the change in LSA residents aged 25 to 64 using the details provided in Table 3.3 and Table 3.4. This 40-year age cohort is used as a proxy for the 19 to 59-age cohort that represents the ready workforce as described earlier. The 25 to 64 age cohort is an established age grouping for demographic and socioeconomic data published by Statistics Canada.

Residents aged 5 to 44 in 2017 will be 25 to 64 in 2037, while those aged 45 to 64 in 2016 will be 65 or older by that time. Thus, the calculation requires that one take the 5 to 44 age cohort from 2017 and move it ahead 20 years, making adjustments for migration and the probability of deaths during that time.

Using this simple methodology, the number of North Baffin residents aged 25 to 64 can be estimated to grow to 3,860 by 2037 while the number of Inuit within this population is estimated to grow to 3,660—an increase of 1,130 (see Table 3.5a).

If the Project is going to grow its Inuit workforce, these new entrants into the labour market are important to study.

Iqaluit has a different demographic profile than the rest of the territory and is affected by migration from throughout Nunavut and from southern Canada to a much greater degree than anywhere else in the territory. It is also important to note that 45% of Iqaluit's population is non-Inuit. These differences represent challenges in estimating Iqaluit's future Inuit population.

Table 3.5(a): Projected Population of North Baffin LSA, 20-year outlook		
	Total	**Inuit**
Aged 25 to 64 in 2017	**2,730**	**2,530**
Aged 5 to 44 in 2017	**4,240**	**4,020**
Total deaths within the 2016 5 to 44 age cohort over the 20-year time period	-288	-273
Net Migration within the 2016 5 to 44 age cohort over the 20-year time period	-88	-84
Aged 25 to 64 in 2037	**3,860**	**3,660**
Change over 20 years (aged 25 to 64 cohort)	**1,130**	**1,130**

Notes:
- 2017 population estimates data are estimates published by Nunavut Bureau of Statistics.
- Mortality and migration rates are projections based on historical territorial data.
- Mortality rates and migration data are not available at the community level on an annual basis. Communities were assigned a percentage of territorial estimates based on 2017 age distributions.
- Age cohort data were rounded to the nearest 10.

Using the same methodology as applied to the North Baffin LSA, it can be observed that the number of Iqaluit residents aged 5 to 44 in 2017 was almost identical to those aged 25 to 64—5,080 and 4,820, respectively (Table 3.5b). However, there is a difference between the Inuit populations of these two cohorts, 2,920 and 2,340. Historically, Iqaluit has been a community that grows as a result of in-migration, but it is also true that in the last ten years, Iqaluit's rate of growth has matched that of Nunavut. For the purpose of this study, it can be assumed that net migration cancels any losses caused by death, meaning the population aged 25 to 64 will grow by a small amount (260), but the number of Inuit in that age cohort will grow by approximately 580.

Table 3.5(b): Projected Population of Iqaluit, 20-year outlook		
	Total	**Inuit**
Aged 25 to 64 in 2017	**4,820**	**2,340**
Aged 5 to 44 in 2017	**5,080**	**2,920**
Total deaths within the 2016 5 to 44 age cohort over the 20-year time period	-345	-198
Net Migration within the 2016 5 to 44 age cohort over the 20-year time period	347	198
Aged 25 to 64 in 2037	**5,080**	**2,920**
Change over 20 years (aged 25 to 64 cohort)	**260**	**580**

Outside the LSA in the Secondary Labour Market, the demographic profile is similar to that of the North Baffin communities though the median age is higher meaning there is a comparatively smaller proportion of children in the secondary labour market. Residents aged 5 to 44 still vastly outnumber those aged 45 to 64 however. Over the next 20 years, the number of Inuit within the 25 to 64 age cohort will grow by 890 from 2,310 to 3,200 (Table 3.5c).

Table 3.5(c): Projected Population of Baffinland's Secondary Labour Market, 20-year outlook		
	Total	**Inuit**
Aged 25 to 64 in 2017	**2,570**	**2,310**
Aged 5 to 44 in 2017	**3,770**	**3,510**
Total deaths within the 2016 5 to 44 age cohort over the 20-year time period	-256	-238
Net Migration within the 2016 5 to 44 age cohort over the 20-year time period	-79	-73
Aged 25 to 64 in 2037	**3,440**	**3,200**
Change over 20 years (aged 25 to 64 cohort)	**870**	**890**

Taken together, the Qikiqtaaluk population aged 25 to 64 is predicted to expand from its 2017 number (10,120) to about 12,380, while the total Inuit population in this age cohort will expand from 7,180 to 9,780 (see Figure 3.3a). Figure 3.3(b) provides the geographic breakdown for the Inuit population in this age cohort. For simplicity, it was assumed that the growth path would be linear.

This age-cohort represents the underlying pool of available labour; that is, it is an approximation of the ready labour supply. In the next sections, other factors are applied to this number to determine more precisely the labour that is ready, able, and willing to work for the Project.

Figure 3.3(a): Ready Labour Supply, Qikiqtaaluk Region

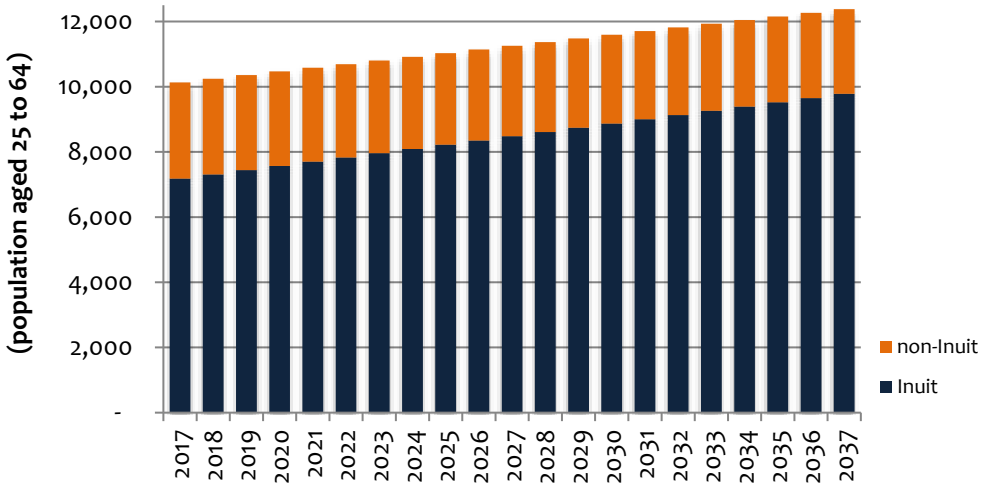
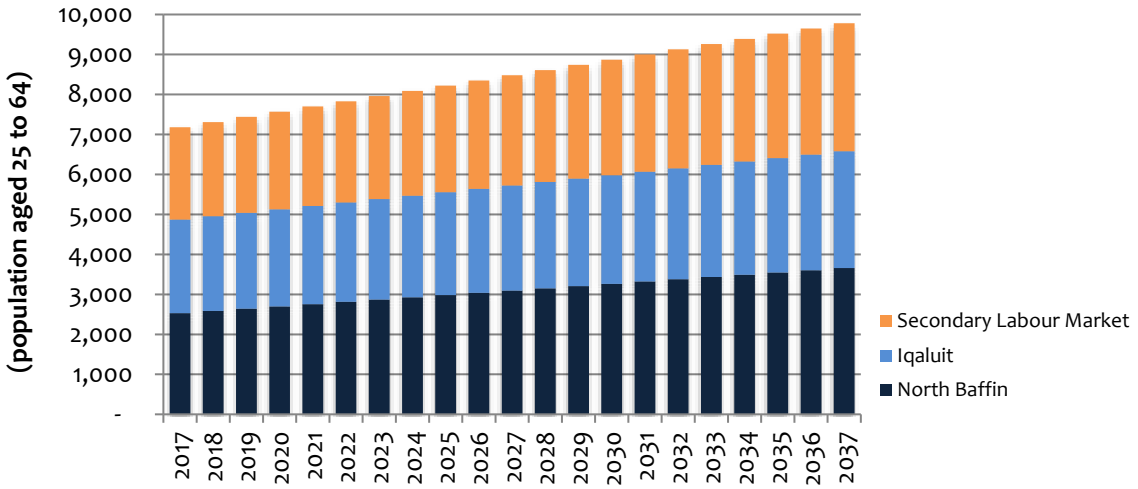


Figure 3.3(b): Ready Inuit Labour Supply, Qikiqtaaluk Region



3.3 Education Levels

The next step in the analysis is to study the education levels of LSA residents to determine how many are able to work—that is, how many have the minimum required qualifications. While the IIBA requires Baffinland to consider skills and equivalencies as an alternative to formal certification where appropriate, education levels are still considered in this analysis to be an important limiting factor.

Not having a high school certificate does not mean a person is unemployable, but it does reduce the probability of working and lowers the number and range of jobs he or she is qualified to do. It should be reiterated that Baffinland expects that entry-level or unskilled jobs where a high school diploma or its equivalency is not a prerequisite for employment will represent just 10% of all the operations-related jobs created by the Project. **Education and training are vital for increased participation**.

The Project has introduced mitigation measures that address training and workforce readiness (and specific training and education initiatives are mandated by the IIBA), however, these can only affect graduation rates indirectly through incentives for students to remain in school. Families, communities, governments, and students themselves, have far greater roles in producing high school graduates. It is also a critical point that investments in training are more successful in improving the employability of labour when that labour has the foundational numeracy and literacy skills typically associated with a high school education or its equivalency.

The *2016 Canadian Census* found that 40% of residents aged 15 and over living in the Baffin Region, but excluding Iqaluit, had a high school diploma or certificate.[16] In Iqaluit, 72% of residents in this age cohort have graduated from high school. The higher education levels in Iqaluit are due to in-migration from other parts of Nunavut and Canada. These migrants tend to relocate to the territorial capital because of employment opportunities and have already attained high school certificates and, often times, university diplomas prior to their arrival.

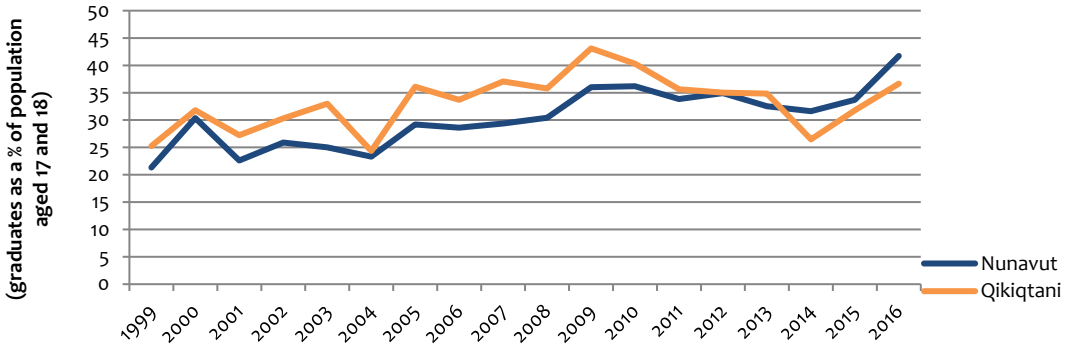
Low graduation rates have long been an issue for the territory and will have implications for the assessment of a potential labour force for the Project.[17] Since 1999, rates have been slowly improving with noticeable ups and downs. Graduation rates were 42% in Nunavut, which is a record high, and 37%

[16] Statistics Canada (2017). Nunavut. Census Profile. 2016 Census. Statistics Canada Catalogue no. 98-316-X2016001. Ottawa. Released November 29, 2017. https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E (accessed October 24, 2018).

[17] Clinton G. and Vail, S. (2001). *2001 Nunavut Economic Outlook*. The Conference Board of Canada, May 2001.

in the Qikiqtaaluk region in 2016. Prior to that, these rates have been as high as 36% for Nunavut (2010) and 43% for the Qikiqtaaluk region (2009), but on average, have been 34% and 36%, respectively, over the past decade (Figure 3.4). At these rates, no more than 3 or 4 of every 10 students entering the workforce will actually qualify for jobs requiring a high school certificate as a prerequisite.

Figure 3.4: Graduation Rates, 1999 to 2016



Source: Department of Education. Graduation Rates. Published by Nunavut Bureau of Statistics.

From these graduation rates, the territory produces 200+ graduates each year (with the highest number being 245 in 2009). The Qikiqtaaluk region typically produces in excess of 100 graduates annually, though the number over the past two years has been lower (Table 3.6).

Table 3.6: Nunavut Secondary School Graduates, 2011 to 2016

	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
Number of Graduates - Nunavut						
Total Graduates	229	240	218	206	208	252
Total, 17 and 18 Year Olds[1]	1,353	1,368	1,340	1,303	1,234	1,208
Graduation Rate	33.9	34.9	32.5	31.6	33.7	41.7
Number of Graduates – Qikiqtaaluk						
Total Graduates	119	124	119	86	95	109
Total, 17 and 18 Year Olds	668	708	683	650	598	595
Graduation Rate (%)	35.6	35.0	34.8	26.5	31.8	36.6
Percentage of Total Graduates by Sex						
Females	50.2	52.1	55.5	55.3	56.7	57.1
Males	49.8	47.9	44.5	44.7	43.3	42.9
Percentage of Total Graduates by Ethnicity						
Inuit	90.0	95.0	95.0	92.7	93.8	92.9
Non-Inuit	10.0	5.0	5.0	7.3	6.3	7.1

Source: Department of Education, Government of Nunavut. Prepared by Nunavut Bureau of Statistics, September 21, 2017

The *2016 Census* provides an estimate of the education status of the LSA population by highest certificate, diploma, or degree (Table 3.7).[18] There are more residents in Iqaluit with post-secondary education than in the North Baffin LSA communities (62% of Iqalummiut aged 25 to 64 have some

[18] Statistics Canada (2017). *2016 Census*.

measure of postsecondary certificate, diploma, or degree compared to 36% of the North Baffin population and 35% of the Secondary Labour Market in that age cohort). This would suggest that Baffinland might be able to fill some jobs requiring higher levels of education from within the Iqaluit labour market. However, 45% of Iqaluit's residents are non-Inuit, and Inuit with higher levels of education who are living in Iqaluit are typically already employed. Therefore, to attract and retain skilled Inuit workers from Iqaluit, Baffinland will have to entice them away from their current employment.

Table 3.7: LSA Population by Education

	Iqaluit	%	North Baffin	%	Secondary Labour Market	%
Total population aged 25 to 64 years	**4,420**		**2,470**		**2,195**	
No certificate, diploma or degree	**930**	**21%**	**1,255**	**51%**	**1,130**	**51%**
High school diploma or equivalent	**770**	**17%**	**355**	**14%**	**320**	**15%**
Postsecondary certificate, diploma or degree	**2,720**	**62%**	**890**	**36%**	**760**	**35%**
Apprenticeship or trades certificate or diploma	330	7%	245	10%	165	8%
College, CEGEP or other non-university certificate or diploma	1,035	23%	450	18%	410	19%
University certificate or diploma below bachelor level	85	2%	20	1%	10	0%
University certificate, diploma or degree at bachelor level or above	1,270	29%	180	7%	180	8%
Bachelor's degree	805	18%	120	5%	120	5%
University certificate, diploma or degree above bachelor level	465	11%	60	2%	60	3%

Source: Statistics Canada. *2016 Census*. Catalogue no. 98-316-X2016001. November 29, 2017.
Note that figures may not add up due to the effects of rounding. Data for Igloolik and Clyde River have been suppressed by Statistics Canada because of an insufficient response to the survey.

3.4 Employment Status of Potential LSA Labour Supply

Nunavut's labour market is characterized by a shortage of jobs, especially ones with low skill level requirements, and high rates of unemployment, especially outside Iqaluit. The introduction of a mining project such as the one at Mary River can be viewed as an opportunity to address these labour market challenges. Ideally, if the LSA could supply the Project with all of its labour needs, those jobs would go a long way in eliminating Nunavut's unemployment challenges and transforming the overall financial wellbeing of the population. So, from a territorial perspective, there is an interest in looking at the unemployed population to supply the Project with labour before considering those who are already working.

The most current labour force data is gathered by Statistics Canada through its *Labour Force Survey* (Table 3.8). The drawback to this survey is that it represents the entire territory, and does not provide data on a community-by-community basis. However, it does disaggregate the data between Inuit and non-Inuit, gender, and age, all of which is relevant to this assessment.

From the data one can see the unemployment rate is very high by Canadian standards (national unemployment is currently below 6%) and there is a large segment of the working age population that is not in the labour force. In the context of a typical Labour Market Analysis, these results would be seen as positive because it suggests there are a large number of residents ready to work (they are old enough) and who are unemployed.

The next important point is that almost all unemployed Nunavummiut are Inuit. Non-Inuit residents tend to be working or are not in the labour market—in 2017, there were 4,900 non-Inuit of working age, 4,300 were in the labour force, and 4,200 were employed. This is an important fact for the

Project's employment goals. Inuit make up the vast majority of unemployed or idle labour, which aligns with the goal of employing Inuit as a priority.

A final point is the difference in labour force characteristics related to gender. The unemployment rate amongst females is half that of males. A part of this difference can be explained by the fact that fewer females participate in the workforce. But it is also true that females in Nunavut perform better in school and therefore, as a whole, are more qualified for a wider variety of jobs. These gender-related data have only a small effect on estimates of the potential labour supply because the Project is expected to attract male employees more so than female employees. However, it should also be acknowledged the IIBA establishes access to employment opportunities for women as a priority.

Table 3.8: Labour Force Characteristics, 2017

	Total (15+)
Population	24,300
Labour force	15,700
Employment	13,400
Unemployment	2,300
Not in the labour force	8,600
Participation rate (%)	64.3
Employment rate (%)	54.9
Unemployment rate (%)	14.6

	Inuit	Non-Inuit
Population	19,500	4,900
Labour force	11,300	4,300
Employment	9,200	4,200
Unemployment	2,200	X
Not in the labour force	8,200	600
Participation rate (%)	58.3	88.5
Employment rate (%)	47.1	86.2
Unemployment rate (%)	19.2	X

	Male	Female
Population	12,600	11,700
Labour force	8,400	7,300
Employment	7,000	6,400
Unemployment	1,400	900
Not in the labour force	4,200	4,400
Participation rate (%)	66.4	62.0
Employment rate (%)	55.2	54.6
Unemployment rate (%)	16.9	12.1

	Youth (15 to 24)	Adult (25+)
Population	5,900	18,500
Labour force	2,700	13,000
Employment	2,000	11,300
Unemployment	700	1,600
Not in the labour force	3,200	5,500
Participation rate (%)	46.1	70.1
Employment rate (%)	34.5	61.4

Unemployment rate (%)	*25.1*	*12.5*

Source: Statistics Canada, Labour Force Survey, Special Tabulations

File prepared by Nunavut Bureau of Statistics, July 4, 2018

Employment data for the LSA communities is collected by Statistics Canada through its census. Unlike the Labour Force Survey that produces a time series based on a monthly survey, the census is taken once every five years and therefore presents a snapshot of the labour market at a single point in time (Table 3.9a and Table 3.9b). It is also noteworthy that the labour force statistics collected through the census is based on a 25% sample of the population.

Participation and employment rates were low for the North Baffin communities in 2016, with averages of 58.5% and 42.7 % respectively.[19] This indicates a large percentage of the North Baffin adult population are neither working nor are they looking for work. Iqaluit is entirely different. That community exhibits a very robust labour market, with a participation rate approaching 82% and an employment rate close to 74%.

Table 3.9(a): Qikiqtaaluk Labour Markets, 2016

	Baffin	Iqaluit	North Baffin	Secondary Labour Market
Total population aged 15 years and over	12,840	5,675	3,770	3,350
In the labour force	8,895	4,640	2,205	2,025
Employed	7,350	4,195	1,610	1,540
Unemployed	1,540	445	600	500
Not in the labour force	3,950	1,035	1,565	1,325
Participation rate	69.3	81.8	58.5	60.4
Employment rate	57.2	73.9	42.7	46.0
Unemployment rate	17.3	9.6	27.2	24.7

Source: Statistics Canada (2017). 2016 Census.

Table 3.9(b): North Baffin Labour Markets, 2016

	Arctic Bay	Clyde River	Hall Beach	Igloolik	Pond Inlet
Total population aged 15 years and over	535	685	510	1,010	1,030
In the labour force	280	410	305	585	625
Employed	225	245	225	450	465
Unemployed	60	165	80	140	155
Not in the labour force	255	270	210	425	405
Participation rate	52.3	59.9	59.8	58	61
Employment rate	42.1	35.8	44.1	45	45
Unemployment rate	21.4	40.2	26.2	24	25

Source: Statistics Canada (2017). 2016 Census.

[19] By comparison, the *Census* found that participation and employment rates for all Canadians were 65.2% and 60.2% respectively .

These labour market data lend further support to the goal of concentrating hiring efforts in North Baffin LSA communities in addition to the efforts in employing Inuit. That is, the majority of unemployed labour within the LSA fall within one or both of these two population segments. Additional Inuit labour can be found in the Secondary Labour Market communities, where there are 500 unemployed primarily-Inuit residents and 1,325 residents not currently in the labour market.

3.5 Estimating the Future Labour Supply

As already noted, there are a limited number of jobs with the Project that do not require a high school diploma and the majority of these are already filled by Inuit from the LSA—in 2016, 53 of the 94 FTE Level D jobs were filled by LSA Inuit. If the Inuit employment number is to grow beyond the number of unskilled positions, it will have to be in jobs that require a high school certificate or equivalency in combination with some training and on-the-job experience. Therefore, estimates of the future labour supply should be focussed on Inuit residents that have graduated from high school or have otherwise earned a high school diploma; that is, it can be assumed that the LSA will produce enough workers to fill most, if not all, unskilled jobs at the Project, but for Inuit participation to grow beyond that it will have to be in higher skilled positions.

This future labour supply can be estimated by combining the projections for the working age population with assumptions on future graduation rates.

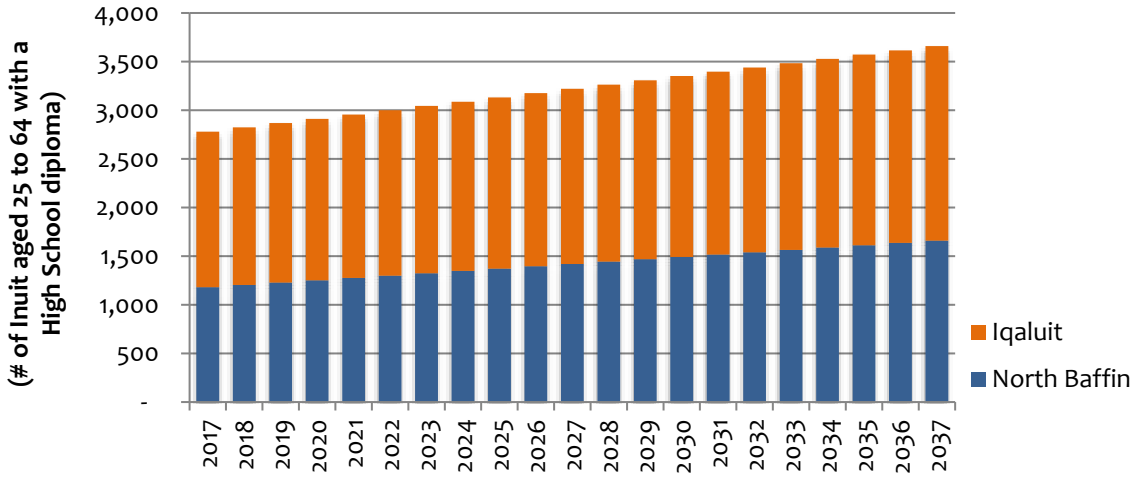
- There were approximately 2,730 North Baffin residents aged 25 to 64 in 2017, 2,530 of whom were Inuit.
- The Inuit cohort will grow by approximately 1,130 (2,530 to 3,660) in 20 years from 2017 to 2037.
- Using *2016 Census* data, it is estimated that 1,180 Inuit North Baffin residents in the 25 to 64 age cohort had a high school certificate.
- The average graduation rate in Qikiqtaaluk communities was 36% over the past 10 years.
- If graduation rates remain close to this average over the next 20 years, then approximately 400 of entrants into this cohort will have a high school diploma.
- If graduation rates were to rise incrementally to 50% over this time frame, then the number will entrants into this cohort with a high school education will increase by approximately 500.

These results can be divided by gender. Recent evidence from Nunavut's school system shows females perform better—55% of graduates over the past five years have been female. Assuming this trend will continue, the number of North Baffin Inuit male graduates will increase by 230 while female graduates will rise by 270 in the case where graduation rates improve incrementally to 50% by 2037.

Similar estimates can be made for the Inuit population in Iqaluit. It is estimated that 1,600 Inuit aged 25 to 64 live in Iqaluit and that 68% have a high school education. The number of Inuit in this age bracket is expected to grow by 580 over the next 20 years. Assuming that the Inuit graduation rate matches the current Census results (68%) in the city, the number of Inuit aged 25 to 64 who have a high school diploma will increase by 400, or at a rate of approximately 20 each year.

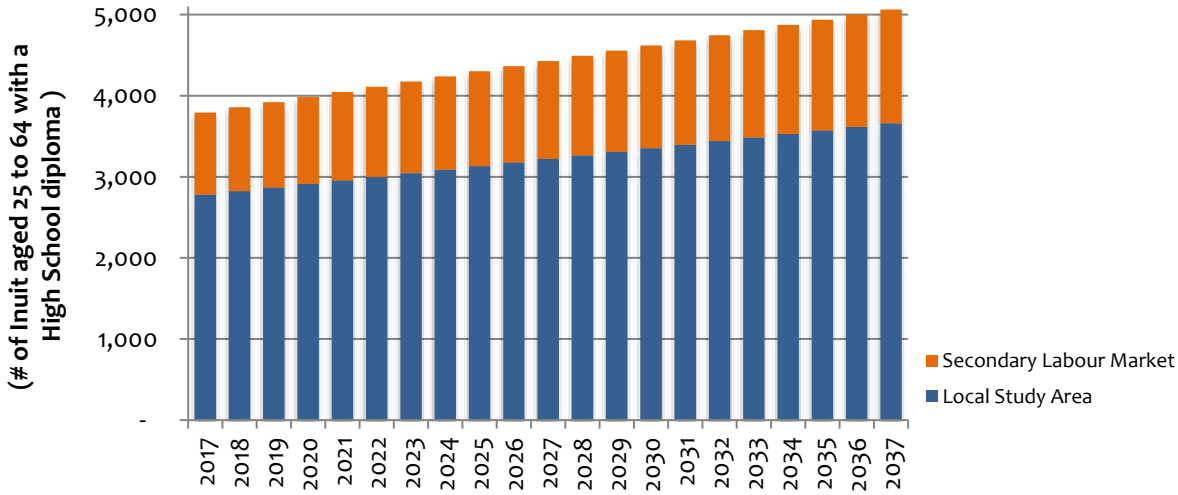
Together, the number of Inuit aged 25 to 64 with a high school diploma living in the Local Study Area of North Baffin and Iqaluit is expected to grow from approximately 2,780 in 2017 to 3,660 by 2037 (see Figure 3.5). **This is an approximation of the ready and able Inuit labour supply**.

Figure 3.5 Ready and Able Inuit Labour Supply in North Baffin and Iqaluit



The ready and able Inuit labour supply in the Secondary Labour Market shows similar characteristics to that in the North Baffin communities. Based on the 2016 Census results, it is estimated that there were 1,000 Inuit aged 25 to 64 in 2017 that had a high school diploma. This number is estimated to increase by 400 over the next 20 years assuming that graduation rates amongst Inuit improves gradually to 50% by 2037. Combined with that from the Local Study Area, this brings the ready and able workforce up to 3,800 in 2017, growing to 5,000 by 2037 (see Figure 3.6).

Figure 3.6 Ready and Able Inuit Labour Supply in the Local Study Area and Secondary Labour Market

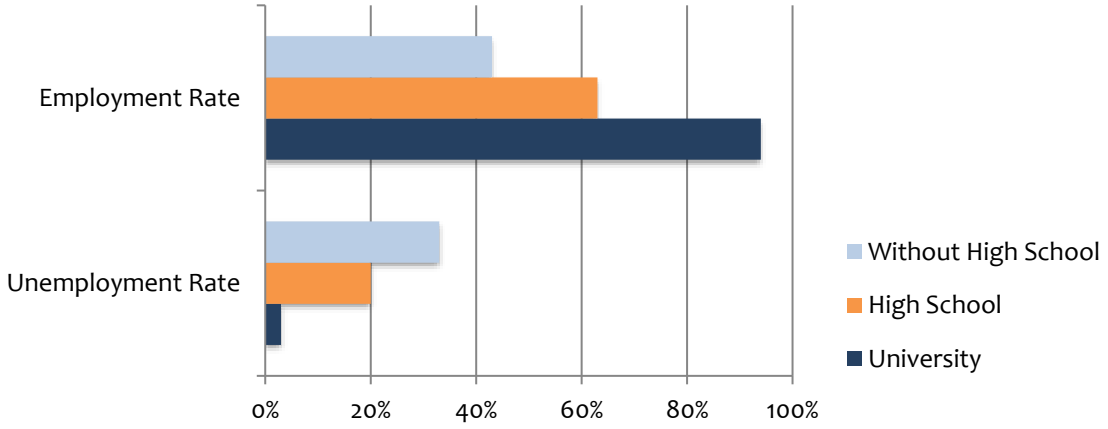


As noted earlier, there is a keen interest to have the Project contribute to improving Nunavut's employment rate, and in particular, within the Inuit population residing in North Baffin communities. This requires that the Project hire people who are currently unemployed or not in the labour force. The statistics on this subject indicate that the characteristics of this group (unemployed or not in the labour force) and employed are different.

The primary difference between them is education. There are other factors that keep people out of the workforce, some of which will be discussed later in this report. A university education that results in a bachelor's degree all but guarantees employment in Nunavut. Results from the *2016 Census*

indicate that at the time of the survey there were 325 Inuit aged 25 to 64 in the labour market with at least a bachelor's degree and that 320 of them were employed.[20] At the other end of the spectrum, there were 6,555 Inuit in this age range without a high school diploma of which 3,755 were either unemployed (1,370) or were not in the labour force (2,385). This equates to an employment rate of 43% (see Figure 3.7). The employment rate for Inuit with at least a high school education was 66%.

Figure 3.7: Employment and Unemployment rates by education, Inuit, 25 to 64 age cohort



Source: Statistics Canada (2017), *2016 Census*.

These results can be applied to the 2017 ready and able Inuit labour supply calculated earlier to get a better sense of the characteristics of the available labour (those who are currently not working). Earlier, it was determined that there were approximately 2,780 Inuit aged 25 to 64 living in the Local Study Area and 3,790 in the Qikiqtaaluk region that have at least a high school diploma. Assuming that 66% of these people are employed leaves 1,290 who are unemployed.

There is a greater number of Inuit in this age range that are available to work but do not have a high school education (1,940).

There isn't enough evidence to separate the data further. Nevertheless, this provides a useful starting point in understanding the available labour supply for the Project.

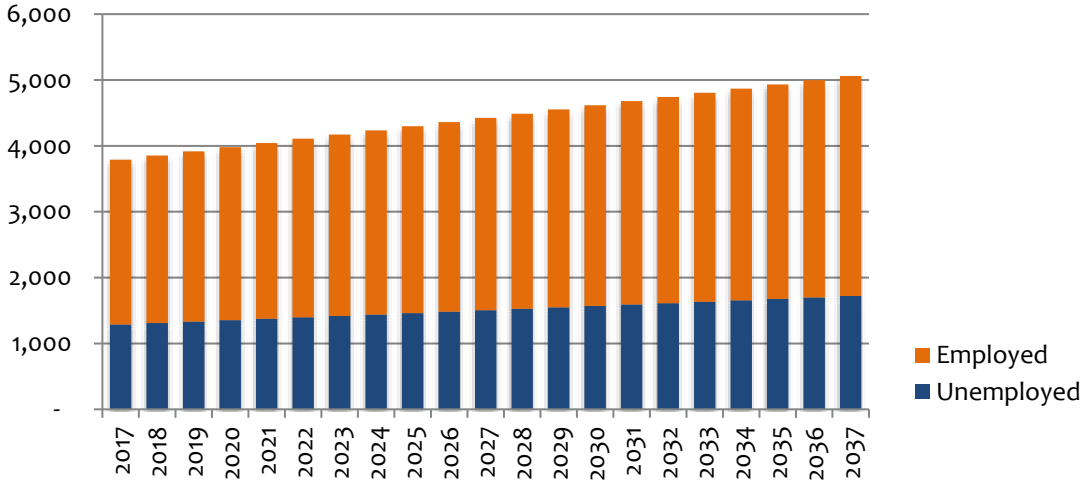
Repeating an earlier conclusion, these calculations offer evidence that the largest pool of Inuit labour who are currently unemployed or not in the labour force are also without a high school education. How this changes over the next twenty years requires additional assumptions regarding future labour demand in the LSA economy as a whole not just from the Project.

A safe assumption is that an education is becoming increasingly important to one's employability, and that demand for Inuit labour with higher levels of education will only increase. A conclusion for the Project, then, is that competition for Inuit who graduate from high school will grow and will be a constant challenge for the Project in meeting its Inuit employment targets.

For the purpose of demonstration, Figure 3.8 offers an illustration of the future Inuit labour supply assuming the 66% employment rate for Inuit with a high school education remains unchanged over the life of the Project. The figure shows the ready and able Inuit labour supply separated by their employment status.

[20] These results are for Nunavut as a whole and therefore contain some bias. At the community level, one would expect the employment rates to be better in Iqaluit, Rankin Inlet, and Cambridge Bay, and worse elsewhere on average. Despite the bias, these results provide information regarding employment by highest level of education that provide a good understanding of the labour market in the Local Study Area.

Figure 3.8 Employment Status of Ready and Able Inuit Labour Supply



Returning to the projected ready and able Inuit labour supply, it is also important to consider that only a fraction of these people will apply for jobs with the Project. Recall the additional factors that can be barriers (perceived or otherwise) to participation in the Project's workforce that are in addition to their current employment status:

- Aptitudes;
- Interest;
- Familiarity with wage employment;
- Family responsibilities;
- Language;
- Criminal record; and,
- Dependencies.

These are largely qualitative factors, and therefore it is not possible to determine precisely how many of these ready and able people are also willing to work at the Project. For example:

- How many are already employed and are willing to leave their current job?
- How many are fully capable of working at the Project, but who are just not interested?
- How many have family responsibilities that prevent them from working at the Project?
- How many are ready and able but prefer to work fulltime in the traditional economy?

There is other evidence that can help piece together a better understanding of how these barriers affect the potential labour supply. The Meadowbank Mine in the Kivalliq Region has been operating since 2010. Inuit employment was relatively stable for the first five years of operations, averaging close to 250, before climbing to 300 in 2015. (see Appendix A for a full analysis of Inuit employment at the Meadowbank Mine as well as the employment record of NWT diamond mines).[21] This employment record was achieved from an Inuit population aged 25 to 64 of 4,230, meaning the participation rate of the ready workforce was 7%.

Agnico Eagle surveys its employees for reasons why they leave their job with the Project. Their answers help explain some of the potential barriers to participation. Among the reasons cited are:

- Spousal relationship issues

[21] The ready Inuit labour supply in the North Baffin LSA (number of Inuit aged 25 to 64) was 2,600 in 2016.

- Work was too hard or did not like the work
- Too much gossip amongst co-workers
- No babysitter or daycare
- Found a new job in town
- Homesick – need to go home

Note that these are largely issues of willingness and are similar to the possible barriers to employment that were listed earlier in this chapter.

The analysis presented in Appendix A also provides evidence of the investments Agnico Eagle have made in growing its Inuit workforce, the types of jobs Inuit are filling, and more details on the challenges faced by employees and the employer.

An important lesson from the experience of Agnico Eagle and of the diamond mines in the NWT is the evolution of investments in training. In both cases, the initial approach (from the mining companies and government) was to use the increased labour demand generated from large mining projects as an impetus to address skills gaps within the labour force. This approach was initially successful in getting a large number of people through a basic training regiment and giving a lot of people an opportunity for employment. However, this approach also contributed to high rates of turnover as many newly trained individuals found they were not ready, able, and willing to work at these mine sites. These training programs also found that students without the required numeracy and literacy skills were not as successful as those with these necessary building blocks.

The results prompted important changes in approach. Investments in training became more focussed on individuals who showed a higher probability of success. Students were made aware of the work requirements as a part of the initial training. And, more emphasis was given to education upgrading in an effort to improve students success rate once the enrolled in training programs.

The experience of Inuit at the Meadowbank Mine does not provide enough information to determine a precise estimate of the willingness of the LSA's Inuit labour supply, but it does offer a reasonable starting point. For example, it is reasonable to assume that similarities exist between Inuit households in the Kivalliq Region and the North Baffin LSA and the secondary labour market. There are also similarities in education and employment levels prior to the mines' development. Thus, it can be surmised that possible labour force constraints related to aptitude, interest, family, etc. are also similar.

More caution is advised when using the Meadowbank results in the analysis of Iqaluit's labour supply. The socio-economic conditions in Iqaluit are different than they were in the Kivalliq Region in 2010 when the mine went into production and Inuit are far more likely to be employed in Iqaluit. Higher levels of education and income suggest Iqaluit residents are less likely to be attracted to job opportunities at a mine site. The physical distance between Iqaluit and Mary River compared to that between Baker Lake and Meadowbank is another factor to consider.[22]

3.6 Summary of Labour Force Estimation

This chapter has been focussed on establishing an estimate of Inuit labour that are ready, able, and willing to work for the Project at some point during its operational life.

[22] In the NWT, the operators of the three diamond mines have been largely unsuccessful in attracting Indigenous labour from regions outside the North and South Slave. Employers have observed reluctance on the part of potential labour from the Sahtu, Gwich'n, and Inuvialuit regions to join their workforce. Anecdotally, it has been suggested that many of the potential workers from these regions don't see the diamond mines as a part of their economy.

The 2017 population was used as the starting point to which employment constraints were added. This base population (14,400) was separated by ethnicity and age.

- 10,480 are Inuit
- 7,550 are in the 25 to 64-age range (Inuit and non-Inuit), and
- 4,870 are Inuit and are in the 25 to 64 age range.

This group represents the basic or ready labour supply; **all LSA Inuit employees will come from this group**.[23] If we broaden the labour market to include all Qikiqtaaluk communities, the total population increases to 20,150, where 10,140 are aged 25 to 64, and 7,180 are Inuit.

There is an argument for separating the basic labour supply by gender. Baffinland is committed to increasing the participation of women in its Project, but evidence from other mining projects in Nunavut and the Northwest Territories shows this can be a challenge. It is not uncommon to find women representing no more than 20% of a mining project's workforce, and often times, this percentage is below 15%. This fact doesn't eliminate women from the potential labour supply, but it does suggest there are additional challenges in attracting and retaining female employees.

Education levels were applied to the ready labour supply, thus establishing a ready and able labour supply. In North Baffin LSA communities as well as the Secondary Labour Market communities, approximately 49% of the adult Inuit population have a high school diploma, certificate, or equivalency. The percentage is higher in Iqaluit at close to 79% but the non-Inuit population has a significant influence on this percentage. Using data from the *2016 Census*, it was estimated that 68% of Iqaluit's adult Inuit population had completed high school or its equivalency. Together, the North Baffin and Iqaluit ready and able Inuit labour pool is estimated to equal 2,780. Adding in the Secondary Labour Market communities brings this number up to approximately 3,800.

Adding the education variable separates the labour supply into two groups: (1) individuals who could work in unskilled jobs where a high school education is not necessarily a prerequisite for employment; and, (2) individuals who could work in semi-skilled or higher skill-level jobs that typically require a high school education combined with additional training, education, and/or work experience. This second category represents 90% of the operational jobs at the Project, and is therefore an important category to pay attention to.

The base population was also subdivided by employment status. Unemployed or inactive labour is thought to be the more willing to work at the Project. However, the majority within this group have not completed high school. This led to the conclusion that if the Project is to increase Inuit labour force participation, it will have to attract qualified employees who are employed elsewhere.

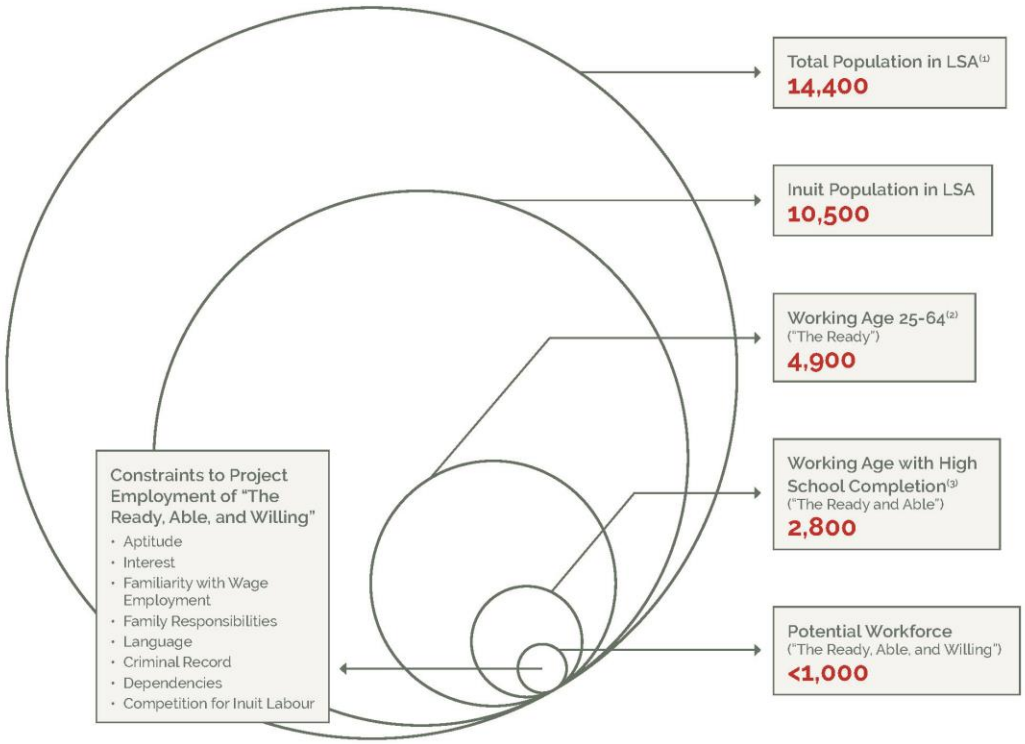
Another option for attracting Inuit employees who lack formal education and skill certifications includes being more flexible in employing Inuit based on equivalencies (as committed to in the IIBA). Additional training, skills upgrading, and apprenticeship programs offered by Baffinland could also assist in this regard.

As a final step, additional constraints were considered such as an individual's aptitude, interest, family situation, language, and dependencies. These are all reasons why someone who is otherwise ready and able to work might choose not to or will not remain in their new job for very long. Combined, these factors were described as an individual's willingness to work at the Project. They are qualitative but are no less important to understanding the potential Inuit labour supply. The Meadowbank Mine in the Kivalliq Region provided evidence of these willingness factors through its owner's experience with turnover and challenges in growing the Inuit workforce.

[23] Remember that the 25 to 64 age cohort is being used as a proxy for the population that are old enough to work at the Project.

Figure 3.9 helps in visualizing how the basic labour force (the ready labour supply) is reduced to more accurately reflect a realistic estimate of the potential workforce (the ready, able, and willing labour supply). The key finding is that this final number is a very small fraction of the basic number. Other important findings relate to how many Inuit qualify for jobs requiring a high school education and that point to a need to attract new hires from within the Inuit population who are already employed, as well as the need to implement new training and skills upgrading programs, to increase hiring based on equivalencies, and to look at non-Inuit labour from within the LSA.

Figure 3.9: Ready, Able, and Willing Inuit Labour Supply



NOTES:
1. Total population refers to that of the Project's socio-economic local study area.
2. While the minimum legal working age is 18, the working age of 25 to 64 years old from Statistics Canada has been used.
3. While high school education is not mandatory, candidates for employments with a high school diploma have a better chance at employment.
4. Circle sizes are relative to population size.

4 Conclusion

The 2018 Labour Market Analysis has described the labour demand by job classification generated by the Mary River Project and what should be expected in terms of Inuit workforce participation. A key finding of this report was that there are not enough available, interested, and qualified Inuit in the combined LSA and Secondary Labour Market communities to fill all the jobs created by the Project, but that growth is possible and indeed, should be expected.

A focus of this research was to determine a reasonable estimate of the LSA's Inuit labour supply. This will provide, among other things, the required background information for establishing realistic employment targets.

The LSA Inuit population was 10,500 in 2017, but not all of these people can or should be considered a part of the pool of *potential* labour. For starters, almost half of the population is too young to be in the workforce. In addition, the majority (~90%) of jobs created by the Project require a high school diploma or its equivalency and at least some training or job experience as a minimum qualification. However, Nunavut has the lowest high school graduation rates in the country. After accounting for working age and education, the pool of Inuit labour in the LSA is reduced to 2,780.

Projections of population growth and graduation rates established estimates of the future labour supply where the pool of ready and able Inuit labour will grow incrementally to 3,660 by 2037.

However, there are other factors in addition to age and education that must be considered. These are not easily quantified because they involve an individual's willingness to work at the Project. Some of the factors considered in this report include:

- Current employment status (willingness to change jobs)
- Aptitudes
- Interest
- Familiarity with wage employment
- Family responsibilities
- Language
- Criminal record
- Dependencies
- Competition from other employers

None of these factors disqualify an individual from employment at the Project, but depending on the circumstances of each individual, they can reduce the likelihood of applying for a job and/or being successful in their employment over the long term.

Combining what was learned about the LSA's Inuit population and the potential constraints to employment, it seems reasonable to conclude that the Project will improve its Inuit employment record over time. Progress is likely to be slow however and will be dependent on such things as higher graduation rates.

Annual employment targets can be useful but should be realistic and based on up-to-date information on the Inuit labour supply, changes in the labour needs of the Project, and changes in the competition for Inuit labour from elsewhere in the economy. Ultimately, improving Inuit labour force participation will be a shared responsibility. Baffinland has an important role in attracting and retaining Inuit employees, but individuals, families, communities, Inuit organisations, and government departments can also contribute. It is assumed that all parties are genuinely interested in improving the workforce participation of Inuit in the Project, however, it must be acknowledged that some factors that prevent an otherwise eligible person from working cannot be eliminated and are out of the control of industry.

Appendix 1: Participation of Indigenous Labour at Other Northern Mining Operations

Agnico Eagle Mines Limited's Meadowbank Mine located in the Kivalliq Region of Nunavut and the diamond mines located in the Northwest Territories (i.e. Ekati, Diavik, and Snap Lake) are the most recent examples of northern mines that have experience in growing their resident Indigenous workforce. These two examples provide evidence of the challenges and opportunities in entering this type of labour market.

Meadowbank Mine[24]

Labour Force Experience

The Meadowbank Gold Mine is situated northwest of Baker Lake, Nunavut. It began production in 2010. Prior to that, the Kivalliq region's last mining operation was the Rankin Inlet nickel and copper mine that closed in 1962.

When Meadowbank entered production, there were 246 Inuit employed in the operations' workforce out of a total workforce of 602 (Table A1).[25] The number remained close to that mark until 2015, when it grew to 302. It is important to note that Agnico Eagle has three classifications for jobs: permanent, temporary (or non-permanent), and on-call. Furthermore:

- The majority of Inuit working at the mine are permanent employees.
- Inuit fill all on-call positions.
- Inuit fill only a small fraction (5%) of temporary jobs.

Most jobs associated with production are permanent, while all construction jobs are temporary. There were 39 Inuit employed in non-permanent construction jobs in December 2010 compared with 571 non-Inuit from southern Canada.

Table A1: Meadowbank Mine Employment

	2010	2011	2012	2013	2014	2015
Inuit Employment	246	249	247	244	269	302
Non-Inuit Employment	356	453	540	521	519	511

Source: Meadowbank Gold Mine 2015 Socio-Economic Monitoring Report

What is not shown in the employment numbers is the effect of turnover. Turnover within the construction workforce has been extremely high, in large part, because of the temporary nature of the jobs—layoffs, end of term or end of job, temporary jobs, and quitting are all included in the turnover calculation. But the turnover in permanent positions was also high over the first five years of operations (Table A2). Many Inuit residents who were without a job in 2010 were given the

[24] The facts and data in this section originate from the *Meadowbank Gold Mine 2015 Socio-Economic Monitoring Report* prepared by Stratos Inc. for Agnico Eagle Mines Ltd. December 2016.

[25] Note that these figures do not include construction or development labour. Agnico Eagle classifies these jobs as non-permanent. The number of Inuit employed in non-permanent jobs equaled 39 in December 2010 compared with 571 non-permanent (construction) jobs filled by southern workers. In relative terms, Inuit represented 6.4% of the construction crew at that time.

opportunity to work at the mine site, but not all of them were necessarily ready, willing, and able to continue working there. Turnover amongst Inuit employees in the first year of operations was 39%. Reasons given by employees for leaving their job include:

- Spousal relationship issues
- Did not like the work or too tired to continue working
- Too much gossip amongst co-workers
- No babysitter or daycare
- Found a new job in town
- Homesick – need to go home
- Work was too hard or did not like the work
- Increase in rent for social service housing

Table A2: Employee Turnover

	2010	2011	2012	2013	2014	2015
Inuit (non-permanent)	172%	131%	127%	67%	70%	25%
Inuit (permanent)	39%	23%	16%	23%	26%	12%
Non-Inuit	7%	5%	11%	5%	7%	3%

Source: Meadowbank Gold Mine 2015 Socio-Economic Monitoring Report

Agnico Eagle reports employment by gender, but does not subdivide that indicator by ethnicity. It must be assumed that not all female employees are Inuit or Nunavummiut. The percentage of women employed in permanent positions has oscillated between 8% and 18% (Table A3).

Table A3: Employment by Gender

	2010	2011	2012	2013	2014	2015
Male	512	649	673	688	669	619
Female	90	53	114	77	120	138
(% of females)	15%	8%	14%	10%	15%	18%

Source: Meadowbank Gold Mine 2015 Socio-Economic Monitoring Report

The majority of Inuit employees work in unskilled or semi-skilled positions (Table A4). In 2015, just 1% of the Inuit workforce (3 people) worked in skilled positions and none worked in either professional or management jobs.

Table A4: Inuit Employees by Job Classification		
	2014	2015
Management (A)	0%	0%
Professional (A)	0.4%	0%
Skilled (B)	1.9%	1.0%
Semi-Skilled (C)	42.4%	46.0%
Unskilled (D)	55.4%	53.0%
Source: Meadowbank Gold Mine 2015 Socio-Economic Monitoring Report		

The employment numbers should be viewed alongside the population data for the Kivalliq Region to make better sense of the participation rate (Table A5 and A6). The region is home to 10,528 residents as of 2016, 9,526 (90.5%) of who are Inuit, and 45% of who are between the ages of 25 and 64. The 302 Inuit residents working at Meadowbank represent approximately 7% of the Inuit population aged 25 to 64 in the region.[26]

Table A5: Kivalliq Population, 2016			
	Total	Inuit	Non-Inuit
Kivalliq Region	10,528	9,526	1,002
Arviat	2,772	2,591	181
Baker Lake	1,997	1,815	182
Chesterfield Inlet	473	427	46
Coral Harbour	1,080	1,034	46
Naujaat	1,069	1,015	54
Rankin Inlet	2,675	2,205	470
Whale Cove	462	439	23
Source: Nunavut Bureau of Statistics			

Table A6: Kivalliq Population by Age Cohort, 2016		
	Population	% of Total
0 to 4	1,234	12%
5 to 14	2,252	21%
15 to 24	1,974	19%
25 to 44	2,945	28%
45 to 64	1,762	17%
65 and over	361	3%
Total	10,528	100%
Source: Nunavut Bureau of Statistics		

[26] It is understood that Inuit between the ages of 18 and 24 are eligible for work at Meadowbank. The 25 to 64 age range is used because it is a close proxy of the working age population and data for this cohort are readily available across Nunavut's communities.

The relative stability in the mine's Inuit workforce and the 7% participation rate provide some evidence to the willingness of the Inuit labour supply to work at this project. One should exercise caution in making too much of this evidence however, since the number of unskilled and semi-skilled jobs appears to be the most significant factor in limiting participation.

Education and Training Efforts

Agnico Eagle has made several investments in education and training (Table A7). For example, it has invested $284,000 per year in school-based initiatives to grow interest in math, science, and mining among school-aged children over the period 2010 to 2014. The company has also provided scholarships to encourage post-secondary education.

The company invests over $3 million annually in the Kivalliq Mine Training Society (KMTS) though cash and in-kind support and $190,000 annually in the Arviat Diamond Drillers and Welders Program. The KMTS provides support for the development and delivery of community-based work readiness and labour pool initiatives to help prepare Inuit for employment opportunities. The KMTS has also supported the Arviat Drillers program, as well as community-based initiatives, such as the Making it Work program and Community Net-Work program, which provide supports to communities to help employees and their families cope with the challenges that come with employment.

Table A7: Agnico Eagle Mine Limited's Cash and In-Kind Support for Training

	2010	2011	2012	2013	2014	2015
Kivalliq Mine Training Society	$1M	$0	$3.3M	$3.6M	$3.6M	$3.6M
Arviat Diamond Drillers and Welders Program	$250,000	$60,000	$190,000	$190,000	$190,000	$190,000

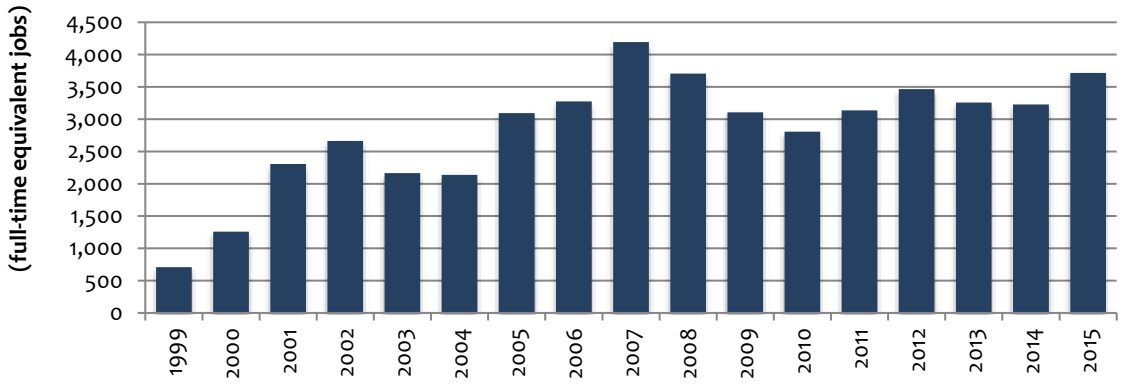
Source: Meadowbank Gold Mine 2015 Socio-Economic Monitoring Report

NWT Diamond Mines (Ekati, Diavik, and Snap Lake)

Labour Force Experience

As of mid-2015, there were three operating mines in the North Slave region of the Northwest Territories (however, the Snap Lake Mine closed in December 2015). All three operated fly in/fly out (FIFO) work camps on a 2-week rotation. The labour requirements of these operations share some similarities with the proposed expansion of Baffinland's Mary River Project in that the total labour demand grew over the course of 10 to 15 years, starting with a single mine creating 708 FTE jobs in its first full year of production (1999), and reaching 3,700 FTE jobs by 2015, with the peak employment coming in 2007 with close to 4,200 FTE jobs (Figure A1).[27]

Figure A1: Job Creation in NWT's Diamond Mining Industry, 1999 to 2015



Source: *Socio-Economic Monitoring Reports*, 1999 to 2015, Diavik Diamond Mines Inc., BHP Billiton, De Beers Canada, Dominion Diamonds Corporation.

Over the 16 years[28] of mining activity since operations began at Ekati, which includes the construction of two additional mines (Diavik and Snap Lake), the NWT resident workforce has grown to a range between 1,400 and 1,600 jobs on a FTE basis. In the most recent year for which data are available, 2015, this workforce totalled 1,750—easily its highest level to date. Within these employment results, approximately half of the resident employees are of Indigenous decent (Figure A2).

Observe the relative stability in the participation of NWT labour in the operations workforce of the three diamond mines. Since 2005, the average NWT Indigenous workforce has equalled 775 with a standard deviation of 45. This stability is set against an overall workforce that changes every year, primarily due to the varied labour force requirements of construction or development projects at the mine sites. As a result, the relative participation rate is more varied (Figure A3).

The stability can also be examined as a means of understanding the willingness of the ready and able labour supply to participate in mining jobs. Though similar to the Meadowbank Mine, the number of unskilled and semi-skilled jobs is likely a more significant factor in limiting participation at the NWT mines.

[27] These data were assembled from annual Socio-Economic Monitoring reports produced by the mine owners over the past 16 years.

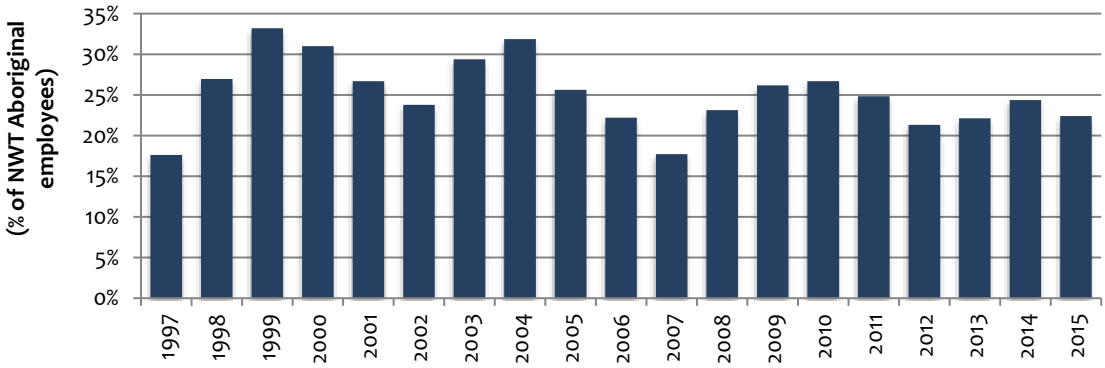
[28] The first full year of the first mine's operations is the starting point of the analysis, similar to the Labour Market Analysis timeframe for Baffinland's Mary River Project.

Figure A2: NWT Resident Employment in Diamond Mining, 1999 to 2015



Source: *Socio-Economic Monitoring Reports*, 1999 to 2015, Diavik Diamond Mines Inc., BHP Billiton, De Beers Canada, Dominion Diamonds Corporation.

Figure A3: Relative Contribution to Mine Employment by NWT Indigenous residents, 1997 to 2015



Source: *Socio-Economic Monitoring Reports*, 1999 to 2015, Diavik Diamond Mines Inc., BHP Billiton, De Beers Canada, Dominion Diamonds Corporation.

The relative participation of Indigenous residents in NWT's mining industry would be much higher if the analysis were to look exclusively at the operations side of these mines. This is because construction-related jobs have not been as attractive to the Indigenous labour. There are several possible reasons for this:

- The majority of construction jobs require skills that the resident workforce does not have.
- The volume of tradespeople needed far exceeds the supply.
- The construction jobs are temporary.

By comparison, the operations jobs are full-time permanent positions, there are a greater variety of jobs, and the opportunity for promotion is better.

There are more skilled positions at the NWT diamond mines than any other positions—48.4% of all jobs. NWT Indigenous employees represent 12% of the workforce for that job classification. There are far fewer unskilled jobs—308 out of 3,420 (9%)—but NWT Indigenous employees fill 54% of these jobs (Table A8).

Table A8: Indigenous Workforce by Job Classification, 2015

	NWT Indigenous	Total Jobs	%
Management	0	35	0%
Professional	18	379	5%
Skilled	199	1,655	12%
Semi-skilled	427	1,048	41%
Unskilled	166	308	54%
Total	810	3,420	24%

Source: *Socio-Economic Monitoring Reports*, 1999 to 2015, Diavik Diamond Mines Inc., BHP Billiton, De Beers Canada, Dominion Diamonds Corporation.
Note: Construction jobs are excluded.

The large majority of the NWT Indigenous workforce lives in the North Slave, South Slave, or Tlicho region of the territory, though each mine does employ Indigenous people who live elsewhere in the territory and each mine owner offers some form of travel incentive to compensate them for the cost of travel to an official pick-up point. The Indigenous population of the three primary regions was 12,218 in 2015, with the entire territory's Indigenous population equalling 22,257 (Table A9).

Table A9: Indigenous Labour Force Participation in NWT mining, 2014

	Indigenous Labour working at mines	Indigenous Population (2015)	%
Primary Affected Communities	737	12,218	6.0%
Other Communities	50	10,039	0.5%
Total	787	22,257	3.5%

Source: Socio-Economic Monitoring Reports and NWT Bureau of Statistics, Population by Ethnicity

Education and Training Efforts[29]

The three diamond mines invest in education and training through a combination of on-site training and apprenticeships, contributions to the NWT Mine Training Society (MTS), and funding scholarships in an effort in increase NWT Indigenous and non-Indigenous employment and retention and to promote the advancement of its existing employees. Over a ten-year period from 2004 to 2013, the mining industry provided $16.7 million in cash and in-kind support to MTS programs. This contribution is in addition to government support for training in mine operation and service positions that equalled $32.2 million over the same time period.

The combined investments from industry and government have resulted in 1,074 northern residents gaining employment, where 1,050 were Indigenous residents. In total, 2,796 people have been assessed for training by the MTS between 2004 and October 2014, of whom 2,149 have received training or other supports.

[29] The facts and figures in this section are sourced from the NWT & Nunavut Chamber of Mines, 2014. "Measuring Success 2014." Compiled by the NWT and Nunavut Chamber of Mines, November 2014.

The MTS has targeted training in a number of areas: Mineral Process Operating Technician; Camp Cook; Cook Apprenticeship; Heavy Equipment Operator; Geoscience Field Assistant; Introduction to Underground Mining; Underground Mining; and General Construction. Most recently, in addition to specific job skills, programs include life skills training to help participants settle into employment and be able to balance home and work life. In addition, students from the Underground Miner Training Program and Mineral Process Operator Training Program are provided paid term training positions at the mines and many are hired into full-time positions. As of 2012, the three diamond mines had sponsored more than 200 apprenticeships, 100 underground miners, and 65 trades trainees.

The NWT diamond mines also support higher education through various scholarship programs. In 2013, the three companies provided nearly $464,000 in scholarships under a variety of banners including Impact Benefit Agreement or Participation Agreement beneficiaries, Socio-Economic Agreement commitments, employee dependants, special post-secondary scholarship and sponsorships, and to non-IBA affiliated recipients.

Important Takeaways from Other Northern Mine Employment

The two northern mining districts discussed have been successful in employing a larger number of Indigenous residents than what were originally predicted in their respective environmental assessments. After facing initial periods where turnover was a principal concern, both have been challenged in growing this workforce beyond unskilled and semi-skilled jobs. Indigenous resident participation in the mining industry grew quickly but topped out when this group had filled a majority of unskilled and semi-skilled jobs.

The challenge does not appear to be a lack of training programs or training dollars. Rather, too many within this Indigenous workforce do not have the education requirements needed to enrol in higher learning programs or progress into more skilled positions. And, there is evidence that suggests progress in the area of education has been slow and even stagnant at times. To further exacerbate the situation, most new jobs created at mine sites once they are up and running tend to be in skilled positions. For example, in 2012, 52% of the jobs at the Snap Lake Diamond Mine were classified as unskilled or semi-skilled, while 42% was classified as skilled. By 2015, the percentage of unskilled and semi-skilled jobs had dropped to 38% of the overall workforce, while the relative number of skilled jobs had grown to 55%. As a result, Indigenous resident participation in that project dropped in relative and absolute terms.[30]

Analysis has shown that job creation alone is not enough to ensure Indigenous resident employment. And in all four mines examined, the mines' owner(s) have invested heavily in training. The marginal benefits of these investments appear to decrease over time and are limited by the absence of new candidates for training programs. Training can assist some employees in gaining promotion from unskilled to semi-skilled positions, but further education or successful apprenticeships are typically required to move into skilled positions.

[30] De Beers Canada, 2016. *2015 Employment Report*. Reported in the 2015 Socio-Economic Monitoring Report.

APPENDIX 14
TOTE ROAD EARTHWORKS EXECUTION PLAN

April 2017

MARY RIVER PROJECT

Tote Road Earthworks Execution Plan and Design Report

Submitted to:

Baffinland Iron Mines Corporation
2275 Upper Middle Road East, Suite 300
Oakville ON Canada
L6H 0C3

REPORT

Report Number: 1667708 (Rev. 0)

Distribution:

1 e-copy – Baffinland Iron Mines Corporation
1 e-copy – Golder Associates Ltd.

Golder Associates

Executive Summary

This report presents the Tote Road Earthworks Execution Plan (the Plan) for the Baffinland Iron Mines Corporation's (Baffinland) Mary River Project. The primary objectives of this Plan are to prioritize the sites along the Tote Road requiring remediation and to provide remediation designs for Baffinland to implement.

The Mary River Project (Mine Site) is located at approximately latitude 71°19' north, longitude 79°12' west. Operations at this iron ore mine comprise the blasting and excavation of ore and waste rock. Once crushed, the ore is loaded onto B-train haul trucks and transported to the Milne Port facility, via the Tote Road, for shipment to processing facilities offsite. The Tote Road extends from the Milne Port to the Mine Site, a distance of 104 km.

The Plan is required to address Baffinland's commitment to Environment and Climate Change Canada (ECCC) and Indigenous and Northern Affairs (INAC) as stated in the sedimentation mitigation action plan (Golder 2016). To meet the needs for remediation design, the Plan includes culvert replacement, road re-surfacing, and other road improvements in consideration of the design prepared by Hatch Ltd. (Hatch). Golder was retained by Baffinland to develop the Tote Road Earthworks Execution Plan for use in the upcoming construction season(s). The Plan included:

- Collaborating with Baffinland to prioritize the culvert sites requiring remediation;
- Preparing detailed designs for several culvert sites; and,
- Preparing and submitting a design report.

Golder prepared detailed designs for 14 individual culvert sites. The remaining sites were not included because there was not enough information for design and/ or their need for remediation was not as urgent as those chosen. Design elements used in developing individual site detailed design comprised:

- Designing road to match with existing alignment or requested realignment based on Baffinland's needs;
- Prescribing materials to be used for: embankment, pavement, culvert pipe bedding, trench backfill, and erosion protection;
- Detailing installation requirements, based on a desktop study (not supported by field study); and
- Providing an inventory on the number and diameter(s) of culvert pipes, drainage crossing fish bearing status, and embedment depth of pipes where fish passage is required.

Baffinland plans to carry out the work prior to the spring freshet and post-summer. The works are planned to be carried out with minimal impact during the open water season. Golder will provide offsite engineering during the duration of this project. It is recommended that inspections of the culvert sites to be remediated in the future be carried out in 2017. Routine inspections should also be carried out by Baffinland throughout the year.

Table of Contents

1.0 INTRODUCTION 1

2.0 BACKGROUND INFORMATION 1

2.1 Sedimentation Mitigation Action Plan Site Visit 1

2.2 Available Background Information 2

2.3 Limitations on Background Information Review 3

3.0 METHODS 3

4.0 DESIGN BASIS 5

4.1 Design Criteria and Assumptions 5

5.0 DESCRIPTION OF DESIGN ELEMENTS 6

6.0 CONSTRUCTION CONSIDERATIONS 7

7.0 INSPECTION REQUIREMENTS 7

8.0 PATH FORWARD 8

Tables

Table 1: Remediation sites identified during sedimentation mitigation action plan (prioritized sites for initial phase are identified with an asterisk (*)) 13

Table 2: Parameters used for roadway design 13

Table 3: Assumptions used for Parameters in Table 2 14

Table 4: Road design speeds 14

FIGURES

Figure 1: General Arrangement Plan and Culvert Sites

APPENDICES

APPENDIX A
Prioritization of Sites

APPENDIX B
Construction Drawings

APPENDIX C
Specifications

APPENDIX D
Inspection Form

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was retained by Baffinland Iron Mines Corporation (Baffinland) to develop a Tote Road earthworks execution plan (the Plan) for the Mary River Project in Nunavut. The Plan is required to address Baffinland's commitment to Environment and Climate Change Canada (ECCC) and Indigenous and Northern Affairs (INAC) as stated in the sedimentation mitigation action plan (Golder 2016). The Plan is to include culvert replacement, road re-surfacing, and other road improvements in consideration of the design prepared by Hatch Ltd. (Hatch).

Baffinland owns and operates the Mary River Project, an open pit iron ore mine located on northern Baffin Island, in Nunavut at approximately latitude 71°19' north, longitude 79°12' west. Operations comprise the blasting and excavation of ore and waste rock with the ore hauled from the open pit to a crusher. Following crushing, the ore is loaded onto B-train haul trucks and hauled to the Milne Port facility, via the Tote Road, for shipment to processing facilities offsite. The Tote Road extends from the Milne Port to the Mine Site, a distance of 104 km.

Construction drawings were prepared for Baffinland by Hatch for the Tote Road Upgrade in 2013. Earthwork upgrades to the Tote Road have been ongoing including the completion of the bridge construction in 2014 (Hatch 2014b) and those activities outlined in the sedimentation mitigation action plan (Golder 2016).

The primary objectives of this Plan are to prioritize the sites requiring remediation and to provide remediation designs for Baffinland to implement.

The report summarizes the Plan, and presents drawings and specifications prepared by Golder, as follows:

- A description of the background information used to develop the earthworks execution plan and designs is provided in Section 2.0;
- A description of the methodology, design considerations, design elements and construction considerations are provided in Sections 3.0, 0, 5.0, and 6.0, respectively;
- Inspection requirements are provided in Section 7.0; and
- The path forward is described in Section 8.0.

Environmental aspects of the works were excluded from Golder's scope of work as Baffinland stated that it would be responsible for these items. Baffinland's Environmental Protection Plan will be followed during the prescribed work and culvert installations.

The Reader is instructed to read the entire report, including appendices.

2.0 BACKGROUND INFORMATION

2.1 Sedimentation Mitigation Action Plan Site Visit

Golder carried out a site visit in August 2016 as part of the scope for the development of the Sedimentation Mitigation Action Plan (Golder 2016). Through site observations and input from Baffinland's staff, a preliminary list of sites that require remediation was developed. Approximately 55 sites were identified and observations on the condition and possible remedial actions were noted. This complete list of sites is provided in Table 1 (following the text of the report).

2.2 Available Background Information

The reports and data provided by Baffinland and listed in the following sections were reviewed as part of the desktop study for the Plan.

Previous Reports & Design Drawings

- Baffinland (Baffinland Iron Mines Corporation). 2013. DFO Culvert Package (Re: Changes to culverts along the Tote Road). Prepared for Fisheries and Oceans Canada (DFO). Prescott, Ontario. , August 29, 2013. 521 p.
- Golder (Golder Associates Limited). 2016. Mary River Project, Sedimentation Mitigation Action Plan, Rev. 1. Prepared for Baffinland Iron Mines. Project No. 1661774 (5000). September 29, 2016.
- Hatch (Hatch Limited). 2013a. Mary River Project, Project Wide Civil Standard Drawing, Typical Culvert Details Dwg. No. H349000-1000-10-041-0003. Prepared for Baffinland Iron Mines. Oakville, ON. June 7, 2013. 1 p.
- Hatch (Hatch Limited). 2013b. Tote Road Design Criteria. Prepared for Baffinland Iron Mines Corporation. Oakville ON: Hatch Ltd. 15 p. April 2, 2013.
- Hatch (Hatch Limited). 2013c. Tote Road Culvert Design Summary. Prepared for Baffinland Iron Mines Corporation. Oakville ON: Hatch Ltd. August 27, 2013.
- Hatch (Hatch Limited). 2014a. Mary River Project, Tote Road Culvert Data, Sheets 1 through 5, January 23, 2014. Prepared for Baffinland Iron Mines. Dwg. No. H349000-3000-10-088-0030 through H349000-3000-10-088-034. 5 p.
- Hatch (Hatch Limited). 2014b. Construction Summary Report: Tote Road Upgrade Package – Bridge Crossings, December 4, 2014. Prepared for Baffinland Iron Mines. 53 p. File No. H349000-3130-10-124-0005.
- Knight Piésold (Knight Piésold Consulting). 2007. Tote Road Alignment: Reissuing Updated Figures 1 to 43. Prepared for Baffinland Iron Mines. Oakville, ON. 48 p. (Ref. No. NB07-00698). August 17, 2007.
- Knight Piésold (Knight Piésold Consulting). 2007. Table 1: Mary River Project, Bulk Sampling Program – Road Upgrade, Summary of Water Crossings – Sorted by Chainage, August 21, 2007. Prepared for Baffinland Iron Mines. Oakville, ON. 3 p.
- Tetra Tech EBA (Tetra Tech EBA Engineering Consultants Limited). 2014. Inspection of the Milne Inlet Tote Road and Associated Borrow Sources, November 2014. Prepared for Baffinland Iron Mines. 50 p. File No. E14103210-01.

Satellite Imagery

- Worldview (satellite imagery from Worldview 2 and Worldview 3 satellites, by DigitalGlobe). 2012, 2015, & 2016. Provided by Baffinland Iron Mines.

Photogrammetry/Grid & DEM

- Derived from satellite imagery, the following were provided:
  - PhotoSat. 2015. “Thinned” point cloud (gridded) data from photogrammetric grid development, November 4, 2016. Prepared for Baffinland Iron Mines. PhotoSat Transmittal Ref. 3697.
  - PhotoSat. 2016. “Thinned” point cloud data (gridded), December 2016. Prepared for Baffinland Iron Mines.

GPS & Map Data

- Baffinland (Baffinland Iron Mines Corporation). 2015. Tote Road Culverts GPS points (*.gpx file), October 3, 2015.
- NRC ESS (Natural Resources Canada, Earth Sciences Sector). 1965. CanMatrix Provisional Map 47 H09, Nunavut, Edition 1 MCE, Series A 713. Accessed December 2016.

AutoCAD

- Baffinland (Baffinland Iron Mines Corporation). 2017. (Railway Centreline) Mary River Track Centreline with laydowns, quarries and water sources (AutoCAD File), January 16, 2017.
- Knight Piésold (Knight Piésold Consulting). 2009. (As-built) Road Upgrades, Plan and Profile (AutoCAD File), October 9, 2009. Prepared for Baffinland Iron Mines.

2.3 Limitations on Background Information Review

The Plan is based on a desktop review and relies on the accuracy of the data provided. The background data provided by Baffinland was used to infer the existing conditions and develop the designs, however, it was noted that the “as-built” information (Knight Piésold 2009) was not up-to-date. In some instances the as-built alignment did not match the most recent satellite imagery (Worldview 2016), specifically where upgrade work was carried out (as described in Section 1.0). Therefore numerous sources of information were used to infer the actual conditions.

The locations of the culvert sites were inferred from a combination of the “as-built” information (Knight Piésold 2009), the Hatch design information (Hatch 2014a), GPS coordinates provided by Baffinland (Baffinland 2015) and the satellite imagery (Worldview 2016).

The site conditions, including the condition of the culverts and sedimentation issues, were inferred from the available photographs, notes and satellite imagery. The existing roadway dimensions (i.e. side slope, road widths, and embankment heights) were derived from the processed satellite data (Worldview 2016).

3.0 METHODS

The Plan was developed as follows:

- Identify areas of the Tote Road that require remediation/ improvements;
  - As described in Section 2.1, as part of the sedimentation mitigation action plan development, approximately 55 sites were identified along the Tote Road with potential sedimentation issues (Figure 1).

- Prioritize the sites for remediation;
  - As it is not feasible to remediate all the sites in one construction season, it was necessary to select the sites to be remediated first. A ranking system described in Appendix A was developed together with Baffinland staff to prioritize the remediation projects. With the aid of the ranking system, Baffinland identified 19 sites for the initial remediation efforts. The 19 sites were reviewed in detail to develop a design for remediation for each site. Of the 19 sites, 5 sites were identified to have insufficient information to develop a detailed design.
  - These 5 sites are noted to have permafrost degradation and ditch erosion issues. Therefore it was determined that these sites would be inspected in the summer of 2017 and remediation plans would be developed after site inspections were carried out and additional information was collected. The 14 remaining sites are identified in Table 1. The remaining sites will be inspected in the summer of 2017 and remediation plans will be developed for future years, as required.
- Establish the design basis for the various sites;
  - Once the selected sites were determined the design basis was established. Hatch design criteria documents (listed in Section 2.0) were used as a reference. A description of the design basis is provided in Section 4.0.
- Complete the design for the selected sites;
  - The Hatch design (2014a) of the culvert crossings was referenced as it is the permitted construction plan for the Tote Road. Environmental and hydrological studies were not part of this scope of work, therefore no changes to the Hatch design for the number of culverts, size of the culverts or embedment depth of the culverts were proposed.
  - The design of the road sections along the culvert crossings was completed using RoadEng software. RoadEng is a software tool designed by Softree, which is specifically used for haul road design. This program serves as an efficient tool for road alignment design, including geometric design (grades and curves) and earthwork volume estimation.
  - Site remediation designs were developed on a site-by-site basis with site specific notes and design considerations developed in conjunction with the road design models. The design elements are described in Section 5.0 and the construction drawings and specifications are provided in Appendices B and C.
- Provide inspection requirements;
  - Inspection of sites with that have been remediated as well as those without remediation designs is required. Details on the inspection requirements are provided in Section 7.0.

4.0 DESIGN BASIS

The objectives driving the design are described as follows:

- Reduce the sediment loading of watercourses caused by the Tote Road;
  - The sedimentation of the affected watercourse crossings is a result of several issues including erosion upstream of the culvert crossings, impedance of flow due to damaged or buried culverts or poorly aligned culverts, and inadequate erosion protection at the culvert locations;
- Improve position, alignment, and invert elevations of the fish-bearing culverts to foster fish passage;
- Improve the safety of the Tote Road;
  - At several of the existing culvert sites the Tote Road is narrow with a width less than 10 m. As part of the design, widening the existing road driving surface is a key requirement.
  - Safety berms are required where the road embankment drop-off is 3.0 m or greater.
- Limit interruptions to the active Tote Road traffic during construction;

The objectives are to be met under the over-riding constraint that not all culvert sites identified as needing rehabilitation or reconstruction can be dealt with in a single construction season.

4.1 Design Criteria and Assumptions

The following criteria and assumptions were used for the design of the earthworks at the culvert sites:

- Minimum road width of 10 m (as per Hatch 2013b);
- Maximum embankment slope of 1.5 : 1 (horizontal : vertical) (as per Hatch 2013b);
- Pavement structure of 200 mm of surface material and 300 mm of base material (as per Hatch 2013b). It was not part of the project scope to confirm the pavement design;
- Road design parameters (as presented in Table 2; derived from road geometry calculations and assumptions listed in Table 3) including:
  - Design speed;
  - Stopping sight distance (TAC 1999);
  - Horizontal curves;
    - Minimum radius for rollover model (Douglas 2016)
    - Minimum radius for sliding model (TAC 1999)
  - Vertical Curves; and
    - Crest curve k (TAC 1999)
    - Sag curve k (TAC 1999)

- Pavement structure.
  - Pavement design (from Hatch 2013b)
  - The values for the parameters adopted in each road section design were selected based on fitting the new alignment smoothly to the existing road or an improved alignment and/or minimizing earthworks materials. The design speed was reduced from the standard of 65 km/hr (associated with a posted speed limit of 55 km/hr) if the specific arrangement of the site made it absolutely necessary. Any stretches of road not built to fit the design standard (i.e. not using a 65 km/hr design speed) must be posted with the corresponding reduced speed limit. For any given design speed (used for geometric road design), the posted speed is generally 10 km/hr less (i.e. for a design speed of 50 km/hr, the posted speed limit shall be 40 km/hr). The details of the designs are discussed in Section 5.0 and the site specific design speeds and speed limits are presented in Table 4.

- Culvert pipe design details from Hatch (2014a). It was not part of the project scope to complete any hydrology or environmental studies for the culverts;
- Baffinland will inspect the culverts in the field for opportunity to repair and/or extend the existing culverts rather than replace them; however, for the purposes of the design, full replacement was assumed;
- In recognition of the active use of the Tote Road, the designs can be constructed while maintaining a minimum of one lane of traffic;
- No consideration was given to the proposed rail line or new/ expanded borrow sources as per Baffinland's request. Because the Tote Road will be realigned/ upgraded as part of the rail construction, the rail requirements were not considered;
- Granular materials readily available/ produced on-site (if suitable) were used in the design for backfill and erosion protection. Baffinland currently produces several material types onsite for road maintenance (from approved quarry locations) and construction, which include:
  - Screened material consisting of 32 mm minus material;
  - Jaw run material consisting of 150 mm minus material; and
  - Run of quarry material consisting of various rock sizes.
- No geotechnical data was available and no geotechnical investigations were carried out.

5.0 DESCRIPTION OF DESIGN ELEMENTS

The design elements of the earthworks are described in the following section. The construction drawings are presented in Appendix B and the specifications are presented in Appendix C.

Culvert design details are provided on the construction drawings in Appendix B. The number of culverts, diameter and embedment depth (for fish passage crossings) were taken from the Hatch Tote Road Culvert Data (2014a) as no hydrological, hydraulic, or environmental studies were carried out. The culvert locations, slopes, lengths, and invert elevations were designed to best fit the streambed in the road design models. The actual locations will need to be field fit to match the site conditions.

The typical installation details for the culverts are shown in the drawings in Appendix B. To replace an existing culvert, a trench will need to be excavated or blasted. The culvert trench will be backfilled with granular fill and compacted. Bedding and embedment material will consist of Screened Material (Type 5). Compaction requirements will be performance-based. Backfill on top of the embedment material will consist of Jaw Run Material (Type 8).

The designed roadway alignments best fit the existing roadway alignments wherever possible considering the design criteria described in Section 4.1. Where the addition of the embankment height increase by about 1 m or more, the road embankment was offset to the left or right side of the existing road to maintain traffic during construction. Two realignment designs (for BG04 and CV186) were developed, as requested by Baffinland, to improve the truck safety and efficiency on the roadway. The roadway alignments, cross-sections and layout points are provided in the construction drawings in Appendix B. The design speeds for each site are provided in Table 4.

The roadway embankment fill will consist of Jaw Run Material (Type 8) or Run of Quarry Material (Type 12) depending on the required fill thickness. The pavement will consist of 200 mm of Screened Material (Type 5) as surfacing on 300 mm of Jaw Run (Type 8) base material. Where embankment heights exceed 3 m, safety berms are required. Safety berms are required to be a minimum of 1.05 m high based on 55 inch diameter tires on the B-train haul trucks. The safety berms are to be constructed of Jaw Run Material (Type 8).

6.0 CONSTRUCTION CONSIDERATIONS

A phased construction approach is required to complete this work as it is not feasible to remediate all the sites in 2017. Therefore 14 sites were selected for the initial phase of remediation. Subsequent phases of remediation will be developed in 2017 upon completion of the inspection and based on updated site condition data (as described in Section 7.0).

It is important to note that field fitting of the culverts will be required. A review of the existing individual culvert conditions including structural integrity and installation inverts (i.e. perched, or embedded) will need to be carried out by Baffinland to determine if the existing culvert can be extended and/ or repaired, or if it needs to be replaced.

It is expected that if constructed pre-freshet, some settlement may occur post-freshet and the road surface may need to be topped up with fill and re-graded.

Golder will provide offsite engineering support for the duration of the project.

7.0 INSPECTION REQUIREMENTS

It is a requirement of the Plan that inspection (and maintenance, as required) be carried out. The following inspection schedule, tasks, and group(s) responsible for the inspections are as follows:

- During freshet 2017:
  - Performance of completed construction sites – Baffinland.
- After freshet 2017:
  - Performance of completed construction sites – Baffinland;

- As-built condition of completed construction sites – Geotechnical Engineer accompanied by Baffinland; and
- Condition of sites to be inspected (remainder from Table 1) – Geotechnical Engineer accompanied by Baffinland.

Additionally, regular inspections are to be carried out by Baffinland immediately before, during and after each freshet as well as after any significant precipitation event throughout the mine operating period. Inspections of culvert crossings are required to evaluate performance and identify areas of concern. Example inspection forms are attached in Appendix D for culvert crossings.

8.0 PATH FORWARD

Baffinland will carry out the earthworks with off-site geotechnical engineering support by Golder.

An inspection of the remaining sites will be carried out by an engineer in 2017 to identify remedial requirements and information that are pertinent to the design.

A plan similar to this Plan will be developed to include the remaining sites to be remediated.

STUDY LIMITATIONS

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Report Signature Page

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TAC (Transportation Association of Canada). 1999. *Geometric design guide for Canadian roads*. Ottawa: TAC.

Worldview (satellite imagery from Worldview 2 and Worldview 3 satellites, by DigitalGlobe). 2012, 2015, & 2016. Provided by Baffinland Iron Mines.

TABLES

Table 1: Remediation sites identified during sedimentation mitigation action plan (prioritized sites for initial phase are identified with an asterisk (*))

Culvert ID	Station	Culvert ID (Cont'd)	Station (Continued)	Culvert ID (Cont'd)	Station (Continued)	Culvert ID (Cont'd)	Station (Continued)
BG01*	099+480	BG28	086+130	CV58	059+780	CV187*	102+860
BG03	095+590	BG29*	084+710	CV059*	059+220	CV212 (A&B)	074+250
BG04*	094+000	BG31	082+020	CV60	058+110	CV212 (C&D)	074+500
BG10	-	BG32*	078+130	CV091 and CV092	042+450	CV213	078+400
BG11	091+430	BG33	077+000	CV094	041+120	CV214 (A)	078+400
BG11-B&C	-	CV001*	094+350	CV099*	037+340	CV214 (B)	078+840
BG14-B	090+520	CV030	077+440	CV104	033+600	CV215	079+530
BG14-C	090+730	CV031	-	CV106*	032+680	CV216*	080+580
BG17	090+030	CV032	-	CV112*	030+800	CV217	079+830
BG19	89+680	CV033	075+640	CV114	029+220	CV222 (prev. labelled CV001-D)	095+080
BG19-B-DS	089+780	CV033-A-US	076+510	CV115	027+200	CV223 A-E (2 sites)	096+980 & 097+070
BG19-C-DS	090+110	CV040	072+070	CV129	015+310	CV224*	097+570
BG25 (A&B)	086+940	CV046 A & B*	065+740	CV165	006+750	CV225	098+840
BG27	086+500	CV049	062+540	CV186*	102+580	-	-

Table 2: Parameters used for roadway design

Parameter	Design Speed (km/hr)			
	65	**50**	**40**	**30**
Stopping sight distance (m)	100	65	45	30
R_{min} for Rollover Model (m)	220	130	85	45
R_{min} for sliding model (m)	175	104	66	37
Crest k (m/%)	20	9	4	2
Sag k (m/%)	21	12	7	4

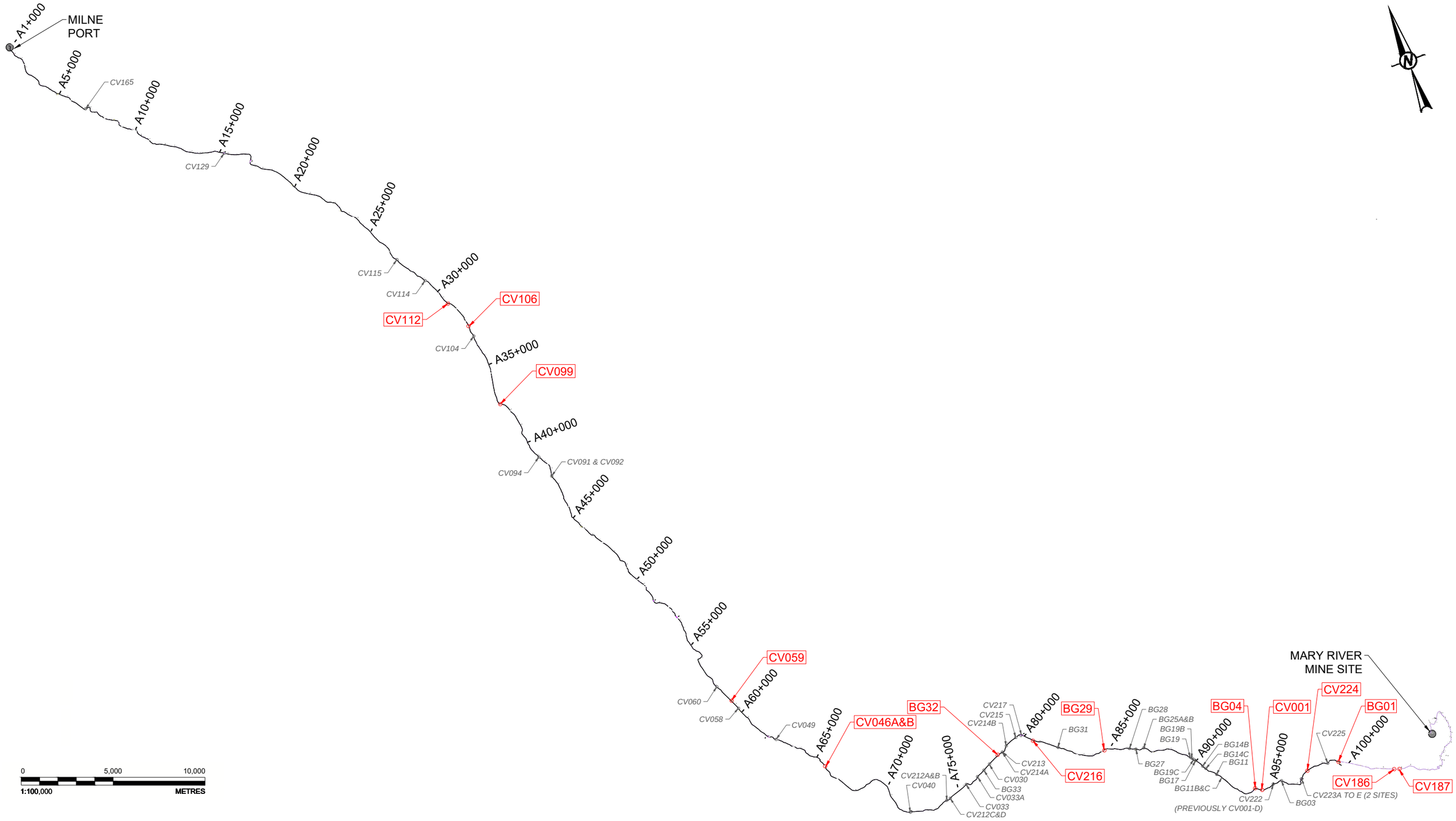
Table 3: Assumptions used for Parameters in Table 2

Assumptions	Value
Stopping sight distance	
Brake reaction time (sec)	2.5
Coefficient of friction	0.33 to 0.40
Horizontal curve radius	
Lateral coefficient of friction	0.15
Superelevation in circular curve, e_{max} (ft/ft)	0.4
Crest curve k	
Driver's eye height, h_1 (m)	1.05
Obstacle height, h_2 (m)	0.3
Sag curve k	
Headlight height, h_3 (m)	0.6
Upward angle of lit area, α (deg)	1

Table 4: Road design speeds

Culvert Site ID	Station	Road Design Speed (km/hr) (for model development)	Posted Speed Limit (km/hr)
BG01	099+480	40	30
BG04	094+000	65	55
BG29	084+710	40	30
BG32	078+130	65	55
CV001	094+350	50	40
CV046 A&B	065+740	50	40
CV059	059+220	65	55
CV099	037+340	65	55
CV106	032+680	50	40
CV112	030+800	50	40
CV186	102+580	50	40
CV187	102+860	50	40
CV216	080+580	50	40
CV224	097+570	50	40

FIGURES



LEGEND

- A100+000 —	TOTE ROAD STATIONING AT CENTRELINE
BG01	PRIORITY CULVERT SITE
CV040	INSPECTION CULVERT SITE

NOTES

1. COORDINATE SYSTEM IS UTM (NAD 83) ZONE 17N.
2. CULVERT SITE LOCATIONS, AND AS-BUILT ROAD ALIGNMENT AND STATIONING FROM FILE "ACAD-330 - 359_r1 - 2015-02-20.dwg" PROVIDED BY CLIENT.
3. CULVERT SITE LOCATIONS FOR BG10, CV031, AND CV032 WERE NOT PROVIDED AND THEREFORE ARE NOT SHOWN ON THIS FIGURE.

CLIENT
Baffinland

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-04-03
DESIGNED	CK
PREPARED	SEC
REVIEWED	MJT
APPROVED	MJT

PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS EXECUTION PLAN

TITLE
GENERAL ARRANGEMENT PLAN & CULVERT SITES

PROJECT NO.	PHASE	REV.	FIGURE
1667708	2000	0	1

Path: \\golder.gds\gal\mississauga\skm\Client\Baffinland_Iron_Mines_Corp\Baffin_Island\99_PROJ\1667708_Tote_Road_Earthworks\40_PROD\0016_Tote_Road_Culvert_Sites\ | File Name: 1667708-0016-CM-0001.dwg
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APPENDIX A

Prioritization of Sites

A1.0 EARTHWORKS PRIORITIZATION

The objectives of the Tote Road earthworks execution plan were to develop a prioritized list of culvert sites to be remediated in the upcoming construction season(s) and to produce detailed designs for these sites. The process used to rank the sites in order of priority is presented in this Appendix. It should be noted that the list of sites determined from this ranking process is not definitive but an objective means to rate sites based on their relative need of remediation; the rating and subsequent ranking was used as a starting point for prioritization of remediation earthworks in discussion with Baffinland.

The selection of factors chosen to develop the ratings was driven by the availability of recent data, and if the individual factor would be unbiased considering overall project impacts, project history, and/or the interdependency of site works. The process used to determine the “priority sites” is illustrated in Figure A1.

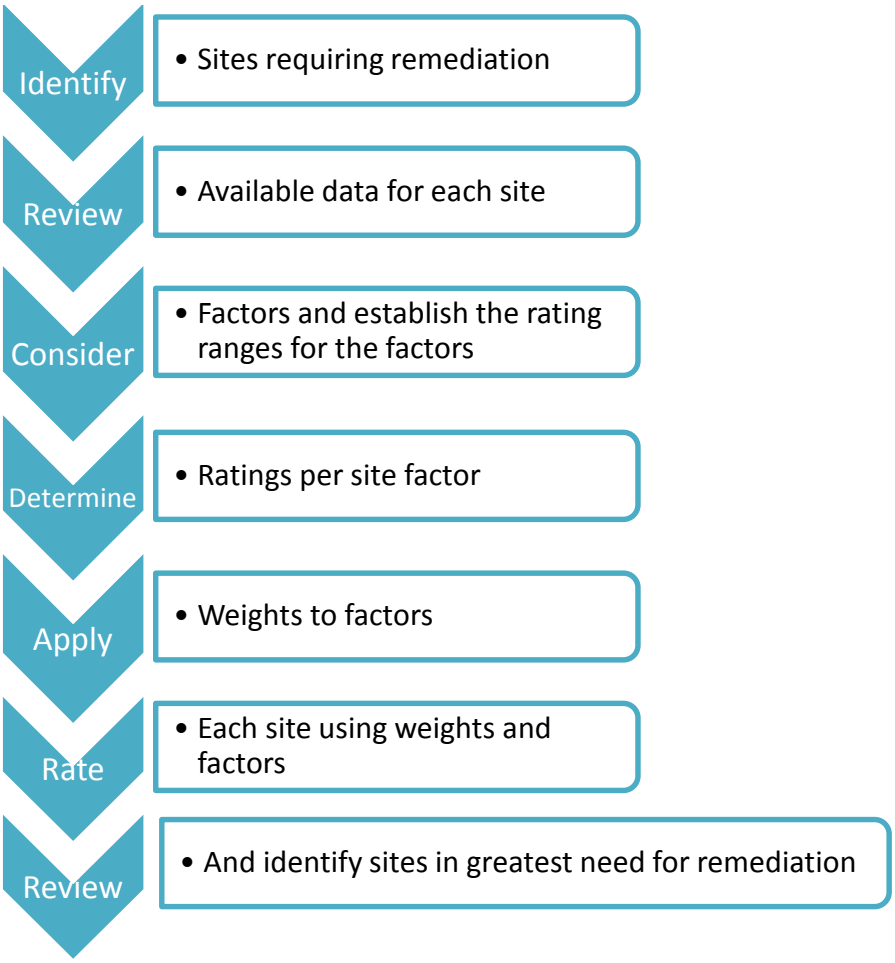


Figure A1: Overview of prioritization process.

A1.1 Identify the Sites

The potential sites that require remediation were identified previously during the development of the sedimentation mitigation action plan (Golder 2016) as well as through input from Baffinland’s routine inspections. As part of the sedimentation mitigation action plan (Golder 2016) a Golder engineer carried out a site visit and drove the Tote

Road with Baffinland staff, collaboratively identifying a preliminary list of sites needing remediation. This list provided the starting point for the prioritization process.

Baffinland later added sites with potential fish passage issues, resulting in 55 sites identified as potential sites for remediation. This complete list of culvert sites is provided in Table 1 of the report.

A1.2 Consider Factors and Rating Ranges

The factors used to rate the sites and the associated ratings are listed in Table A1. The factors and ratings were agreed upon with Baffinland during the prioritization process.

Table A1: Factors and Ratings

Factor	Importance of Factor in Decision Matrix	Rating	Definition
Fish passage status	Location that impacts a fish-bearing stream – the likelihood of fish not being able to pass through is a high priority.	3	Yes
		1	Potential
		0	Not applicable
Fish bearing status	Location that impacts a fish-bearing stream – a high priority for environmental reasons.	3	Yes
		1	Potential/ Marginal
		0	No
Observed Sedimentation	Area where sedimentation problems have been observed – the severity of the sedimentation problems has a high priority.	3	High
		1	Low
		0	None
Culvert Integrity	Area where drainage is blocked – a high priority for sedimentation reasons.	3	Full blockage
		1	Minor blockage
		0	None
Top Width of Road	Area where the road width is narrow – a high priority for safety reasons.	3	≤ 5 m
		2	5< x ≤ 7 m
		1	7< x ≤ 9 m
		0	>9 m (9.2 Hatch design, our values rounded to nearest whole number)

Factor	Importance of Factor in Decision Matrix	Rating	Definition
Embankment Height	Area where the embankment height is low – a priority for culvert structural integrity and thermal cover reasons.	3	x < 2 m for low coverage
		2	2 ≤ x <3 m
		1	3 ≤ x < 4
		0	≥ 4 m
Drainage Basin	Area with a large drainage basin – a priority due to the potential for sedimentation.	3	x ≥ 125 km^2
		2	25 ≤ x < 125 km^2
		1	2 ≤ x < 25 km^2
		0	0 ≤ x < 2 km^2
Embankment Slopes	Area with steep side slopes – a priority due to embankment instability & is a possible source of sedimentation.	3	>45° (1H:1V)
		2	34 < x ≤ 45°
		0	≤ 34° (Hatch Design 1.5H:1V)
Back Slope	Area with steep back slopes – could be problematic due to slope instability, contributing to sedimentation	1	2H:1V Slope, x ≥ 20 °
		0	x < 20 °

A1.3 Determine the Ratings per Site Factor

The site rating factors were chosen through a data review at each site by means of a desktop study. No field work was conducted to support this scope. Based on the information reviewed a rating was applied to each factor, per site, using the factors and ratings in Table A1. Then a weight was applied to each factor to determine the relative importance of each factor. The weighted factors were summed to result in a composite site rating. This is described further in Section A1.5.

Baffinland and Golder staffs collaborated in the review of the individual ratings of each site. During the process, Baffinland staff provided additional information on several sites where background information was insufficient for the rating. Data from several sources (Table A2) was reviewed to determine the individual site ratings. A description of the various sources and their use in the factor and rating development, is provided in the following subsections.

Table A2: Sources of Data

Factor	Type of Data Source
Fish Passage Status	Photographs
Fish Bearing Status	Typical Culvert Details (Hatch 2013a)
Observed Sedimentation	Photographs, DEM, and satellite imagery
Culvert Integrity	Photographs
Top Width of Road	DEM and satellite imagery
Embankment Height	DEM

Factor	Type of Data Source
Drainage Basin Area	DFO Culvert Package (Baffinland 2013)
Embankment Slopes (angle)	DEM
Back Slope (angle of back slope adjacent to site)	DEM

A1.3.1 Digital Elevation Model (DEM)

A digital elevation model (DEM) was generated using point cloud information provided by PhotoSat (2016). The DEM was a triangular irregular network (TIN) created by connecting proximal points in the point cloud to create a three-dimensional (3D) surface. The 3D surface was used for geometrical measurements at the culvert crossing such as embankment height, top width of road, embankment slope, back slope, and culvert cover.

A1.3.2 Satellite Imagery

Satellite imagery (Worldview 2015 & 2016) was used to identify crossings, adjacent culverts, and changes in roadway alignments (over time). In some instances the satellite imagery was used to identify sedimentation and/or ponding at crossings.

A1.3.3 Photographs

Geotagged photographs obtained by Golder (taken during the 2016 site visit) provided information on the existing structural condition of culverts and qualitative information on the cover over the culverts, and sedimentation at the drainage outlet. These images were spatially placed in the 3D model, and were used during the rating of individual sites where available.

A1.3.4 Reports

The drainage basin area and the fish bearing status of the culverts was obtained from Baffinland (2013) and Hatch (2013a), respectively. No hydrology or environmental studies were carried out as part of this work.

A1.3.5 Limitations

Where the information was insufficient for a site rating factor, an average rating was applied.

A1.4 Apply Weight to factors

A weight of 1 or 3 was applied to each factor, for low and high contribution to the potential for sedimentation, respectively.

The weights for each factor are provided in Table A3.

Table A3: Weight of Factors

Factor	Weight
Fish Passage Status	3
Fish Bearing Status	3
Observed Sedimentation	3

Factor	Weight
Culvert Integrity	3
Top Width of Road	3
Embankment Height	1
Drainage Basin Area	3
Embankment Slopes (angle)	1
Back Slope (angle of back slope adjacent to site)	1

A1.5 Rating the Individual Sites

The sites were rated based on the factors and weights, Equation A1:

$$Site\ Rating = \frac{\sum_{i=1}^{9} R_i w_i}{\sum_{i=1}^{9} w_i} \qquad \text{Eq A1}$$

where:

R = rating from 0 to 3 for the factor

w = weight of 1 or 3 for the factor

i = counter for the factor (there are 9 factors)

The site rating was then converted to a percent, Equation A2:

$$Rating\ Percent = \frac{Site\ Rating}{Maximum\ Rating} * 100 \qquad \text{Eq A2}$$

where:

Maximum Rating = 3.

Using the site rating, the sites were ranked in decreasing order where the highest rated sites had the highest ranking, indicating the highest potential for negative impact and the highest need for rehabilitation.

The objective of the prioritization process was to objectively rate the sites to obtain a ranked list of potential sites to be remediated in the upcoming construction season(s). Upon completion of the ranking, the sites were reviewed and sites that would be remediated in the upcoming construction season(s) were carried forward into detailed design.

A1.6 Review Sites and Identify those for Remediation

Once the ranked site list was established, Baffinland reviewed and revised the order of the priority sites based on their detailed knowledge of existing site conditions. Although the number of sites to be remediated in the 2017 construction season is unknown, Baffinland selected 19 sites as priority sites and requested a detailed design for each. Golder individually reviewed the 19 sites, and found only 14 of the 19 sites had sufficient information for detailed design.

The remaining sites will be inspected in 2017 to develop future plans for remediation. Table A4 lists the sites considered in the earthworks execution plan.

Table A4: Tote Road Earthwork Sites

Priority Sites	Remaining Sites	Remaining Sites (cont.)
Sites based on ranking	*Sites removed from Priority Sites list due to insufficient information for detailed design*	BG25 (A&B)
BG01	BG17	BG27
BG04	CV040	BG28
BG32	CV165	BG33
CV001	CV223 (A-C)	CV030
CV059	CV223 (D&E)	CV031
CV106	*Sites removed from priority list based on Baffinland's detailed knowledge of the site.*	CV032
CV112	BG11	CV033
CV216	BG31	CV033-A
CV224	CV001 D	CV58
Unranked sites added to list based on Baffinland's knowledge of the site	CV049	CV60
BG29	CV094	CV091 and CV092
CV046 A&B	CV217	CV104
CV099	*Lower ranked sites not considered for this phase*	CV114
CV186	BG03	CV115
CV187	BG11 (B&C)	CV129
	BG14-B	CV212 (C&D)
	BG14-C	CV213CV214 (A)
	BG19	CV214 (B)
	BG19-B	CV215
	BG19-C	CV222 (previously CV001-D)
		CV225

APPENDIX B

Construction Drawings

Reduced Size
NOT TO SCALE

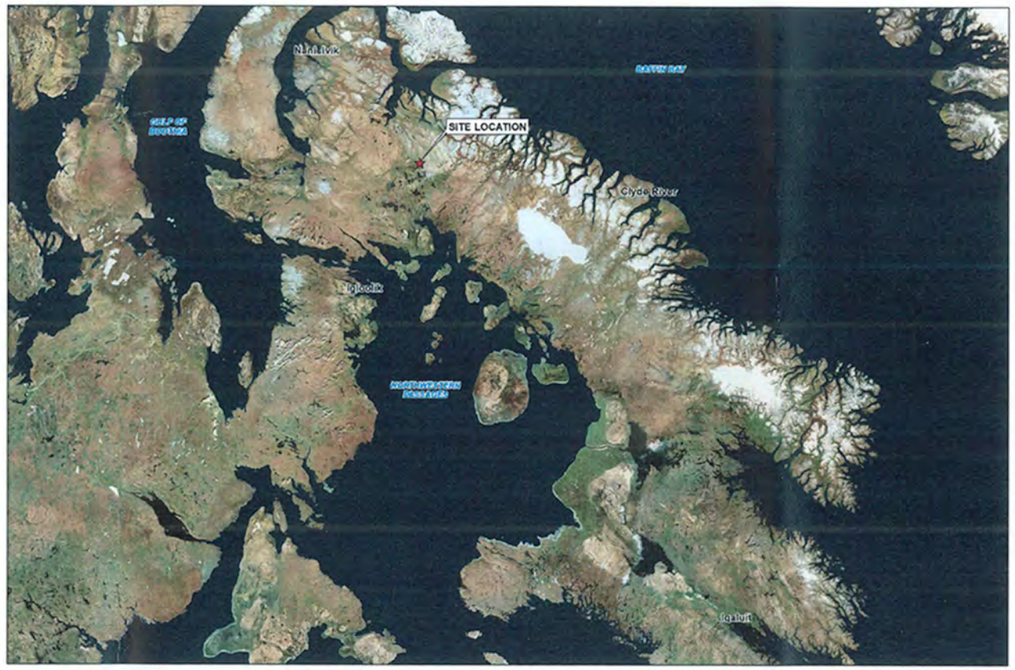
BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT
TOTE ROAD EARTHWORKS
BG01

INDEX OF DRAWINGS		
DRAWING NO.	DRAWING SHEET TITLE	REVISION NO.
001	TITLE SHEET - BG01	2
002	PIPE CROSSING TYPICAL DETAILS & GENERAL NOTES - BG01	2
003	CULVERT INSTALLATION DESIGN RECOMMENDATIONS & DESIGN TABLES - BG01	2
004	ROAD PLAN, PROFILE AND SECTIONS - BG01	2

SPECIFICATIONS		
SPECIFICATION NO.	SPECIFICATION TITLE	REVISION NO.
1667708-S	TOTE ROAD EARTHWORKS	1

DESIGN REPORT		
REPORT NO.	REPORT TITLE	REVISION NO.
1667708	TOTE ROAD EARTHWORKS	0



KEY PLAN
NOT TO SCALE

REV	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2017-04-03	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 1 / REPORT REV. 0	CK/RAD	JJL	MJT	RAD
1	2017-03-24	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 0	CK/RAD	JJL	MJT	RAD
0	2017-03-09	ISSUED FOR CONSTRUCTION	CK/RAD	JJL	MJT	RAD
A	2017-03-02	ISSUED FOR CLIENT REVIEW	CK/RAD	JJL	MJT	RAD

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GOLDER ASSOCIATES LTD.
Signature
Date 17-04-03
PERMIT NUMBER: P 049
NT/NU Association of Professional Engineers and Geoscientists

REGISTERED PROFESSIONAL ENGINEER
R.A.
LICENCE
2017-04-03
NORTHWEST TERRITORIES AND NUNAVUT

Baffinland
CONSULTANT

Golder Associates

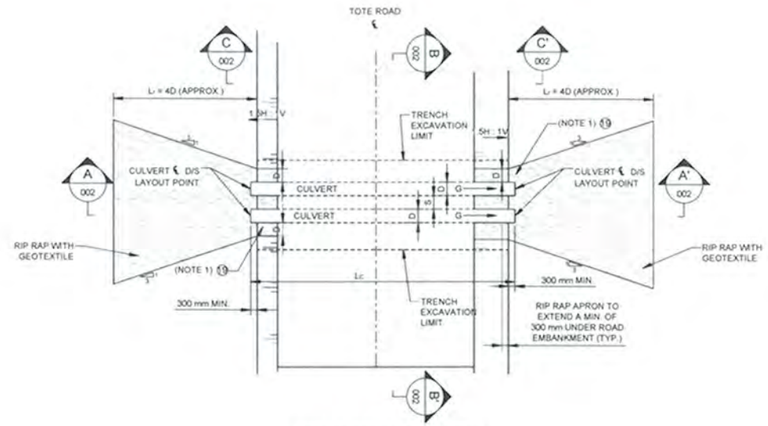
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6925 CENTURY AVENUE, SUITE 100
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CANADA
905-567-4444
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PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

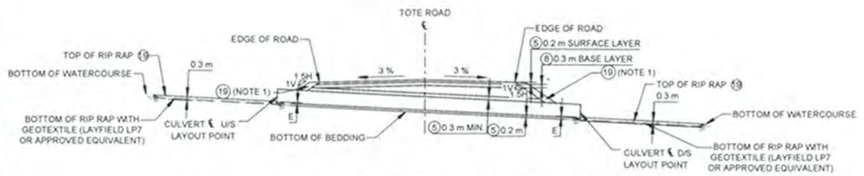
TITLE
TITLE SHEET - BG01

PROJECT NO.	PHASE	REV	1 of 4	DRAWING
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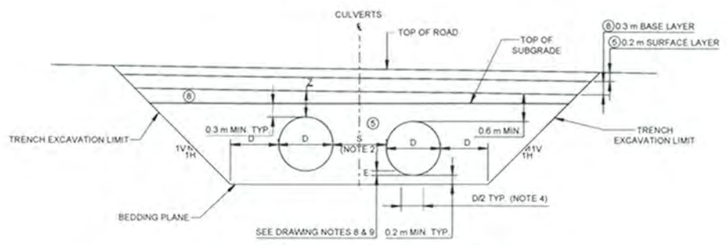
Reduced Size
NOT TO SCALE



PIPE CROSSING PLAN VIEW
SCALE 1:200 m



SCALE 1:200 m (A / 002) PIPE CROSSING TYPICAL PROFILE



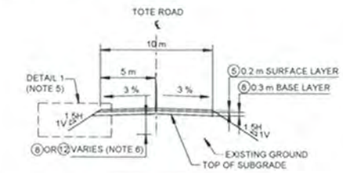
SCALE 1:50 m (B / 002) PIPE CROSSING TYPICAL SECTION

LEGEND

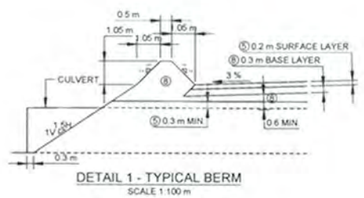
(5)	SCREENED MATERIAL	(12)	RUN OF QUARRY (ROQ)
(8)	JAW RUN	(19)	EROSION PROTECTION

DRAWING NOTES

1. EROSION PROTECTION SHALL BE PLACED AROUND THE CULVERT INLET AND OUTLET AS PER THE DIRECTION OF THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
2. THE MINIMUM SPACING (S) BETWEEN CULVERTS SHALL BE D, WHERE D IS THE CULVERT DIAMETER, OR 1.5 m, WHICHEVER IS GREATER.
3. THE MINIMUM COVER DEFINED AS THE DISTANCE BETWEEN THE TOP OF CULVERT TO THE TOP OF SUBGRADE SHALL BE 0.6 m OR D/4, WHERE D IS THE CULVERT DIAMETER, WHICHEVER IS GREATER.
4. THE BEDDING TO BE SHAPED TO RECEIVE PIPE.
5. SAFETY BERMS ARE REQUIRED FOR EMBANKMENTS GREATER THAN 3 m IN HEIGHT.
6. FOR EMBANKMENT FILL DEPTHS LESS THAN 0.6 m, TYPE 8 MATERIAL SHALL BE USED; FOR FILL DEPTHS GREATER THAN 0.6 m, AND DEPENDING ON THE FILL EXTENTS, TYPE 12 MATERIAL MAY BE USED.
7. DEFINITIONS AND VALUES OF D,Lc,Lr, AND G CAN BE FOUND IN DESIGN TABLES ON DRAWING 003.
8. FOR FISH BEARING CULVERT WITH MULTIPLE PIPES, ONLY ONE SHALL BE EMBEDDED BY "E" AND ALL OTHER PIPES SHALL BE PLACED ON GROUND / BOTTOM OF WATER COURSE.
9. AS PER CULVERT DETAILS (DWG 003)FOR FISH BEARING CULVERT, E = 0.1 D. FOR NON-FISH BEARING CULVERT E=0.



SCALE 1:200 m (C / 002) EMBANKMENT SECTION



DETAIL 1 - TYPICAL BERM
SCALE 1:100 m

GENERAL CONSTRUCTION NOTES

1. IT IS THE RESPONSIBILITY OF THE USER OF THIS DRAWING TO ENSURE THE USE OF ITS MOST RECENT REVISION.
2. THE INFORMATION PROVIDED ON THE DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE MOST RECENT REVISION OF THE SPECIFICATIONS AND REPORT LISTED ON DWG. 001.
3. IN THE EVENT OF DISCREPANCY BETWEEN THE DRAWINGS AND THE SPECIFICATIONS CLARIFICATION AND/OR DIRECTION SHALL BE PROVIDED AS OUTLINED IN THE SPECIFICATIONS.
4. PRIOR TO COMMENCING CONSTRUCTION ACTIVITIES, THE CONTRACTOR SHALL BE FAMILIAR WITH THE SCOPE OF WORK.
5. THE INFORMATION PRESENTED ON THESE DRAWINGS IS INTENDED TO CONVEY THE PIPE CROSSING CONSTRUCTION DETAILS AND ROAD EMBANKMENT DETAILS.
6. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED.
7. COORDINATE SYSTEM IS UTM (NAD 83) ZONE 17N.
8. CONTOUR INTERVAL IS 1 M WITH EXISTING TOPOGRAPHY.
9. THE DESIGN OF EACH INSTALLATION ARE BASED ON A DESK STUDY USING A DIGITAL ELEVATION MODEL AND SATELLITE IMAGERY PROVIDED BY BAFFINLAND, AND ARE NOT SUPPORTED BY FIELD STUDY.
10. THE GROUND SURFACE ELEVATIONS ARE CONSIDERED TO BE APPROXIMATE.
11. A DECISION ON WHETHER TO EXTEND OR REPLACE EACH CULVERT WILL BE MADE BY THE OWNER'S REPRESENTATIVE.
12. FIELD FITTING OF CULVERTS (INCLUDING LOCATIONS, LENGTHS, INVERT DEPTHS, GRADIENTS, AND SKEWS) TO ACTUAL CONDITIONS AT EACH SITE SHALL BE AS DIRECTED BY THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
13. FILL MATERIALS SHALL BE HANDLED, SORTED, PLACED AND COMPACTED AS SHOWN ON THE DRAWINGS, DESCRIBED IN THE SPECIFICATIONS AND TO THE SATISFACTION OF THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
14. NO GEOTECHNICAL OR STRUCTURAL ANALYSIS OF THE CULVERT INSTALLATIONS HAS **BEEN CARRIED OUT. A MINIMUM CULVERT COVER OF 0.6 m OR D/4 (WHERE D IS THE** DIAMETER OF THE CIRCULAR CULVERT PIPE) HAS BEEN ASSUMED TO BE APPROPRIATE FOR 10 TONNE AXLE LOADS; USE OF HEAVIER TRUCKS WILL REQUIRE STRUCTURAL ANALYSIS OF THE CULVERT INSTALLATION.
15. FISH BEARING STATUS IN CULVERT DETAILS TABLE ON DWG. 003 TAKEN FROM HATCH TOTE ROAD CULVERT DATA SHEETS H349000-3000-10-088-0030 THROUGH H349000-3000-10-088-0034.
16. NO HYDROLOGIC OR HYDRAULIC ANALYSIS WAS CARRIED OUT. NUMBER OF CULVERTS, CULVERT DIAMETER(S), CULVERT LENGTH(S), EMBEDMENT DEPTH (E), AND REQUIREMENTS FOR RIP RAP FROM HATCH TOTE ROAD CULVERT DATA SHEETS H349000-3000-10-088-0030 THROUGH H349000-3000-10-088-0034.
17. IN SECTIONS, SKEWED CULVERTS ARE PROJECTED ONTO PLANE OF CROSS-SECTIONS.
18. AT LIMITS OF CONSTRUCTION NEW PAVEMENT THICKNESS NEEDS TO BE TAPERED TO MATCH EXISTING PAVEMENT SURFACE.
19. THE OWNER'S REPRESENTATIVE WILL CONFIRM THE REQUIREMENT FOR SAFETY BERMS ALONG THE ROAD EDGES BASED ON ENCOUNTERED FIELD CONDITIONS. TYPICAL BERM DETAILS ARE SHOWN ON DWG.002.
20. SITE SPECIFIC NOTES ON DWG. 003 MUST BE READ IN CONJUNCTION WITH THESE GENERAL NOTES, AND THE SPECIFICATIONS AND DRAWINGS LISTED ON DWG.001.
21. BAFFINLAND IS RESPONSIBLE FOR PERMITTING OF THE PROPOSED WORKS (IF REQUIRED).
22. PRIOR TO CONSTRUCTION, BAFFINLAND'S ENVIRONMENTAL REPRESENTATIVE WILL BE CONSULTED TO APPROVE THE REQUIRED EROSION CONTROL AND MITIGATION MEASURES ADJACENT TO WATER BODIES.

0 2 4
1:50 METRES

0 5 10
1:100 METRES

0 10 20
1:200 METRES

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PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

TITLE
TYPICAL DETAILS AND GENERAL NOTES - BG01

PROJECT NO	PHASE	REV	2 of 4	DRAWING
1667708	3000	2		002

Reduced Size
NOT TO SCALE

CULVERT DETAILS1

STATION (m)	FISH BEARING STATUS (REFER TO NOTE 15 ON DWG. 002)	EXISTING CULVERT DIAMETER (D) (mm) (REFER TO NOTE 16 ON DWG. 002)	EXISTING CULVERT LENGTH (m) (REFER TO NOTE 16 ON DWG. 002)	EXISTING CULVERT GRADIENT (G) (%) (REFER TO NOTE 16 ON DWG. 002)	EMBEDMENT DEPTH (E) (mm) (REFER TO NOTE 16 ON DWG. 002)	PROPOSED CULVERT LENGTH (m)	DEPTH FROM SUBGRADE TO TOP OF CULVERT AT CENTRELINE OF ROAD (Z) (m)	EASTING OF CENTRELINE OF PIPE AT CENTRELINE OF ROAD (m)	NORTHING OF CENTRELINE OF PIPE AT CENTRELINE OF ROAD (m)	INLET INVERT ELEVATION (m)	OUTLET INVERT ELEVATION (m)	CULVERT GRADIENT (G) (%)	CULVERT SKEW (deg)	INLET RIP RAP REQUIRED?	OUTLET RIP RAP REQUIRED?	RIP RAP APRON LENGTH (Lr) (m)
0+159.0	YES	1200	18		120	48	5.4	558004.8	7914938.4	160.3	159.3	2	95	N	Y	4.8
0+172.7	YES	1200	18	3.73	120	48	5.5	558015.4	7914929.8	160.3	159.3	2	113	N	Y	4.8
0+175.4	YES	1200	18		120	48	5.7	558017.4	7914928.1	160.2	159.2	2	113	N	Y	4.8

*CULVERT LOCATION DETAILS ARE BASED ON A DESK STUDY USING A DIGITAL ELEVATION MODEL AND SATELLITE IMAGERY PROVIDED BY BAFFINLAND, AND ARE NOT SUPPORTED BY FIELD STUDY (REFER TO GENERAL CONSTRUCTION NOTE 11 ON DWG. 002)

SITE SPECIFIC NOTES FOR CULVERT BG01

AS INDICATED IN THE GENERAL CONSTRUCTION NOTES ON DWG. 002, THE SITE SPECIFIC NOTES ARE BASED ONLY ON A DESKTOP STUDY OF THE SITE; NO FIELD WORK WAS CARRIED OUT TO SUPPORT THIS WORK. AN INSPECTION OF THE SITE SHALL BE CARRIED OUT BY THE OWNER'S REPRESENTATIVE AND/OR GEOTECHNICAL ENGINEER PRIOR TO CONSTRUCTION. THE SITE SPECIFIC NOTES ARE INTENDED TO BE COMPREHENSIVE BUT NOT ALL-INCLUSIVE.

1. **RAISE ROAD EMBANKMENT TO REDUCE ROAD APPROACH GRADIENTS, MAINTAINING THE ROAD EMBANKMENT SIDE SLOPES NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL) AND THE ROAD RUNNING SURFACE WIDTH A MINIMUM OF 10 m.**
2. CONSTRUCT A NEW ROAD EMBANKMENT TO THE LEFT SIDE OF THE EXISTING EMBANKMENT TO FACILITATE THE MAINTENANCE OF TRAFFIC DURING CONSTRUCTION OF THE NEW EMBANKMENT.
3. CAP THE ROAD SURFACE WITH SUITABLE RUNNING SURFACE MATERIAL (SEE TYPICAL SECTION ON DWG. 002).
4. PROVIDE SAFETY BERMS WHERE EMBANKMENT FILL IS GREATER THAN 3 m ABOVE EXISTING GROUND SURFACE.
5. PROVIDE RIP RAP PROTECTION AT THE CULVERT INLET AND OUTLET.
6. THE EXISTING CULVERT MAY BE PERCHED. REINSTALL CULVERTS TO DESIGN. THE CULVERT END(S) MAY BE DAMAGED. REPLACE CULVERTS IF REQUIRED.
7. MARK THE CULVERT ENDS WITH DELINEATORS OF SUFFICIENT SIZE AND HEIGHT TO REDUCE THE RISK OF DAMAGE TO THE CULVERT PIPE ENDS BY SNOW PLOWING, SIDE SLOPING, OR OTHER MAINTENANCE OPERATIONS.

ROAD LAYOUT DETAILS

STATION (m)	TOP OF SUBGRADE			CENTRELINE CUT DEPTH* (TOP OF SUBGRADE TO EXISTING ROAD SURFACE) (m)	TOE OF EMBANKMENT SLOPE		
	CENTRELINE EASTING (m)	CENTRELINE NORTHING (m)	CENTRELINE ELEVATION (m)		OFFSET TO LEFT TOE** (m)	OFFSET TO RIGHT TOE** (m)	GRADIENT TO NEXT POINT (%)
0+000.0	557877.3	7915029.5	171.7	-0.2	5.1	5.2	-3.5
0+020.0	557889.3	7915013.5	171	-0.3	6.3	16.5	-3.5
0+024.4	557892	7915010	170.8	-0.4	6.4	14.3	-3.5
0+040.0	557902.2	7914998.3	170.3	-0.5	6.6	15.0	-3.5
0+060.0	557917.9	7914985.8	169.6	-0.6	7.9	7.2	-3.5
0+066.5	557923.5	7914982.5	169.3	-0.6	7.0	7.2	-3.5
0+080.0	557935.3	7914975.9	168.9	-0.8	6.8	7.6	
0+100.0	557952.7	7914966.2	168	-1.2	6.6	8.7	-4.1
0+120.0	557970.5	7914957	167.2	-2.5	6.3	14.1	-4.1
0+127.1	557976.7	7914953.7	166.9	-2.6	7.0	14.2	-3.2
0+140.0	557988.2	7914947.8	166.5	-1.7	10.8	14.1	-1.7
0+148.0	557995.3	7914944.2	166.4	-2.9	13.1	13.9	-0.4
0+159.0	558004.8	7914938.5	166.3	-6.2	17.8	9.9	0.5
0+160.0	558005.6	7914937.9	166.3	-6.2	18.9	9.9	1.2
0+168.8	558012.5	7914932.4	166.4	-6.2	19.4	9.9	2.1
0+172.7	558015.4	7914929.9	166.5	-5.9	19.7	9.8	2.6
0+175.4	558017.4	7914928.1	166.6	-5.4	20.0	9.6	3.1
0+180.0	558020.9	7914925	166.7	-5.3	20.1	9.5	4.9
0+200.0	558035.9	7914911.8	167.7	-3.7	21.5	8.3	7.7
0+220.0	558050.9	7914898.6	169.3	-1.2	24.3	7.3	9.6
0+226.2	558055.6	7914894.5	169.9	-1	25.3	7.0	10.0
0+229.4	558057.9	7914892.4	170.2	-1	25.6	7.0	8.7
0+240.0	558065.9	7914885.4	171.1	-0.3	18.9	6.4	6.9
0+244.0	558069	7914882.7	171.4	-0.3	15.1	6.4	4.4
0+260.0	558081.5	7914872.8	172.1	-0.3	5.8	6.3	1.3
0+268.3	558088.4	7914868.3	172.2	-0.2	5.8	6.3	0.3
0+280.0	558098.5	7914862.4	172.2	-0.2	6.0	6.2	0.3
0+287.2	558105	7914859.2	172.2	-0.2	6.1	6.3	0.3
0+300.0	558116.6	7914853.9	172.3	-0.3	6.3	6.1	0.3
0+320.0	558134.7	7914845.4	172.3	-0.3	5.5	5.3	0.3
0+325.2	558139.4	7914843.3	172.4	-0.4	5.6	5.2	

* NEGATIVE CUT DEPTH DENOTES FILL
** MEASURED ON GROUND SURFACE

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PERMIT TO PRACTICE
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Date 17-04-25
PERMIT NUMBER: P 049
NT/NU Association of Professional Engineers and Geoscientists

REGISTERED PROFESSIONAL ENGINEER
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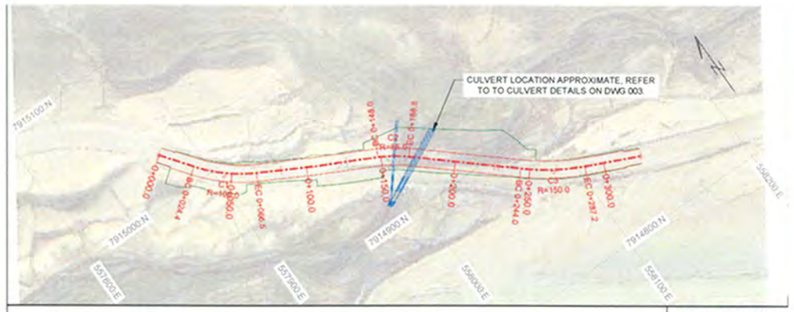
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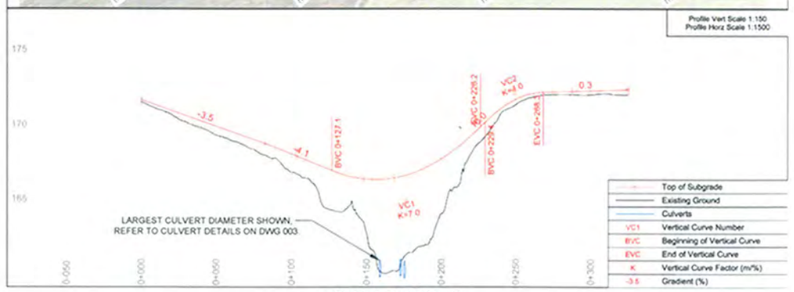
PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

TITLE
CULVERT INSTALLATION DESIGN RECOMMENDATIONS & DESIGN TABLES - BG01

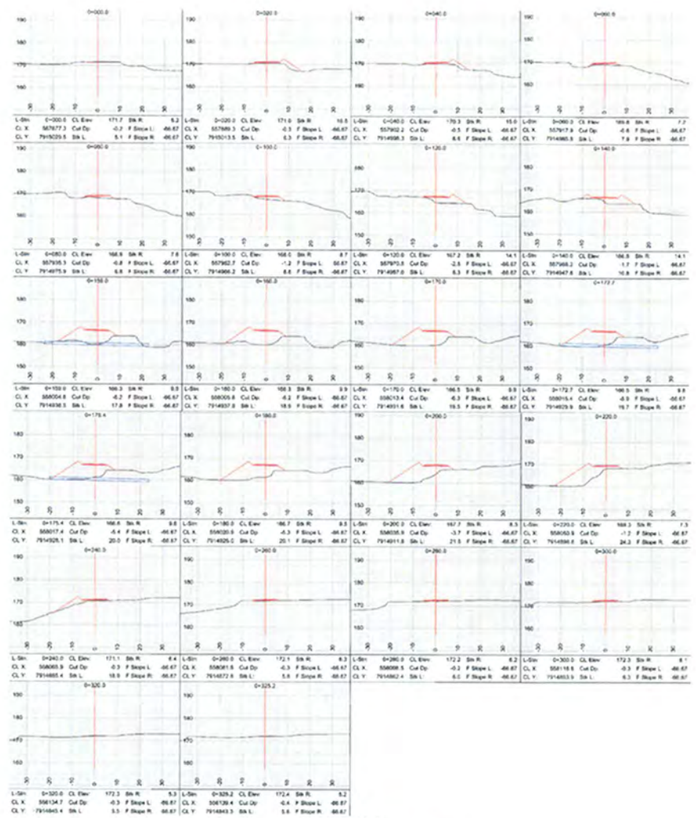
PROJECT NO.	PHASE	REV		DRAWING
1667708	3000	2	3 of 4	003

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PLAN AND PROFILE



SECTIONS
(REFER TO GENERAL CONSTRUCTION NOTE 17)

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0	2017-03-09	ISSUED FOR CONSTRUCTION	CK/RAD	JJL	MJT	RAD
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Date 11-04-03
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REGISTERED PROFESSIONAL ENGINEER
R.A. DOUGLAS
LICENSEE
2017-04-03
NWT/NU

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TITLE
ROAD PLAN, PROFILE AND SECTIONS - BG01

PROJECT NO	PHASE	REV		DRAWING
1667708	3000	2	4 of 4	004

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BG04

INDEX OF DRAWINGS		
DRAWING NO.	DRAWING SHEET TITLE	REVISION NO.
001	TITLE SHEET - BG04	2
002	PIPE CROSSING TYPICAL DETAILS & GENERAL NOTES - BG04	2
003	CULVERT INSTALLATION DESIGN RECOMMENDATIONS & DESIGN TABLES - BG04	2
004	ROAD PLAN, PROFILE AND SECTIONS - BG04	2

SPECIFICATIONS		
SPECIFICATION NO.	SPECIFICATION TITLE	REVISION NO.
1667708-S	TOTE ROAD EARTHWORKS	1

DESIGN REPORT		
REPORT NO.	REPORT TITLE	REVISION NO.
1667708	TOTE ROAD EARTHWORKS	0



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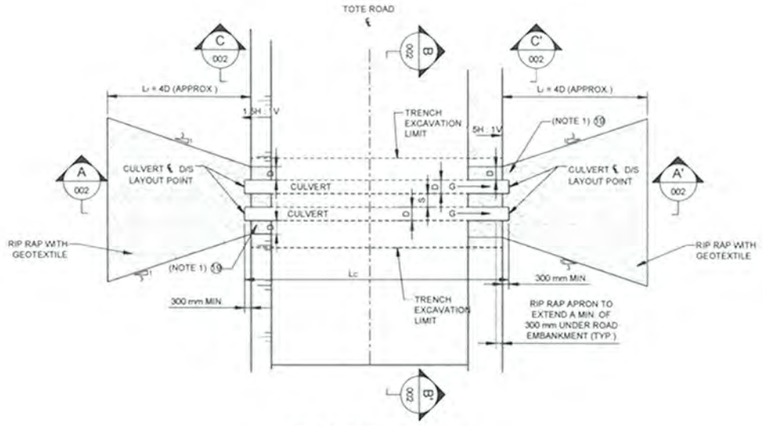
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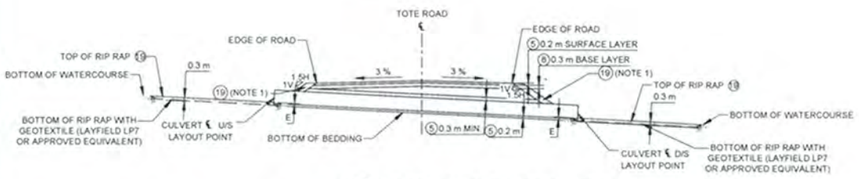
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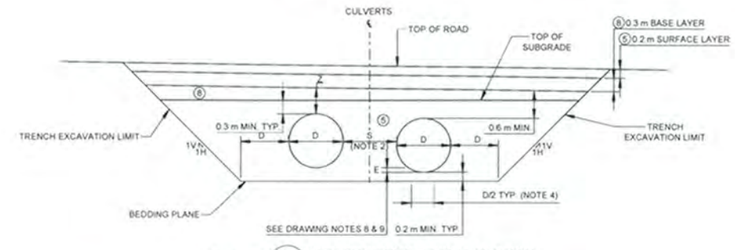
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PIPE CROSSING PLAN VIEW
SCALE 1:200 m



SCALE 1:200 m (A, 002) PIPE CROSSING TYPICAL PROFILE



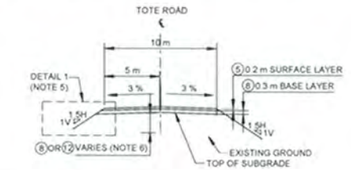
SCALE 1:50 m (B, 002) PIPE CROSSING TYPICAL SECTION

LEGEND

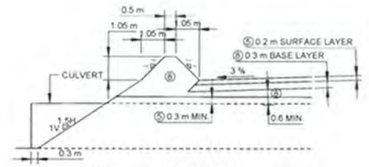
(5)	SCREENED MATERIAL	(12)	RUN OF QUARRY (ROQ)
(8)	JAW RUN	(19)	EROSION PROTECTION

DRAWING NOTES

1. EROSION PROTECTION SHALL BE PLACED AROUND THE CULVERT INLET AND OUTLET AS PER THE DIRECTION OF THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
2. THE MINIMUM SPACING (S) BETWEEN CULVERTS SHALL BE D, WHERE D IS THE CULVERT DIAMETER, OR 1.5 m, WHICHEVER IS GREATER.
3. THE MINIMUM COVER DEFINED AS THE DISTANCE BETWEEN THE TOP OF CULVERT TO THE TOP OF SUBGRADE SHALL BE 0.6 m OR D/4, WHERE D IS THE CULVERT DIAMETER, WHICHEVER IS GREATER.
4. THE BEDDING TO BE SHAPED TO RECEIVE PIPE.
5. SAFETY BERMS ARE REQUIRED FOR EMBANKMENTS GREATER THAN 3 m IN HEIGHT.
6. FOR EMBANKMENT FILL DEPTHS LESS THAN 0.6 m, TYPE 8 MATERIAL SHALL BE USED; FOR FILL DEPTHS GREATER THAN 0.6 m, AND DEPENDING ON THE FILL EXTENTS, TYPE 12 MATERIAL MAY BE USED.
7. DEFINITIONS AND VALUES OF D,Lc,Lr, AND G CAN BE FOUND IN DESIGN TABLES ON DRAWING 003.
8. FOR FISH BEARING CULVERT WITH MULTIPLE PIPES, ONLY ONE SHALL BE EMBEDDED BY "E" AND ALL OTHER PIPES SHALL BE PLACED ON GROUND / BOTTOM OF WATER COURSE.
9. AS PER CULVERT DETAILS (DWG 003)FOR FISH BEARING CULVERT, E = 0.1 D. FOR NON-FISH BEARING CULVERT E=0.



SCALE 1:200 m (C, 002) EMBANKMENT SECTION



DETAIL 1 - TYPICAL BERM
SCALE 1:100 m

GENERAL CONSTRUCTION NOTES

1. IT IS THE RESPONSIBILITY OF THE USER OF THIS DRAWING TO ENSURE THE USE OF ITS MOST RECENT REVISION.
2. THE INFORMATION PROVIDED ON THE DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE MOST RECENT REVISION OF THE SPECIFICATIONS AND REPORT LISTED ON DWG. 001.
3. IN THE EVENT OF DISCREPANCY BETWEEN THE DRAWINGS AND THE SPECIFICATIONS, CLARIFICATION AND/OR DIRECTION SHALL BE PROVIDED AS OUTLINED IN THE SPECIFICATIONS.
4. PRIOR TO COMMENCING CONSTRUCTION ACTIVITIES, THE CONTRACTOR SHALL BE FAMILIAR WITH THE SCOPE OF WORK.
5. THE INFORMATION PRESENTED ON THESE DRAWINGS IS INTENDED TO CONVEY THE PIPE CROSSING CONSTRUCTION DETAILS AND ROAD EMBANKMENT DETAILS.
6. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED.
7. COORDINATE SYSTEM IS UTM (NAD 83) ZONE 17N.
8. CONTOUR INTERVAL IS 1 M WITH EXISTING TOPOGRAPHY.
9. THE DESIGN OF EACH INSTALLATION ARE BASED ON A DESK STUDY USING A DIGITAL ELEVATION MODEL AND SATELLITE IMAGERY PROVIDED BY BAFFINLAND, AND ARE NOT SUPPORTED BY FIELD STUDY.
10. THE GROUND SURFACE ELEVATIONS ARE CONSIDERED TO BE APPROXIMATE.
11. A DECISION ON WHETHER TO EXTEND OR REPLACE EACH CULVERT WILL BE MADE BY THE OWNER'S REPRESENTATIVE.
12. FIELD FITTING OF CULVERTS (INCLUDING LOCATIONS, LENGTHS, INVERT DEPTHS, GRADIENTS, AND SKEWS) TO ACTUAL CONDITIONS AT EACH SITE SHALL BE AS DIRECTED BY THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
13. FILL MATERIALS SHALL BE HANDLED, SORTED, PLACED AND COMPACTED AS SHOWN ON THE DRAWINGS, DESCRIBED IN THE SPECIFICATIONS AND TO THE SATISFACTION OF THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
14. NO GEOTECHNICAL OR STRUCTURAL ANALYSIS OF THE CULVERT INSTALLATIONS HAS **BEEN CARRIED OUT, A MINIMUM CULVERT COVER OF 0.6 m OR D/4 (WHERE D IS THE** DIAMETER OF THE CIRCULAR CULVERT PIPE) HAS BEEN ASSUMED TO BE APPROPRIATE FOR 10 TONNE AXLE LOADS. USE OF HEAVIER TRUCKS WILL REQUIRE STRUCTURAL ANALYSIS OF THE CULVERT INSTALLATION.
15. FISH BEARING STATUS IN CULVERT DETAILS TABLE ON DWG. 003 TAKEN FROM HATCH TOTE ROAD CULVERT DATA SHEETS H349000-3000-10-088-0030 THROUGH H349000-3000-10-088-0034.
16. NO HYDROLOGIC OR HYDRAULIC ANALYSIS WAS CARRIED OUT. NUMBER OF CULVERTS, CULVERT DIAMETER(S), CULVERT LENGTH(S), EMBEDMENT DEPTH (E), AND REQUIREMENTS FOR RIP RAP FROM HATCH TOTE ROAD CULVERT DATA SHEETS H349000-3000-10-088-0030 THROUGH H349000-3000-10-088-0034.
17. IN SECTIONS, SKEWED CULVERTS ARE PROJECTED ONTO PLANE OF CROSS-SECTIONS.
18. AT LIMITS OF CONSTRUCTION NEW PAVEMENT THICKNESS NEEDS TO BE TAPERED TO MATCH EXISTING PAVEMENT SURFACE.
19. THE OWNER'S REPRESENTATIVE WILL CONFIRM THE REQUIREMENT FOR SAFETY BERMS ALONG THE ROAD EDGES BASED ON ENCOUNTERED FIELD CONDITIONS. TYPICAL BERM DETAILS ARE SHOWN ON DWG 002.
20. SITE SPECIFIC NOTES ON DWG. 003 MUST BE READ IN CONJUNCTION WITH THESE GENERAL NOTES, AND THE SPECIFICATIONS AND DRAWINGS LISTED ON DWG.001.
21. BAFFINLAND IS RESPONSIBLE FOR PERMITTING OF THE PROPOSED WORKS (IF REQUIRED).
22. PRIOR TO CONSTRUCTION, BAFFINLAND'S ENVIRONMENTAL REPRESENTATIVE WILL BE CONSULTED TO APPROVE THE REQUIRED EROSION CONTROL AND MITIGATION MEASURES ADJACENT TO WATER BODIES.

0 2 4
1:50 METRES

0 5 10
1:100 METRES

0 10 20
1:200 METRES

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R.A. DOUGLAS
LICENSEE
2017-04-03
NWT/NU

CLIENT: Baffinland

CONSULTANT: Golder Associates

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MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

TITLE
TYPICAL DETAILS AND GENERAL NOTES - BG04

PROJECT NO.	PHASE	REV.	2 of 4	DRAWING
1667708	3000	2		002

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CULVERT DETAILS†																
STATION (m)	FISH BEARING STATUS (REFER TO NOTE 15 ON DWG. 002)	EXISTING CULVERT DIAMETER (D) (mm) (REFER TO NOTE 16 ON DWG. 002)	EXISTING CULVERT LENGTH (m) (REFER TO NOTE 16 ON DWG. 002)	EXISTING CULVERT GRADIENT (%) (REFER TO NOTE 16 ON DWG. 002)	EMBEDMENT DEPTH (E) (mm) (REFER TO NOTE 16 ON DWG. 002)	PROPOSED CULVERT LENGTH (m)	DEPTH FROM SUBGRADE TO TOP OF CULVERT AT CENTRELINE OF ROAD (Z) (m)	EASTING OF CENTRELINE OF PIPE AT CENTRELINE OF ROAD (m)	NORTHING OF CENTRELINE OF PIPE AT CENTRELINE OF ROAD (m)	INLET INVERT ELEVATION (m)	OUTLET INVERT ELEVATION (m)	CULVERT GRADIENT (G) (%)	CULVERT SKEW (deg)	INLET RIP RAP REQUIRED?	OUTLET RIP RAP REQUIRED?	RIP RAP APRON LENGTH (Lr) (m)
0+160.2	YES	1200	15	0.91		30.5	1.9	553254.3	7915076.7	164	163.7	1	76	N	N	
0+164.2	YES	1200	15	0.71	120	30.5	1.8	553256.3	7915076.3	164.1	163.8	1	76	N	N	

†CULVERT LOCATION DETAILS ARE BASED ON A DESK STUDY USING A DIGITAL ELEVATION MODEL AND SATELLITE IMAGERY PROVIDED BY BAFFINLAND, AND ARE NOT SUPPORTED BY FIELD STUDY (REFER TO GENERAL CONSTRUCTION NOTE 12 ON DWG. 002)

SITE SPECIFIC NOTES FOR CULVERT BG04

AS INDICATED IN THE GENERAL NOTES ON DWG. 002, THE SITE SPECIFIC NOTES ARE BASED ONLY ON A DESKTOP STUDY OF THE SITE. NO FIELD WORK WAS CARRIED OUT TO SUPPORT THIS WORK. AN INSPECTION OF THE SITE SHALL BE CARRIED OUT BY THE OWNER'S REPRESENTATIVE AND/OR GEOTECHNICAL ENGINEER PRIOR TO CONSTRUCTION. THE SITE SPECIFIC NOTES ARE INTENDED TO BE COMPREHENSIVE, BUT IS NOT ALL-INCLUSIVE.

1. CONSTRUCT THE ROAD ALONG THE REALIGNMENT (SEE DWG.004).
2. REMOVE THE EXISTING ROAD EMBANKMENT WITHIN THE LIMITS OF STREAMBED TO REINSTATE THE STREAMBED TO THE APPROVAL OF THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
3. CAP THE ROAD SURFACE WITH SUITABLE RUNNING SURFACE MATERIAL (SEE TYPICAL SECTION ON DWG. 002).
4. PROVIDE SAFETY BERMS WHERE EMBANKMENT FILL IS GREATER THAN 3 M ABOVE EXISTING GROUND SURFACE (SEE TYPICAL SECTION ON DWG. 002).
5. PROVIDE RIP RAP PROTECTION AT THE CULVERT INLET AND OUTLET.
6. MARK THE CULVERT ENDS WITH DELINEATORS OF SUFFICIENT SIZE AND HEIGHT TO REDUCE THE RISK OF DAMAGE TO THE CULVERT PIPE ENDS BY SNOW PLOWING, SIDE SLOPING, OR OTHER MAINTENANCE OPERATIONS.

ROAD LAYOUT DETAILS							
STATION (m)	TOP OF SUBGRADE			CENTRELINE CUT DEPTH* (TOP OF SUBGRADE TO EXISTING ROAD SURFACE) (m)	TOE OF EMBANKMENT SLOPE		
	CENTRELINE EASTING (m)	CENTRELINE NORTHING (m)	CENTRELINE ELEVATION (m)		OFFSET TO LEFT TOE** (m)	OFFSET TO RIGHT TOE** (m)	GRADIENT TO NEXT POINT (%)
0+000.0	553102.7	7915036.6	168.4	-0.1	5.4	5	0.1
0+016.2	553116.5	7915045.1	168.5	-0.1	6.3	5.9	0.1
0+017.7	553117.8	7915045.9	168.5	-0.1	6.3	5.9	0
0+020.0	553119.7	7915047.1	168.5	-0.1	6.3	5.8	-0.3
0+029.0	553127.6	7915051.6	168.4	-0.2	6.5	5.8	-0.5
0+040.0	553137.4	7915056.5	168.4	-0.2	6.4	5.9	-0.5
0+055.3	553151.4	7915062.6	168.3	-0.1	6.2	5.8	-0.6
0+060.0	553155.6	7915064.3	168.3	-0.1	6.1	5.9	-1.2
0+080.0	553174.6	7915070.4	168	-0.2	6	5.9	-1.8
0+083.2	553177.9	7915071.2	168	-0.1	6	5.9	-1.9
0+100.0	553194.4	7915074.7	167.7	-0.2	6.1	5.9	-1.9
0+117.1	553211.3	7915077	167.3	-0.1	6.1	5.8	-1.8
0+120.0	553214.2	7915077.2	167.3	-0.1	6.1	5.8	-1.3
0+140.0	553234.2	7915077.9	167	-0.9	7.4	6.7	-0.3
0+160.0	553254.1	7915076.8	167	-3	14.8	14.2	0.2
0+160.2	553254.3	7915076.8	167	-3	14.8	14.2	0.3
0+164.2	553258.3	7915076.3	167	-3	14.8	14.3	0.7
0+179.6	553273.5	7915074	167.1	-0.5	11.1	11.2	1.1
0+180.0	553273.9	7915073.9	167.1	-0.5	11.1	11.1	1.1
0+192.6	553286.2	7915071.1	167.2	-0.2	6.3	5.8	0.9
0+200.0	553293.3	7915069.2	167.3	-0.3	6.4	6.2	0.7
0+203.8	553297	7915068.1	167.3	-0.4	6.4	6.2	0.6
0+220.0	553312.3	7915062.8	167.4	-0.2	6.1	6	
0+240.0	553330.5	7915054.6	167.5	-0.1	6.1	5.9	0.4
0+260.0	553348	7915044.9	167.6	-0.1	6.1	5.9	0.4
0+274.4	553360	7915036.9	167.7	-0.1	6	5.9	0.4
0+280.0	553364.5	7915033.6	167.7	-0.1	6	5.8	0.4
0+289.9	553372.6	7915027.8	167.7	-0.1	5.2	5.1	

* NEGATIVE CUT DEPTH DENOTES FILL
** MEASURED ON GROUND SURFACE

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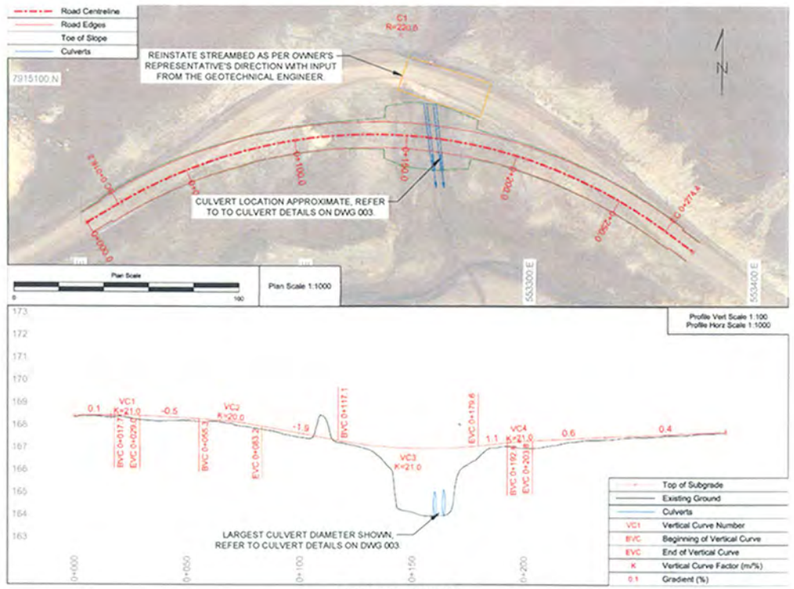
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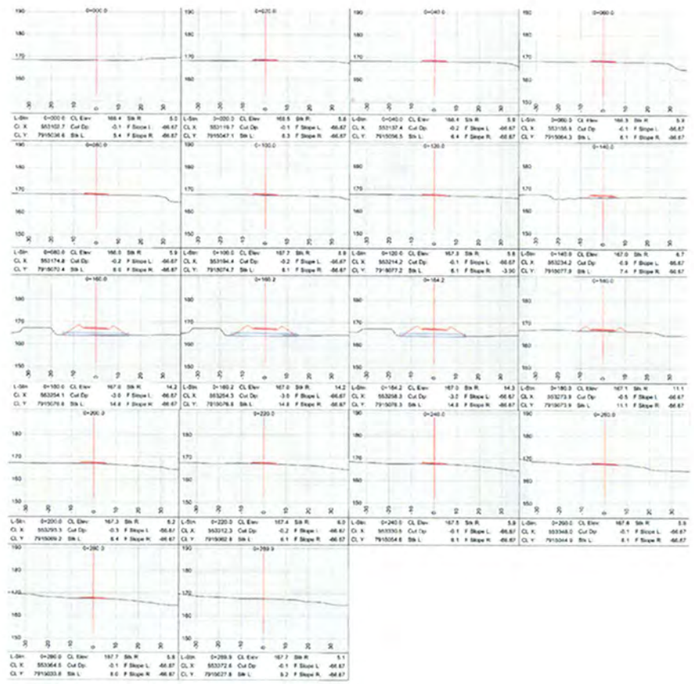
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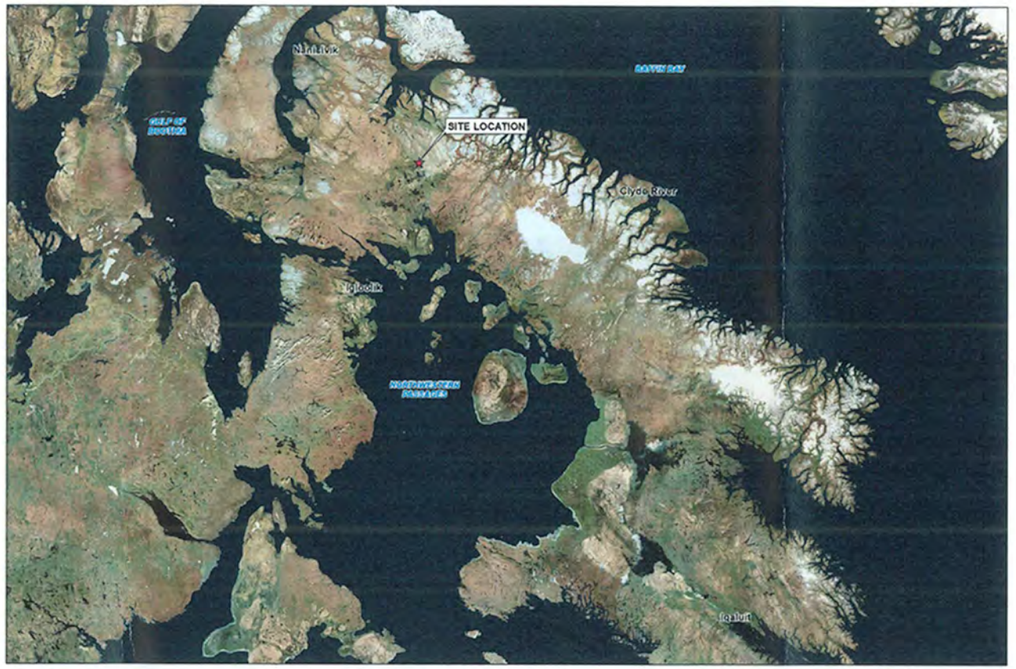
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MARY RIVER PROJECT
TOTE ROAD EARTHWORKS
BG29

INDEX OF DRAWINGS		
DRAWING NO.	DRAWING SHEET TITLE	REVISION NO.
001	TITLE SHEET - BG29	2
002	PIPE CROSSING TYPICAL DETAILS & GENERAL NOTES - BG29	2
003	CULVERT INSTALLATION DESIGN RECOMMENDATIONS & DESIGN TABLES - BG29	2
004	ROAD PLAN, PROFILE AND SECTIONS - BG29	2

SPECIFICATIONS		
SPECIFICATION NO.	SPECIFICATION TITLE	REVISION NO.
1667708-S	TOTE ROAD EARTHWORKS	1

DESIGN REPORT		
REPORT NO.	REPORT TITLE	REVISION NO.
1667708	TOTE ROAD EARTHWORKS	0



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2	2017-04-03	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 1 / REPORT REV. 0	CK/RAD	JJL	MJT	RAD
1	2017-03-24	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 0	CK/RAD	JJL	MJT	RAD
0	2017-03-10	ISSUED FOR CONSTRUCTION	CK/RAD	JJL	MJT	RAD
A	2017-03-09	ISSUED FOR CLIENT REVIEW	CK/RAD	JJL	MJT	RAD

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Date 2017-04-03
PERMIT NUMBER: P 049
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REGISTERED PROFESSIONAL ENGINEER
R.A. DOUGLAS
LICENSEE
2017-04-03
NWT/NU

CLIENT: Baffinland
CONSULTANT: Golder Associates

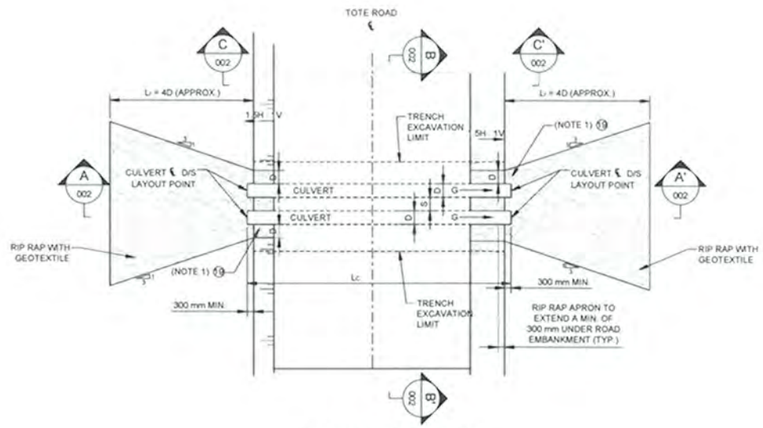
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MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

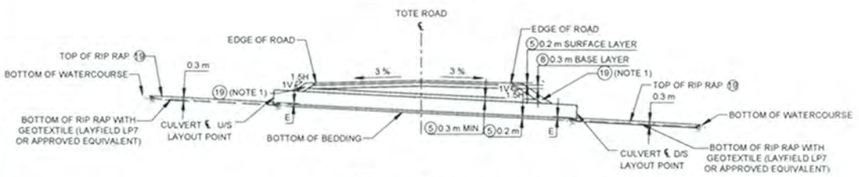
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TITLE SHEET - BG29

PROJECT NO.	PHASE	REV.	1 of 4	DRAWING
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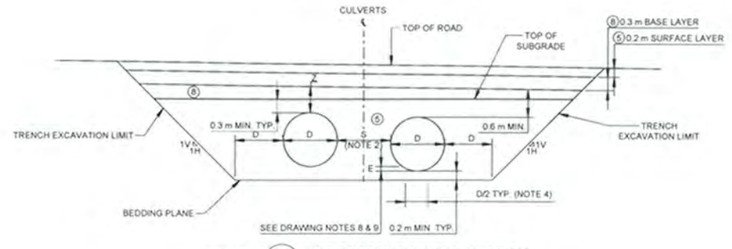
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PIPE CROSSING PLAN VIEW
SCALE 1:200 m



SCALE 1:200 m (A / 002) PIPE CROSSING TYPICAL PROFILE



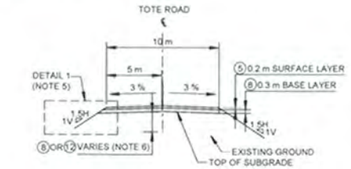
SCALE 1:50 m (B / 002) PIPE CROSSING TYPICAL SECTION

LEGEND

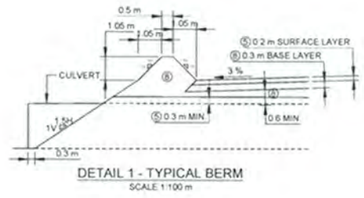
(5)	SCREENED MATERIAL	(12)	RUN OF QUARRY (ROQ)
(8)	JAW RUN	(19)	EROSION PROTECTION

DRAWING NOTES

1. EROSION PROTECTION SHALL BE PLACED AROUND THE CULVERT INLET AND OUTLET AS PER THE DIRECTION OF THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
2. THE MINIMUM SPACING (S) BETWEEN CULVERTS SHALL BE D, WHERE D IS THE CULVERT DIAMETER, OR 1.5 m, WHICHEVER IS GREATER.
3. THE MINIMUM COVER DEFINED AS THE DISTANCE BETWEEN THE TOP OF CULVERT TO THE TOP OF SUBGRADE SHALL BE 0.6 m OR D/4, WHERE D IS THE CULVERT DIAMETER, WHICHEVER IS GREATER.
4. THE BEDDING TO BE SHAPED TO RECEIVE PIPE.
5. SAFETY BERMS ARE REQUIRED FOR EMBANKMENTS GREATER THAN 3 m IN HEIGHT.
6. FOR EMBANKMENT FILL DEPTHS LESS THAN 0.6 m, TYPE 8 MATERIAL SHALL BE USED. FOR FILL DEPTHS GREATER THAN 0.6 m, AND DEPENDING ON THE FILL EXTENTS, TYPE 12 MATERIAL MAY BE USED.
7. DEFINITIONS AND VALUES OF D,Lc,Lr, AND G CAN BE FOUND IN DESIGN TABLES ON DRAWING 003.
8. FOR FISH BEARING CULVERT WITH MULTIPLE PIPES, ONLY ONE SHALL BE EMBEDDED BY "E" AND ALL OTHER PIPES SHALL BE PLACED ON GROUND / BOTTOM OF WATER COURSE.
9. AS PER CULVERT DETAILS (DWG 003)FOR FISH BEARING CULVERT, E = 0.1 D. FOR NON-FISH BEARING CULVERT E=0.



SCALE 1:200 m (C / 002) EMBANKMENT SECTION



DETAIL 1 - TYPICAL BERM
SCALE 1:100 m

GENERAL CONSTRUCTION NOTES

1. IT IS THE RESPONSIBILITY OF THE USER OF THIS DRAWING TO ENSURE THE USE OF ITS MOST RECENT REVISION.
2. THE INFORMATION PROVIDED ON THE DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE MOST RECENT REVISION OF THE SPECIFICATIONS AND REPORT LISTED ON DWG. 001.
3. IN THE EVENT OF DISCREPANCY BETWEEN THE DRAWINGS AND THE SPECIFICATIONS CLARIFICATION AND/OR DIRECTION SHALL BE PROVIDED AS OUTLINED IN THE SPECIFICATIONS.
4. PRIOR TO COMMENCING CONSTRUCTION ACTIVITIES, THE CONTRACTOR SHALL BE FAMILIAR WITH THE SCOPE OF WORK.
5. THE INFORMATION PRESENTED ON THESE DRAWINGS IS INTENDED TO CONVEY THE PIPE CROSSING CONSTRUCTION DETAILS AND ROAD EMBANKMENT DETAILS.
6. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED.
7. COORDINATE SYSTEM IS UTM (NAD 83) ZONE 17N.
8. CONTOUR INTERVAL IS 1 M WITH EXISTING TOPOGRAPHY.
9. THE DESIGN OF EACH INSTALLATION ARE BASED ON A DESK STUDY USING A DIGITAL ELEVATION MODEL AND SATELLITE IMAGERY PROVIDED BY BAFFINLAND, AND ARE NOT SUPPORTED BY FIELD STUDY.
10. THE GROUND SURFACE ELEVATIONS ARE CONSIDERED TO BE APPROXIMATE.
11. A DECISION ON WHETHER TO EXTEND OR REPLACE EACH CULVERT WILL BE MADE BY THE OWNER'S REPRESENTATIVE.
12. FIELD FITTING OF CULVERTS (INCLUDING LOCATIONS, LENGTHS, INVERT DEPTHS, GRADIENTS, AND SKEWS) TO ACTUAL CONDITIONS AT EACH SITE SHALL BE AS DIRECTED BY THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
13. FILL MATERIALS SHALL BE HANDLED, SORTED, PLACED AND COMPACTED AS SHOWN ON THE DRAWINGS, DESCRIBED IN THE SPECIFICATIONS AND TO THE SATISFACTION OF THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
14. NO GEOTECHNICAL OR STRUCTURAL ANALYSIS OF THE CULVERT INSTALLATIONS HAS **BEEN CARRIED OUT. A MINIMUM CULVERT COVER OF 0.6 m OR D/4 (WHERE D IS THE** DIAMETER OF THE CIRCULAR CULVERT PIPE) HAS BEEN ASSUMED TO BE APPROPRIATE FOR 10 TONNE AXLE LOADS; USE OF HEAVIER TRUCKS WILL REQUIRE STRUCTURAL ANALYSIS OF THE CULVERT INSTALLATION.
15. FISH BEARING STATUS IN CULVERT DETAILS TABLE ON DWG. 003 TAKEN FROM HATCH TOTE ROAD CULVERT DATA SHEETS H349000-3000-10-088-0030 THROUGH H349000-3000-10-088-0034.
16. NO HYDROLOGIC OR HYDRAULIC ANALYSIS WAS CARRIED OUT. NUMBER OF CULVERTS, CULVERT DIAMETER(S), CULVERT LENGTH(S), EMBEDMENT DEPTH (E), AND REQUIREMENTS FOR RIP RAP FROM HATCH TOTE ROAD CULVERT DATA SHEETS H349000-3000-10-088-0030 THROUGH H349000-3000-10-088-0034.
17. IN SECTIONS, SKEWED CULVERTS ARE PROJECTED ONTO PLANE OF CROSS-SECTIONS.
18. AT LIMITS OF CONSTRUCTION NEW PAVEMENT THICKNESS NEEDS TO BE TAPERED TO MATCH EXISTING PAVEMENT SURFACE.
19. THE OWNER'S REPRESENTATIVE WILL CONFIRM THE REQUIREMENT FOR SAFETY BERMS ALONG THE ROAD EDGES BASED ON ENCOUNTERED FIELD CONDITIONS. TYPICAL BERM DETAILS ARE SHOWN ON DWG.002.
20. SITE SPECIFIC NOTES ON DWG. 003 MUST BE READ IN CONJUNCTION WITH THESE GENERAL NOTES, AND THE SPECIFICATIONS AND DRAWINGS LISTED ON DWG.001.
21. BAFFINLAND IS RESPONSIBLE FOR PERMITTING OF THE PROPOSED WORKS (IF REQUIRED).
22. PRIOR TO CONSTRUCTION, BAFFINLAND'S ENVIRONMENTAL REPRESENTATIVE WILL BE CONSULTED TO APPROVE THE REQUIRED EROSION CONTROL AND MITIGATION MEASURES ADJACENT TO WATER BODIES.

0 2 4
1:50 METRES

0 5 10
1:100 METRES

0 10 20
1:200 METRES

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PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

TITLE
TYPICAL DETAILS AND GENERAL NOTES - BG29

PROJECT NO	PHASE	REV.	2 of 4	DRAWING
1667708	3000	2		002

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CULVERT DETAILS†

STATION (m)	FISH BEARING STATUS (REFER TO NOTE 15 ON DWG. 002)	EXISTING CULVERT DIAMETER (D) (mm) (REFER TO NOTE 16 ON DWG. 002)	EXISTING CULVERT LENGTH (m) (REFER TO NOTE 16 ON DWG. 002)	EXISTING CULVERT GRADIENT (%) (REFER TO NOTE 16 ON DWG. 002)	EMBEDMENT DEPTH (E) (mm) (REFER TO NOTE 16 ON DWG. 002)	PROPOSED CULVERT LENGTH (m)	DEPTH FROM SUBGRADE TO TOP OF CULVERT AT CENTRELINE OF ROAD (Z) (m)	EASTING OF CENTRELINE OF PIPE AT CENTRELINE OF ROAD (m)	NORTHING OF CENTRELINE OF PIPE AT CENTRELINE OF ROAD (m)	INLET INVERT ELEVATION (m)	OUTLET INVERT ELEVATION (m)	CULVERT GRADIENT (G) (%)	CULVERT SKEW (deg)	INLET RIP RAP REQUIRED?	OUTLET RIP RAP REQUIRED?	RIP RAP APRON LENGTH (Lr) (m)
0+061.5	POTENTIAL	1000	15	0.31		42.5	4.3	546216.3	7919878.3	152.8	152.0	2	63	N	N	

†CULVERT LOCATION DETAILS ARE BASED ON A DESK STUDY USING A DIGITAL ELEVATION MODEL AND SATELLITE IMAGERY PROVIDED BY BAFFINLAND, AND ARE NOT SUPPORTED BY FIELD STUDY (REFER TO GENERAL CONSTRUCTION NOTE 12 ON DWG. 002)

SITE SPECIFIC NOTES FOR CULVERT BG29

AS INDICATED IN THE GENERAL CONSTRUCTION NOTES ON DWG. 002, THE SITE SPECIFIC NOTES ARE BASED ONLY ON A DESKTOP STUDY OF THE SITE. NO FIELD WORK WAS CARRIED OUT TO SUPPORT THIS WORK. AN INSPECTION OF THE SITE SHALL BE CARRIED OUT BY THE OWNER'S REPRESENTATIVE AND/OR GEOTECHNICAL ENGINEER PRIOR TO CONSTRUCTION. THE SITE SPECIFIC NOTES ARE INTENDED TO BE COMPREHENSIVE BUT NOT ALL-INCLUSIVE.

1. **CUT THE EXISTING ROAD EMBANKMENT SIDE SLOPES TO NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL), MAINTAINING THE ROAD RUNNING SURFACE WIDTH A MINIMUM OF 10 m.**
2. **RAISE THE ROAD EMBANKMENT TO PROVIDE ADEQUATE CULVERT PIPE COVER, MAINTAINING THE ROAD EMBANKMENT SIDE SLOPES NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL) AND THE ROAD RUNNING SURFACE A MINIMUM WIDTH OF 10 m.**
3. CONSTRUCT THE NEW ROAD EMBANKMENT TO THE LEFT SIDE OF THE EXISTING EMBANKMENT TO FACILITATE THE MAINTENANCE OF TRAFFIC DURING CONSTRUCTION OF THE NEW EMBANKMENT.
4. CAP THE ROAD SURFACE WITH SUITABLE RUNNING SURFACE MATERIAL (SEE TYPICAL SECTION ON DWG. 002)
5. PROVIDE SAFETY BERMS WHERE EMBANKMENT FILL IS GREATER THAN 3 m ABOVE EXISTING GROUND SURFACE.
6. PROVIDE RIP RAP PROTECTION AT THE CULVERT INLET AND OUTLET.
7. MARK THE CULVERT ENDS WITH DELINEATORS OF SUFFICIENT SIZE AND HEIGHT TO REDUCE THE RISK OF DAMAGE TO THE CULVERT PIPE ENDS BY SNOW PLOWING, SIDE SLOPING, OR OTHER MAINTENANCE OPERATIONS.

ROAD LAYOUT DETAILS

STATION (m)	TOP OF SUBGRADE			CENTRELINE CUT DEPTH* (TOP OF SUBGRADE TO EXISTING ROAD SURFACE) (m)	TOE OF EMBANKMENT SLOPE		
	CENTRELINE EASTING (m)	CENTRELINE NORTHING (m)	CENTRELINE ELEVATION (m)		OFFSET TO LEFT TOE** (m)	OFFSET TO RIGHT TOE** (m)	GRADIENT TO NEXT POINT (%)
0+000.0	546142.8	7919848.1	159.9	-0.1	5.0	5.2	0.7
0+000.0	546142.9	7919848.1	159.9	-0.1	5.0	5.2	
0+020.0	546162.7	7919849.9	160	-0.1	5.9	6.2	0.0
0+025.5	546168.1	7919851.1	160	-0.2	5.9	6.2	-1.8
0+040.0	546181.8	7919855.6	159.8	-0.5	6.5	6.7	-4.5
0+047.1	546188.3	7919858.5	159.4	-0.5	6.3	6.8	-5.4
0+060.0	546199.4	7919865	158.7	-0.5	20.2	6.5	-5.4
0+070.0	546207.4	7919871	158.2	-4.8	18.9	8.3	-5.4
0+070.7	546208	7919871.4	158.2	-5	18.9	8.4	-4.7
0+080.0	546215.1	7919877.4	157.7	-5.3	17.8	8.7	-4.0
0+081.5	546216.3	7919878.3	157.7	-5.3	17.4	8.7	-3.8
0+082.8	546217.3	7919879.2	157.6	-5.3	16.9	8.8	-2.4
0+100.0	546231.2	7919889.3	157.2	-1.9	11.6	8.4	-1.0
0+102.6	546233.4	7919890.8	157.2	-1.7	7.7	8.2	0.4
0+120.0	546248.1	7919900	157.2	-1.2	6.8	7.6	3.1
0+140.0	546265.1	7919910.6	157.9	-0.7	6.7	6.2	5.0
0+146.4	546270.5	7919914	158.2	-0.6	6.4	5.9	5.5
0+147.2	546271.1	7919914.4	158.2	-0.5	6.1	5.9	5.5
0+151.2	546274.7	7919916.4	158.4	-0.3	5.8	6.0	4.9
0+160.0	546282.5	7919920.2	158.9	0	5.8	5.9	2.9
0+180.0	546301.7	7919925.8	159.4	-0.1	6.0	5.9	1.2
0+182.9	546304.5	7919926.2	159.5	-0.1	6.0	5.9	1.0
0+192.0	546313.7	7919926.9	159.6	-0.1	5.9	5.9	1.1
0+200.0	546321.6	7919926.7	159.7	-0.1	6.1	5.9	1.4
0+210.5	546332.1	7919925.3	159.8	-0.2	6.3	5.9	1.5
0+218.1	546339.4	7919923.5	159.9	-0.2	6.4	5.8	1.5
0+220.0	546341.2	7919922.9	160	-0.2	6.4	5.8	1.2
0+230.7	546351.2	7919919.1	160.1	-0.1	6.0	5.8	0.9
0+233.0	546353.3	7919918.1	160.1	-0.1	5.3	5.0	0.8
0+240.0	546359.7	7919915.2	160.2	-0.2	5.3	5.1	0.8
0+242.5	546361.9	7919914.1	160.2	-0.2	5.3	5.1	

* NEGATIVE CUT DEPTH DENOTES FILL
** MEASURED ON GROUND SURFACE

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R.A. DOUCET
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ONTARIO

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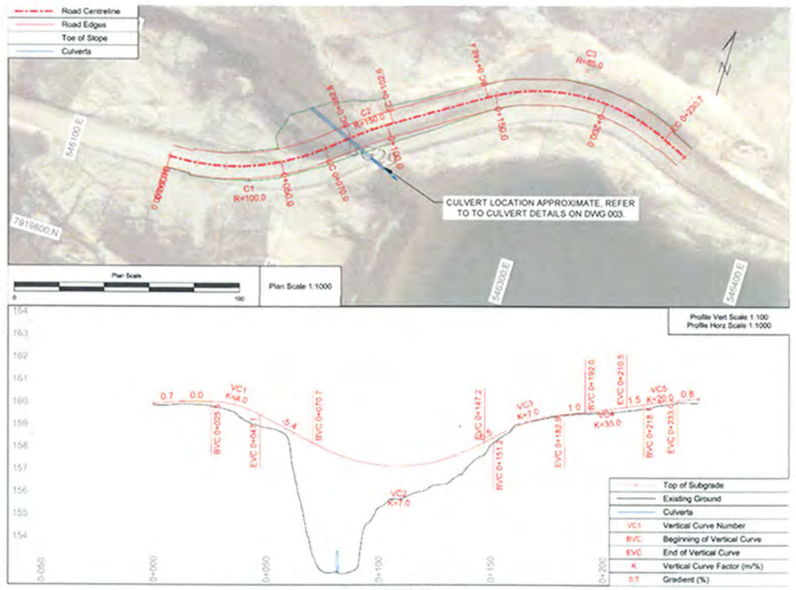
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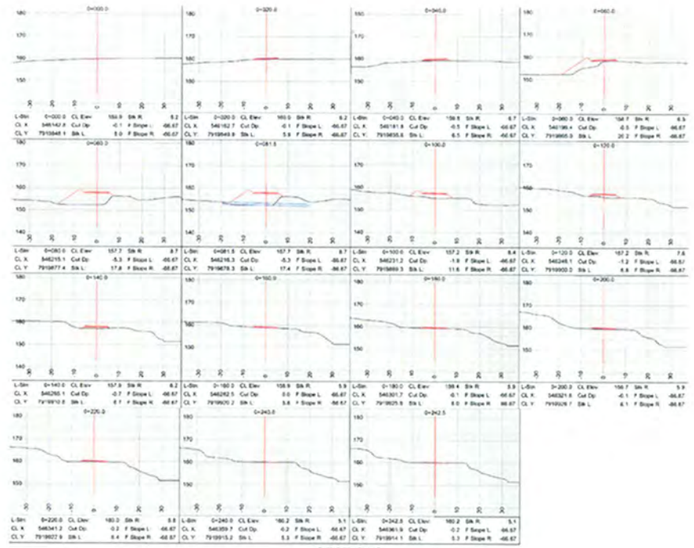
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CULVERT INSTALLATION DESIGN RECOMMENDATIONS & DESIGN TABLES - BG29

PROJECT NO.	PHASE	REV	3 of 4	DRAWING
1667708	3000	2		003

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PLAN AND PROFILE



SECTIONS
(REFER TO GENERAL CONSTRUCTION NOTE 17)

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ROAD PLAN, PROFILE AND SECTIONS - BG29

PROJECT NO.	PHASE	REV.	4 of 4	DRAWING
1667708	3000	2		004

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MARY RIVER PROJECT
TOTE ROAD EARTHWORKS
BG32

INDEX OF DRAWINGS		
DRAWING NO.	DRAWING SHEET TITLE	REVISION NO.
001	TITLE SHEET - BG32	2
002	PIPE CROSSING TYPICAL DETAILS & GENERAL NOTES - BG32	2
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DESIGN REPORT		
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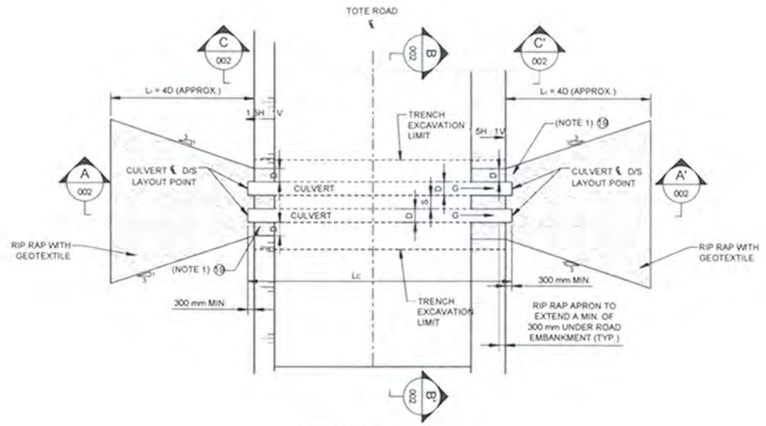
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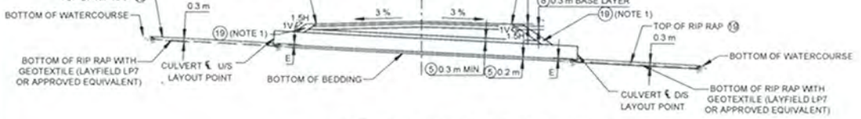
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PROJECT NO.	PHASE	REV.		DRAWING
1667708	3000	2	1 of 4	001

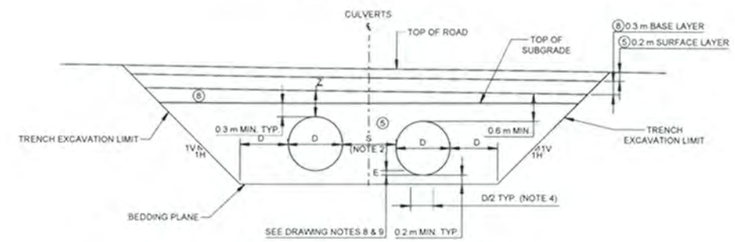
Reduced Size
NOT TO SCALE



PIPE CROSSING PLAN VIEW
SCALE 1:200 m



SCALE 1:200 m (A / 002) PIPE CROSSING TYPICAL PROFILE



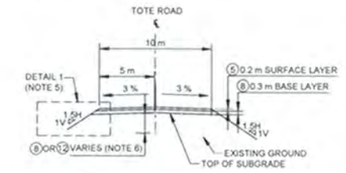
SCALE 1:50 m (B / 002) PIPE CROSSING TYPICAL SECTION

LEGEND

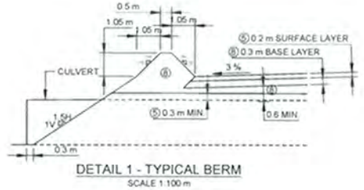
(5)	SCREENED MATERIAL	(12)	RUN OF QUARRY (ROQ)
(8)	JAW RUN	(19)	EROSION PROTECTION

DRAWING NOTES

1. EROSION PROTECTION SHALL BE PLACED AROUND THE CULVERT INLET AND OUTLET AS PER THE DIRECTION OF THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
2. THE MINIMUM SPACING (S) BETWEEN CULVERTS SHALL BE D, WHERE D IS THE CULVERT DIAMETER, OR 1.5 m, WHICHEVER IS GREATER.
3. THE MINIMUM COVER DEFINED AS THE DISTANCE BETWEEN THE TOP OF CULVERT TO THE TOP OF SUBGRADE SHALL BE 0.6 m OR Di4, WHERE D IS THE CULVERT DIAMETER, WHICHEVER IS GREATER.
4. THE BEDDING TO BE SHAPED TO RECEIVE PIPE.
5. SAFETY BERMS ARE REQUIRED FOR EMBANKMENTS GREATER THAN 3 m IN HEIGHT.
6. FOR EMBANKMENT FILL DEPTHS LESS THAN 0.6 m, TYPE 8 MATERIAL SHALL BE USED. FOR FILL DEPTHS GREATER THAN 0.6 m, AND DEPENDING ON THE FILL EXTENTS, TYPE 12 MATERIAL MAY BE USED.
7. DEFINITIONS AND VALUES OF D,Lc,Lr, AND G CAN BE FOUND IN DESIGN TABLES ON DRAWING 003.
8. FOR FISH BEARING CULVERT WITH MULTIPLE PIPES, ONLY ONE SHALL BE EMBEDDED BY "E" AND ALL OTHER PIPES SHALL BE PLACED ON GROUND / BOTTOM OF WATER COURSE.
9. AS PER CULVERT DETAILS (DWG 003) FOR FISH BEARING CULVERT, E = 0.1 D. FOR NON-FISH BEARING CULVERT E=0.



SCALE 1:200 m (C / 002) EMBANKMENT SECTION



DETAIL 1 - TYPICAL BERM
SCALE 1:100 m

GENERAL CONSTRUCTION NOTES

1. IT IS THE RESPONSIBILITY OF THE USER OF THIS DRAWING TO ENSURE THE USE OF ITS MOST RECENT REVISION.
2. THE INFORMATION PROVIDED ON THE DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE MOST RECENT REVISION OF THE SPECIFICATIONS AND REPORT LISTED ON DWG. 001.
3. IN THE EVENT OF DISCREPANCY BETWEEN THE DRAWINGS AND THE SPECIFICATIONS CLARIFICATION AND/OR DIRECTION SHALL BE PROVIDED AS OUTLINED IN THE SPECIFICATIONS.
4. PRIOR TO COMMENCING CONSTRUCTION ACTIVITIES, THE CONTRACTOR SHALL BE FAMILIAR WITH THE SCOPE OF WORK.
5. THE INFORMATION PRESENTED ON THESE DRAWINGS IS INTENDED TO CONVEY THE PIPE CROSSING CONSTRUCTION DETAILS AND ROAD EMBANKMENT DETAILS.
6. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED.
7. COORDINATE SYSTEM IS UTM (NAD 83) ZONE 17N.
8. CONTOUR INTERVAL IS 1 M WITH EXISTING TOPOGRAPHY.
9. THE DESIGN OF EACH INSTALLATION ARE BASED ON A DESK STUDY USING A DIGITAL ELEVATION MODEL AND SATELLITE IMAGERY PROVIDED BY BAFFINLAND, AND ARE NOT SUPPORTED BY FIELD STUDY.
10. THE GROUND SURFACE ELEVATIONS ARE CONSIDERED TO BE APPROXIMATE.
11. A DECISION ON WHETHER TO EXTEND OR REPLACE EACH CULVERT WILL BE MADE BY THE OWNER'S REPRESENTATIVE.
12. FIELD FITTING OF CULVERTS (INCLUDING LOCATIONS, LENGTHS, INVERT DEPTHS, GRADIENTS, AND SKEWS) TO ACTUAL CONDITIONS AT EACH SITE SHALL BE AS DIRECTED BY THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
13. FILL MATERIALS SHALL BE HANDLED, SORTED, PLACED AND COMPACTED AS SHOWN ON THE DRAWINGS, DESCRIBED IN THE SPECIFICATIONS AND TO THE SATISFACTION OF THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
14. NO GEOTECHNICAL OR STRUCTURAL ANALYSIS OF THE CULVERT INSTALLATIONS HAS **BEEN CARRIED OUT. A MINIMUM CULVERT COVER OF 0.6 m OR Di4 (WHERE D IS THE** DIAMETER OF THE CIRCULAR CULVERT PIPE) HAS BEEN ASSUMED TO BE APPROPRIATE FOR 10 TONNE AXLE LOADS; USE OF HEAVIER TRUCKS WILL REQUIRE STRUCTURAL ANALYSIS OF THE CULVERT INSTALLATION.
15. FISH BEARING STATUS IN CULVERT DETAILS TABLE ON DWG. 003 TAKEN FROM HATCH TOTE ROAD CULVERT DATA SHEETS H349000-3000-10-088-0030 THROUGH H349000-3000-10-088-0034.
16. NO HYDROLOGIC OR HYDRAULIC ANALYSIS WAS CARRIED OUT. NUMBER OF CULVERTS, CULVERT DIAMETER(S), CULVERT LENGTH(S), EMBEDMENT DEPTH (E), AND REQUIREMENTS FOR RIP RAP FROM HATCH TOTE ROAD CULVERT DATA SHEETS H349000-3000-10-088-0030 THROUGH H349000-3000-10-088-0034.
17. IN SECTIONS, SKEWED CULVERTS ARE PROJECTED ONTO PLANE OF CROSS-SECTIONS.
18. AT LIMITS OF CONSTRUCTION NEW PAVEMENT THICKNESS NEEDS TO BE TAPERED TO MATCH EXISTING PAVEMENT SURFACE.
19. THE OWNER'S REPRESENTATIVE WILL CONFIRM THE REQUIREMENT FOR SAFETY BERMS ALONG THE ROAD EDGES BASED ON ENCOUNTERED FIELD CONDITIONS. TYPICAL BERM DETAILS ARE SHOWN ON DWG.002.
20. SITE SPECIFIC NOTES ON DWG. 003 MUST BE READ IN CONJUNCTION WITH THESE GENERAL NOTES, AND THE SPECIFICATIONS AND DRAWINGS LISTED ON DWG.001.
21. BAFFINLAND IS RESPONSIBLE FOR PERMITTING OF THE PROPOSED WORKS (IF REQUIRED).
22. PRIOR TO CONSTRUCTION, BAFFINLAND'S ENVIRONMENTAL REPRESENTATIVE WILL BE CONSULTED TO APPROVE THE REQUIRED EROSION CONTROL AND MITIGATION MEASURES ADJACENT TO WATER BODIES.

0 2 4
1:50 METRES

0 5 10
1:100 METRES

0 10 20
1:200 METRES

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2017-04-03	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 1 / REPORT REV. 0	JJL	CK/RAD	MJT	RAD
1	2017-03-24	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 0	JJL	CK/RAD	MJT	RAD
0	2017-03-09	ISSUED FOR CONSTRUCTION	JJL	CK/RAD	MJT	RAD
A	2017-02-24	ISSUED FOR CLIENT REVIEW	JJL	CK/RAD	MJT	RAD

PERMIT TO PRACTICE GOLDER ASSOCIATES LTD.
Signature
Date 19-04-23
PERMIT NUMBER: P 049
NT/NU Association of Professional Engineers and Geoscientists

REGISTERED PROFESSIONAL ENGINEER
R.A. DOUGLAS
LICENSEE
2017-04-19
NWT/NU

Baffinland
Golder Associates

MISSISSAUGA OFFICE
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MISSISSAUGA, ON
CANADA
905-567-4444
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PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

TITLE
TYPICAL DETAILS AND GENERAL NOTES - BG32

PROJECT NO.	PHASE	REV.	2 of 4	DRAWING
1667708	3000	2		002

Reduced Size
NOT TO SCALE

CULVERT DETAILS†

STATION (m)	FISH BEARING STATUS (REFER TO NOTE 15 ON DWG. 002)	EXISTING CULVERT DIAMETER (D) (mm) (REFER TO NOTE 16 ON DWG. 002)	EXISTING CULVERT LENGTH (m) (REFER TO NOTE 16 ON DWG. 002)	EXISTING CULVERT GRADIENT (%) (REFER TO NOTE 16 ON DWG. 002)	EMBEDMENT DEPTH (E) (mm) (REFER TO NOTE 16 ON DWG. 002)	PROPOSED CULVERT LENGTH (m)	DEPTH FROM SUBGRADE TO TOP OF CULVERT AT CENTRELINE OF ROAD (Z) (m)	EASTING OF CENTRELINE OF PIPE AT CENTRELINE OF ROAD (m)	NORTHING OF CENTRELINE OF PIPE AT CENTRELINE OF ROAD (m)	INLET INVERT ELEVATION (m)	OUTLET INVERT ELEVATION (m)	CULVERT GRADIENT (G) (%)	CULVERT SKEW (deg)	INLET RIP RAP REQUIRED?	OUTLET RIP RAP REQUIRED?	RIP RAP APRON LENGTH (Lr) (m)
0+097.5	YES	2000	17.5	0.37		30	0.9	540720.1	7921602.8	143.3	142.7	2	58	N	N	
0+101.5	YES	2000	17.5	0.63		30	0.7	540723.8	7921604.4	143.5	142.9	2	58	N	N	

†CULVERT LOCATION DETAILS ARE BASED ON A DESK STUDY USING A DIGITAL ELEVATION MODEL AND SATELLITE IMAGERY PROVIDED BY BAFFINLAND, AND ARE NOT SUPPORTED BY FIELD STUDY (REFER TO GENERAL CONSTRUCTION NOTE 12 ON DWG. 002)

SITE SPECIFIC NOTES FOR CULVERT BG32

AS INDICATED IN THE GENERAL CONSTRUCTION NOTES ON DWG. 002, THE SITE SPECIFIC NOTES ARE BASED ONLY ON A DESKTOP STUDY OF THE SITE. NO FIELD WORK WAS CARRIED OUT TO SUPPORT THIS WORK. AN INSPECTION OF THE SITE SHALL BE CARRIED OUT BY THE OWNER'S REPRESENTATIVE AND/OR GEOTECHNICAL ENGINEER PRIOR TO CONSTRUCTION. THE SITE SPECIFIC NOTES ARE INTENDED TO BE COMPREHENSIVE BUT NOT ALL-INCLUSIVE.

1. **WIDEN THE ROAD RUNNING SURFACE TO A MINIMUM WIDTH OF 10 m, MAINTAINING THE ROAD EMBANKMENT SIDE SLOPES NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL).**
2. **WIDEN THE ROAD RUNNING SURFACE TO A MINIMUM OF 10 m ON THE APPROACHES TO THE CULVERT LOCATION, MAINTAINING THE ROAD EMBANKMENT SIDE SLOPES NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL).**
3. **CUT THE EXISTING ROAD EMBANKMENT SIDE SLOPES TO NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL), MAINTAINING THE ROAD RUNNING SURFACE WIDTH A MINIMUM OF 10 m.**
4. CAP THE ROAD SURFACE WITH SUITABLE RUNNING SURFACE MATERIAL (SEE TYPICAL SECTION ON DWG. 002).
5. PROVIDE SAFETY BERMS WHERE EMBANKMENT FILL IS GREATER THAN 3 m ABOVE EXISTING GROUND SURFACE.
6. PROVIDE RIP RAP PROTECTION AT THE CULVERT INLET AND OUTLET.
7. THE EXISTING CULVERT MAY BE PERCHED. REINSTALL CULVERTS TO DESIGN.
8. MARK THE CULVERT ENDS WITH DELINEATORS OF SUFFICIENT SIZE AND HEIGHT TO REDUCE THE RISK OF DAMAGE TO THE CULVERT PIPE ENDS BY SNOW PLOWING, SIDE SLOPING, OR OTHER MAINTENANCE OPERATIONS.

ROAD LAYOUT DETAILS

STATION (m)	TOP OF SUBGRADE			CENTRELINE CUT DEPTH* (TOP OF SUBGRADE TO EXISTING ROAD SURFACE) (m)	TOE OF EMBANKMENT SLOPE		
	CENTRELINE EASTING (m)	CENTRELINE NORTHING (m)	CENTRELINE ELEVATION (m)		OFFSET TO LEFT TOE** (m)	OFFSET TO RIGHT TOE** (m)	GRADIENT TO NEXT POINT (%)
0+000.0	540633.1	7921558.9	146.4	-0.1	5.2	5.1	-0.8
0+020.0	540650.9	7921567.9	146.2	-0.2	6.7	5.8	
0+040.0	540668.8	7921577	146.1	-0.6	7.1	6.3	-0.4
0+060.0	540686.6	7921586	146	-0.6	8.2	6.5	-0.4
0+080.0	540704.5	7921595	145.9	-0.5	13.1	6.1	-0.4
0+087.5	540711.2	7921598.4	145.9	-0.4	14.0	6.1	-0.4
0+097.5	540720.1	7921602.8	145.9	-0.3	14.1	5.8	-0.4
0+100.0	540722.4	7921603.8	145.8	-0.2	13.9	5.9	-0.4
0+101.5	540723.8	7921604.4	145.8	-0.2	13.8	5.9	
0+120.0	540740.9	7921611.5	145.8	-0.2	9.2	5.9	-0.2
0+132.5	540752.7	7921615.7	145.8	-0.4	8.7	6.0	-0.2
0+140.0	540759.8	7921618	145.8	-0.6	8.4	6.5	-0.2
0+160.0	540778.8	7921624.3	145.7	-0.6	7.2	6.4	-0.2
0+180.0	540797.8	7921630.5	145.7	-0.5	6.5	6.4	
0+200.0	540816.8	7921636.8	145.7	-0.3	6.1	6.3	0.4
0+220.0	540835.9	7921642.8	145.8	-0.3	5.9	6.2	0.4
0+231.9	540847.3	7921646.3	145.9	-0.2	5.0	5.2	

* NEGATIVE CUT DEPTH DENOTES FILL.
** MEASURED ON GROUND SURFACE

REV	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2017-04-03	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 1 / REPORT REV. 0	JJL	CK/RAD	MJT	RAD
1	2017-03-24	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 0	JJL	CK/RAD	MJT	RAD
0	2017-03-09	ISSUED FOR CONSTRUCTION	JJL	CK/RAD	MJT	RAD
A	2017-02-24	ISSUED FOR CLIENT REVIEW	JJL	CK/RAD	MJT	RAD

PERMIT TO PRACTICE GOLDER ASSOCIATES LTD.
Signature
Date 19-04-03
PERMIT NUMBER: P 049
NT/NU Association of Professional Engineers and Geoscientists

REGISTERED PROFESSIONAL ENGINEER
R.A. DOUGLAS
CONSULTANT
LICENSEE
2019-04-03
NWT/NU

Baffinland

Golder Associates

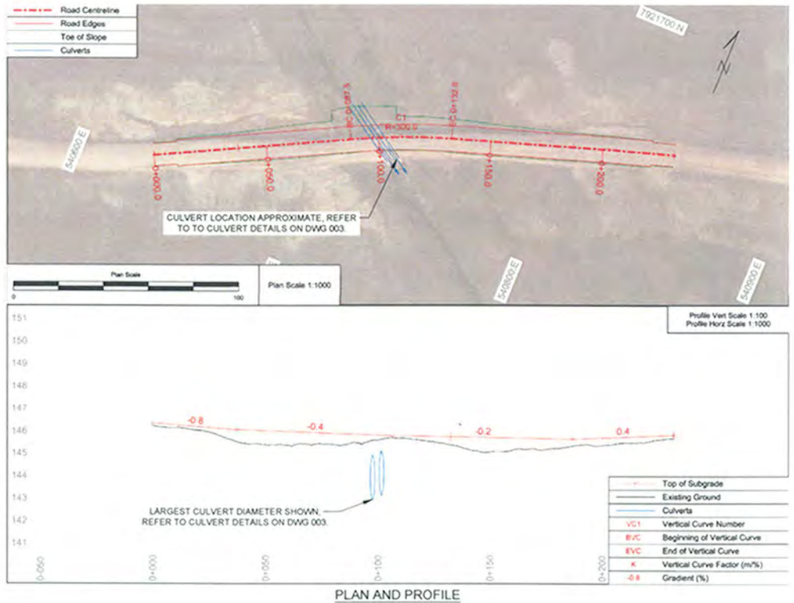
MISSISSAUGA OFFICE
6925 CENTURY AVENUE, SUITE 100
MISSISSAUGA, ON
CANADA
905-567-4444
www.golder.com

PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

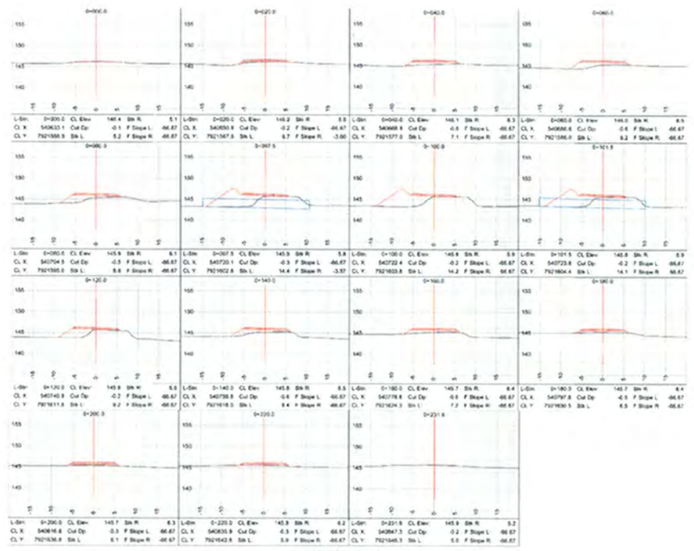
TITLE
CULVERT INSTALLATION DESIGN RECOMMENDATIONS & DESIGN TABLES - BG32

PROJECT NO.	PHASE	REV	3 of 4	DRAWING
1667708	3000	2		003

Reduced Size
NOT TO SCALE



PLAN AND PROFILE



SECTIONS
(REFER TO GENERAL CONSTRUCTION NOTE 17)

REV	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2017-04-03	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 1 / REPORT REV. 0	JJL	CK/RAD	MJT	RAD
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0	2017-03-09	ISSUED FOR CONSTRUCTION	JJL	CK/RAD	MJT	RAD
A	2017-02-24	ISSUED FOR CLIENT REVIEW	JJL	CK/RAD	MJT	RAD

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GOLDER ASSOCIATES LTD.
Signature
Date 17-04-03
PERMIT NUMBER: P 549
NT/NU Association of Professional Engineers and Geoscientists

REGISTERED PROFESSIONAL ENGINEER
R.A. DOUGLAS
LICENSEE
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NUNAVUT

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PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

TITLE
ROAD PLAN, PROFILE AND SECTIONS - BG32

PROJECT NO	PHASE	REV		DRAWING
1667708	3000	2	4 of 4	004

Reduced Size
NOT TO SCALE

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT
TOTE ROAD EARTHWORKS
CV001

INDEX OF DRAWINGS		
DRAWING NO.	DRAWING SHEET TITLE	REVISION NO.
001	TITLE SHEET - CV001	2
002	PIPE CROSSING TYPICAL DETAILS & GENERAL NOTES - CV001	2
003	CULVERT INSTALLATION DESIGN RECOMMENDATIONS & DESIGN TABLES - CV001	2
004	ROAD PLAN, PROFILE AND SECTIONS - CV001	2

SPECIFICATIONS		
SPECIFICATION NO.	SPECIFICATION TITLE	REVISION NO.
1667708-S	TOTE ROAD EARTHWORKS	1

DESIGN REPORT		
REPORT NO.	REPORT TITLE	REVISION NO.
1667708	TOTE ROAD EARTHWORKS	0



KEY PLAN
NOT TO SCALE

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2017-04-03	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 1 / REPORT REV. 0	JJL	CK/RAD	MJT	RAD
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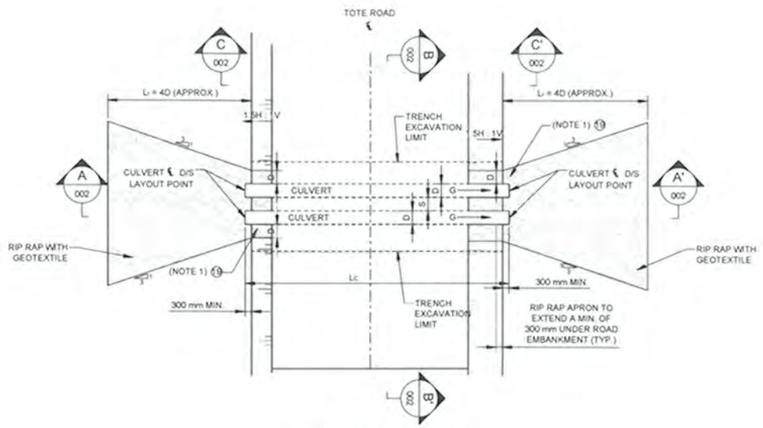
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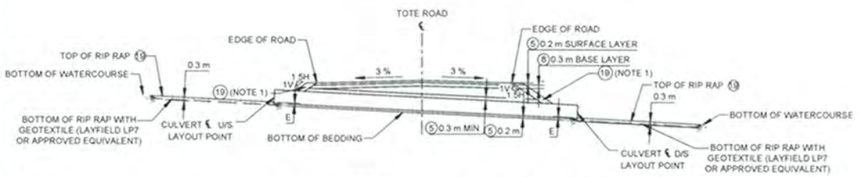
TITLE
TITLE SHEET - CV001

PROJECT NO.	PHASE	REV.	1 of 4	DRAWING
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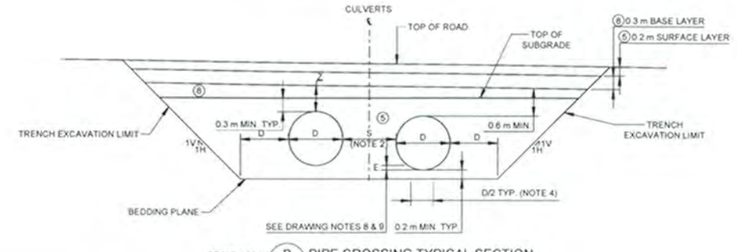
Reduced Size
NOT TO SCALE



PIPE CROSSING PLAN VIEW
SCALE 1:200 m



SCALE 1:200 m (A / 002) PIPE CROSSING TYPICAL PROFILE



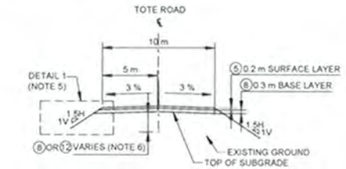
SCALE 1:50 m (B / 002) PIPE CROSSING TYPICAL SECTION

LEGEND

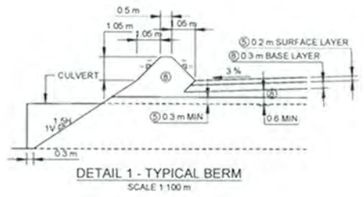
(5)	SCREENED MATERIAL	(12)	RUN OF QUARRY (ROQ)
(8)	JAW RUN	(19)	EROSION PROTECTION

DRAWING NOTES

1. EROSION PROTECTION SHALL BE PLACED AROUND THE CULVERT INLET AND OUTLET AS PER THE DIRECTION OF THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
2. THE MINIMUM SPACING (S) BETWEEN CULVERTS SHALL BE D, WHERE D IS THE CULVERT DIAMETER, OR 1.5 m, WHICHEVER IS GREATER.
3. THE MINIMUM COVER DEFINED AS THE DISTANCE BETWEEN THE TOP OF CULVERT TO THE TOP OF SUBGRADE SHALL BE 0.6 m OR D/4, WHERE D IS THE CULVERT DIAMETER, WHICHEVER IS GREATER.
4. THE BEDDING TO BE SHAPED TO RECEIVE PIPE.
5. SAFETY BERMS ARE REQUIRED FOR EMBANKMENTS GREATER THAN 3 m IN HEIGHT.
6. FOR EMBANKMENT FILL DEPTHS LESS THAN 0.6 m, TYPE 8 MATERIAL SHALL BE USED. FOR FILL DEPTHS GREATER THAN 0.6 m, AND DEPENDING ON THE FILL EXTENTS, TYPE 12 MATERIAL MAY BE USED.
7. DEFINITIONS AND VALUES OF D,Lc,Lr, AND G CAN BE FOUND IN DESIGN TABLES ON DRAWING 003.
8. FOR FISH BEARING CULVERT WITH MULTIPLE PIPES, ONLY ONE SHALL BE EMBEDDED BY "E" AND ALL OTHER PIPES SHALL BE PLACED ON GROUND / BOTTOM OF WATER COURSE.
9. AS PER CULVERT DETAILS [DWG 003]FOR FISH BEARING CULVERT, E = 0.1 D. FOR NON-FISH BEARING CULVERT E=0.



SCALE 1:200 m (C / 002) EMBANKMENT SECTION



DETAIL 1 - TYPICAL BERM
SCALE 1:100 m

GENERAL CONSTRUCTION NOTES

1. IT IS THE RESPONSIBILITY OF THE USER OF THIS DRAWING TO ENSURE THE USE OF ITS MOST RECENT REVISION.
2. THE INFORMATION PROVIDED ON THE DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE MOST RECENT REVISION OF THE SPECIFICATIONS AND REPORT LISTED ON DWG. 001.
3. IN THE EVENT OF DISCREPANCY BETWEEN THE DRAWINGS AND THE SPECIFICATIONS CLARIFICATION AND/OR DIRECTION SHALL BE PROVIDED AS OUTLINED IN THE SPECIFICATIONS.
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6. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED.
7. COORDINATE SYSTEM IS UTM (NAD 83) ZONE 17N.
8. CONTOUR INTERVAL IS 1 M WITH EXISTING TOPOGRAPHY.
9. THE DESIGN OF EACH INSTALLATION ARE BASED ON A DESK STUDY USING A DIGITAL ELEVATION MODEL AND SATELLITE IMAGERY PROVIDED BY BAFFINLAND, AND ARE NOT SUPPORTED BY FIELD STUDY.
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11. A DECISION ON WHETHER TO EXTEND OR REPLACE EACH CULVERT WILL BE MADE BY THE OWNER'S REPRESENTATIVE.
12. FIELD FITTING OF CULVERTS (INCLUDING LOCATIONS, LENGTHS, INVERT DEPTHS, GRADIENTS, AND SKEWS) TO ACTUAL CONDITIONS AT EACH SITE SHALL BE AS DIRECTED BY THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
13. FILL MATERIALS SHALL BE HANDLED, SORTED, PLACED AND COMPACTED AS SHOWN ON THE DRAWINGS, DESCRIBED IN THE SPECIFICATIONS AND TO THE SATISFACTION OF THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
14. NO GEOTECHNICAL OR STRUCTURAL ANALYSIS OF THE CULVERT INSTALLATIONS HAS **BEEN CARRIED OUT. A MINIMUM CULVERT COVER OF 0.6 m OR D/4 (WHERE D IS THE** DIAMETER OF THE CIRCULAR CULVERT PIPE) HAS BEEN ASSUMED TO BE APPROPRIATE FOR 10 TONNE AXLE LOADS; USE OF HEAVIER TRUCKS WILL REQUIRE STRUCTURAL ANALYSIS OF THE CULVERT INSTALLATION.
15. FISH BEARING STATUS IN CULVERT DETAILS TABLE ON DWG. 003 TAKEN FROM HATCH TOTE ROAD CULVERT DATA SHEETS H349000-3000-10-088-0030 THROUGH H349000-3000-10-088-0034.
16. NO HYDROLOGIC OR HYDRAULIC ANALYSIS WAS CARRIED OUT. NUMBER OF CULVERTS, CULVERT DIAMETER(S), CULVERT LENGTH(S), EMBEDMENT DEPTH (E), AND REQUIREMENTS FOR RIP RAP FROM HATCH TOTE ROAD CULVERT DATA SHEETS H349000-3000-10-088-0030 THROUGH H349000-3000-10-088-0034.
17. IN SECTIONS, SKEWED CULVERTS ARE PROJECTED ONTO PLANE OF CROSS-SECTIONS.
18. AT LIMITS OF CONSTRUCTION NEW PAVEMENT THICKNESS NEEDS TO BE TAPERED TO MATCH EXISTING PAVEMENT SURFACE.
19. THE OWNER'S REPRESENTATIVE WILL CONFIRM THE REQUIREMENT FOR SAFETY BERMS ALONG THE ROAD EDGES BASED ON ENCOUNTERED FIELD CONDITIONS. TYPICAL BERM DETAILS ARE SHOWN ON DWG. 002.
20. SITE SPECIFIC NOTES ON DWG. 003 MUST BE READ IN CONJUNCTION WITH THESE GENERAL NOTES, AND THE SPECIFICATIONS AND DRAWINGS LISTED ON DWG. 001.
21. BAFFINLAND IS RESPONSIBLE FOR PERMITTING OF THE PROPOSED WORKS (IF REQUIRED).
22. PRIOR TO CONSTRUCTION, BAFFINLAND'S ENVIRONMENTAL REPRESENTATIVE WILL BE CONSULTED TO APPROVE THE REQUIRED EROSION CONTROL AND MITIGATION MEASURES ADJACENT TO WATER BODIES.



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2	2017-04-03	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 1 / REPORT REV. 0	JJL	CK/RAD	MJT	RAD
1	2017-03-24	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 0	JJL	CK/RAD	MJT	RAD
0	2017-03-09	ISSUED FOR CONSTRUCTION	JJL	CK/RAD	MJT	RAD
A	2017-02-24	ISSUED FOR CLIENT REVIEW	JJL	CK/RAD	MJT	RAD

PERMIT-TO-PRACTICE GOLDER ASSOCIATES LTD.
Signature
Date 17-04-03
PERMIT NUMBER: P 049
NT/NU Association of Professional Engineers and Geoscientists

REGISTERED PROFESSIONAL ENGINEER
R.A. DOUGLAS
LICENSEE
2017-04-03
NUNAVUT

Baffinland
CONSULTANT

Golder Associates

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MISSISSAUGA, ON
CANADA
905-567-4444
www.golder.com

PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

TITLE
TYPICAL DETAILS AND GENERAL NOTES - CV001

PROJECT NO	PHASE	REV	2 of 4	DRAWING
1667708	3000	2		002

Reduced Size
NOT TO SCALE

CULVERT DETAILS†																
STATION (m)	FISH BEARING STATUS (REFER TO NOTE 15 ON DWG. 002)	EXISTING CULVERT DIAMETER (D) (mm) (REFER TO NOTE 16 ON DWG. 002)	EXISTING CULVERT LENGTH (m) (REFER TO NOTE 16 ON DWG. 002)	EXISTING CULVERT GRADIENT (%) (REFER TO NOTE 16 ON DWG. 002)	EMBEDMENT DEPTH (E) (mm) (REFER TO NOTE 16 ON DWG. 002)	PROPOSED CULVERT LENGTH (m)	DEPTH FROM SUBGRADE TO TOP OF CULVERT AT CENTRELINE OF ROAD (Z) (m)	EASTING OF CENTRELINE OF PIPE AT CENTRELINE OF ROAD (m)	NORTHING OF CENTRELINE OF PIPE AT CENTRELINE OF ROAD (m)	INLET INVERT ELEVATION (m)	OUTLET INVERT ELEVATION (m)	CULVERT GRADIENT (G) (%)	CULVERT SKEW (deg)	INLET RIP RAP REQUIRED?	OUTLET RIP RAP REQUIRED?	RIP RAP APRON LENGTH (Lr) (m)
0+087.4	POTENTIAL	1000	15	1.16	100	18.5	0.8	553539.1	7914904.2	167.3	167.1	1	115	N	N	
0+089.9	POTENTIAL	500	15	1.61	50	18.5	1.4	553542.4	7914902.5	167.3	167.1	1	115	N	N	

†CULVERT LOCATION DETAILS ARE BASED ON A DESK STUDY USING A DIGITAL ELEVATION MODEL AND SATELLITE IMAGERY PROVIDED BY BAFFINLAND, AND ARE NOT SUPPORTED BY FIELD STUDY (REFER TO GENERAL CONSTRUCTION NOTE 12 ON DWG. 002)

SITE SPECIFIC NOTES FOR CULVERT CV001

AS INDICATED IN THE GENERAL CONSTRUCTION NOTES ON DWG. 002, THE SITE SPECIFIC NOTES ARE BASED ONLY ON A DESKTOP STUDY OF THE SITE; NO FIELD WORK WAS CARRIED OUT TO SUPPORT THIS WORK. AN INSPECTION OF THE SITE SHALL BE CARRIED OUT BY THE OWNER'S REPRESENTATIVE AND/OR GEOTECHNICAL ENGINEER PRIOR TO CONSTRUCTION. THE SITE SPECIFIC NOTES ARE INTENDED TO BE COMPREHENSIVE BUT NOT ALL-INCLUSIVE.

1. **RAISE THE ROAD EMBANKMENT TO PROVIDE ADEQUATE COVER. WIDEN THE ROAD RUNNING SURFACE TO A MINIMUM WIDTH OF 10 m, MAINTAINING THE ROAD EMBANKMENT SIDE SLOPES NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL).**
2. CAP THE ROAD SURFACE WITH SUITABLE RUNNING SURFACE MATERIAL (SEE TYPICAL SECTION ON DWG. 002).
3. EXTEND OR REPLACE CULVERTS (REFER TO GENERAL CONSTRUCTION NOTE 11). IF EXTENDING, CLEAR SEDIMENT FROM EXISTING CULVERTS.
4. PROVIDE RIP RAP PROTECTION AT THE CULVERT INLET AND OUTLET.
5. MARK THE CULVERT ENDS WITH DELINEATORS OF SUFFICIENT SIZE AND HEIGHT TO REDUCE THE RISK OF DAMAGE TO THE CULVERT PIPE ENDS BY SNOW PLOWING, SIDE SLOPING, OR OTHER MAINTENANCE OPERATIONS.

ROAD LAYOUT DETAILS							
STATION (m)	TOP OF SUBGRADE			CENTRELINE CUT DEPTH* (TOP OF SUBGRADE TO EXISTING ROAD SURFACE) (m)	TOE OF EMBANKMENT SLOPE		
	CENTRELINE EASTING (m)	CENTRELINE NORTHING (m)	CENTRELINE ELEVATION (m)		OFFSET TO LEFT TOE** (m)	OFFSET TO RIGHT TOE** (m)	GRADIENT TO NEXT POINT (%)
0+000.0	553469.8	7914955.5	167.7	-0.1	5.2	5.1	-0.1
0+013.5	553480.4	7914947.1	167.7	-0.2	6.0	7.3	0.2
0+020.0	553485.5	7914943.1	167.7	-0.3	6.0	6.7	1.3
0+040.0	553501.8	7914931.4	168	-0.6	6.6	6.8	2.4
0+046.8	553507.3	7914927.4	168.1	-0.8	6.8	7.2	2.7
0+060.0	553518	7914919.7	168.5	-1.2	7.4	7.7	2.7
0+069.1	553525.3	7914914.4	168.7	-1.3	7.8	7.9	2.1
0+079.6	553533.8	7914908.3	169	-1.1	8.2	8.2	1.5
0+080.0	553534.2	7914908	169	-1.1	8.2	8.2	1.1
0+085.9	553539.1	7914904.7	169	-0.9	8.2	7.6	0.7
0+087.4	553540.3	7914903.9	169	-0.9	8.1	7.6	0.5
0+089.9	553542.4	7914902.5	169.1	-1	8.3	7.5	-0.2
0+100.0	553550.9	7914897	169	-1	8.3	7.6	-1.3
0+109.7	553559	7914891.7	168.9	-1	7.8	7.6	-1.8
0+113.3	553562	7914889.8	168.8	-1	7.5	7.6	-1.8
0+120.0	553567.7	7914886.2	168.7	-0.9	7.4	7.5	-1.8
0+140.0	553585.7	7914877.6	168.4	-0.4	6.3	6.9	-1.8
0+143.4	553588.9	7914876.4	168.3	-0.3	6.2	6.7	-1.1
0+160.0	553604.9	7914871.8	168.1	-0.2	5.8	6.5	0.0
0+169.6	553614.3	7914870.1	168.1	-0.1	5.9	6.4	0.4
0+180.0	553624.6	7914869	168.1	-0.2	5.9	6.4	0.4
0+200.0	553644.6	7914869.2	168.2	-0.2	5.9	6.2	0.4
0+200.1	553644.7	7914869.3	168.2	-0.2	5.9	6.2	0.4
0+216.2	553660.7	7914870.7	168.3	-0.1	5.2	5.3	

* NEGATIVE CUT DEPTH DENOTES FILL
** MEASURED ON GROUND SURFACE

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PERMIT TO PRACTICE
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Signature
Date 2017-04-03
PERMIT NUMBER: P 049
NT/NU Association of Professional Engineers and Geoscientists

REGISTERED PROFESSIONAL ENGINEER
R.A. DOUGLAS
LICENSEE
17-04-03
NWT/NU

CLIENT: Baffinland

CONSULTANT: Golder Associates

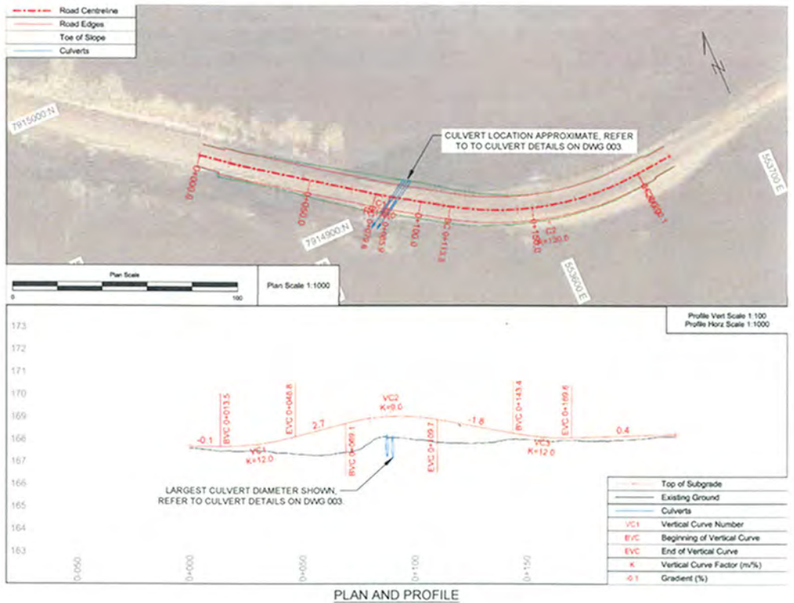
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MISSISSAUGA, ON
CANADA
905-567-4444
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PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

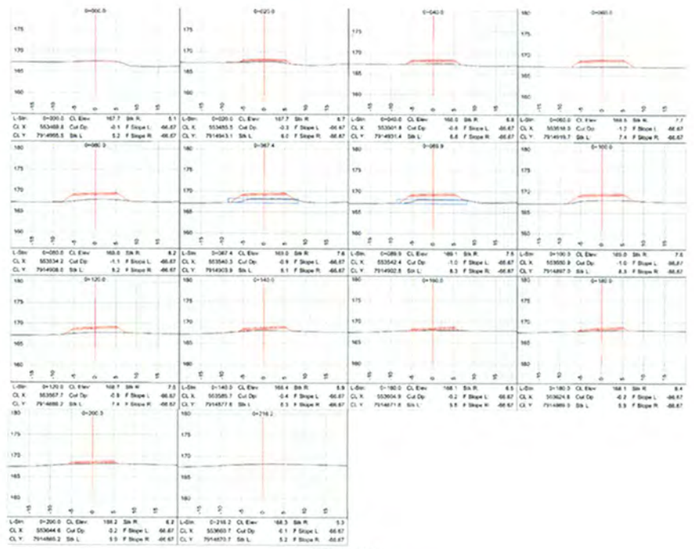
TITLE
CULVERT INSTALLATION DESIGN RECOMMENDATIONS & DESIGN TABLES - CV001

PROJECT NO	PHASE	REV	3 of 4	DRAWING
1667708	3000	2		003

Reduced Size
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PLAN AND PROFILE



SECTIONS
(REFER TO GENERAL CONSTRUCTION NOTE 17)

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R.A. DOUGLAS
LICENSEE
2017-04-03
NORTHWEST TERRITORIES AND NUNAVUT

Baffinland

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PROJECT
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TOTE ROAD EARTHWORKS

TITLE
ROAD PLAN, PROFILE AND SECTIONS - CV001

PROJECT NO	PHASE	REV	4 of 4	DRAWING
1667708	3000	2		004

Reduced Size
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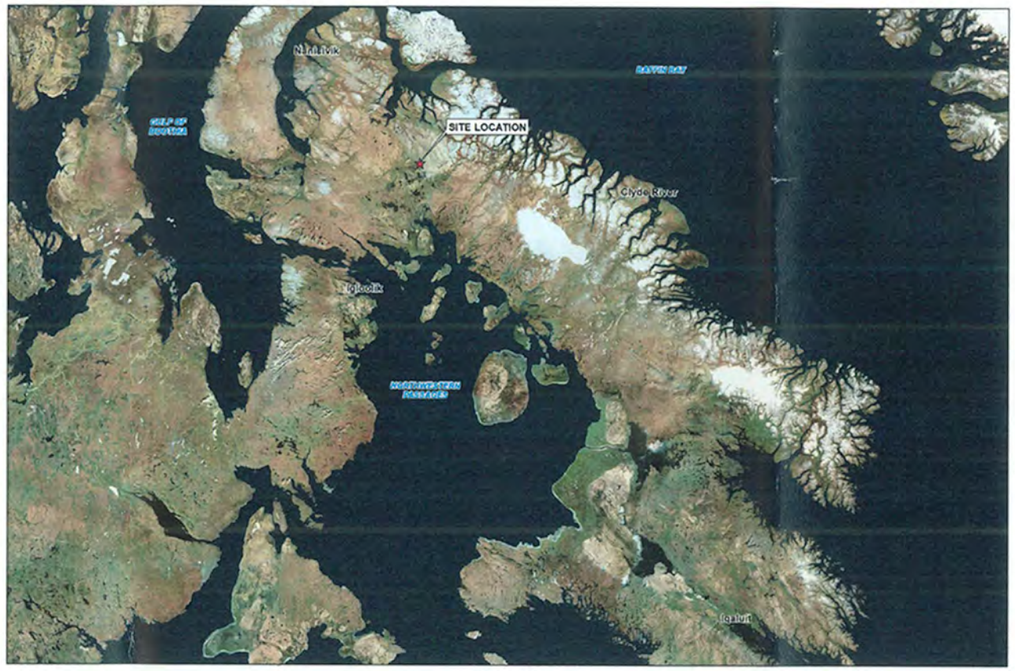
BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT
TOTE ROAD EARTHWORKS
CV046 A&B

INDEX OF DRAWINGS		
DRAWING NO.	DRAWING SHEET TITLE	REVISION NO.
001	TITLE SHEET - CV046 A&B	2
002	PIPE CROSSING TYPICAL DETAILS & GENERAL NOTES - CV046 A&B	2
003	CULVERT INSTALLATION DESIGN RECOMMENDATIONS & DESIGN TABLES - CV046 A&B	2
004	ROAD PLAN, PROFILE AND SECTIONS - CV046 A&B	2

SPECIFICATIONS		
SPECIFICATION NO.	SPECIFICATION TITLE	REVISION NO.
1667708-S	TOTE ROAD EARTHWORKS	1

DESIGN REPORT		
REPORT NO.	REPORT TITLE	REVISION NO.
1667708	TOTE ROAD EARTHWORKS	0



KEY PLAN
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REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
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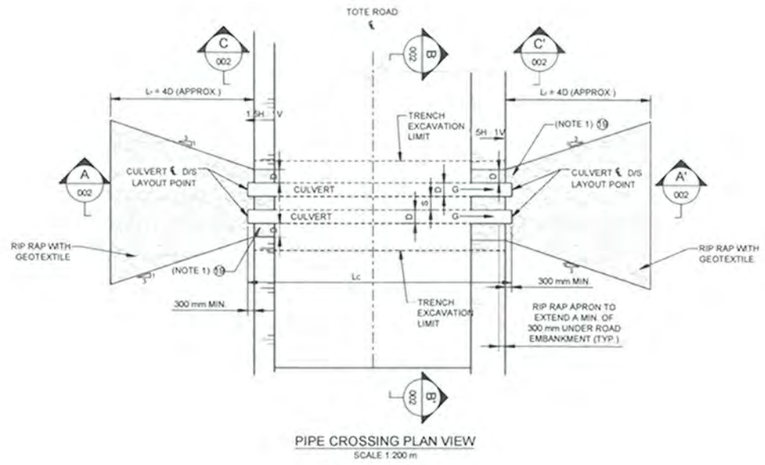
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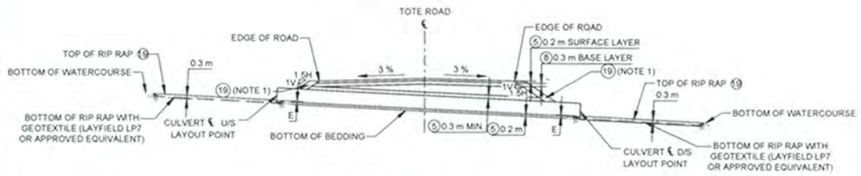
TITLE
TITLE SHEET - CV046 A&B

PROJECT NO	PHASE	REV	1 of 4	DRAWING
1667708	3000	2		001

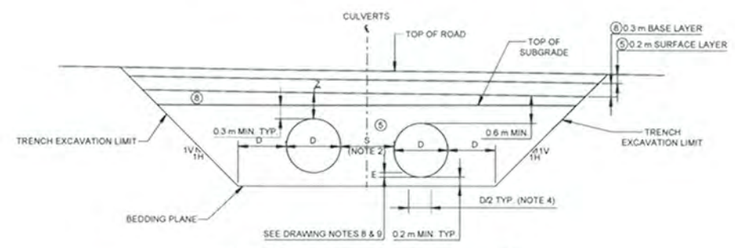
Reduced Size
NOT TO SCALE



PIPE CROSSING PLAN VIEW
SCALE 1:200 m



SCALE 1:200 m (A 002) PIPE CROSSING TYPICAL PROFILE



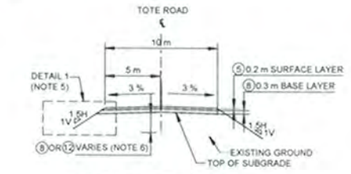
SCALE 1:50 m (B 002) PIPE CROSSING TYPICAL SECTION

LEGEND

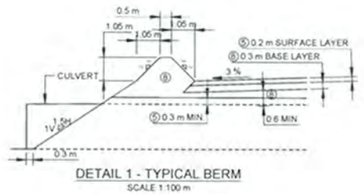
(5)	SCREENED MATERIAL	(12)	RUN OF QUARRY (ROQ)
(8)	JAW RUN	(19)	EROSION PROTECTION

DRAWING NOTES

1. EROSION PROTECTION SHALL BE PLACED AROUND THE CULVERT INLET AND OUTLET AS PER THE DIRECTION OF THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
2. THE MINIMUM SPACING (S) BETWEEN CULVERTS SHALL BE D, WHERE D IS THE CULVERT DIAMETER, OR 1.5 m, WHICHEVER IS GREATER.
3. THE MINIMUM COVER DEFINED AS THE DISTANCE BETWEEN THE TOP OF CULVERT TO THE TOP OF SUBGRADE SHALL BE 0.6 m OR D/4, WHERE D IS THE CULVERT DIAMETER, WHICHEVER IS GREATER.
4. THE BEDDING TO BE SHAPED TO RECEIVE PIPE.
5. SAFETY BERMS ARE REQUIRED FOR EMBANKMENTS GREATER THAN 3 m IN HEIGHT.
6. FOR EMBANKMENT FILL DEPTHS LESS THAN 0.6 m, TYPE 8 MATERIAL SHALL BE USED. FOR FILL DEPTHS GREATER THAN 0.6 m, AND DEPENDING ON THE FILL EXTENTS, TYPE 12 MATERIAL MAY BE USED.
7. DEFINITIONS AND VALUES OF D,Lc,Lr, AND G CAN BE FOUND IN DESIGN TABLES ON DRAWING 003.
8. FOR FISH BEARING CULVERT WITH MULTIPLE PIPES, ONLY ONE SHALL BE EMBEDDED BY "E" AND ALL OTHER PIPES SHALL BE PLACED ON GROUND / BOTTOM OF WATER COURSE.
9. AS PER CULVERT DETAILS (DWG 003)FOR FISH BEARING CULVERT, E = 0.1 D. FOR NON-FISH BEARING CULVERT E=0.



SCALE 1:200 m (C 002) EMBANKMENT SECTION



DETAIL 1 - TYPICAL BERM
SCALE 1:100 m

GENERAL CONSTRUCTION NOTES

1. IT IS THE RESPONSIBILITY OF THE USER OF THIS DRAWING TO ENSURE THE USE OF ITS MOST RECENT REVISION.
2. THE INFORMATION PROVIDED ON THE DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE MOST RECENT REVISION OF THE SPECIFICATIONS AND REPORT LISTED ON DWG. 001.
3. IN THE EVENT OF DISCREPANCY BETWEEN THE DRAWINGS AND THE SPECIFICATIONS, CLARIFICATION AND/OR DIRECTION SHALL BE PROVIDED AS OUTLINED IN THE SPECIFICATIONS.
4. PRIOR TO COMMENCING CONSTRUCTION ACTIVITIES, THE CONTRACTOR SHALL BE FAMILIAR WITH THE SCOPE OF WORK.
5. THE INFORMATION PRESENTED ON THESE DRAWINGS IS INTENDED TO CONVEY THE PIPE CROSSING CONSTRUCTION DETAILS AND ROAD EMBANKMENT DETAILS.
6. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED.
7. COORDINATE SYSTEM IS UTM (NAD 83) ZONE 17N.
8. CONTOUR INTERVAL IS 1 M WITH EXISTING TOPOGRAPHY.
9. THE DESIGN OF EACH INSTALLATION ARE BASED ON A DESK STUDY USING A DIGITAL ELEVATION MODEL AND SATELLITE IMAGERY PROVIDED BY BAFFINLAND, AND ARE NOT SUPPORTED BY FIELD STUDY.
10. THE GROUND SURFACE ELEVATIONS ARE CONSIDERED TO BE APPROXIMATE.
11. A DECISION ON WHETHER TO EXTEND OR REPLACE EACH CULVERT WILL BE MADE BY THE OWNER'S REPRESENTATIVE.
12. FIELD FITTING OF CULVERTS (INCLUDING LOCATIONS, LENGTHS, INVERT DEPTHS, GRADIENTS, AND SKEWS) TO ACTUAL CONDITIONS AT EACH SITE SHALL BE AS DIRECTED BY THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
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14. NO GEOTECHNICAL OR STRUCTURAL ANALYSIS OF THE CULVERT INSTALLATIONS HAS **BEEN CARRIED OUT. A MINIMUM CULVERT COVER OF 0.6 m OR D/4 (WHERE D IS THE** DIAMETER OF THE CIRCULAR CULVERT PIPE) HAS BEEN ASSUMED TO BE APPROPRIATE FOR 10 TONNE AXLE LOADS. USE OF HEAVIER TRUCKS WILL REQUIRE STRUCTURAL ANALYSIS OF THE CULVERT INSTALLATION.
15. FISH BEARING STATUS IN CULVERT DETAILS TABLE ON DWG. 003 TAKEN FROM HATCH TOTE ROAD CULVERT DATA SHEETS H349000-3000-10-088-0030 THROUGH H349000-3000-10-088-0034.
16. NO HYDROLOGIC OR HYDRAULIC ANALYSIS WAS CARRIED OUT. NUMBER OF CULVERTS, CULVERT DIAMETER(S), CULVERT LENGTH(S), EMBEDMENT DEPTH (E), AND REQUIREMENTS FOR RIP RAP FROM HATCH TOTE ROAD CULVERT DATA SHEETS H349000-3000-10-088-0030 THROUGH H349000-3000-10-088-0034.
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18. AT LIMITS OF CONSTRUCTION NEW PAVEMENT THICKNESS NEEDS TO BE TAPERED TO MATCH EXISTING PAVEMENT SURFACE.
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0 2 4
1:50 METRES

0 5 10
1:100 METRES

0 10 20
1:200 METRES

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PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

TITLE
TYPICAL DETAILS AND GENERAL NOTES - CV046 A&B

PROJECT NO.	PHASE	REV.	2 of 4	DRAWING
1667708	3000	2		002

Reduced Size
NOT TO SCALE

CULVERT DETAILS1

STATION (m)	FISH BEARING STATUS (REFER TO NOTE 15 ON DWG. 002)	EXISTING CULVERT DIAMETER (D) (mm) (REFER TO NOTE 16 ON DWG. 002)	EXISTING CULVERT LENGTH (m) (REFER TO NOTE 16 ON DWG. 002)	EXISTING CULVERT GRADIENT (%) (REFER TO NOTE 16 ON DWG. 002)	EMBEDMENT DEPTH (E) (mm) (REFER TO NOTE 16 ON DWG. 002)	PROPOSED CULVERT LENGTH (m)	DEPTH FROM SUBGRADE TO TOP OF CULVERT AT CENTRELINE OF ROAD (Z) (m)	EASTING OF CENTRELINE OF PIPE AT CENTRELINE OF ROAD (m)	NORTHING OF CENTRELINE OF PIPE AT CENTRELINE OF ROAD (m)	INLET INVERT ELEVATION (m)	OUTLET INVERT ELEVATION (m)	CULVERT GRADIENT (G) (%)	CULVERT SKEW (deg)	INLET RIP RAP REQUIRED?	OUTLET RIP RAP REQUIRED?	RIP RAP APRON LENGTH (Lr) (m)
0+103.3	POTENTIAL	500	15	4.39		49	1.2	531695.1	7924264.4	236.0	235.1	2	142	N	N	
0+107.3	POTENTIAL	500	15	5.32	50	49	1.4	531695.0	7924260.4	236.0	235.1	2	141	N	Y	2
0+111.3	POTENTIAL	1000	15	8.63	100	49	1	531694.9	7924256.4	236.0	235.1	2	140	N	Y	4
0+115.3	POTENTIAL	500	15	5.26	50	49	1.7	531694.6	7924252.4	236.1	235.1	2	139	N	Y	2
0+119.3	POTENTIAL	500	15	4.97	50	49	1.9	531694.3	7924248.4	236.1	235.1	2	139	N	Y	2

1CULVERT LOCATION DETAILS ARE BASED ON A DESK STUDY USING A DIGITAL ELEVATION MODEL AND SATELLITE IMAGERY PROVIDED BY BAFFINLAND, AND ARE NOT SUPPORTED BY FIELD STUDY (REFER TO GENERAL CONSTRUCTION NOTE 12 ON DWG. 002).

SITE SPECIFIC NOTES FOR CULVERT CV046 A&B

AS INDICATED IN THE GENERAL CONSTRUCTION NOTES ON DWG. 002, THE SITE SPECIFIC NOTES ARE BASED ONLY ON A DESKTOP STUDY OF THE SITE; NO FIELD WORK WAS CARRIED OUT TO SUPPORT THIS WORK. AN INSPECTION OF THE SITE SHALL BE CARRIED OUT BY THE OWNER'S REPRESENTATIVE AND/OR GEOTECHNICAL ENGINEER PRIOR TO CONSTRUCTION. THE SITE SPECIFIC NOTES ARE INTENDED TO BE COMPREHENSIVE BUT NOT ALL-INCLUSIVE.

1. **ADD/ SHAPE EMBANKMENT FILL TO FLATTEN THE ROAD EMBANKMENT SIDE SLOPES TO NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL), MAINTAINING THE ROAD RUNNING SURFACE WIDTH A MINIMUM OF 10 m.**
2. **RAISE THE ROAD EMBANKMENT TO PROVIDE ADEQUATE COVER, MAINTAINING THE ROAD EMBANKMENT SIDE SLOPES NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL).**
3. CAP THE ROAD SURFACE WITH SUITABLE RUNNING SURFACE MATERIAL (SEE TYPICAL SECTION ON DWG. 002).
4. PROVIDE RIP RAP PROTECTION AT THE CULVERT INLET AND OUTLET.
5. THE CULVERT MAY BE PERCHED. REINSTALL CULVERT.
6. MARK THE CULVERT ENDS WITH DELINEATORS OF SUFFICIENT SIZE AND HEIGHT TO REDUCE THE RISK OF DAMAGE TO THE CULVERT PIPE ENDS BY SNOW PLOWING, SIDE SLOPING, OR OTHER MAINTENANCE OPERATIONS.

ROAD LAYOUT DETAILS

STATION (m)	TOP OF SUBGRADE			CENTRELINE CUT DEPTH* (TOP OF SUBGRADE TO EXISTING ROAD SURFACE) (m)	TOE OF EMBANKMENT SLOPE		
	CENTRELINE EASTING (m)	CENTRELINE NORTHING (m)	CENTRELINE ELEVATION (m)		OFFSET TO LEFT TOE** (m)	OFFSET TO RIGHT TOE** (m)	GRADIENT TO NEXT POINT (%)
0+000.0	531656.3	7924357.8	233.7	-0.4	5.2	5.3	1.3
0+008.8	531661.5	7924350.8	233.8	-0.3	5.3	5.3	1.7
0+020.0	531668.2	7924341.7	234	-0.3	6.3	6	2.3
0+022.2	531669.6	7924339.9	234.1	-0.4	6.4	6	3.1
0+040.0	531679.1	7924325	234.6	-0.7	7.1	6.2	4.6
0+058.2	531686.7	7924308.4	235.5	-0.4	8.1	6	5.4
0+060.0	531687.3	7924306.8	235.6	-0.4	8.1	6	5.4
0+060.2	531687.4	7924306.6	235.6	-0.4	8.1	6	4.5
0+076.6	531692	7924290.8	236.3	-0.3	6.7	6	3.6
0+080.0	531692.7	7924287.5	236.5	-0.3	6.2	6.1	3.6
0+100.0	531695	7924267.7	237.2	-0.4	6.4	6	3.6
0+101.0	531695	7924266.7	237.2	-0.4	6.4	6.1	3.7
0+103.3	531695.1	7924264.4	237.3	-0.4	6.5	6.1	3.9
0+107.3	531695.1	7924260.4	237.4	-0.5	6.5	6.2	4.3
0+111.3	531694.9	7924256.4	237.6	-0.5	6.6	6.4	4.6
0+115.3	531694.7	7924252.4	237.8	-0.6	6.7	6.5	4.8
0+115.9	531694.6	7924251.8	237.8	-0.6	6.7	6.5	4.9
0+119.3	531694.4	7924248.4	238	-0.6	6.7	6.7	5.1
0+120.0	531694.3	7924247.7	238	-0.7	6.7	6.8	5.5
0+127.3	531693.7	7924240.5	238.4	-0.7	6.4	7.6	6.3
0+140.0	531693.3	7924227.7	239.2	-0.5	6.3	7.3	7
0+144.6	531693.4	7924223.1	239.5	-0.5	6.2	6.9	7.2
0+160.0	531695.1	7924207.8	240.7	-0.5	6.9	6.1	7.2
0+160.7	531695.2	7924207.2	240.7	-0.5	6.9	6.1	7.2
0+180.0	531698.6	7924188.1	242.1	-0.2	5.9	6	
0+200.0	531702	7924168.4	243.6	-0.5	6.3	6.1	
0+211.2	531704	7924157.4	244.3	-0.5	5.5	5	

* NEGATIVE CUT DEPTH DENOTES FILL
** MEASURED ON GROUND SURFACE

REV	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2017-04-03	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 1 / REPORT REV. 0	JJL	CK/RAD	MJT	RAD
1	2017-03-24	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 0	JJL	CK/RAD	MJT	RAD
0	2017-03-09	ISSUED FOR CONSTRUCTION	JJL	CK/RAD	MJT	RAD
A	2017-02-24	ISSUED FOR CLIENT REVIEW	JJL	CK/RAD	MJT	RAD

PERMIT TO PRACTICE GOLDER ASSOCIATES LTD.
Signature: [signature]
Date: 17-04-03
PERMIT NUMBER: P 049
NT/NU Association of Professional Engineers and Geoscientists

REGISTERED PROFESSIONAL ENGINEER
R.A. DOUGLAS
CONSULTANT
LICENSEE
2017-04-03
NORTHWEST TERRITORIES AND NUNAVUT

Baffinland

Golder Associates

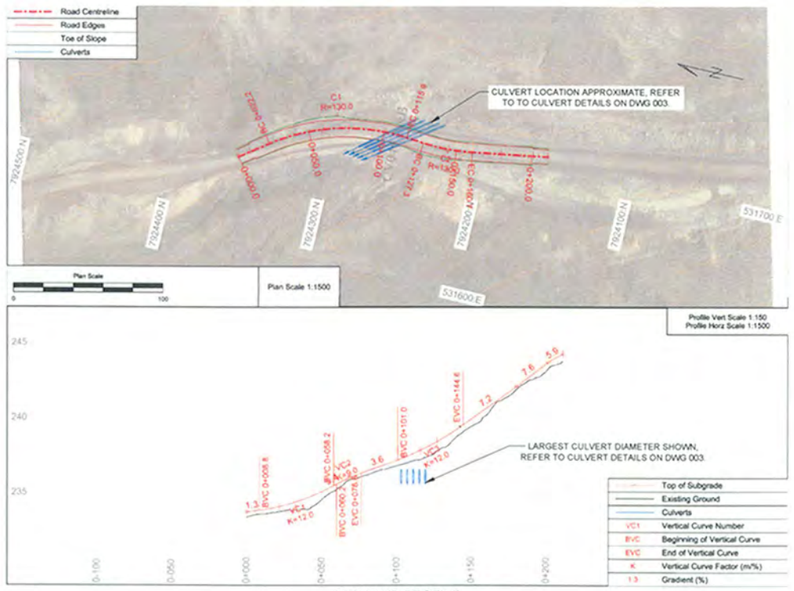
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6925 CENTURY AVENUE, SUITE 100
MISSISSAUGA, ON
CANADA
905-567-4444
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PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

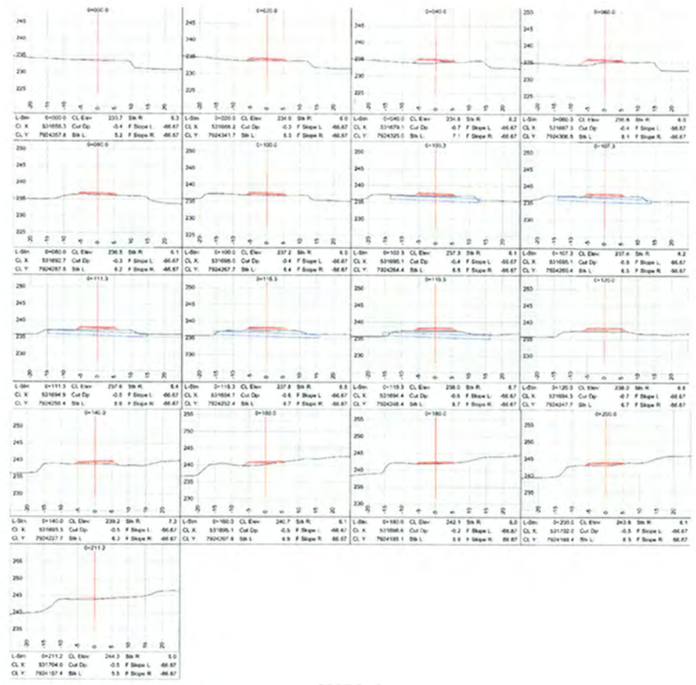
TITLE
CULVERT INSTALLATION DESIGN RECOMMENDATIONS & DESIGN TABLES - CV046 A&B

PROJECT NO	PHASE	REV	3 of 4	DRAWING
1667708	3000	2		003

Reduced Size
NOT TO SCALE



PLAN AND PROFILE



SECTIONS
(REFER TO GENERAL CONSTRUCTION NOTE 17)

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2017-04-03	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 1 / REPORT REV. 0	JJL	CK/RAD	MJT	RAD
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0	2017-03-09	ISSUED FOR CONSTRUCTION	JJL	CK/RAD	MJT	RAD
A	2017-02-24	ISSUED FOR CLIENT REVIEW	JJL	CK/RAD	MJT	RAD

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Baffinland

PROJECT
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TITLE
ROAD PLAN, PROFILE AND SECTIONS - CV046 A&B

PROJECT NO	PHASE	REV	4 of 4	DRAWING
1667708	3000	2		004

Reduced Size
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BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT
TOTE ROAD EARTHWORKS
CV059

INDEX OF DRAWINGS		
DRAWING NO.	DRAWING SHEET TITLE	REVISION NO.
001	TITLE SHEET - CV059	2
002	PIPE CROSSING TYPICAL DETAILS & GENERAL NOTES - CV059	2
003	CULVERT INSTALLATION DESIGN RECOMMENDATIONS & DESIGN TABLES - CV059	2
004	ROAD PLAN, PROFILE AND SECTIONS - CV059	2

SPECIFICATIONS		
SPECIFICATION NO.	SPECIFICATION TITLE	REVISION NO.
1667708-S	TOTE ROAD EARTHWORKS	1

DESIGN REPORT		
REPORT NO.	REPORT TITLE	REVISION NO.
1667706	TOTE ROAD EARTHWORKS	0



KEY PLAN
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REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2017-04-03	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 1 / REPORT REV. 0	CK/RAD	JJL	MJT	RAD
1	2017-03-24	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 0	CK/RAD	JJL	MJT	RAD
0	2017-03-10	ISSUED FOR CONSTRUCTION	CK/RAD	JJL	MJT	RAD
A	2017-03-08	ISSUED FOR CLIENT REVIEW	CK/RAD	JJL	MJT	RAD

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Baffinland
CONSULTANT

Golder Associates

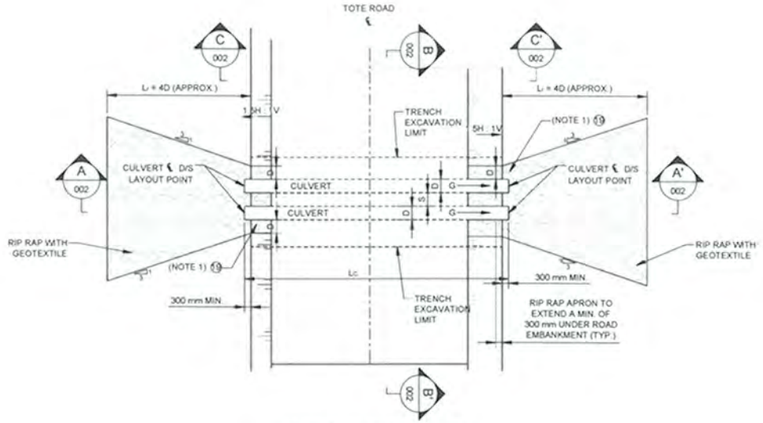
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PROJECT
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TOTE ROAD EARTHWORKS

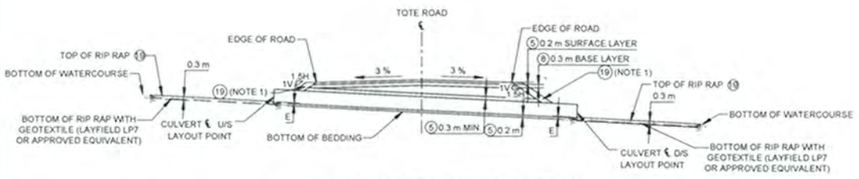
TITLE
TITLE SHEET - CV059

PROJECT NO	PHASE	REV	1 of 4	DRAWING
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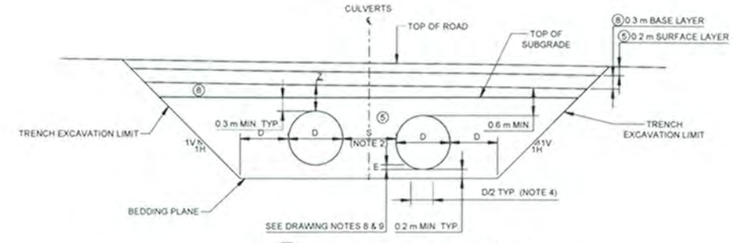
Reduced Size
NOT TO SCALE



PIPE CROSSING PLAN VIEW
SCALE 1:200 m



SCALE 1:200 m (A, 002) PIPE CROSSING TYPICAL PROFILE



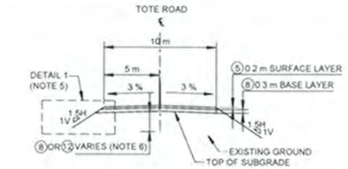
SCALE 1:50 m (B, 002) PIPE CROSSING TYPICAL SECTION

LEGEND

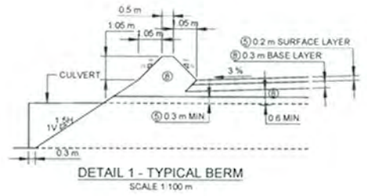
(5)	SCREENED MATERIAL	(12)	RUN OF QUARRY (ROQ)
(8)	JAW RUN	(19)	EROSION PROTECTION

DRAWING NOTES

1. EROSION PROTECTION SHALL BE PLACED AROUND THE CULVERT INLET AND OUTLET AS PER THE DIRECTION OF THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
2. THE MINIMUM SPACING (S) BETWEEN CULVERTS SHALL BE D, WHERE D IS THE CULVERT DIAMETER, OR 1.5 m, WHICHEVER IS GREATER.
3. THE MINIMUM COVER DEFINED AS THE DISTANCE BETWEEN THE TOP OF CULVERT TO THE TOP OF SUBGRADE SHALL BE 0.6 m OR D/4, WHERE D IS THE CULVERT DIAMETER, WHICHEVER IS GREATER.
4. THE BEDDING TO BE SHAPED TO RECEIVE PIPE.
5. SAFETY BERMS ARE REQUIRED FOR EMBANKMENTS GREATER THAN 3 m IN HEIGHT.
6. FOR EMBANKMENT FILL DEPTHS LESS THAN 0.6 m, TYPE 8 MATERIAL SHALL BE USED. FOR FILL DEPTHS GREATER THAN 0.6 m, AND DEPENDING ON THE FILL EXTENTS, TYPE 12 MATERIAL MAY BE USED.
7. DEFINITIONS AND VALUES OF D,L_c,L_r, AND G CAN BE FOUND IN DESIGN TABLES ON DRAWING 003.
8. FOR FISH BEARING CULVERT WITH MULTIPLE PIPES, ONLY ONE SHALL BE EMBEDDED BY "E" AND ALL OTHER PIPES SHALL BE PLACED ON GROUND / BOTTOM OF WATER COURSE.
9. AS PER CULVERT DETAILS (DWG 003)FOR FISH BEARING CULVERT, E = 0.1 D. FOR NON-FISH BEARING CULVERT E=0.



SCALE 1:200 m (C, 002) EMBANKMENT SECTION



DETAIL 1 - TYPICAL BERM
SCALE 1:100 m

GENERAL CONSTRUCTION NOTES

1. IT IS THE RESPONSIBILITY OF THE USER OF THIS DRAWING TO ENSURE THE USE OF ITS MOST RECENT REVISION.
2. THE INFORMATION PROVIDED ON THE DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE MOST RECENT REVISION OF THE SPECIFICATIONS AND REPORT LISTED ON DWG. 001.
3. IN THE EVENT OF DISCREPANCY BETWEEN THE DRAWINGS AND THE SPECIFICATIONS CLARIFICATION AND/OR DIRECTION SHALL BE PROVIDED AS OUTLINED IN THE SPECIFICATIONS.
4. PRIOR TO COMMENCING CONSTRUCTION ACTIVITIES, THE CONTRACTOR SHALL BE FAMILIAR WITH THE SCOPE OF WORK.
5. THE INFORMATION PRESENTED ON THESE DRAWINGS IS INTENDED TO CONVEY THE PIPE CROSSING CONSTRUCTION DETAILS AND ROAD EMBANKMENT DETAILS.
6. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED.
7. COORDINATE SYSTEM IS UTM (NAD 83) ZONE 17N.
8. CONTOUR INTERVAL IS 1 M WITH EXISTING TOPOGRAPHY.
9. THE DESIGN OF EACH INSTALLATION ARE BASED ON A DESK STUDY USING A DIGITAL ELEVATION MODEL AND SATELLITE IMAGERY PROVIDED BY BAFFINLAND, AND ARE NOT SUPPORTED BY FIELD STUDY.
10. THE GROUND SURFACE ELEVATIONS ARE CONSIDERED TO BE APPROXIMATE.
11. A DECISION ON WHETHER TO EXTEND OR REPLACE EACH CULVERT WILL BE MADE BY THE OWNER'S REPRESENTATIVE.
12. FIELD FITTING OF CULVERTS (INCLUDING LOCATIONS, LENGTHS, INVERT DEPTHS, GRADIENTS, AND SKEWS) TO ACTUAL CONDITIONS AT EACH SITE SHALL BE AS DIRECTED BY THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
13. FILL MATERIALS SHALL BE HANDLED, SORTED, PLACED AND COMPACTED AS SHOWN ON THE DRAWINGS, DESCRIBED IN THE SPECIFICATIONS AND TO THE SATISFACTION OF THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
14. NO GEOTECHNICAL OR STRUCTURAL ANALYSIS OF THE CULVERT INSTALLATIONS HAS **BEEN CARRIED OUT. A MINIMUM CULVERT COVER OF 0.6 m OR D/4 (WHERE D IS THE** DIAMETER OF THE CIRCULAR CULVERT PIPE) HAS BEEN ASSUMED TO BE APPROPRIATE FOR 10 TONNE AXLE LOADS. USE OF HEAVIER TRUCKS WILL REQUIRE STRUCTURAL ANALYSIS OF THE CULVERT INSTALLATION.
15. FISH BEARING STATUS IN CULVERT DETAILS TABLE ON DWG. 003 TAKEN FROM HATCH TOTE ROAD CULVERT DATA SHEETS H349000-3000-10-088-0030 THROUGH H349000-3000-10-088-0034.
16. NO HYDROLOGIC OR HYDRAULIC ANALYSIS WAS CARRIED OUT. NUMBER OF CULVERTS, CULVERT DIAMETER(S), CULVERT LENGTH(S), EMBEDMENT DEPTH (E), AND REQUIREMENTS FOR RIP RAP FROM HATCH TOTE ROAD CULVERT DATA SHEETS H349000-3000-10-088-0030 THROUGH H349000-3000-10-088-0034.
17. IN SECTIONS, SKEWED CULVERTS ARE PROJECTED ONTO PLANE OF CROSS-SECTIONS.
18. AT LIMITS OF CONSTRUCTION NEW PAVEMENT THICKNESS NEEDS TO BE TAPERED TO MATCH EXISTING PAVEMENT SURFACE.
19. THE OWNER'S REPRESENTATIVE WILL CONFIRM THE REQUIREMENT FOR SAFETY BERMS ALONG THE ROAD EDGES BASED ON ENCOUNTERED FIELD CONDITIONS. TYPICAL BERM DETAILS ARE SHOWN ON DWG 002.
20. SITE SPECIFIC NOTES ON DWG. 003 MUST BE READ IN CONJUNCTION WITH THESE GENERAL NOTES, AND THE SPECIFICATIONS AND DRAWINGS LISTED ON DWG.001.
21. BAFFINLAND IS RESPONSIBLE FOR PERMITTING OF THE PROPOSED WORKS (IF REQUIRED).
22. PRIOR TO CONSTRUCTION, BAFFINLAND'S ENVIRONMENTAL REPRESENTATIVE WILL BE CONSULTED TO APPROVE THE REQUIRED EROSION CONTROL AND MITIGATION MEASURES ADJACENT TO WATER BODIES.

0 2 4
1:50 METRES

0 5 10
1:100 METRES

0 10 20
1:200 METRES

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1	2017-03-24	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 0	CK/RAD	JJL	MJT	RAD
0	2017-03-10	ISSUED FOR CONSTRUCTION	CK/RAD	JJL	MJT	RAD
A	2017-03-08	ISSUED FOR CLIENT REVIEW	CK/RAD	JJL	MJT	RAD

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Date 19-Apr-17
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REGISTERED PROFESSIONAL ENGINEER
R.A. DOUGLAS
LICENSEE
2017-04-03
NORTHWEST TERRITORIES AND NUNAVUT

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PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

TITLE
TYPICAL DETAILS AND GENERAL NOTES - CV059

PROJECT NO.	PHASE	REV.	2 of 4	DRAWING
1667708	3000	2		002

Reduced Size
NOT TO SCALE

CULVERT DETAILS†

STATION (m)	FISH BEARING STATUS (REFER TO NOTE 15 ON DWG. 002)	EXISTING CULVERT DIAMETER (D) (mm) (REFER TO NOTE 16 ON DWG. 002)	EXISTING CULVERT LENGTH (m) (REFER TO NOTE 16 ON DWG. 002)	EXISTING CULVERT GRADIENT (%) (REFER TO NOTE 16 ON DWG. 002)	EMBEDMENT DEPTH (E) (mm) (REFER TO NOTE 16 ON DWG. 002)	PROPOSED CULVERT LENGTH (m)	DEPTH FROM SUBGRADE TO TOP OF CULVERT AT CENTRELINE OF ROAD (Z) (m)	EASTING OF CENTRELINE OF PIPE AT CENTRELINE OF ROAD (m)	NORTHING OF CENTRELINE OF PIPE AT CENTRELINE OF ROAD (m)	INLET INVERT ELEVATION (m)	OUTLET INVERT ELEVATION (m)	CULVERT GRADIENT (G) (%)	CULVERT SKEW (deg)	INLET RIP RAP REQUIRED?	OUTLET RIP RAP REQUIRED?	RIP RAP APRON LENGTH (Lr) (m)
0+099.0	POTENTIAL	500	12	2.44		17	1	528094.4	7929360.7	162.2	161.8	2	70	N	N	
0+101.0	POTENTIAL	500	12	3.23	50	17	1	528095.3	7929358.9	162.2	161.8	2	70	N	N	
0+103.0	POTENTIAL	500	12	1.85	50	17	1	528096.1	7929357.1	162.2	161.8	2	70	N	N	
0+105.0	POTENTIAL	500	12	2.32	50	17	1	528097.0	7929355.3	162.2	161.8	2	70	N	N	

†CULVERT LOCATION DETAILS ARE BASED ON A DESK STUDY USING A DIGITAL ELEVATION MODEL AND SATELLITE IMAGERY PROVIDED BY BAFFINLAND, AND ARE NOT SUPPORTED BY FIELD STUDY (REFER TO GENERAL CONSTRUCTION NOTE 12 ON DWG. 002)

SITE SPECIFIC NOTES FOR CULVERT CV059

AS INDICATED IN THE GENERAL CONSTRUCTION NOTES ON DWG. 002, THE SITE SPECIFIC NOTES ARE BASED ONLY ON A DESKTOP STUDY OF THE SITE; NO FIELD WORK WAS CARRIED OUT TO SUPPORT THIS WORK. AN INSPECTION OF THE SITE SHALL BE CARRIED OUT BY THE OWNER'S REPRESENTATIVE AND/OR GEOTECHNICAL ENGINEER PRIOR TO CONSTRUCTION. THE SITE SPECIFIC NOTES ARE INTENDED TO BE COMPREHENSIVE BUT NOT ALL-INCLUSIVE.

1. **WIDEN THE ROAD RUNNING SURFACE TO A MINIMUM WIDTH OF 10 m, MAINTAINING THE ROAD EMBANKMENT SIDE SLOPES NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL).**
2. **WIDEN THE ROAD RUNNING SURFACE TO A MINIMUM OF 10 m ON THE APPROACHES TO THE CULVERT LOCATION, MAINTAINING THE ROAD EMBANKMENT SIDE SLOPES NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL).**
3. **ADD/ SHAPE EMBANKMENT FILL TO FLATTEN THE ROAD EMBANKMENT SIDE SLOPES TO NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL), MAINTAINING THE ROAD RUNNING SURFACE WIDTH A MINIMUM OF 10 m.**
4. CAP THE ROAD SURFACE WITH SUITABLE RUNNING SURFACE MATERIAL (SEE TYPICAL SECTION ON DWG. 002).
5. EXTEND OR REPLACE CULVERTS (REFER TO GENERAL CONSTRUCTION NOTE 11). IF EXTENDING, CLEAR SEDIMENTS FROM EXISTING CULVERT.
6. PROVIDE RIP RAP PROTECTION AT THE CULVERT INLET AND OUTLET.
7. MARK THE CULVERT ENDS WITH DELINEATORS OF SUFFICIENT SIZE AND HEIGHT TO REDUCE THE RISK OF DAMAGE TO THE CULVERT PIPE ENDS BY SNOW PLOWING, SIDE SLOPING, OR OTHER MAINTENANCE OPERATIONS.

ROAD LAYOUT DETAILS

STATION (m)	TOP OF SUBGRADE			CENTRELINE CUT DEPTH* (TOP OF SUBGRADE TO EXISTING ROAD SURFACE) (m)	TOE OF EMBANKMENT SLOPE		
	CENTRELINE EASTING (m)	CENTRELINE NORTHING (m)	CENTRELINE ELEVATION (m)		OFFSET TO LEFT TOE** (m)	OFFSET TO RIGHT TOE** (m)	GRADIENT TO NEXT POINT (%)
0+000.0	528050.3	7929449.3	163.7	-0.1	5.1	5.3	-0.6
0+002.4	528051.3	7929447.1	163.7	0	5	5.3	-0.6
0+020.0	528058.5	7929431.1	163.6	-0.2	5.8	6.4	-0.6
0+034.6	528064.8	7929417.9	163.5	-0.2	5.8	6.4	-0.5
0+040.0	528067.2	7929413.1	163.5	-0.2	5.8	6.4	-0.3
0+057.3	528075.1	7929397.6	163.4	-0.2	5.8	6.3	0
0+060.0	528076.3	7929395.3	163.4	-0.2	5.8	6.2	0.1
0+068.3	528080.2	7929388	163.4	-0.2	5.9	6.2	0.2
0+080.0	528085.6	7929377.6	163.5	-0.2	6.2	6	0.2
0+092.9	528091.6	7929366.1	163.5	-0.2	7	5.9	0.2
0+099.0	528094.4	7929360.7	163.5	-0.3	8.1	6.3	0.2
0+100.0	528094.8	7929359.8	163.5	-0.3	8.1	6.1	0.2
0+101.0	528095.3	7929358.9	163.5	-0.3	8	6	0.2
0+103.0	528096.2	7929357.1	163.5	-0.2	7.8	5.9	0.2
0+105.0	528097	7929355.3	163.5	-0.2	7.6	5.9	
0+115.3	528101.3	7929346	163.5	-0.3	7	6	0.2
0+120.0	528103.1	7929341.6	163.5	-0.3	6.7	6.1	0.2
0+140.0	528111.1	7929323.3	163.6	-0.2	6.1	5.9	0.2
0+157.5	528118.1	7929307.2	163.6	-0.2	5.1	5.1	

* NEGATIVE CUT DEPTH DENOTES FILL
** MEASURED ON GROUND SURFACE

REV	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2017-04-03	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 1 / REPORT REV. 0	CK/RAD	JJL	MJT	RAD
1	2017-03-24	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 0	CK/RAD	JJL	MJT	RAD
0	2017-03-10	ISSUED FOR CONSTRUCTION	CK/RAD	JJL	MJT	RAD
A	2017-03-08	ISSUED FOR CLIENT REVIEW	CK/RAD	JJL	MJT	RAD

PERMIT TO PRACTICE
GOLDER ASSOCIATES LTD.
Signature
Date 17-04-03
PERMIT NUMBER: P 049
NT/NU Association of Professional Engineers and Geoscientists

REGISTERED PROFESSIONAL ENGINEER
R.A. DOUGLAS
LICENSEE
2017-04-03
NWT/NU

CLIENT: Baffinland

CONSULTANT: Golder Associates

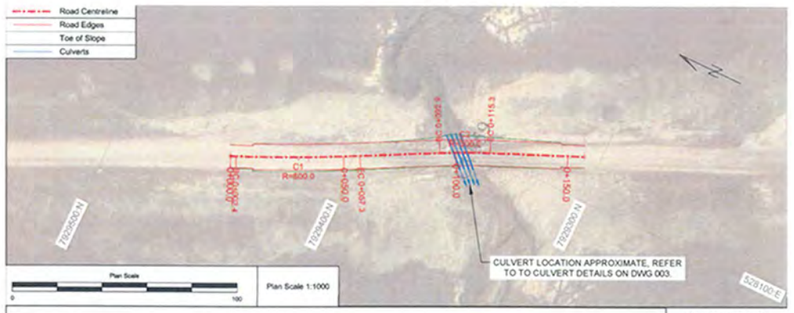
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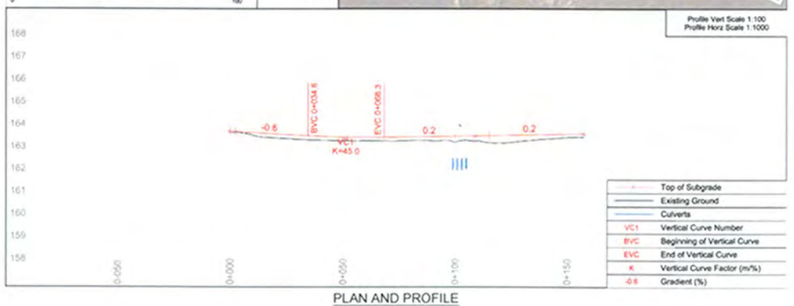
PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

TITLE
CULVERT INSTALLATION DESIGN RECOMMENDATIONS & DESIGN TABLES - CV059

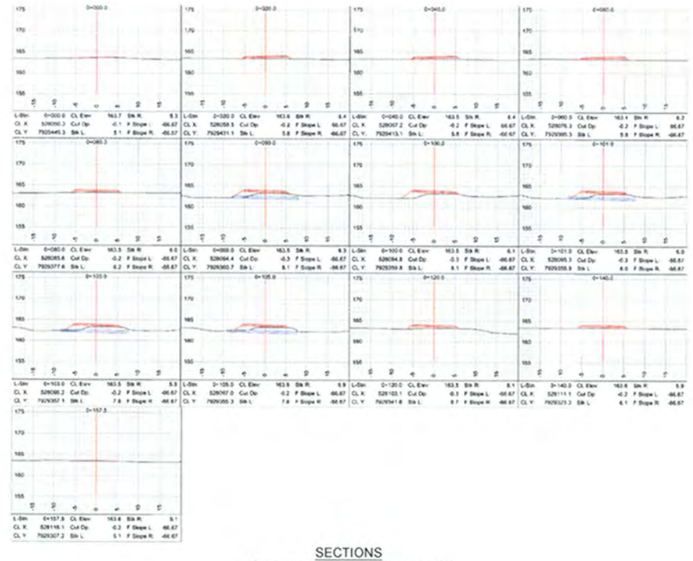
PROJECT NO	PHASE	REV	3 of 4	DRAWING
1667708	3000	2		003

Reduced Size
NOT TO SCALE





PLAN AND PROFILE



SECTIONS
(REFER TO GENERAL CONSTRUCTION NOTE 17)

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
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Signature
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NT/NU Association of Professional Engineers and Geoscientists

REGISTERED PROFESSIONAL ENGINEER
R.A. DOUGLAS
LICENSEE
2017-04-03
NUNAVUT

Baffinland

Golder Associates

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PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

TITLE
ROAD PLAN, PROFILE AND SECTIONS - CV059

PROJECT NO	PHASE	REV.	4 of 4	DRAWING
1667708	3000	2		004

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BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT
TOTE ROAD EARTHWORKS
CV099

INDEX OF DRAWINGS		
DRAWING NO.	DRAWING SHEET TITLE	REVISION NO.
001	TITLE SHEET - CV099	2
002	PIPE CROSSING TYPICAL DETAILS & GENERAL NOTES - CV099	2
003	CULVERT INSTALLATION DESIGN RECOMMENDATIONS & DESIGN TABLES - CV099	2
004	ROAD PLAN, PROFILE AND SECTIONS - CV099	2

SPECIFICATIONS		
SPECIFICATION NO.	SPECIFICATION TITLE	REVISION NO.
1667708-S	TOTE ROAD EARTHWORKS	1

DESIGN REPORT		
REPORT NO.	REPORT TITLE	REVISION NO.
1667708	TOTE ROAD EARTHWORKS	0



KEY PLAN
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REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
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0	2017-03-09	ISSUED FOR CONSTRUCTION	JJL	CK/RAD	MJT	RAD
A	2017-02-24	ISSUED FOR CLIENT REVIEW	JJL	CK/RAD	MJT	RAD

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REGISTERED PROFESSIONAL ENGINEER
R.A. DOUGLAS
LICENSEE
2017-04-03
NORTHWEST TERRITORIES AND NUNAVUT

CLIENT: Baffinland

CONSULTANT: Golder Associates

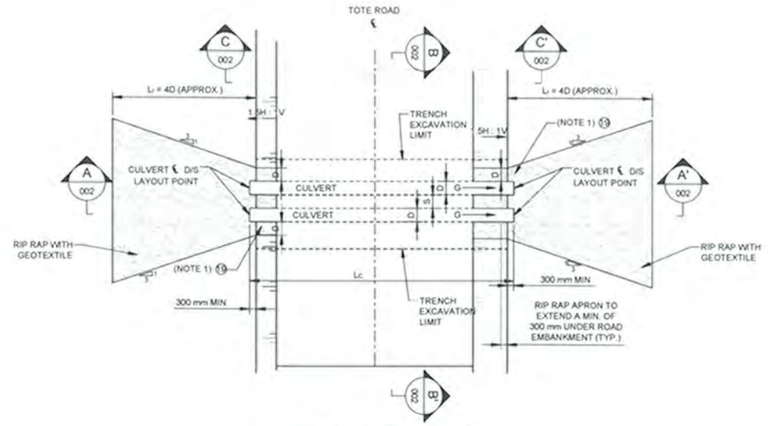
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PROJECT
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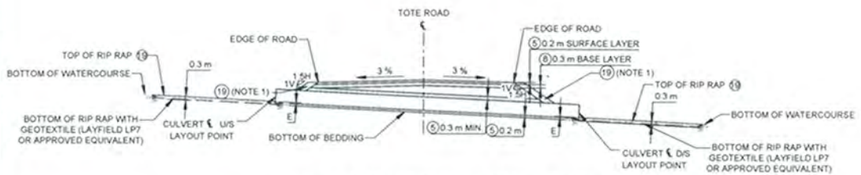
TITLE
TITLE SHEET - CV099

PROJECT NO.	PHASE	REV.	1 of 4	DRAWING
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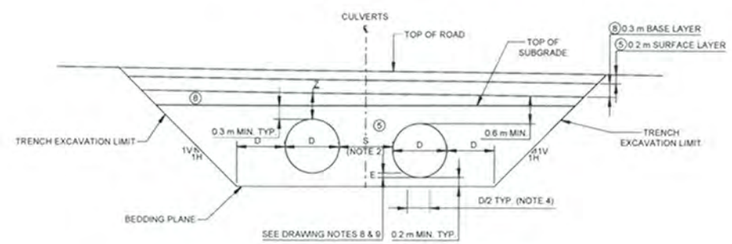
Reduced Size
NOT TO SCALE



PIPE CROSSING PLAN VIEW
SCALE 1:200 m



SCALE 1:200 m (A 002) PIPE CROSSING TYPICAL PROFILE



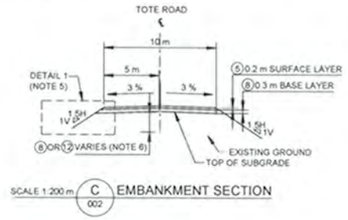
SCALE 1:50 m (B 002) PIPE CROSSING TYPICAL SECTION

LEGEND

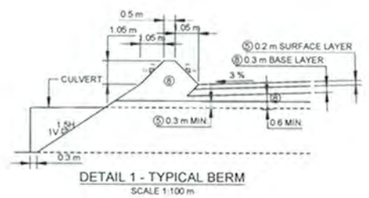
(5)	SCREENED MATERIAL	(13)	RUN OF QUARRY (ROQ)
(8)	JAW RUN	(19)	EROSION PROTECTION

DRAWING NOTES

1. EROSION PROTECTION SHALL BE PLACED AROUND THE CULVERT INLET AND OUTLET AS PER THE DIRECTION OF THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
2. THE MINIMUM SPACING (S) BETWEEN CULVERTS SHALL BE D, WHERE D IS THE CULVERT DIAMETER, OR 1.5 m, WHICHEVER IS GREATER.
3. THE MINIMUM COVER DEFINED AS THE DISTANCE BETWEEN THE TOP OF CULVERT TO THE TOP OF SUBGRADE SHALL BE 0.6 m OR D/4, WHERE D IS THE CULVERT DIAMETER, WHICHEVER IS GREATER.
4. THE BEDDING TO BE SHAPED TO RECEIVE PIPE.
5. SAFETY BERMS ARE REQUIRED FOR EMBANKMENTS GREATER THAN 3 m IN HEIGHT.
6. FOR EMBANKMENT FILL DEPTHS LESS THAN 0.6 m, TYPE 8 MATERIAL SHALL BE USED; FOR FILL DEPTHS GREATER THAN 0.6 m, AND DEPENDING ON THE FILL EXTENTS, TYPE 12 MATERIAL MAY BE USED.
7. DEFINITIONS AND VALUES OF D,Lc,Lr, AND G CAN BE FOUND IN DESIGN TABLES ON DRAWING 003.
8. FOR FISH BEARING CULVERT WITH MULTIPLE PIPES, ONLY ONE SHALL BE EMBEDDED BY "E" AND ALL OTHER PIPES SHALL BE PLACED ON GROUND / BOTTOM OF WATER COURSE.
9. AS PER CULVERT DETAILS (DWG 003)FOR FISH BEARING CULVERT, E = 0.1 D. FOR NON-FISH BEARING CULVERT E=0.



SCALE 1:200 m (C 002) EMBANKMENT SECTION



DETAIL 1 - TYPICAL BERM
SCALE 1:100 m

GENERAL CONSTRUCTION NOTES

1. IT IS THE RESPONSIBILITY OF THE USER OF THIS DRAWING TO ENSURE THE USE OF ITS MOST RECENT REVISION.
2. THE INFORMATION PROVIDED ON THE DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE MOST RECENT REVISION OF THE SPECIFICATIONS AND REPORT LISTED ON DWG. 001.
3. IN THE EVENT OF DISCREPANCY BETWEEN THE DRAWINGS AND THE SPECIFICATIONS CLARIFICATION AND/OR DIRECTION SHALL BE PROVIDED AS OUTLINED IN THE SPECIFICATIONS.
4. PRIOR TO COMMENCING CONSTRUCTION ACTIVITIES, THE CONTRACTOR SHALL BE FAMILIAR WITH THE SCOPE OF WORK.
5. THE INFORMATION PRESENTED ON THESE DRAWINGS IS INTENDED TO CONVEY THE PIPE CROSSING CONSTRUCTION DETAILS AND ROAD EMBANKMENT DETAILS.
6. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED.
7. COORDINATE SYSTEM IS UTM (NAD 83) ZONE 17N.
8. CONTOUR INTERVAL IS 1 M WITH EXISTING TOPOGRAPHY.
9. THE DESIGN OF EACH INSTALLATION ARE BASED ON A DESK STUDY USING A DIGITAL ELEVATION MODEL AND SATELLITE IMAGERY PROVIDED BY BAFFINLAND, AND ARE NOT SUPPORTED BY FIELD STUDY.
10. THE GROUND SURFACE ELEVATIONS ARE CONSIDERED TO BE APPROXIMATE.
11. A DECISION ON WHETHER TO EXTEND OR REPLACE EACH CULVERT WILL BE MADE BY THE OWNER'S REPRESENTATIVE.
12. FIELD FITTING OF CULVERTS (INCLUDING LOCATIONS, LENGTHS, INVERT DEPTHS, GRADIENTS, AND SKEWS) TO ACTUAL CONDITIONS AT EACH SITE SHALL BE AS DIRECTED BY THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
13. FILL MATERIALS SHALL BE HANDLED, SORTED, PLACED AND COMPACTED AS SHOWN ON THE DRAWINGS, DESCRIBED IN THE SPECIFICATIONS AND TO THE SATISFACTION OF THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
14. NO GEOTECHNICAL OR STRUCTURAL ANALYSIS OF THE CULVERT INSTALLATIONS HAS **BEEN CARRIED OUT. A MINIMUM CULVERT COVER OF 0.6 m OR D/4 (WHERE D IS THE** DIAMETER OF THE CIRCULAR CULVERT PIPE) HAS BEEN ASSUMED TO BE APPROPRIATE FOR 10 TONNE AXLE LOADS; USE OF HEAVIER TRUCKS WILL REQUIRE STRUCTURAL ANALYSIS OF THE CULVERT INSTALLATION.
15. FISH BEARING STATUS IN CULVERT DETAILS TABLE ON DWG. 003 TAKEN FROM HATCH TOTE ROAD CULVERT DATA SHEETS H349000-3000-10-088-0030 THROUGH H349000-3000-10-088-0034.
16. NO HYDROLOGIC OR HYDRAULIC ANALYSIS WAS CARRIED OUT. NUMBER OF CULVERTS, CULVERT DIAMETER(S), CULVERT LENGTH(S), EMBEDMENT DEPTH (E), AND REQUIREMENTS FOR RIP RAP FROM HATCH TOTE ROAD CULVERT DATA SHEETS H349000-3000-10-088-0030 THROUGH H349000-3000-10-088-0034.
17. IN SECTIONS, SKEWED CULVERTS ARE PROJECTED ONTO PLANE OF CROSS-SECTIONS.
18. AT LIMITS OF CONSTRUCTION NEW PAVEMENT THICKNESS NEEDS TO BE TAPERED TO MATCH EXISTING PAVEMENT SURFACE.
19. THE OWNER'S REPRESENTATIVE WILL CONFIRM THE REQUIREMENT FOR SAFETY BERMS ALONG THE ROAD EDGES BASED ON ENCOUNTERED FIELD CONDITIONS. TYPICAL BERM DETAILS ARE SHOWN ON DWG.002.
20. SITE SPECIFIC NOTES ON DWG. 003 MUST BE READ IN CONJUNCTION WITH THESE GENERAL NOTES, AND THE SPECIFICATIONS AND DRAWINGS LISTED ON DWG.001.
21. BAFFINLAND IS RESPONSIBLE FOR PERMITTING OF THE PROPOSED WORKS (IF REQUIRED).
22. PRIOR TO CONSTRUCTION, BAFFINLAND'S ENVIRONMENTAL REPRESENTATIVE WILL BE CONSULTED TO APPROVE THE REQUIRED EROSION CONTROL AND MITIGATION MEASURES ADJACENT TO WATER BODIES.

0 2 4
1:50 METRES

0 5 10
1:100 METRES

0 10 20
1:200 METRES

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0	2017-03-09	ISSUED FOR CONSTRUCTION	JJL	CK/RAD	MJT	RAD
A	2017-02-24	ISSUED FOR CLIENT REVIEW.	JJL	CK/RAD	MJT	RAD

PERMIT TO PRACTICE GOLDER ASSOCIATES LTD.
Signature
Date 19-04-03
PERMIT NUMBER: P 049
NT/NU Association of Professional Engineers and Geoscientists

REGISTERED PROFESSIONAL ENGINEER
R.A. DOUGLAS
LICENSEE
2017-04-21
NWT/NU

CLIENT: Baffinland

CONSULTANT: Golder Associates

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PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

TITLE
TYPICAL DETAILS AND GENERAL NOTES - CV099

PROJECT NO.	PHASE	REV.	2 of 4	DRAWING
1667708	3000	2		002

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CULVERT DETAILS†

STATION (m)	FISH BEARING STATUS (REFER TO NOTE 15 ON DWG. 002)	EXISTING CULVERT DIAMETER (D) (mm) (REFER TO NOTE 16 ON DWG. 002)	EXISTING CULVERT LENGTH (m) (REFER TO NOTE 16 ON DWG. 002)	EXISTING CULVERT GRADIENT (%) (REFER TO NOTE 16 ON DWG. 002)	EMBEDMENT DEPTH (E) (mm) (REFER TO NOTE 16 ON DWG. 002)	PROPOSED CULVERT LENGTH (m)	DEPTH FROM SUBGRADE TO TOP OF CULVERT AT CENTRELINE OF ROAD (Z) (m)	EASTING OF CENTRELINE OF PIPE AT CENTRELINE OF ROAD (m)	NORTHING OF CENTRELINE OF PIPE AT CENTRELINE OF ROAD (m)	INLET INVERT ELEVATION (m)	OUTLET INVERT ELEVATION (m)	CULVERT GRADIENT (G) (%)	CULVERT SKEW (deg)	INLET RIP RAP REQUIRED?	OUTLET RIP RAP REQUIRED?	RIP RAP APRON LENGTH (Lr) (m)
0+074.0	YES	1200	21	2.43	120	57	3.8	521890.8	7948843.9	124.2	123.1	2	110	N	Y	4.8
0+078.0	YES	2000	21	1.76	200	57	3.1	521893.4	7948840.8	124.2	123.1	2	110	N	Y	8

†CULVERT LOCATION DETAILS ARE BASED ON A DESK STUDY USING A DIGITAL ELEVATION MODEL AND SATELLITE IMAGERY PROVIDED BY BAFFINLAND, AND ARE NOT SUPPORTED BY FIELD STUDY (REFER TO GENERAL CONSTRUCTION NOTE 12 ON DWG. 002)

SITE SPECIFIC NOTES FOR CULVERT CV099

AS INDICATED IN THE GENERAL CONSTRUCTION NOTES ON DWG. 002, THE SITE SPECIFIC NOTES ARE BASED ONLY ON A DESKTOP STUDY OF THE SITE. NO FIELD WORK WAS CARRIED OUT TO SUPPORT THIS WORK. AN INSPECTION OF THE SITE SHALL BE CARRIED OUT BY THE OWNER'S REPRESENTATIVE AND/OR GEOTECHNICAL ENGINEER PRIOR TO CONSTRUCTION. THE SITE SPECIFIC NOTES ARE INTENDED TO BE COMPREHENSIVE BUT NOT ALL-INCLUSIVE.

1. CAP THE ROAD SURFACE WITH SUITABLE RUNNING SURFACE MATERIAL (SEE TYPICAL SECTION ON DWG. 002).
2. PROVIDE RIP RAP PROTECTION AT THE CULVERT INLET AND OUTLET.
3. THE CULVERT MAY BE PERCHED. REINSTALL CULVERT.
4. MARK THE CULVERT ENDS WITH DELINEATORS OF SUFFICIENT SIZE AND HEIGHT TO REDUCE THE RISK OF DAMAGE TO THE CULVERT PIPE ENDS BY SNOW PLOWING, SIDE SLOPING, OR OTHER MAINTENANCE OPERATIONS.

ROAD LAYOUT DETAILS

STATION (m)	TOP OF SUBGRADE			CENTRELINE CUT DEPTH* (TOP OF SUBGRADE TO EXISTING ROAD SURFACE) (m)	TOE OF EMBANKMENT SLOPE		
	CENTRELINE EASTING (m)	CENTRELINE NORTHING (m)	CENTRELINE ELEVATION (m)		OFFSET TO LEFT TOE** (m)	OFFSET TO RIGHT TOE** (m)	GRADIENT TO NEXT POINT (%)
0+000.0	521848.1	7948904.2	126.9	-0.1	5	5.3	1
0+008.8	521852.8	7948896.8	126.9	-0.2	5.1	5.4	1.1
0+013.5	521855.3	7948892.7	127	-0.2	5.8	6.2	1.3
0+020.0	521858.6	7948887.3	127.1	-0.2	5.8	6.3	2
0+040.0	521870.1	7948870.8	127.5	-0.4	6	6.7	2.9
0+060.0	521882.2	7948854.9	128.1	-0.5	6.4	6.7	3.5
0+063.3	521884.3	7948852.3	128.2	-0.6	6.4	6.8	3.8
0+074.0	521891	7948843.9	128.6	-0.7	6.6	7	4.2
0+078.0	521893.5	7948840.8	128.8	-0.8	6.7	7	4.3
0+080.0	521894.7	7948839.3	128.8	-0.8	6.8	7	4.8
0+100.0	521907.3	7948823.7	129.8	-0.7	6.6	6.7	5.8
0+120.0	521919.8	7948808.1	131	-0.6	6.4	6.5	6.7
0+140.0	521932.3	7948792.5	132.3	-0.1	6	6.2	7.3
0+142.8	521934.1	7948790.4	132.5	-0.1	5.2	5.3	7.3
0+152.0	521939.8	7948783.2	133.2	-0.2	5.1	5.2	

* NEGATIVE CUT DEPTH DENOTES FILL
** MEASURED ON GROUND SURFACE

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NT/NU Association of Professional Engineers and Geoscientists

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R.A. DOUGLAS
LICENSEE
2017-04-03
NWT/NU

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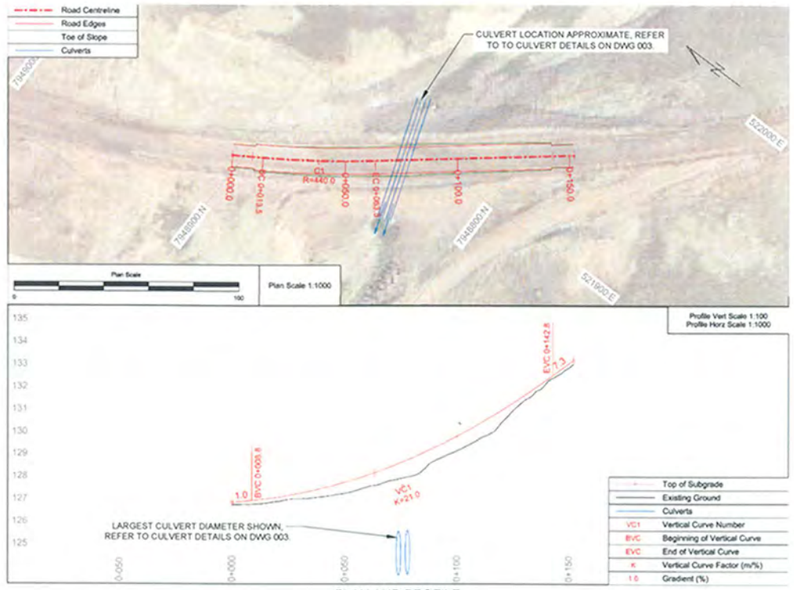
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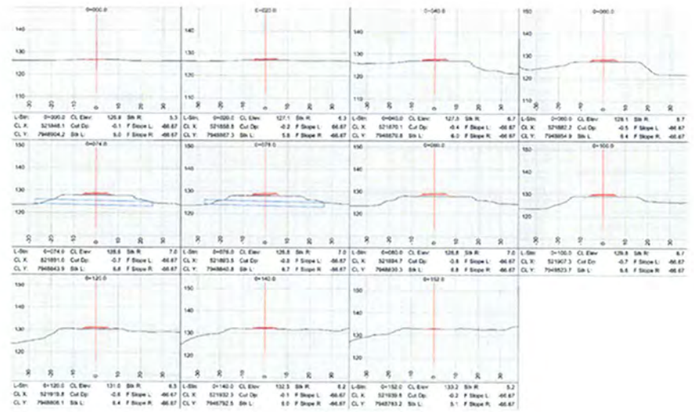
TITLE
CULVERT INSTALLATION DESIGN RECOMMENDATIONS & DESIGN TABLES - CV099

PROJECT NO.	PHASE	REV.	3 of 4	DRAWING
1667708	3000	2		003

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PLAN AND PROFILE



SECTIONS
(REFER TO GENERAL CONSTRUCTION NOTE 17)

REV	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2017-04-03	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 1 / REPORT REV. 0	JJL	CK/RAD	MJT	RAD
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0	2017-03-09	ISSUED FOR CONSTRUCTION	JJL	CK/RAD	MJT	RAD
A	2017-02-24	ISSUED FOR CLIENT REVIEW	JJL	CK/RAD	MJT	RAD

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GOLDER ASSOCIATES LTD.
Signature
Date 17-04-03
PERMIT NUMBER: P 049
NT/NU Association of Professional Engineers and Geoscientists

REGISTERED PROFESSIONAL ENGINEER
R.A. DOUGLAS
LICENSEE
2017-04-03
NORTHWEST TERRITORIES AND NUNAVUT

Baffinland

Golder Associates

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6925 CENTURY AVENUE, SUITE 100
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PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

TITLE
ROAD PLAN, PROFILE AND SECTIONS - CV099

PROJECT NO	PHASE	REV	4 of 4	DRAWING
1667708	3000	2		004

Reduced Size
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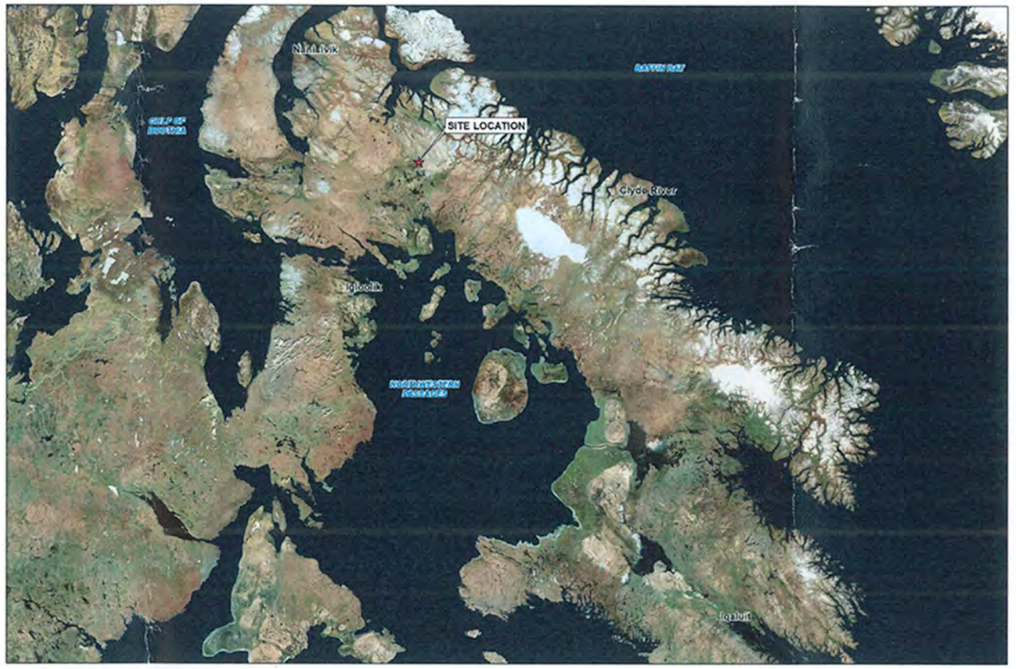
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MARY RIVER PROJECT
TOTE ROAD EARTHWORKS
CV106

INDEX OF DRAWINGS		
DRAWING NO.	DRAWING SHEET TITLE	REVISION NO.
001	TITLE SHEET - CV106	2
002	PIPE CROSSING TYPICAL DETAILS & GENERAL NOTES - CV106	2
003	CULVERT INSTALLATION DESIGN RECOMMENDATIONS & DESIGN TABLES - CV106	2
004	ROAD PLAN, PROFILE AND SECTIONS - CV106	2

SPECIFICATIONS		
SPECIFICATION NO.	SPECIFICATION TITLE	REVISION NO.
1667708-S	TOTE ROAD EARTHWORKS	1

DESIGN REPORT		
REPORT NO.	REPORT TITLE	REVISION NO.
1667708	TOTE ROAD EARTHWORKS	0



KEY PLAN
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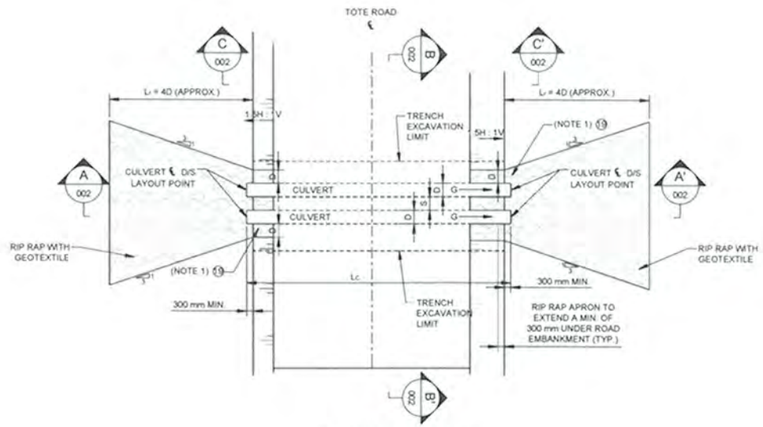
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PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

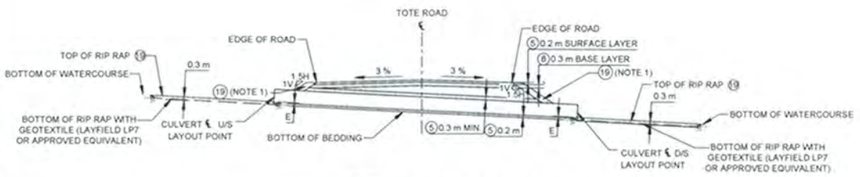
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TITLE SHEET - CV106

PROJECT NO	PHASE	REV	1 of 4	DRAWING
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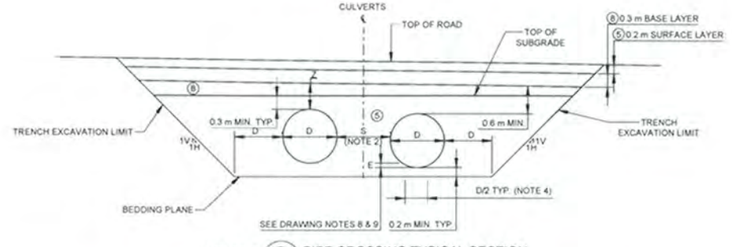
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PIPE CROSSING PLAN VIEW
SCALE 1:200 m



SCALE 1:200 m A 002 PIPE CROSSING TYPICAL PROFILE



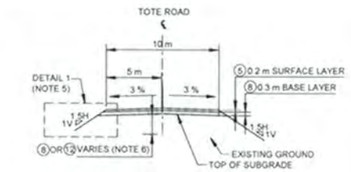
SCALE 1:50 m B 002 PIPE CROSSING TYPICAL SECTION

LEGEND

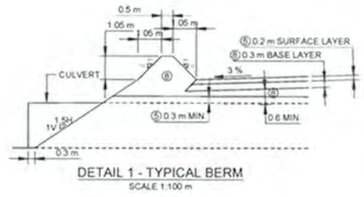
(5)	SCREENED MATERIAL	(12)	RUN OF QUARRY (ROQ)
(8)	JAW RUN	(19)	EROSION PROTECTION

DRAWING NOTES

1. EROSION PROTECTION SHALL BE PLACED AROUND THE CULVERT INLET AND OUTLET AS PER THE DIRECTION OF THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
2. THE MINIMUM SPACING (S) BETWEEN CULVERTS SHALL BE D, WHERE D IS THE CULVERT DIAMETER, OR 1.5 m, WHICHEVER IS GREATER.
3. THE MINIMUM COVER DEFINED AS THE DISTANCE BETWEEN THE TOP OF CULVERT TO THE TOP OF SUBGRADE SHALL BE 0.6 m OR D/4, WHERE D IS THE CULVERT DIAMETER, WHICHEVER IS GREATER.
4. THE BEDDING TO BE SHAPED TO RECEIVE PIPE.
5. SAFETY BERMS ARE REQUIRED FOR EMBANKMENTS GREATER THAN 3 m IN HEIGHT.
6. FOR EMBANKMENT FILL DEPTHS LESS THAN 0.6 m, TYPE 8 MATERIAL SHALL BE USED. FOR FILL DEPTHS GREATER THAN 0.6 m, AND DEPENDING ON THE FILL EXTENTS, TYPE 12 MATERIAL MAY BE USED.
7. DEFINITIONS AND VALUES OF D,Lc,L_T, AND G CAN BE FOUND IN DESIGN TABLES ON DRAWING 003.
8. FOR FISH BEARING CULVERT WITH MULTIPLE PIPES, ONLY ONE SHALL BE EMBEDDED BY "E" AND ALL OTHER PIPES SHALL BE PLACED ON GROUND / BOTTOM OF WATER COURSE.
9. AS PER CULVERT DETAILS (DWG 003)FOR FISH BEARING CULVERT, E = 0.1 D. FOR NON-FISH BEARING CULVERT E=0.



SCALE 1:200 m C 002 EMBANKMENT SECTION



DETAIL 1 - TYPICAL BERM
SCALE 1:100 m

GENERAL CONSTRUCTION NOTES

1. IT IS THE RESPONSIBILITY OF THE USER OF THIS DRAWING TO ENSURE THE USE OF ITS MOST RECENT REVISION.
2. THE INFORMATION PROVIDED ON THE DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE MOST RECENT REVISION OF THE SPECIFICATIONS AND REPORT LISTED ON DWG. 001.
3. IN THE EVENT OF DISCREPANCY BETWEEN THE DRAWINGS AND THE SPECIFICATIONS CLARIFICATION AND/OR DIRECTION SHALL BE PROVIDED AS OUTLINED IN THE SPECIFICATIONS.
4. PRIOR TO COMMENCING CONSTRUCTION ACTIVITIES, THE CONTRACTOR SHALL BE FAMILIAR WITH THE SCOPE OF WORK.
5. THE INFORMATION PRESENTED ON THESE DRAWINGS IS INTENDED TO CONVEY THE PIPE CROSSING CONSTRUCTION DETAILS AND ROAD EMBANKMENT DETAILS.
6. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED.
7. COORDINATE SYSTEM IS UTM (NAD 83) ZONE 17N.
8. CONTOUR INTERVAL IS 1 M WITH EXISTING TOPOGRAPHY.
9. THE DESIGN OF EACH INSTALLATION ARE BASED ON A DESK STUDY USING A DIGITAL ELEVATION MODEL AND SATELLITE IMAGERY PROVIDED BY BAFFINLAND, AND ARE NOT SUPPORTED BY FIELD STUDY.
10. THE GROUND SURFACE ELEVATIONS ARE CONSIDERED TO BE APPROXIMATE.
11. A DECISION ON WHETHER TO EXTEND OR REPLACE EACH CULVERT WILL BE MADE BY THE OWNER'S REPRESENTATIVE.
12. FIELD FITTING OF CULVERTS (INCLUDING LOCATIONS, LENGTHS, INVERT DEPTHS, GRADIENTS, AND SKEWS) TO ACTUAL CONDITIONS AT EACH SITE SHALL BE AS DIRECTED BY THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
13. FILL MATERIALS SHALL BE HANDLED, SORTED, PLACED AND COMPACTED AS SHOWN ON THE DRAWINGS, DESCRIBED IN THE SPECIFICATIONS AND TO THE SATISFACTION OF THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
14. NO GEOTECHNICAL OR STRUCTURAL ANALYSIS OF THE CULVERT INSTALLATIONS HAS **BEEN CARRIED OUT. A MINIMUM CULVERT COVER OF 0.6 m OR D/4 (WHERE D IS THE** DIAMETER OF THE CIRCULAR CULVERT PIPE) HAS BEEN ASSUMED TO BE APPROPRIATE FOR 10 TONNE AXLE LOADS. USE OF HEAVIER TRUCKS WILL REQUIRE STRUCTURAL ANALYSIS OF THE CULVERT INSTALLATION.
15. FISH BEARING STATUS IN CULVERT DETAILS TABLE ON DWG. 003 TAKEN FROM HATCH TOTE ROAD CULVERT DATA SHEETS H349000-3000-10-088-0030 THROUGH H349000-3000-10-088-0034.
16. NO HYDROLOGIC OR HYDRAULIC ANALYSIS WAS CARRIED OUT. NUMBER OF CULVERTS, CULVERT DIAMETER(S), CULVERT LENGTH(S), EMBEDMENT DEPTH (E), AND REQUIREMENTS FOR RIP RAP FROM HATCH TOTE ROAD CULVERT DATA SHEETS H349000-3000-10-088-0030 THROUGH H349000-3000-10-088-0034.
17. IN SECTIONS, SKEWED CULVERTS ARE PROJECTED ONTO PLANE OF CROSS-SECTIONS.
18. AT LIMITS OF CONSTRUCTION NEW PAVEMENT THICKNESS NEEDS TO BE TAPERED TO MATCH EXISTING PAVEMENT SURFACE.
19. THE OWNER'S REPRESENTATIVE WILL CONFIRM THE REQUIREMENT FOR SAFETY BERMS ALONG THE ROAD EDGES BASED ON ENCOUNTERED FIELD CONDITIONS. TYPICAL BERM DETAILS ARE SHOWN ON DWG.002.
20. SITE SPECIFIC NOTES ON DWG. 003 MUST BE READ IN CONJUNCTION WITH THESE GENERAL NOTES, AND THE SPECIFICATIONS AND DRAWINGS LISTED ON DWG.001.
21. BAFFINLAND IS RESPONSIBLE FOR PERMITTING OF THE PROPOSED WORKS (IF REQUIRED).
22. PRIOR TO CONSTRUCTION, BAFFINLAND'S ENVIRONMENTAL REPRESENTATIVE WILL BE CONSULTED TO APPROVE THE REQUIRED EROSION CONTROL AND MITIGATION MEASURES ADJACENT TO WATER BODIES.

0 2 4
1:50 METRES

0 5 10
1:100 METRES

0 10 20
1:200 METRES

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PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

TITLE
TYPICAL DETAILS AND GENERAL NOTES - CV106

PROJECT NO	PHASE	REV		DRAWING
1667708	3000	2	2 of 4	002

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CULVERT DETAILS†

STATION (m)	FISH BEARING STATUS (REFER TO NOTE 15 ON DWG. 002)	EXISTING CULVERT DIAMETER (D) (mm) (REFER TO NOTE 16 ON DWG. 002)	EXISTING CULVERT LENGTH (m) (REFER TO NOTE 16 ON DWG. 002)	EXISTING CULVERT GRADIENT (%) (REFER TO NOTE 16 ON DWG. 002)	EMBEDMENT DEPTH (E) (mm) (REFER TO NOTE 16 ON DWG. 002)	PROPOSED CULVERT LENGTH (m)	DEPTH FROM SUBGRADE TO TOP OF CULVERT AT CENTRELINE OF ROAD (Z) (m)	EASTING OF CENTRELINE OF PIPE AT CENTRELINE OF ROAD (m)	NORTHING OF CENTRELINE OF PIPE AT CENTRELINE OF ROAD (m)	INLET INVERT ELEVATION (m)	OUTLET INVERT ELEVATION (m)	CULVERT GRADIENT (G) (%)	CULVERT SKEW (deg)	INLET RIP RAP REQUIRED?	OUTLET RIP RAP REQUIRED?	RIP RAP APRON LENGTH (Lr) (m)
0+076.5	POTENTIAL	1000	15	2.21		25	0.6	521670.5	7953387.9	113.4	113.1	1	135	N	Y	4

†CULVERT LOCATION DETAILS ARE BASED ON A DESK STUDY USING A DIGITAL ELEVATION MODEL AND SATELLITE IMAGERY PROVIDED BY BAFFINLAND, AND ARE NOT SUPPORTED BY FIELD STUDY (REFER TO GENERAL CONSTRUCTION NOTE 12 ON DWG. 002)

SITE SPECIFIC NOTES FOR CULVERT CV106

AS INDICATED IN THE GENERAL CONSTRUCTION NOTES ON DWG. 002, THE SITE SPECIFIC NOTES ARE BASED ONLY ON A DESKTOP STUDY OF THE SITE; NO FIELD WORK WAS CARRIED OUT TO SUPPORT THIS WORK. AN INSPECTION OF THE SITE SHALL BE CARRIED OUT BY THE OWNER'S REPRESENTATIVE AND/OR GEOTECHNICAL ENGINEER PRIOR TO CONSTRUCTION. THE SITE SPECIFIC NOTES ARE INTENDED TO BE COMPREHENSIVE BUT NOT ALL-INCLUSIVE.

1. **RAISE THE ROAD EMBANKMENT TO PROVIDE ADEQUATE CULVERT PIPE COVER, MAINTAINING THE ROAD EMBANKMENT SIDE SLOPES NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL) AND THE ROAD RUNNING SURFACE A MINIMUM OF 10 m.**
2. CAP THE ROAD SURFACE WITH SUITABLE RUNNING SURFACE MATERIAL (SEE TYPICAL SECTION ON DWG. 002).
3. THE EXISTING CULVERT MAY BE PERCHED. REINSTALL CULVERTS TO DESIGN. THE EXISTING CULVERT MAY BE DAMAGED. REPLACE CULVERTS IF REQUIRED.
4. PROVIDE RIP RAP PROTECTION AT THE CULVERT INLET AND OUTLET.
5. MARK THE CULVERT ENDS WITH DELINEATORS OF SUFFICIENT SIZE AND HEIGHT TO REDUCE THE RISK OF DAMAGE TO THE CULVERT PIPE ENDS BY SNOW PLOWING, SIDE SLOPING, OR OTHER MAINTENANCE OPERATIONS.

ROAD LAYOUT DETAILS

STATION (m)	TOP OF SUBGRADE			CENTRELINE CUT DEPTH* (TOP OF SUBGRADE TO EXISTING ROAD SURFACE) (m)	TOE OF EMBANKMENT SLOPE		
	CENTRELINE EASTING (m)	CENTRELINE NORTHING (m)	CENTRELINE ELEVATION (m)		OFFSET TO LEFT TOE** (m)	OFFSET TO RIGHT TOE** (m)	GRADIENT TO NEXT POINT (%)
0+000.0	521658.5	7953463.2	112.3	-0.1	5.7	5.5	
0+020.0	521663.2	7953443.8	113.2	-0.2	6.3	6.1	3.7
0+023.8	521664.2	7953440.1	113.4	-0.3	6.6	6.3	3.7
0+040.0	521667.5	7953424.2	114	-0.8	7.7	6.6	3.7
0+048.5	521668.7	7953415.8	114.3	-1.1	7.9	7.2	3.0
0+060.0	521669.9	7953404.4	114.6	-1.3	7.9	7.8	1.5
0+076.5	521670.6	7953387.9	114.9	-1.4	8.2	8.0	0.4
0+080.0	521670.5	7953384.4	114.9	-1.4	8.4	8.0	-0.2
0+086.5	521670.4	7953378	114.9	-1.3	8.1	7.7	-1.0
0+095.0	521670	7953369.4	114.8	-1.1	7.7	7.3	-1.5
0+100.0	521669.8	7953364.4	114.7	-0.9	7.4	7.0	-1.5
0+120.0	521668.9	7953344.4	114.4	-0.4	6.1	6.4	
0+140.0	521668.1	7953324.5	114.1	-0.2	5.1	5.1	-2.3
0+141.3	521668	7953323.2	114.1	-0.1	5.0	5.0	

* NEGATIVE CUT DEPTH DENOTES FILL
** MEASURED ON GROUND SURFACE

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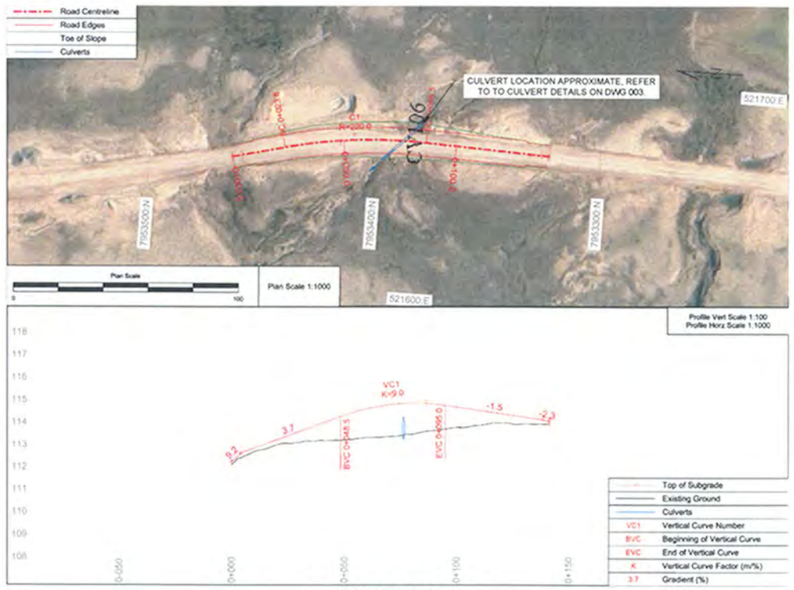
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Baffinland

PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

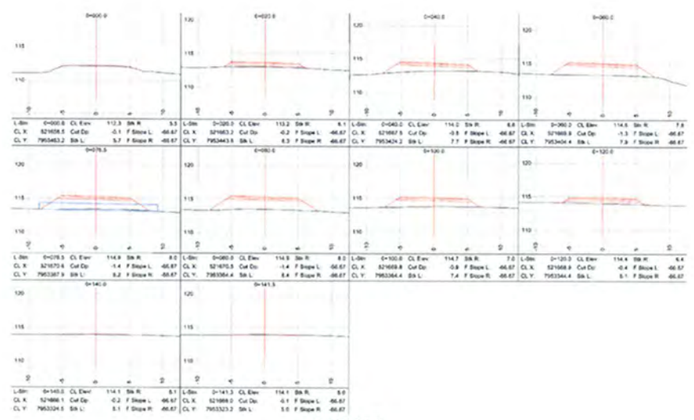
TITLE
CULVERT INSTALLATION DESIGN RECOMMENDATIONS & DESIGN TABLES - CV106

PROJECT NO.	PHASE	REV.	3 of 4	DRAWING
1667708	3000	2		003

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PLAN AND PROFILE



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1667708	3000	2	4 of 4	004

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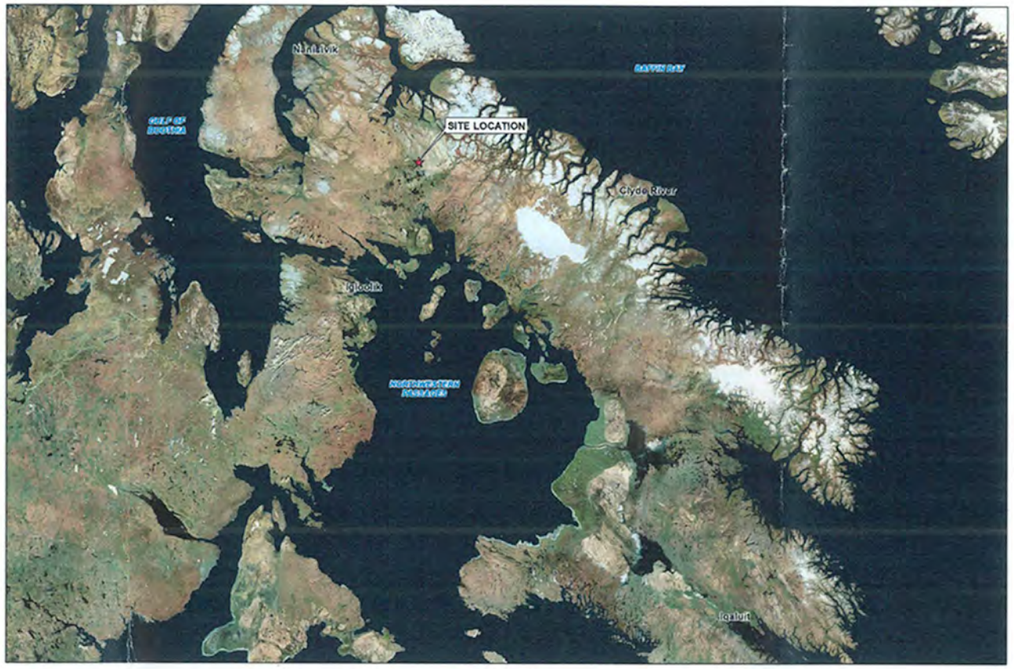
BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT
TOTE ROAD EARTHWORKS
CV112

INDEX OF DRAWINGS		
DRAWING NO.	DRAWING SHEET TITLE	REVISION NO.
001	TITLE SHEET - CV112	2
002	PIPE CROSSING TYPICAL DETAILS & GENERAL NOTES - CV112	2
003	CULVERT INSTALLATION DESIGN RECOMMENDATIONS & DESIGN TABLES - CV112	2
004	ROAD PLAN, PROFILE AND SECTIONS - CV112	2

SPECIFICATIONS		
SPECIFICATION NO.	SPECIFICATION TITLE	REVISION NO.
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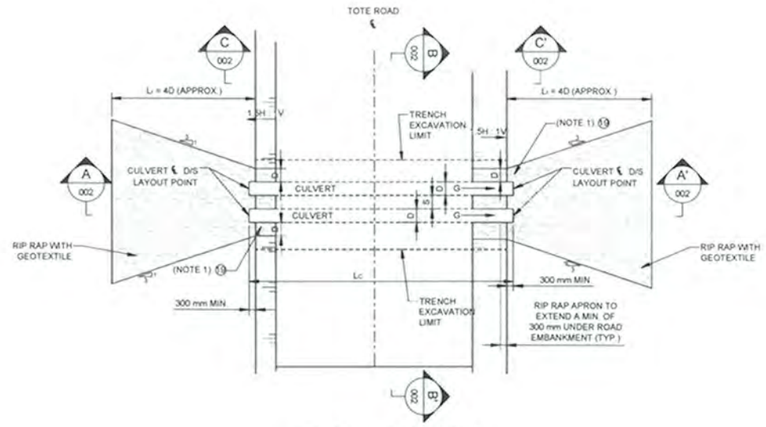
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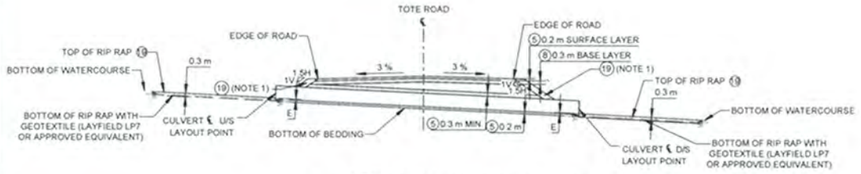
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TITLE SHEET - CV112

PROJECT NO	PHASE	REV	1 of 4	DRAWING
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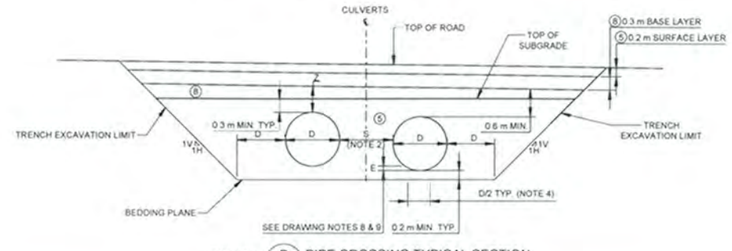
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PIPE CROSSING PLAN VIEW
SCALE 1:200 m



SCALE 1:200 m A 002 PIPE CROSSING TYPICAL PROFILE



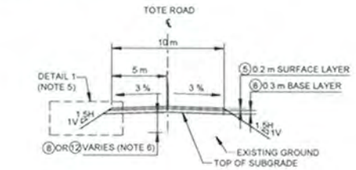
SCALE 1:50 m B 002 PIPE CROSSING TYPICAL SECTION

LEGEND

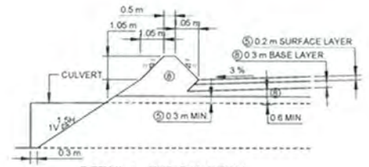
(5)	SCREENED MATERIAL	(12)	RUN OF QUARRY (ROQ)
(8)	JAW RUN	(19)	EROSION PROTECTION

DRAWING NOTES

1. EROSION PROTECTION SHALL BE PLACED AROUND THE CULVERT INLET AND OUTLET AS PER THE DIRECTION OF THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
2. THE MINIMUM SPACING (S) BETWEEN CULVERTS SHALL BE D, WHERE D IS THE CULVERT DIAMETER, OR 1.5 m, WHICHEVER IS GREATER.
3. THE MINIMUM COVER DEFINED AS THE DISTANCE BETWEEN THE TOP OF CULVERT TO THE TOP OF SUBGRADE SHALL BE 0.6 m OR D/4, WHERE D IS THE CULVERT DIAMETER, WHICHEVER IS GREATER.
4. THE BEDDING TO BE SHAPED TO RECEIVE PIPE.
5. SAFETY BERMS ARE REQUIRED FOR EMBANKMENTS GREATER THAN 3 m IN HEIGHT.
6. FOR EMBANKMENT FILL DEPTHS LESS THAN 0.6 m, TYPE 8 MATERIAL SHALL BE USED. FOR FILL DEPTHS GREATER THAN 0.6 m, AND DEPENDING ON THE FILL EXTENTS, TYPE 12 MATERIAL MAY BE USED.
7. DEFINITIONS AND VALUES OF D,Lc,Lr, AND G CAN BE FOUND IN DESIGN TABLES ON DRAWING 003.
8. FOR FISH BEARING CULVERT WITH MULTIPLE PIPES, ONLY ONE SHALL BE EMBEDDED BY "E" AND ALL OTHER PIPES SHALL BE PLACED ON GROUND / BOTTOM OF WATER COURSE.
9. AS PER CULVERT DETAILS (DWG 003)FOR FISH BEARING CULVERT, E = 0.1 D. FOR NON-FISH BEARING CULVERT E=0.



SCALE 1:200 m C 002 EMBANKMENT SECTION



DETAIL 1 - TYPICAL BERM
SCALE 1:100 m

GENERAL CONSTRUCTION NOTES

1. IT IS THE RESPONSIBILITY OF THE USER OF THIS DRAWING TO ENSURE THE USE OF ITS MOST RECENT REVISION.
2. THE INFORMATION PROVIDED ON THE DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE MOST RECENT REVISION OF THE SPECIFICATIONS AND REPORT LISTED ON DWG. 001.
3. IN THE EVENT OF DISCREPANCY BETWEEN THE DRAWINGS AND THE SPECIFICATIONS CLARIFICATION AND/OR DIRECTION SHALL BE PROVIDED AS OUTLINED IN THE SPECIFICATIONS.
4. PRIOR TO COMMENCING CONSTRUCTION ACTIVITIES, THE CONTRACTOR SHALL BE FAMILIAR WITH THE SCOPE OF WORK.
5. THE INFORMATION PRESENTED ON THESE DRAWINGS IS INTENDED TO CONVEY THE PIPE CROSSING CONSTRUCTION DETAILS AND ROAD EMBANKMENT DETAILS.
6. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED.
7. COORDINATE SYSTEM IS UTM (NAD 83) ZONE 17N.
8. CONTOUR INTERVAL IS 1 M WITH EXISTING TOPOGRAPHY.
9. THE DESIGN OF EACH INSTALLATION ARE BASED ON A DESK STUDY USING A DIGITAL ELEVATION MODEL AND SATELLITE IMAGERY PROVIDED BY BAFFINLAND, AND ARE NOT SUPPORTED BY FIELD STUDY.
10. THE GROUND SURFACE ELEVATIONS ARE CONSIDERED TO BE APPROXIMATE.
11. A DECISION ON WHETHER TO EXTEND OR REPLACE EACH CULVERT WILL BE MADE BY THE OWNER'S REPRESENTATIVE.
12. FIELD FITTING OF CULVERTS (INCLUDING LOCATIONS, LENGTHS, INVERT DEPTHS, GRADIENTS, AND SKEWS) TO ACTUAL CONDITIONS AT EACH SITE SHALL BE AS DIRECTED BY THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
13. FILL MATERIALS SHALL BE HANDLED, SORTED, PLACED AND COMPACTED AS SHOWN ON THE DRAWINGS, DESCRIBED IN THE SPECIFICATIONS AND TO THE SATISFACTION OF THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
14. NO GEOTECHNICAL OR STRUCTURAL ANALYSIS OF THE CULVERT INSTALLATIONS HAS **BEEN CARRIED OUT. A MINIMUM CULVERT COVER OF 0.6 m OR D/4 (WHERE D IS THE** DIAMETER OF THE CIRCULAR CULVERT PIPE) HAS BEEN ASSUMED TO BE APPROPRIATE FOR 10 TONNE AXLE LOADS. USE OF HEAVIER TRUCKS WILL REQUIRE STRUCTURAL ANALYSIS OF THE CULVERT INSTALLATION.
15. FISH BEARING STATUS IN CULVERT DETAILS TABLE ON DWG. 003 TAKEN FROM HATCH TOTE ROAD CULVERT DATA SHEETS H349000-3000-10-088-0030 THROUGH H349000-3000-10-088-0034.
16. NO HYDROLOGIC OR HYDRAULIC ANALYSIS WAS CARRIED OUT. NUMBER OF CULVERTS, CULVERT DIAMETER(S), CULVERT LENGTH(S), EMBEDMENT DEPTH (E), AND REQUIREMENTS FOR RIP RAP FROM HATCH TOTE ROAD CULVERT DATA SHEETS H349000-3000-10-088-0030 THROUGH H349000-3000-10-088-0034.
17. IN SECTIONS, SKEWED CULVERTS ARE PROJECTED ONTO PLANE OF CROSS-SECTIONS.
18. AT LIMITS OF CONSTRUCTION NEW PAVEMENT THICKNESS NEEDS TO BE TAPERED TO MATCH EXISTING PAVEMENT SURFACE.
19. THE OWNER'S REPRESENTATIVE WILL CONFIRM THE REQUIREMENT FOR SAFETY BERMS ALONG THE ROAD EDGES BASED ON ENCOUNTERED FIELD CONDITIONS. TYPICAL BERM DETAILS ARE SHOWN ON DWG 002.
20. SITE SPECIFIC NOTES ON DWG. 003 MUST BE READ IN CONJUNCTION WITH THESE GENERAL NOTES, AND THE SPECIFICATIONS AND DRAWINGS LISTED ON DWG 001.
21. BAFFINLAND IS RESPONSIBLE FOR PERMITTING OF THE PROPOSED WORKS (IF REQUIRED).
22. PRIOR TO CONSTRUCTION, BAFFINLAND'S ENVIRONMENTAL REPRESENTATIVE WILL BE CONSULTED TO APPROVE THE REQUIRED EROSION CONTROL AND MITIGATION MEASURES ADJACENT TO WATER BODIES.

0 2 4
1:50 METRES

0 5 10
1:100 METRES

0 10 20
1:200 METRES

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2017-04-03	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 1 / REPORT REV. 0	JJL	CK/RAD	MJT	RAD
1	2017-03-24	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 0	JJL	CK/RAD	MJT	RAD
0	2017-03-09	ISSUED FOR CONSTRUCTION	JJL	CK/RAD	MJT	RAD
A	2017-02-24	ISSUED FOR CLIENT REVIEW	JJL	CK/RAD	MJT	RAD

PERMIT TO PRACTICE
GOLDER ASSOCIATES LTD.
Signature
Date 17-04-03
PERMIT NUMBER: P 049
NT/NU Association of Professional Engineers and Geoscientists

REGISTERED PROFESSIONAL ENGINEER
R.A. DOUGLAS
LICENSEE
17-04-03
NWT/NU

CLIENT: Baffinland

CONSULTANT: Golder Associates

MISSISSAUGA OFFICE
6925 CENTURY AVENUE, SUITE 100
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905-567-4444
www.golder.com

PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

TITLE
TYPICAL DETAILS AND GENERAL NOTES - CV112

PROJECT NO.	PHASE	REV.	2 of 4	DRAWING
1667708	3000	2		002

Reduced Size
NOT TO SCALE

CULVERT DETAILS†

STATION (m)	FISH BEARING STATUS (REFER TO NOTE 15 ON DWG. 002)	EXISTING CULVERT DIAMETER (D) (mm) (REFER TO NOTE 16 ON DWG. 002)	EXISTING CULVERT LENGTH (m) (REFER TO NOTE 16 ON DWG. 002)	EXISTING CULVERT GRADIENT (%) (REFER TO NOTE 16 ON DWG. 002)	EMBEDMENT DEPTH (E) (mm) (REFER TO NOTE 16 ON DWG. 002)	PROPOSED CULVERT LENGTH (m)	DEPTH FROM SUBGRADE TO TOP OF CULVERT AT CENTRELINE OF ROAD (Z) (m)	EASTING OF CENTRELINE OF PIPE AT CENTRELINE OF ROAD (m)	NORTHING OF CENTRELINE OF PIPE AT CENTRELINE OF ROAD (m)	INLET INVERT ELEVATION (m)	OUTLET INVERT ELEVATION (m)	CULVERT GRADIENT (G) (%)	CULVERT SKEW (deg)	INLET RIP RAP REQUIRED?	OUTLET RIP RAP REQUIRED?	RIP RAP APRON LENGTH (Lr) (m)
0+109.3	POTENTIAL	1200	15	2.47		24.4	1	521034.0	7954929.5	113	112.1	4	90	N	Y	4.8
0+112.0	POTENTIAL	500	15	2.99	50	24.7	1.7	521036.2	7954928.1	113	112	4	90	N	N	

† CULVERT LOCATION DETAILS ARE BASED ON A DESK STUDY USING A DIGITAL ELEVATION MODEL AND SATELLITE IMAGERY PROVIDED BY BAFFINLAND, AND ARE NOT SUPPORTED BY FIELD STUDY (REFER TO GENERAL CONSTRUCTION NOTE 12 ON DWG. 002)

SITE SPECIFIC NOTES FOR CULVERT CV112

AS INDICATED IN THE GENERAL CONSTRUCTION NOTES ON DWG. 002, THE SITE SPECIFIC NOTES ARE BASED ONLY ON A DESKTOP STUDY OF THE SITE. NO FIELD WORK WAS CARRIED OUT TO SUPPORT THIS WORK. AN INSPECTION OF THE SITE SHALL BE CARRIED OUT BY THE OWNER'S REPRESENTATIVE AND/OR GEOTECHNICAL ENGINEER PRIOR TO CONSTRUCTION. THE SITE SPECIFIC NOTES ARE INTENDED TO BE COMPREHENSIVE BUT NOT ALL-INCLUSIVE.

1. **WIDEN THE ROAD RUNNING SURFACE AT THE CULVERT LOCATION TO A MINIMUM WIDTH OF 10 m, MAINTAINING THE ROAD EMBANKMENT SIDE SLOPES NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL).**
2. **WIDEN THE ROAD RUNNING SURFACE TO A MINIMUM OF 10 m ON THE APPROACHES TO THE CULVERT LOCATION, MAINTAINING THE ROAD EMBANKMENT SIDE SLOPES NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL).**
3. **ADD/ SHAPE EMBANKMENT FILL TO FLATTEN THE ROAD EMBANKMENT SIDE SLOPES TO NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL), MAINTAINING THE ROAD RUNNING SURFACE WIDTH A MINIMUM OF 10 m.**
4. **RAISE THE ROAD EMBANKMENT TO PROVIDE ADEQUATE CULVERT PIPE COVER, MAINTAINING THE ROAD EMBANKMENT SIDE SLOPES NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL) AND THE ROAD RUNNING SURFACE A MINIMUM OF 10 m.**
5. CAP THE ROAD SURFACE WITH SUITABLE RUNNING SURFACE MATERIAL (SEE TYPICAL SECTION ON DWG. 002).
6. PROVIDE SAFETY BERMS WHERE EMBANKMENT FILL IS GREATER THAN 3 m ABOVE EXISTING GROUND SURFACE.
7. PROVIDE RIP RAP PROTECTION AT THE CULVERT INLET AND OUTLET.
8. THE CULVERT MAY BE PERCHED. REINSTALL CULVERT. THE CULVERT END(S) MAY BE DAMAGED. REPLACE CULVERTS IF REQUIRED.
9. MARK THE CULVERT ENDS WITH DELINEATORS OF SUFFICIENT SIZE AND HEIGHT TO REDUCE THE RISK OF DAMAGE TO THE CULVERT PIPE ENDS BY SNOW PLOWING, SIDE SLOPING, OR OTHER MAINTENANCE OPERATIONS.

ROAD LAYOUT DETAILS

STATION (m)	TOP OF SUBGRADE			CENTRELINE CUT DEPTH* (TOP OF SUBGRADE TO EXISTING ROAD SURFACE) (m)	TOE OF EMBANKMENT SLOPE		
	CENTRELINE EASTING (m)	CENTRELINE NORTHING (m)	CENTRELINE ELEVATION (m)		OFFSET TO LEFT TOE** (m)	OFFSET TO RIGHT TOE** (m)	GRADIENT TO NEXT POINT (%)
0+000.0	520980.9	7955021.4	116.6	-0.1	5.0	5.1	-0.6
0+004.1	520982	7955017.5	116.6	-0.2	5.1	5.1	-1.0
0+020.0	520986.3	7955002.2	116.4	-0.1	5.9	6.0	-1.8
0+034.2	520990.2	7954988.5	116.2	-0.4	6.0	6.2	-2.3
0+038.4	520991.4	7954984.5	116.1	-0.4	6.2	6.2	-2.4
0+040.0	520991.9	7954983	116.1	-0.4	6.2	6.2	-2.4
0+060.0	521000.2	7954964.8	115.6	-0.6	6.5	6.6	-2.4
0+061.3	521000.9	7954963.7	115.6	-0.5	6.5	6.6	-2.0
0+080.0	521011.9	7954948.6	115.2	-0.5	6.4	6.7	-1.2
0+100.0	521026.4	7954934.9	114.9	-0.5	7.2	13.3	-0.7
0+105.1	521030.5	7954931.8	114.9	-0.5	6.3	14.2	-0.6
0+109.3	521033.9	7954929.5	114.9	-0.5	6.4	14.5	-0.6
0+112.0	521036.2	7954928.1	114.9	-0.5	6.4	14.5	-0.6
0+120.0	521043.2	7954924.2	114.8	-0.7	6.7	14.3	
0+129.5	521051.9	7954920.3	114.8	-0.7	6.8	13.8	-0.4
0+140.0	521061.6	7954916.4	114.7	-0.8	6.7	8.4	-0.4
0+141.3	521062.8	7954915.9	114.7	-0.8	6.7	8.1	0.1
0+160.0	521080.2	7954909	114.7	-0.5	6.1	7.0	1.0
0+180.0	521098.8	7954901.6	114.9	-0.3	5.9	7.1	2.0
0+200.0	521117	7954893.3	115.3	-0.5	6.1	7.6	2.9
0+216.0	521131.3	7954886.2	115.8	-0.3	5.8	8.5	3.3
0+220.0	521134.9	7954884.4	115.9	-0.3	5.1	5.3	3.3
0+226.2	521140.5	7954881.6	116.2	-0.2	5.1	5.1	

* NEGATIVE CUT DEPTH DENOTES FILL
** MEASURED ON GROUND SURFACE

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2017-04-03	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 1 / REPORT REV. 0	J.L.	CK/RAD	MJT	RAD
1	2017-03-24	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 0	J.L.	CK/RAD	MJT	RAD
0	2017-03-09	ISSUED FOR CONSTRUCTION	J.L.	CK/RAD	MJT	RAD
A	2017-02-24	ISSUED FOR CLIENT REVIEW	J.L.	CK/RAD	MJT	RAD

PERMIT TO PRACTICE
GOLDER ASSOCIATES LTD.
Signature
Date 19-04-25
PERMIT NUMBER: P 049
NT/NU Association of Professional Engineers and Geoscientists

REGISTERED PROFESSIONAL ENGINEER
R.A. DOUGLAS
CONSULTANT
LICENSEE
2017-04-25
NUNAVUT

Baffinland

Golder Associates

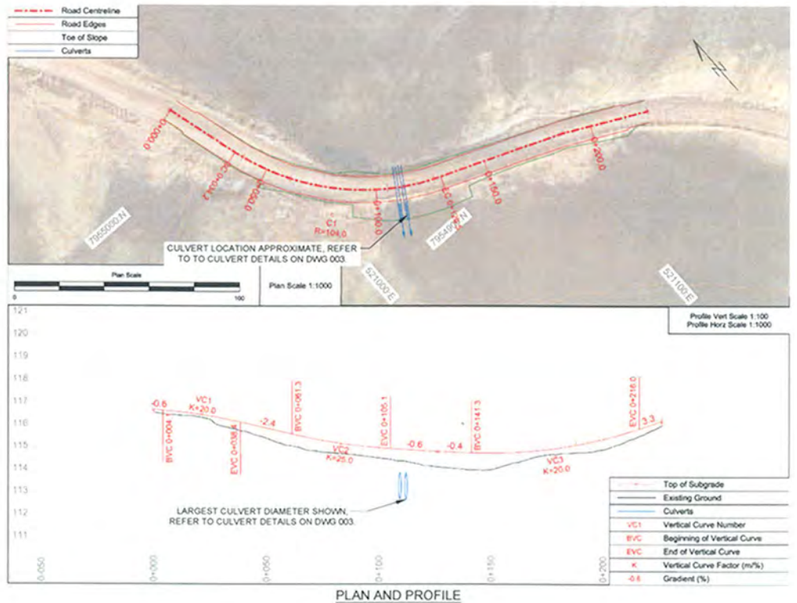
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6925 CENTURY AVENUE, SUITE 100
MISSISSAUGA, ON
CANADA
905-567-4444
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PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

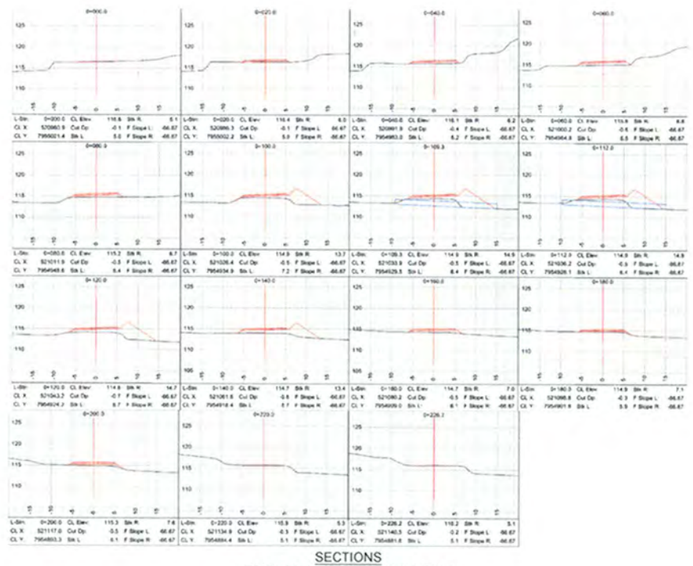
TITLE
CULVERT INSTALLATION DESIGN RECOMMENDATIONS & DESIGN TABLES - CV112

PROJECT NO.	PHASE	REV.	3 of 4	DRAWING
1667708	3000	2		003

Reduced Size
NOT TO SCALE



PLAN AND PROFILE



SECTIONS
(REFER TO GENERAL CONSTRUCTION NOTE 17)

REV	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2017-04-03	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 1 / REPORT REV. 0	JJL	CK/RAD	MJT	RAD
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A	2017-02-24	ISSUED FOR CLIENT REVIEW	JJL	CK/RAD	MJT	RAD

PERMIT TO PRACTICE GOLDER ASSOCIATES LTD.
Signature
Date 17-04-03
PERMIT NUMBER: P 049
NT/NU Association of Professional Engineers and Geoscientists

REGISTERED PROFESSIONAL ENGINEER
R.A. DOUGLAS
LICENSEE
2017-04-03
NWT/NU

CLIENT: Baffinland
CONSULTANT: Golder Associates

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CANADA
905-567-4444
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PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

TITLE
ROAD PLAN, PROFILE AND SECTIONS - CV112

PROJECT NO	PHASE	REV	4 of 4	DRAWING
1667708	3000	2		004

Reduced Size
NOT TO SCALE

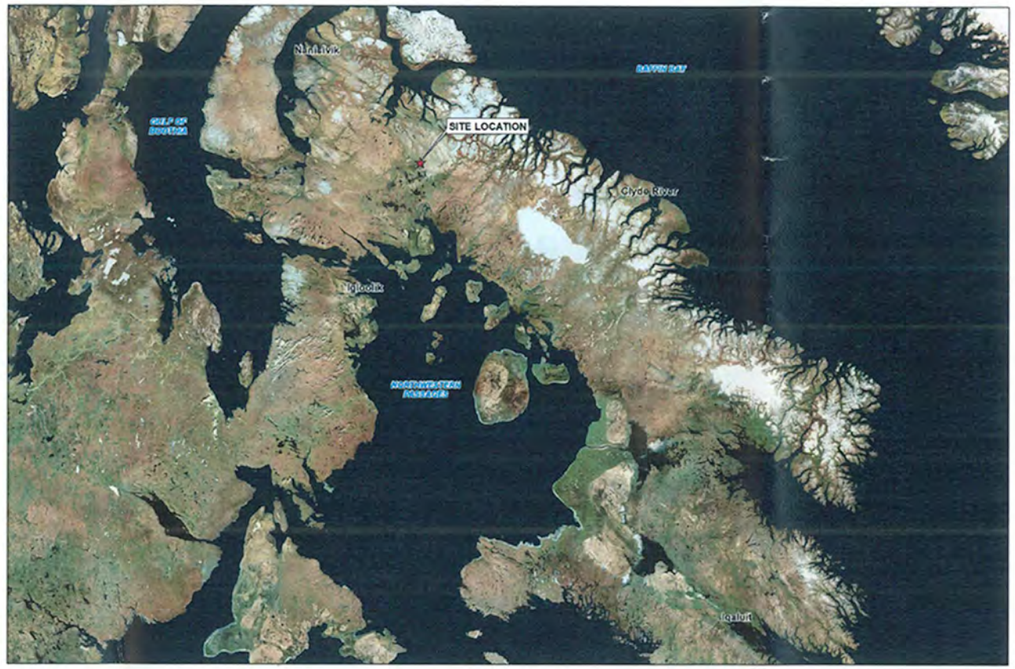
BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT
TOTE ROAD EARTHWORKS
CV186

INDEX OF DRAWINGS		
DRAWING NO.	DRAWING SHEET TITLE	REVISION NO.
001	TITLE SHEET - CV186	2
002	PIPE CROSSING TYPICAL DETAILS & GENERAL NOTES - CV186	2
003	CULVERT INSTALLATION DESIGN RECOMMENDATIONS & DESIGN TABLES - CV186	2
004	ROAD PLAN, PROFILE AND SECTIONS - CV186	2

SPECIFICATIONS		
SPECIFICATION NO.	SPECIFICATION TITLE	REVISION NO.
1667708-S	TOTE ROAD EARTHWORKS	1

DESIGN REPORT		
REPORT NO.	REPORT TITLE	REVISION NO.
1667708	TOTE ROAD EARTHWORKS	0



KEY PLAN
NOT TO SCALE

REV	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2017-04-03	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 1 / REPORT REV. 0	CK/RAD	JJL	MJT	RAD
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A	2017-03-09	ISSUED FOR CLIENT REVIEW	CK/RAD	JJL	MJT	RAD

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GOLDER ASSOCIATES LTD.
Signature
Date 2017-03-24
PERMIT NUMBER: P 049
NT/NU Association of Professional Engineers and Geoscientists

REGISTERED PROFESSIONAL ENGINEER
R.A. DOUGLAS
LICENSEE
2017-03-24
NWT/NU

CLIENT: Baffinland
CONSULTANT: Golder Associates

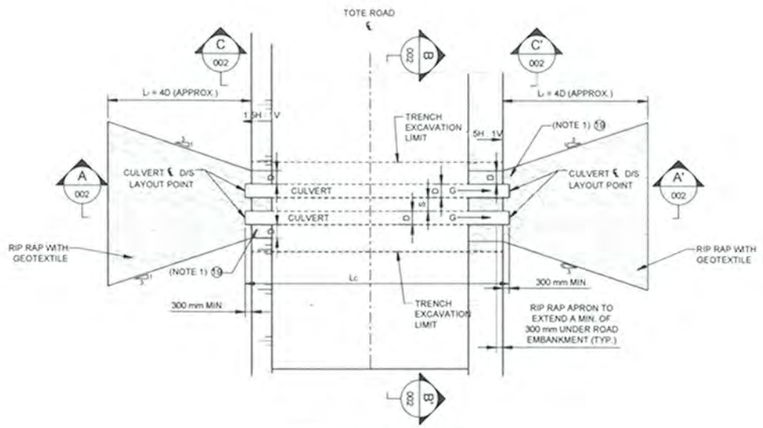
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PROJECT
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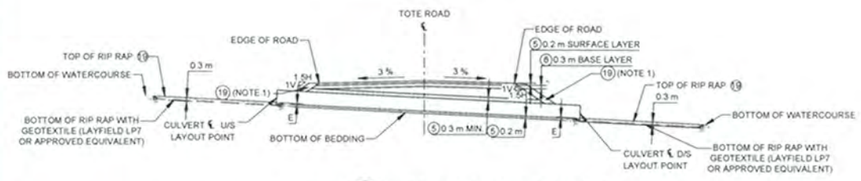
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TITLE SHEET - CV186

PROJECT NO.	PHASE	REV		DRAWING
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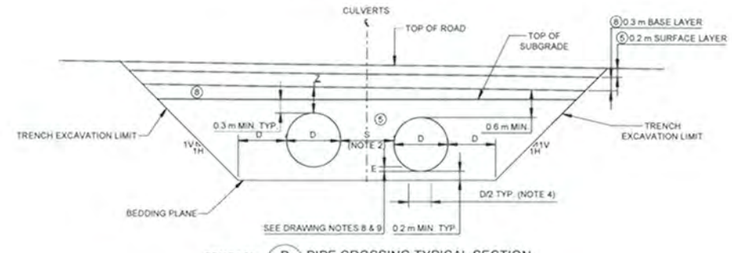
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PIPE CROSSING PLAN VIEW
SCALE 1:200 m



SCALE 1:200 m A 002 PIPE CROSSING TYPICAL PROFILE



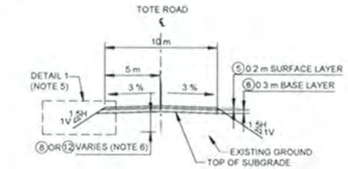
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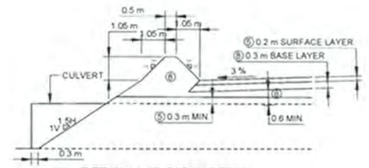
(5)	SCREENED MATERIAL	(12)	RUN OF QUARRY (ROQ)
(8)	JAW RUN	(19)	EROSION PROTECTION

DRAWING NOTES

1. EROSION PROTECTION SHALL BE PLACED AROUND THE CULVERT INLET AND OUTLET AS PER THE DIRECTION OF THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
2. THE MINIMUM SPACING (S) BETWEEN CULVERTS SHALL BE D, WHERE D IS THE CULVERT DIAMETER, OR 1.5 m, WHICHEVER IS GREATER.
3. THE MINIMUM COVER DEFINED AS THE DISTANCE BETWEEN THE TOP OF CULVERT TO THE TOP OF SUBGRADE SHALL BE 0.6 m OR D/4, WHERE D IS THE CULVERT DIAMETER, WHICHEVER IS GREATER.
4. THE BEDDING TO BE SHAPED TO RECEIVE PIPE.
5. SAFETY BERMS ARE REQUIRED FOR EMBANKMENTS GREATER THAN 3 m IN HEIGHT.
6. FOR EMBANKMENT FILL DEPTHS LESS THAN 0.6 m, TYPE 8 MATERIAL SHALL BE USED. FOR FILL DEPTHS GREATER THAN 0.6 m, AND DEPENDING ON THE FILL EXTENTS, TYPE 12 MATERIAL MAY BE USED.
7. DEFINITIONS AND VALUES OF D,Lc,Lr, AND G CAN BE FOUND IN DESIGN TABLES ON DRAWING 003.
8. FOR FISH BEARING CULVERT WITH MULTIPLE PIPES, ONLY ONE SHALL BE EMBEDDED BY "E" AND ALL OTHER PIPES SHALL BE PLACED ON GROUND / BOTTOM OF WATER COURSE.
9. AS PER CULVERT DETAILS (DWG 003)FOR FISH BEARING CULVERT, E = 0.1 D. FOR NON-FISH BEARING CULVERT E=0.



SCALE 1:200 m C 002 EMBANKMENT SECTION



DETAIL 1 - TYPICAL BERM
SCALE 1:100 m

GENERAL CONSTRUCTION NOTES

1. IT IS THE RESPONSIBILITY OF THE USER OF THIS DRAWING TO ENSURE THE USE OF ITS MOST RECENT REVISION.
2. THE INFORMATION PROVIDED ON THE DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE MOST RECENT REVISION OF THE SPECIFICATIONS AND REPORT LISTED ON DWG. 001.
3. IN THE EVENT OF DISCREPANCY BETWEEN THE DRAWINGS AND THE SPECIFICATIONS CLARIFICATION AND/OR DIRECTION SHALL BE PROVIDED AS OUTLINED IN THE SPECIFICATIONS.
4. PRIOR TO COMMENCING CONSTRUCTION ACTIVITIES, THE CONTRACTOR SHALL BE FAMILIAR WITH THE SCOPE OF WORK.
5. THE INFORMATION PRESENTED ON THESE DRAWINGS IS INTENDED TO CONVEY THE PIPE CROSSING CONSTRUCTION DETAILS AND ROAD EMBANKMENT DETAILS.
6. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED.
7. COORDINATE SYSTEM IS UTM (NAD 83) ZONE 17N.
8. CONTOUR INTERVAL IS 1 M WITH EXISTING TOPOGRAPHY.
9. THE DESIGN OF EACH INSTALLATION ARE BASED ON A DESK STUDY USING A DIGITAL ELEVATION MODEL AND SATELLITE IMAGERY PROVIDED BY BAFFINLAND, AND ARE NOT SUPPORTED BY FIELD STUDY.
10. THE GROUND SURFACE ELEVATIONS ARE CONSIDERED TO BE APPROXIMATE.
11. A DECISION ON WHETHER TO EXTEND OR REPLACE EACH CULVERT WILL BE MADE BY THE OWNER'S REPRESENTATIVE.
12. FIELD FITTING OF CULVERTS (INCLUDING LOCATIONS, LENGTHS, INVERT DEPTHS, GRADIENTS, AND SKEWS) TO ACTUAL CONDITIONS AT EACH SITE SHALL BE AS DIRECTED BY THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
13. FILL MATERIALS SHALL BE HANDLED, SORTED, PLACED AND COMPACTED AS SHOWN ON THE DRAWINGS, DESCRIBED IN THE SPECIFICATIONS AND TO THE SATISFACTION OF THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
14. NO GEOTECHNICAL OR STRUCTURAL ANALYSIS OF THE CULVERT INSTALLATIONS HAS **BEEN CARRIED OUT. A MINIMUM CULVERT COVER OF 0.6 m OR D/4 (WHERE D IS THE** DIAMETER OF THE CIRCULAR CULVERT PIPE) HAS BEEN ASSUMED TO BE APPROPRIATE FOR 10 TONNE AXLE LOADS; USE OF HEAVIER TRUCKS WILL REQUIRE STRUCTURAL ANALYSIS OF THE CULVERT INSTALLATION.
15. FISH BEARING STATUS IN CULVERT DETAILS TABLE ON DWG. 003 TAKEN FROM HATCH TOTE ROAD CULVERT DATA SHEETS H349000-3000-10-088-0030 THROUGH H349000-3000-10-088-0034.
16. NO HYDROLOGIC OR HYDRAULIC ANALYSIS WAS CARRIED OUT. NUMBER OF CULVERTS, CULVERT DIAMETER(S), CULVERT LENGTH(S), EMBEDMENT DEPTH (E), AND REQUIREMENTS FOR RIP RAP FROM HATCH TOTE ROAD CULVERT DATA SHEETS H349000-3000-10-088-0030 THROUGH H349000-3000-10-088-0034.
17. IN SECTIONS, SKEWED CULVERTS ARE PROJECTED ONTO PLANE OF CROSS-SECTIONS.
18. AT LIMITS OF CONSTRUCTION NEW PAVEMENT THICKNESS NEEDS TO BE TAPERED TO MATCH EXISTING PAVEMENT SURFACE.
19. THE OWNER'S REPRESENTATIVE WILL CONFIRM THE REQUIREMENT FOR SAFETY BERMS ALONG THE ROAD EDGES BASED ON ENCOUNTERED FIELD CONDITIONS. TYPICAL BERM DETAILS ARE SHOWN ON DWG 002.
20. SITE SPECIFIC NOTES ON DWG. 003 MUST BE READ IN CONJUNCTION WITH THESE GENERAL NOTES, AND THE SPECIFICATIONS AND DRAWINGS LISTED ON DWG 001.
21. BAFFINLAND IS RESPONSIBLE FOR PERMITTING OF THE PROPOSED WORKS (IF REQUIRED).
22. PRIOR TO CONSTRUCTION, BAFFINLAND'S ENVIRONMENTAL REPRESENTATIVE WILL BE CONSULTED TO APPROVE THE REQUIRED EROSION CONTROL AND MITIGATION MEASURES ADJACENT TO WATER BODIES.

0 2 4
1:50 METRES

0 5 10
1:100 METRES

0 10 20
1:200 METRES

REV	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2017-04-03	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 1 / REPORT REV. 0	CK/RAD	JJL	MJT	RAD
1	2017-03-24	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 0	CK/RAD	JJL	MJT	RAD
0	2017-03-10	ISSUED FOR CONSTRUCTION	CK/RAD	JJL	MJT	RAD
A	2017-03-09	ISSUED FOR CLIENT REVIEW	CK/RAD	JJL	MJT	RAD

PERMIT TO PRACTICE
GOLDER ASSOCIATES LTD.
Signature
Date 17-04-05
PERMIT NUMBER: P 049
NT/NU Association of Professional Engineers and Geoscientists

REGISTERED PROFESSIONAL ENGINEER
R.A. DOUGLAS
LICENSEE
17-04-05
NUNAVUT

CLIENT: Baffinland
CONSULTANT: Golder Associates

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CANADA
905-567-4444
www.golder.com

PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

TITLE
TYPICAL DETAILS AND GENERAL NOTES - CV186

PROJECT NO	PHASE	REV	2 OF 4	DRAWING
1667708	3000	2		002

Reduced Size
NOT TO SCALE

CULVERT DETAILS†

STATION (m)	FISH BEARING STATUS (REFER TO NOTE 15 ON DWG. 002)	EXISTING CULVERT DIAMETER (D) (mm) (REFER TO NOTE 16 ON DWG. 002)	EXISTING CULVERT LENGTH (m) (REFER TO NOTE 16 ON DWG. 002)	EXISTING CULVERT GRADIENT (%) (REFER TO NOTE 16 ON DWG. 002)	EMBEDMENT DEPTH (E) (mm) (REFER TO NOTE 16 ON DWG. 002)	PROPOSED CULVERT LENGTH (m)	DEPTH FROM SUBGRADE TO TOP OF CULVERT AT CENTRELINE OF ROAD (Z) (m)	EASTING OF CENTRELINE OF PIPE AT CENTRELINE OF ROAD (m)	NORTHING OF CENTRELINE OF PIPE AT CENTRELINE OF ROAD (m)	INLET INVERT ELEVATION (m)	OUTLET INVERT ELEVATION (m)	CULVERT GRADIENT (G) (%)	CULVERT SKEW (deg)	INLET RIP RAP REQUIRED?	OUTLET RIP RAP REQUIRED?	RIP RAP APRON LENGTH (Lr) (m)
0+265.0	POTENTIAL	1000	21			37	0.9	560720.5	7913497.8	178.4	177.7	2	139	N	Y	4

†CULVERT LOCATION DETAILS ARE BASED ON A DESK STUDY USING A DIGITAL ELEVATION MODEL AND SATELLITE IMAGERY PROVIDED BY BAFFINLAND, AND ARE NOT SUPPORTED BY FIELD STUDY (REFER TO GENERAL CONSTRUCTION NOTE 12 ON DWG. 002)

SITE SPECIFIC NOTES FOR CULVERT CV186

AS INDICATED IN THE GENERAL CONSTRUCTION NOTES ON DWG. 002, THE SITE SPECIFIC NOTES ARE BASED ONLY ON A DESKTOP STUDY OF THE SITE. NO FIELD WORK WAS CARRIED OUT TO SUPPORT THIS WORK. AN INSPECTION OF THE SITE SHALL BE CARRIED OUT BY THE OWNER'S REPRESENTATIVE AND/OR GEOTECHNICAL ENGINEER PRIOR TO CONSTRUCTION. THE SITE SPECIFIC NOTES ARE INTENDED TO BE COMPREHENSIVE BUT NOT ALL-INCLUSIVE.

1. CONSTRUCT THE ROAD ALONG THE REALIGNMENT (REFER TO DWG. 004).
2. **WIDEN THE ROAD RUNNING SURFACE AT THE CULVERT LOCATION TO A MINIMUM OF 10 m, MAINTAINING THE ROAD EMBANKMENT SIDE SLOPES NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL).**
3. **WIDEN THE ROAD RUNNING SURFACE TO A MINIMUM OF 10 m ON THE APPROACHES TO THE CULVERT LOCATION, MAINTAINING THE ROAD EMBANKMENT SIDE SLOPES NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL).**
4. **ADD/ SHAPE EMBANKMENT FILL TO FLATTEN THE ROAD EMBANKMENT SIDE SLOPES TO NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL), MAINTAINING THE ROAD RUNNING SURFACE WIDTH A MINIMUM OF 10 m.**
5. **RAISE THE ROAD EMBANKMENT TO PROVIDE ADEQUATE CULVERT PIPE COVER, MAINTAINING THE ROAD EMBANKMENT SIDE SLOPES NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL) AND THE ROAD RUNNING SURFACE A MINIMUM OF 10 m.**
6. CAP THE ROAD SURFACE WITH SUITABLE RUNNING SURFACE MATERIAL (SEE TYPICAL SECTION ON DWG. 002).
7. PROVIDE SAFETY BERMS WHERE EMBANKMENT FILL IS GREATER THAN 3 m ABOVE EXISTING GROUND SURFACE.
8. PROVIDE RIP RAP PROTECTION AT THE CULVERT INLET AND OUTLET.
9. MARK THE CULVERT ENDS WITH DELINEATORS OF SUFFICIENT SIZE AND HEIGHT TO REDUCE THE RISK OF DAMAGE TO THE CULVERT PIPE ENDS BY SNOW PLOWING, SIDE SLOPING, OR OTHER MAINTENANCE OPERATIONS.

ROAD LAYOUT DETAILS

STATION (m)	TOP OF SUBGRADE			CENTRELINE CUT DEPTH* (TOP OF SUBGRADE TO EXISTING ROAD SURFACE) (m)	TOE OF EMBANKMENT SLOPE		
	CENTRELINE EASTING (m)	CENTRELINE NORTHING (m)	CENTRELINE ELEVATION (m)		OFFSET TO LEFT TOE** (m)	OFFSET TO RIGHT TOE** (m)	GRADIENT TO NEXT POINT (%)
0+000.0	560480.3	7913604.8	181.1	-0.2	5.1	5.0	1.6
0+017.9	560496	7913596.3	181.4	-0.2	5.9	13.2	1.5
0+020.0	560497.9	7913595.4	181.4	-0.2	5.9	13.2	0.3
0+040.0	560515.5	7913585.9	181.4	-0.1	5.8	9.8	-2.0
0+060.0	560533.1	7913576.4	181.1	-0.2	6.2	11.4	-3.5
0+067.9	560540	7913572.7	180.8	-0.3	6.3	13.1	-3.9
0+068.2	560540.4	7913572.5	180.8	-0.3	6.3	13.1	-3.5
0+080.0	560550.7	7913566.9	180.4	-0.2	6.5	13.4	-2.6
0+087.7	560557.5	7913563.3	180.1	-0.4	6.2	13.8	-1.8
0+100.0	560568.5	7913557.7	179.9	-0.4	6.1	13.6	-0.5
0+119.6	560586.5	7913550.2	179.8	-0.2	6.0	11.0	0.3
0+120.0	560587	7913550.1	179.8	-0.2	6.0	11.0	0.3
0+140.0	560606	7913544.2	179.9	-0.1	5.9	10.9	
0+157.4	560623	7913540.4	179.9	-0.2	6.1	10.2	0.0
0+160.0	560625.6	7913540	179.9	-0.2	6.2	10.2	0.0
0+165.0	560630.6	7913539.1	179.9	-0.2	6.3	6.0	0.0
0+180.0	560645.1	7913535.8	179.9	-0.2	6.8	5.8	0.0
0+196.4	560660.7	7913530.6	179.9	-0.3	6.5	6.0	0.0
0+200.0	560664	7913529.3	179.9	-0.2	6.4	6.0	0.0
0+212.1	560675.3	7913524.9	179.9	-0.2	6.2	6.0	0.0
0+220.0	560682.6	7913521.8	179.9	-0.3	6.4	6.0	0.0
0+225.4	560687.5	7913519.5	179.9	-0.3	6.5	10.4	0.2
0+240.0	560700.3	7913512.5	179.9	-0.4	6.8	13.4	0.6
0+260.0	560716.7	7913501	180	-1.2	8.3	6.4	0.9
0+264.0	560719.8	7913498.5	180.1	-1.4	8.3	6.5	0.9
0+264.4	560720.1	7913498.2	180.1	-1.4	8.3	6.5	1.0
0+265.0	560720.5	7913497.9	180.1	-1.4	8.3	6.5	1.1
0+280.0	560732.5	7913488.8	180.3	-0.5	7.8	6.5	1.4
0+284.1	560735.9	7913486.5	180.3	-0.4	7.7	6.4	1.4
0+300.0	560749.7	7913478.6	180.5	-0.2	6.1	6.3	1.4
0+320.0	560768	7913470.6	180.8	-0.2	6.0	6.1	1.4
0+325.7	560773.3	7913468.7	180.9	-0.1	6.1	5.9	1.3
0+328.1	560775.6	7913468	180.9	-0.1	6.1	5.9	0.9
0+337.3	560784.4	7913465.3	181	-0.1	6.1	5.8	0.5
0+340.0	560787	7913464.5	181	-0.1	5.2	5.1	0.5
0+350.9	560797.4	7913461.3	181.1	-0.2	5.1	5.0	

* NEGATIVE CUT DEPTH DENOTES FILL
** MEASURED ON GROUND SURFACE

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2017-04-03	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 1 / REPORT REV. 0	CK/RAD	JJL	MJT	RAD
1	2017-03-24	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 0	CK/RAD	JJL	MJT	RAD
0	2017-03-10	ISSUED FOR CONSTRUCTION	CK/RAD	JJL	MJT	RAD
A	2017-03-09	ISSUED FOR CLIENT REVIEW	CK/RAD	JJL	MJT	RAD

PERMIT TO PRACTICE
GOLDER ASSOCIATES LTD.
Signature
Date 17-04-03
PERMIT NUMBER: P 049
NT/NU Association of Professional Engineers and Geoscientists

REGISTERED PROFESSIONAL ENGINEER
R.A. DOUGLAS
LICENSEE
2017-04-03
NT/NU

Baffinland

Golder Associates

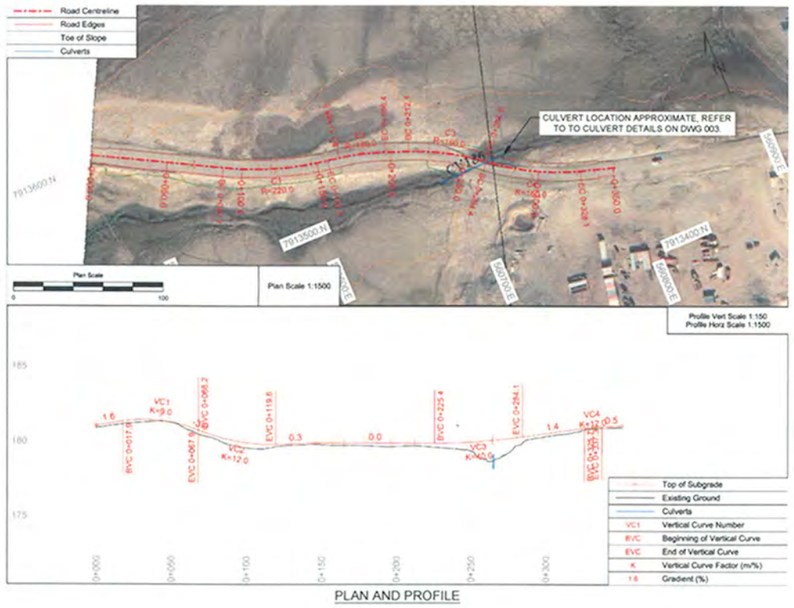
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MISSISSAUGA, ON
CANADA
905-567-4444
www.golder.com

PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

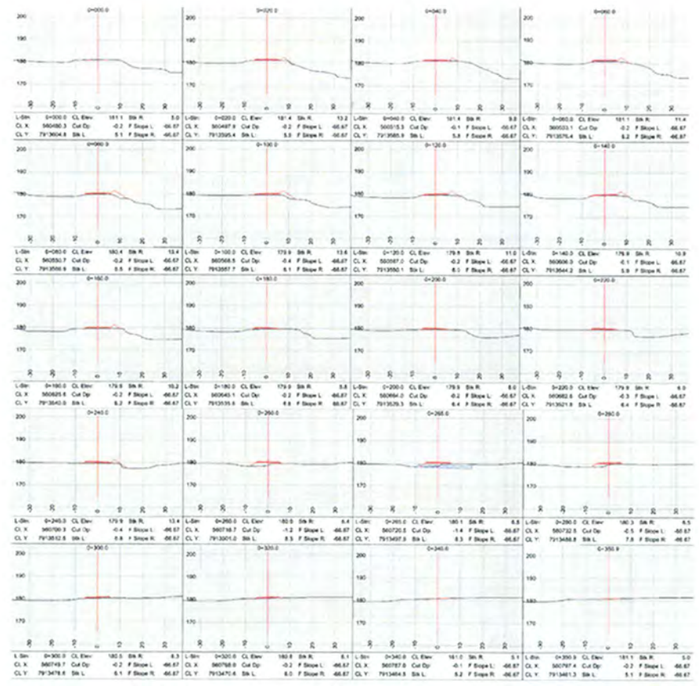
TITLE
CULVERT INSTALLATION DESIGN RECOMMENDATIONS & DESIGN TABLES - CV186

PROJECT NO	PHASE	REV	3 of 4	DRAWING
1667708	3000	2		003

Reduced Size
NOT TO SCALE



PLAN AND PROFILE



SECTIONS
(REFER TO GENERAL CONSTRUCTION NOTE 17)

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2017-04-03	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 1 / REPORT REV. 0	CK/RAD	JJL	MJT	RAD
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0	2017-03-10	ISSUED FOR CONSTRUCTION	CK/RAD	JJL	MJT	RAD
A	2017-03-09	ISSUED FOR CLIENT REVIEW	CK/RAD	JJL	MJT	RAD

PERMIT-TO-PRACTICE: GOLDER ASSOCIATES LTD.
Signature
Date 17-04-03
PERMIT NUMBER: P 049
NT/NU Association of Professional Engineers and Geoscientists

PROFESSIONAL ENGINEER — R.A. DOUGLAS — LICENSEE — 2017-04-03 — NWT/NU

CLIENT: Baffinland

CONSULTANT: Golder Associates

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PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

TITLE
ROAD PLAN, PROFILE AND SECTIONS - CV186

PROJECT NO	PHASE	REV.	4 of 4	DRAWING
1667708	3000	2		004

Reduced Size
NOT TO SCALE

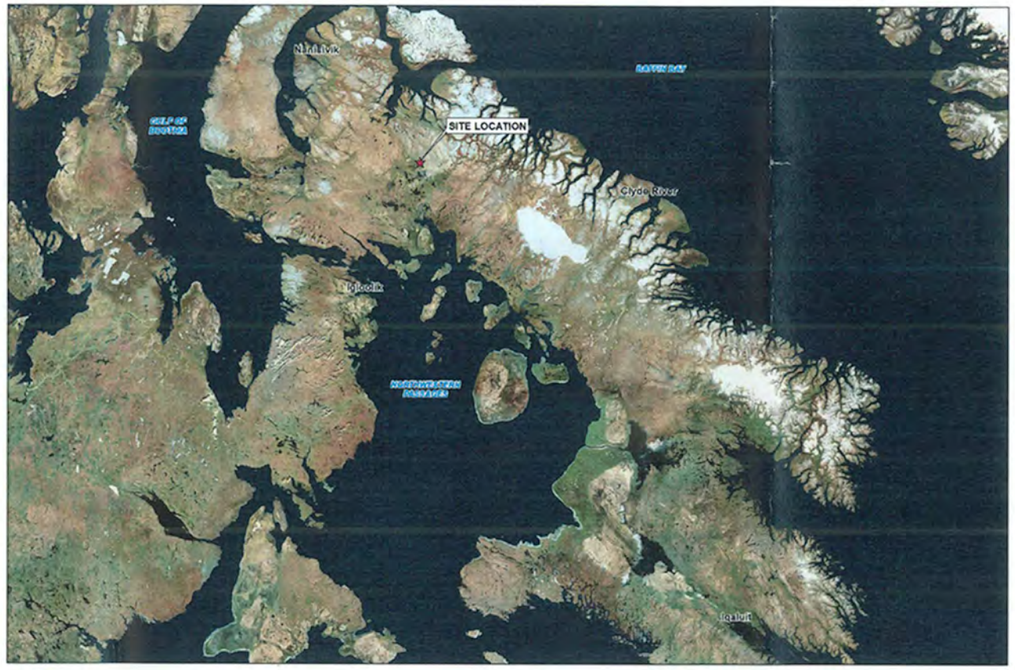
BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT
TOTE ROAD EARTHWORKS
CV187

INDEX OF DRAWINGS		
DRAWING NO.	DRAWING SHEET TITLE	REVISION NO.
001	TITLE SHEET - CV187	2
002	PIPE CROSSING TYPICAL DETAILS & GENERAL NOTES - CV187	2
003	CULVERT INSTALLATION DESIGN RECOMMENDATIONS & DESIGN TABLES - CV187	2
004	ROAD PLAN, PROFILE AND SECTIONS - CV187	2

SPECIFICATIONS		
SPECIFICATION NO.	SPECIFICATION TITLE	REVISION NO.
1667708-S	TOTE ROAD EARTHWORKS	1

DESIGN REPORT		
REPORT NO.	REPORT TITLE	REVISION NO.
1667708	TOTE ROAD EARTHWORKS	0



KEY PLAN
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REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
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0	2017-03-09	ISSUED FOR CONSTRUCTION	JJL	CK/RAD	MJT	RAD
A	2017-02-24	ISSUED FOR CLIENT REVIEW	JJL	CK/RAD	MJT	RAD

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NWT/NU

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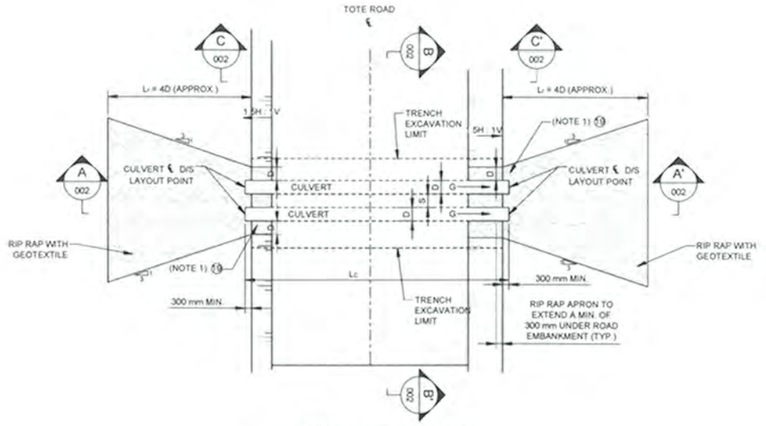
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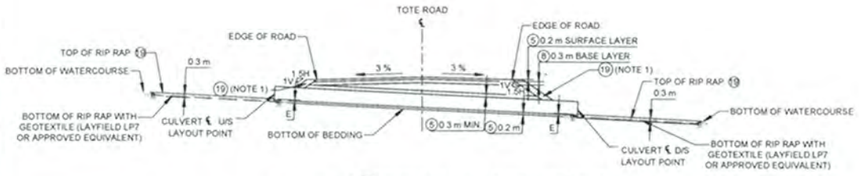
TITLE
TITLE SHEET - CV187

PROJECT NO	PHASE	REV	1 of 4	DRAWING
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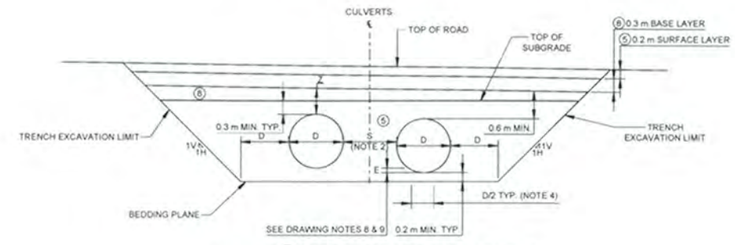
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PIPE CROSSING PLAN VIEW
SCALE 1:200 m



SCALE 1:200 m (A 002) PIPE CROSSING TYPICAL PROFILE



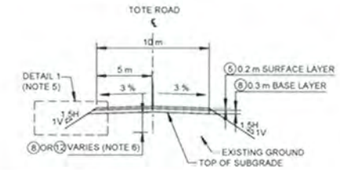
SCALE 1:50 m (B 002) PIPE CROSSING TYPICAL SECTION

LEGEND

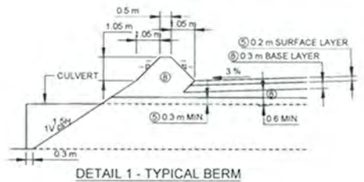
(5)	SCREENED MATERIAL	(12)	RUN OF QUARRY (ROQ)
(6)	JAW RUN	(19)	EROSION PROTECTION

DRAWING NOTES

1. EROSION PROTECTION SHALL BE PLACED AROUND THE CULVERT INLET AND OUTLET AS PER THE DIRECTION OF THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
2. THE MINIMUM SPACING (S) BETWEEN CULVERTS SHALL BE D, WHERE D IS THE CULVERT DIAMETER, OR 1.5 m, WHICHEVER IS GREATER.
3. THE MINIMUM COVER DEFINED AS THE DISTANCE BETWEEN THE TOP OF CULVERT TO THE TOP OF SUBGRADE SHALL BE 0.6 m OR D/4, WHERE D IS THE CULVERT DIAMETER, WHICHEVER IS GREATER.
4. THE BEDDING TO BE SHAPED TO RECEIVE PIPE.
5. SAFETY BERMS ARE REQUIRED FOR EMBANKMENTS GREATER THAN 3 m IN HEIGHT.
6. FOR EMBANKMENT FILL DEPTHS LESS THAN 0.6 m, TYPE 8 MATERIAL SHALL BE USED. FOR FILL DEPTHS GREATER THAN 0.6 m, AND DEPENDING ON THE FILL EXTENTS, TYPE 12 MATERIAL MAY BE USED.
7. DEFINITIONS AND VALUES OF D,Lc,Lr, AND G CAN BE FOUND IN DESIGN TABLES ON DRAWING 003.
8. FOR FISH BEARING CULVERT WITH MULTIPLE PIPES, ONLY ONE SHALL BE EMBEDDED BY "E" AND ALL OTHER PIPES SHALL BE PLACED ON GROUND / BOTTOM OF WATER COURSE.
9. AS PER CULVERT DETAILS (DWG 003)FOR FISH BEARING CULVERT, E = 0.1 D. FOR NON-FISH BEARING CULVERT E=0.



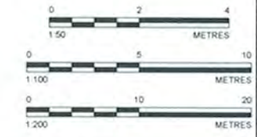
SCALE 1:200 m (C 002) EMBANKMENT SECTION



DETAIL 1 - TYPICAL BERM
SCALE 1:100 m

GENERAL CONSTRUCTION NOTES

1. IT IS THE RESPONSIBILITY OF THE USER OF THIS DRAWING TO ENSURE THE USE OF ITS MOST RECENT REVISION.
2. THE INFORMATION PROVIDED ON THE DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE MOST RECENT REVISION OF THE SPECIFICATIONS AND REPORT LISTED ON DWG. 001.
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8. CONTOUR INTERVAL IS 1 M WITH EXISTING TOPOGRAPHY.
9. THE DESIGN OF EACH INSTALLATION ARE BASED ON A DESK STUDY USING A DIGITAL ELEVATION MODEL AND SATELLITE IMAGERY PROVIDED BY BAFFINLAND, AND ARE NOT SUPPORTED BY FIELD STUDY.
10. THE GROUND SURFACE ELEVATIONS ARE CONSIDERED TO BE APPROXIMATE.
11. A DECISION ON WHETHER TO EXTEND OR REPLACE EACH CULVERT WILL BE MADE BY THE OWNER'S REPRESENTATIVE.
12. FIELD FITTING OF CULVERTS (INCLUDING LOCATIONS, LENGTHS, INVERT DEPTHS, GRADIENTS, AND SKEWS) TO ACTUAL CONDITIONS AT EACH SITE SHALL BE AS DIRECTED BY THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
13. FILL MATERIALS SHALL BE HANDLED, SORTED, PLACED AND COMPACTED AS SHOWN ON THE DRAWINGS, DESCRIBED IN THE SPECIFICATIONS AND TO THE SATISFACTION OF THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
14. NO GEOTECHNICAL OR STRUCTURAL ANALYSIS OF THE CULVERT INSTALLATIONS HAS **BEEN CARRIED OUT. A MINIMUM CULVERT COVER OF 0.6 m OR D/4 (WHERE D IS THE** DIAMETER OF THE CIRCULAR CULVERT PIPE) HAS BEEN ASSUMED TO BE APPROPRIATE FOR 10 TONNE AXLE LOADS; USE OF HEAVIER TRUCKS WILL REQUIRE STRUCTURAL ANALYSIS OF THE CULVERT INSTALLATION.
15. FISH BEARING STATUS IN CULVERT DETAILS TABLE ON DWG. 003 TAKEN FROM HATCH TOTE ROAD CULVERT DATA SHEETS H349000-3000-10-088-0030 THROUGH H349000-3000-10-088-0034.
16. NO HYDROLOGIC OR HYDRAULIC ANALYSIS WAS CARRIED OUT. NUMBER OF CULVERTS, CULVERT DIAMETER(S), CULVERT LENGTH(S), EMBEDMENT DEPTH (E), AND REQUIREMENTS FOR RIP RAP FROM HATCH TOTE ROAD CULVERT DATA SHEETS H349000-3000-10-088-0030 THROUGH H349000-3000-10-088-0034.
17. IN SECTIONS, SKEWED CULVERTS ARE PROJECTED ONTO PLANE OF CROSS-SECTIONS.
18. AT LIMITS OF CONSTRUCTION NEW PAVEMENT THICKNESS NEEDS TO BE TAPERED TO MATCH EXISTING PAVEMENT SURFACE.
19. THE OWNER'S REPRESENTATIVE WILL CONFIRM THE REQUIREMENT FOR SAFETY BERMS ALONG THE ROAD EDGES BASED ON ENCOUNTERED FIELD CONDITIONS. TYPICAL BERM DETAILS ARE SHOWN ON DWG 002.
20. SITE SPECIFIC NOTES ON DWG. 003 MUST BE READ IN CONJUNCTION WITH THESE GENERAL NOTES, AND THE SPECIFICATIONS AND DRAWINGS LISTED ON DWG 001.
21. BAFFINLAND IS RESPONSIBLE FOR PERMITTING OF THE PROPOSED WORKS (IF REQUIRED).
22. PRIOR TO CONSTRUCTION, BAFFINLAND'S ENVIRONMENTAL REPRESENTATIVE WILL BE CONSULTED TO APPROVE THE REQUIRED EROSION CONTROL AND MITIGATION MEASURES ADJACENT TO WATER BODIES.



REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2017-04-03	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 1 / REPORT REV. 0	JJL	CK/RAD	MJT	RAD
1	2017-03-24	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 0	JJL	CK/RAD	MJT	RAD
0	2017-03-09	ISSUED FOR CONSTRUCTION	JJL	CK/RAD	MJT	RAD
A	2017-02-24	ISSUED FOR CLIENT REVIEW	JJL	CK/RAD	MJT	RAD

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REGISTERED PROFESSIONAL ENGINEER
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PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

TITLE
TYPICAL DETAILS AND GENERAL NOTES - CV187

PROJECT NO	PHASE	REV	2 of 4	DRAWING
1667708	3000	2		002

Reduced Size
NOT TO SCALE

CULVERT DETAILS†

STATION (m)	FISH BEARING STATUS (REFER TO NOTE 15 ON DWG. 002)	EXISTING CULVERT DIAMETER (D) (mm) (REFER TO NOTE 16 ON DWG. 002)	EXISTING CULVERT LENGTH (m) (REFER TO NOTE 16 ON DWG. 002)	EXISTING CULVERT GRADIENT (%) (REFER TO NOTE 16 ON DWG. 002)	EMBEDMENT DEPTH (E) (mm) (REFER TO NOTE 16 ON DWG. 002)	PROPOSED CULVERT LENGTH (m)	DEPTH FROM SUBGRADE TO TOP OF CULVERT AT CENTRELINE OF ROAD (Z) (m)	EASTING OF CENTRELINE OF PIPE AT CENTRELINE OF ROAD (m)	NORTHING OF CENTRELINE OF PIPE AT CENTRELINE OF ROAD (m)	INLET INVERT ELEVATION (m)	OUTLET INVERT ELEVATION (m)	CULVERT GRADIENT (G) (%)	CULVERT SKEW (deg)	INLET RIP RAP REQUIRED?	OUTLET RIP RAP REQUIRED?	RIP RAP APRON LENGTH (Lr) (m)
0+054.6	POTENTIAL	500	10			39	1.8	560960.6	7913418.7	181.1	180.7	1	47	N	N	

†CULVERT LOCATION DETAILS ARE BASED ON A DEM STUDY USING A DIGITAL ELEVATION MODEL AND SATELLITE IMAGERY PROVIDED BY BAFFINLAND, AND ARE NOT SUPPORTED BY FIELD STUDY (REFER TO GENERAL CONSTRUCTION NOTE 12 ON DWG. 002)

SITE SPECIFIC NOTES FOR CULVERT CV187

AS INDICATED IN THE GENERAL CONSTRUCTION NOTES ON DWG. 002, THE SITE SPECIFIC NOTES ARE BASED ONLY ON A DESKTOP STUDY OF THE SITE. NO FIELD WORK WAS CARRIED OUT TO SUPPORT THIS WORK. AN INSPECTION OF THE SITE SHALL BE CARRIED OUT BY THE OWNER'S REPRESENTATIVE AND/OR GEOTECHNICAL ENGINEER PRIOR TO CONSTRUCTION. THE SITE SPECIFIC NOTES ARE INTENDED TO BE COMPREHENSIVE BUT NOT ALL-INCLUSIVE.

1. **WIDEN THE ROAD RUNNING SURFACE AT THE CULVERT LOCATION TO A MINIMUM WIDTH OF 10 m, MAINTAINING THE ROAD EMBANKMENT SIDE SLOPES NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL).**
2. **WIDEN THE ROAD RUNNING SURFACE TO A MINIMUM OF 10 m ON THE APPROACHES TO THE CULVERT LOCATION, MAINTAINING THE ROAD EMBANKMENT SIDE SLOPES NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL).**
3. **ADD/ SHAPE EMBANKMENT FILL TO FLATTEN THE ROAD EMBANKMENT SIDE SLOPES TO NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL), MAINTAINING THE ROAD RUNNING SURFACE WIDTH A MINIMUM OF 10 m.**
4. CAP THE ROAD SURFACE WITH SUITABLE RUNNING SURFACE MATERIAL (SEE TYPICAL SECTION ON DWG. 002)
5. PROVIDE SAFETY BERMS WHERE EMBANKMENT FILL IS GREATER THAN 3 M ABOVE EXISTING GROUND SURFACE
6. PROVIDE RIP RAP PROTECTION AT THE CULVERT INLET AND OUTLET.
7. MARK THE CULVERT ENDS WITH DELINEATORS OF SUFFICIENT SIZE AND HEIGHT TO REDUCE THE RISK OF DAMAGE TO THE CULVERT PIPE ENDS BY SNOW PLOWING, SIDE SLOPING, OR OTHER MAINTENANCE OPERATIONS.

ROAD LAYOUT DETAILS

STATION (m)	TOP OF SUBGRADE			CENTRELINE CUT DEPTH* (TOP OF SUBGRADE TO EXISTING ROAD SURFACE) (m)	TOE OF EMBANKMENT SLOPE		
	CENTRELINE EASTING (m)	CENTRELINE NORTHING (m)	CENTRELINE ELEVATION (m)		OFFSET TO LEFT TOE** (m)	OFFSET TO RIGHT TOE** (m)	GRADIENT TO NEXT POINT (%)
0+000.0	560907.4	7913430.9	182	-0.2	5.0	5.2	1.1
0+015.6	560922.6	7913427.4	182.2	-0.2	6.0	6.1	1.3
0+020.0	560926.9	7913426.4	182.2	-0.3	6.1	6.2	2.3
0+040.0	560946.4	7913422	182.7	-0.8	14.1	7.5	3.7
0+054.6	560960.6	7913418.7	183.2	-1	12.9	13.1	4.6
0+060.0	560965.9	7913417.5	183.5	-1	7.4	13.8	5.6
0+080.0	560985.4	7913413	184.6	-0.7	6.8	15.9	7.2
0+097.6	561002.5	7913409.1	185.9	-0.3	6.2	5.8	7.9
0+100.0	561004.9	7913408.5	186.1	-0.2	6.2	5.8	7.9
0+115.0	561019.5	7913405.2	187.2	-0.1	5.1	5.2	

* NEGATIVE CUT DEPTH DENOTES FILL
** MEASURED ON GROUND SURFACE

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0	2017-03-09	ISSUED FOR CONSTRUCTION	JJL	CK/RAD	MJT	RAD
A	2017-02-24	ISSUED FOR CLIENT REVIEW	JJL	CK/RAD	MJT	RAD

PERMIT TO PRACTICE
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REGISTERED PROFESSIONAL ENGINEER
R.A. DOUGLAS
LICENSEE
2017-04-03
NT/NU

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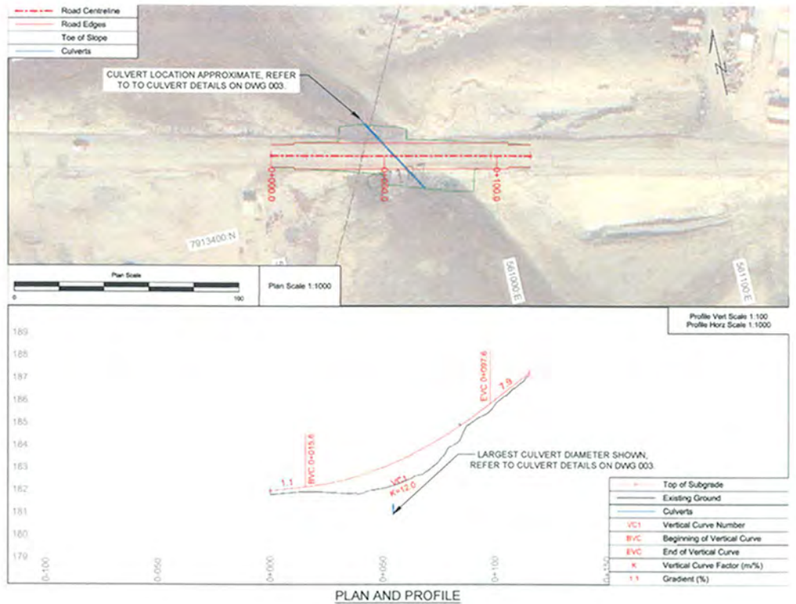
CLIENT
Baffinland

PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

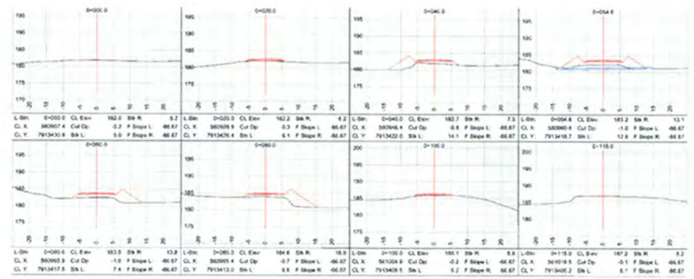
TITLE
CULVERT INSTALLATION DESIGN RECOMMENDATIONS & DESIGN TABLES - CV187

PROJECT NO.	PHASE	REV.	3 of 4	DRAWING
1667708	3000	2		003

Reduced Size
NOT TO SCALE



PLAN AND PROFILE



SECTIONS
(REFER TO GENERAL CONSTRUCTION NOTE 17)

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PROJECT
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TOTE ROAD EARTHWORKS

TITLE
ROAD PLAN, PROFILE AND SECTIONS - CV187

PROJECT NO.	PHASE	REV	4 of 4	DRAWING
1667708	3000	2		004

Reduced Size
NOT TO SCALE

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT
TOTE ROAD EARTHWORKS
CV216

INDEX OF DRAWINGS		
DRAWING NO.	DRAWING SHEET TITLE	REVISION NO.
001	TITLE SHEET - CV216	2
002	PIPE CROSSING TYPICAL DETAILS & GENERAL NOTES - CV216	2
003	CULVERT INSTALLATION DESIGN RECOMMENDATIONS & DESIGN TABLES - CV216	2
004	ROAD PLAN, PROFILE AND SECTIONS - CV216	2

SPECIFICATIONS		
SPECIFICATION NO.	SPECIFICATION TITLE	REVISION NO.
1667708-S	TOTE ROAD EARTHWORKS	1

DESIGN REPORT		
REPORT NO.	REPORT TITLE	REVISION NO.
1667708	TOTE ROAD EARTHWORKS	0



KEY PLAN
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REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
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1	2017-03-24	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 0	CK/RAD	JJL	MJT	RAD
0	2017-03-10	ISSUED FOR CONSTRUCTION	CK/RAD	JJL	MJT	RAD
A	2017-03-06	ISSUED FOR CLIENT REVIEW	CK/RAD	JJL	MJT	RAD

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LICENSEE
2017-04-03
NWT/NU

CLIENT: Baffinland

CONSULTANT: Golder Associates

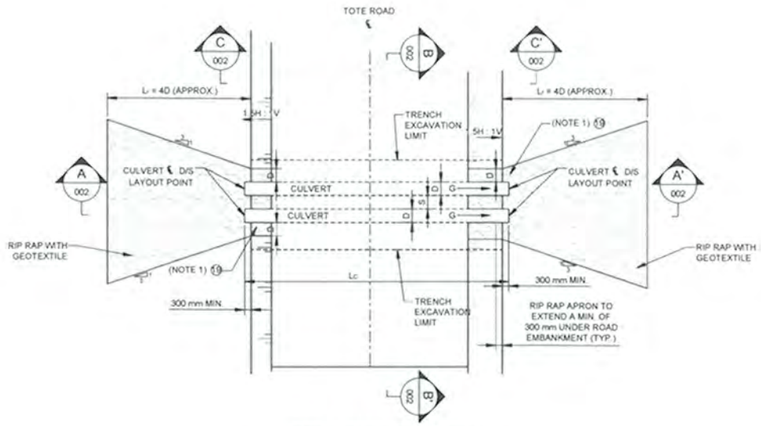
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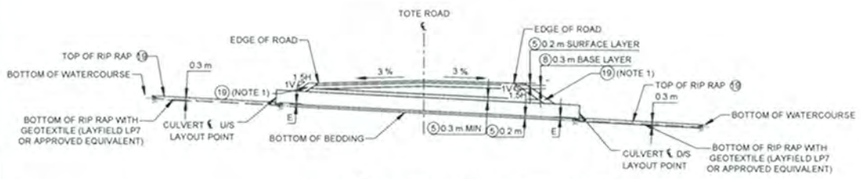
TITLE
TITLE SHEET - CV216

PROJECT NO	PHASE	REV	1 of 4	DRAWING
1667708	3000	2		001

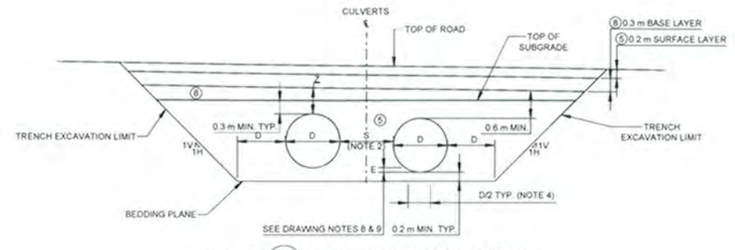
Reduced Size
NOT TO SCALE



PIPE CROSSING PLAN VIEW
SCALE 1:200 m



SCALE 1:200 m (A 002) PIPE CROSSING TYPICAL PROFILE



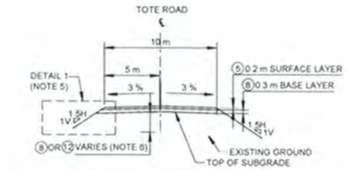
SCALE 1:50 m (B 002) PIPE CROSSING TYPICAL SECTION

LEGEND

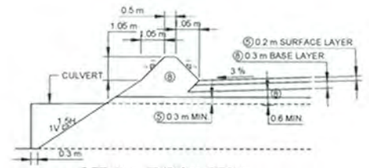
(5)	SCREENED MATERIAL	(12)	RUN OF QUARRY (ROQ)
(6)	JAW RUN	(19)	EROSION PROTECTION

DRAWING NOTES

1. EROSION PROTECTION SHALL BE PLACED AROUND THE CULVERT INLET AND OUTLET AS PER THE DIRECTION OF THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
2. THE MINIMUM SPACING (S) BETWEEN CULVERTS SHALL BE D, WHERE D IS THE CULVERT DIAMETER, OR 1.5 m, WHICHEVER IS GREATER.
3. THE MINIMUM COVER DEFINED AS THE DISTANCE BETWEEN THE TOP OF CULVERT TO THE TOP OF SUBGRADE SHALL BE 0.6 m OR D/4, WHERE D IS THE CULVERT DIAMETER, WHICHEVER IS GREATER.
4. THE BEDDING TO BE SHAPED TO RECEIVE PIPE.
5. SAFETY BERMS ARE REQUIRED FOR EMBANKMENTS GREATER THAN 3 m IN HEIGHT.
6. FOR EMBANKMENT FILL DEPTHS LESS THAN 0.6 m, TYPE 8 MATERIAL SHALL BE USED; FOR FILL DEPTHS GREATER THAN 0.6 m, AND DEPENDING ON THE FILL EXTENTS, TYPE 12 MATERIAL MAY BE USED.
7. DEFINITIONS AND VALUES OF D,Lc,Lr, AND G CAN BE FOUND IN DESIGN TABLES ON DRAWING 003.
8. FOR FISH BEARING CULVERT WITH MULTIPLE PIPES, ONLY ONE SHALL BE EMBEDDED BY "E" AND ALL OTHER PIPES SHALL BE PLACED ON GROUND / BOTTOM OF WATER COURSE.
9. AS PER CULVERT DETAILS (DWG 003)FOR FISH BEARING CULVERT, E = 0.1 D. FOR NON-FISH BEARING CULVERT E=0.



SCALE 1:200 m (C 002) EMBANKMENT SECTION



DETAIL 1 - TYPICAL BERM
SCALE 1:100 m

GENERAL CONSTRUCTION NOTES

1. IT IS THE RESPONSIBILITY OF THE USER OF THIS DRAWING TO ENSURE THE USE OF ITS MOST RECENT REVISION.
2. THE INFORMATION PROVIDED ON THE DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE MOST RECENT REVISION OF THE SPECIFICATIONS AND REPORT LISTED ON DWG. 001.
3. IN THE EVENT OF DISCREPANCY BETWEEN THE DRAWINGS AND THE SPECIFICATIONS CLARIFICATION AND/OR DIRECTION SHALL BE PROVIDED AS OUTLINED IN THE SPECIFICATIONS.
4. PRIOR TO COMMENCING CONSTRUCTION ACTIVITIES, THE CONTRACTOR SHALL BE FAMILIAR WITH THE SCOPE OF WORK.
5. THE INFORMATION PRESENTED ON THESE DRAWINGS IS INTENDED TO CONVEY THE PIPE CROSSING CONSTRUCTION DETAILS AND ROAD EMBANKMENT DETAILS.
6. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED.
7. COORDINATE SYSTEM IS UTM (NAD 83) ZONE 17N.
8. CONTOUR INTERVAL IS 1 M WITH EXISTING TOPOGRAPHY.
9. THE DESIGN OF EACH INSTALLATION ARE BASED ON A DESK STUDY USING A DIGITAL ELEVATION MODEL AND SATELLITE IMAGERY PROVIDED BY BAFFINLAND, AND ARE NOT SUPPORTED BY FIELD STUDY.
10. THE GROUND SURFACE ELEVATIONS ARE CONSIDERED TO BE APPROXIMATE.
11. A DECISION ON WHETHER TO EXTEND OR REPLACE EACH CULVERT WILL BE MADE BY THE OWNER'S REPRESENTATIVE.
12. FIELD FITTING OF CULVERTS (INCLUDING LOCATIONS, LENGTHS, INVERT DEPTHS, GRADIENTS, AND SKEWS) TO ACTUAL CONDITIONS AT EACH SITE SHALL BE AS DIRECTED BY THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
13. FILL MATERIALS SHALL BE HANDLED, SORTED, PLACED AND COMPACTED AS SHOWN ON THE DRAWINGS, DESCRIBED IN THE SPECIFICATIONS AND TO THE SATISFACTION OF THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
14. NO GEOTECHNICAL OR STRUCTURAL ANALYSIS OF THE CULVERT INSTALLATIONS HAS **BEEN CARRIED OUT. A MINIMUM CULVERT COVER OF 0.6 m OR D/4 (WHERE D IS THE** DIAMETER OF THE CIRCULAR CULVERT PIPE) HAS BEEN ASSUMED TO BE APPROPRIATE FOR 10 TONNE AXLE LOADS. USE OF HEAVIER TRUCKS WILL REQUIRE STRUCTURAL ANALYSIS OF THE CULVERT INSTALLATION.
15. FISH BEARING STATUS IN CULVERT DETAILS TABLE ON DWG. 003 TAKEN FROM HATCH TOTE ROAD CULVERT DATA SHEETS H349000-3000-10-088-0030 THROUGH H349000-3000-10-088-0034.
16. NO HYDROLOGIC OR HYDRAULIC ANALYSIS WAS CARRIED OUT. NUMBER OF CULVERTS, CULVERT DIAMETER(S), CULVERT LENGTH(S), EMBEDMENT DEPTH (E), AND REQUIREMENTS FOR RIP RAP FROM HATCH TOTE ROAD CULVERT DATA SHEETS H349000-3000-10-088-0030 THROUGH H349000-3000-10-088-0034.
17. IN SECTIONS, SKEWED CULVERTS ARE PROJECTED ONTO PLANE OF CROSS-SECTIONS.
18. AT LIMITS OF CONSTRUCTION NEW PAVEMENT THICKNESS NEEDS TO BE TAPERED TO MATCH EXISTING PAVEMENT SURFACE.
19. THE OWNER'S REPRESENTATIVE WILL CONFIRM THE REQUIREMENT FOR SAFETY BERMS ALONG THE ROAD EDGES BASED ON ENCOUNTERED FIELD CONDITIONS. TYPICAL BERM DETAILS ARE SHOWN ON DWG 002.
20. SITE SPECIFIC NOTES ON DWG. 003 MUST BE READ IN CONJUNCTION WITH THESE GENERAL NOTES, AND THE SPECIFICATIONS AND DRAWINGS LISTED ON DWG 001.
21. BAFFINLAND IS RESPONSIBLE FOR PERMITTING OF THE PROPOSED WORKS (IF REQUIRED).
22. PRIOR TO CONSTRUCTION, BAFFINLAND'S ENVIRONMENTAL REPRESENTATIVE WILL BE CONSULTED TO APPROVE THE REQUIRED EROSION CONTROL AND MITIGATION MEASURES ADJACENT TO WATER BODIES.

0 2 4
1:50 METRES

0 5 10
1:100 METRES

0 10 20
1:200 METRES

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1	2017-03-24	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 0	CK/RAD	JJL	MJT	RAD
0	2017-03-10	ISSUED FOR CONSTRUCTION	CK/RAD	JJL	MJT	RAD
A	2017-03-08	ISSUED FOR CLIENT REVIEW	CK/RAD	JJL	MJT	RAD

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PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

TITLE
TYPICAL DETAILS AND GENERAL NOTES - CV216

PROJECT NO	PHASE	REV	2 of 4	DRAWING
1667708	3000	2		002

Reduced Size
NOT TO SCALE

CULVERT DETAILS†

STATION (m)	FISH BEARING STATUS (REFER TO NOTE 15 ON DWG. 002)	EXISTING CULVERT DIAMETER (D) (mm) (REFER TO NOTE 16 ON DWG. 002)	EXISTING CULVERT LENGTH (m) (REFER TO NOTE 16 ON DWG. 002)	EXISTING CULVERT GRADIENT (%) (REFER TO NOTE 16 ON DWG. 002)	EMBEDMENT DEPTH (E) (mm) (REFER TO NOTE 16 ON DWG. 002)	PROPOSED CULVERT LENGTH (m)	DEPTH FROM SUBGRADE TO TOP OF CULVERT AT CENTRELINE OF ROAD (Z) (m)	EASTING OF CENTRELINE OF PIPE AT CENTRELINE OF ROAD (m)	NORTHING OF CENTRELINE OF PIPE AT CENTRELINE OF ROAD (m)	INLET INVERT ELEVATION (m)	OUTLET INVERT ELEVATION (m)	CULVERT GRADIENT (G) (%)	CULVERT SKEW (deg)	INLET RIP RAP REQUIRED?	OUTLET RIP RAP REQUIRED?	RIP RAP APRON LENGTH (Lr) (m)
0+117.3	YES	1200	15	0.67	120	20.5	1	542770.8	7921717.1	143.4	143.2	-1	76	N	N	
0+120.0	YES	1200	15	0.9	120	20.5	0.9	542772.9	7921715.5	143.4	143.2	-1	77	N	N	

†CULVERT LOCATION DETAILS ARE BASED ON A DESK STUDY USING A DIGITAL ELEVATION MODEL AND SATELLITE IMAGERY PROVIDED BY BAFFINLAND, AND ARE NOT SUPPORTED BY FIELD STUDY (REFER TO GENERAL CONSTRUCTION NOTE 12 ON DWG. 002)

SITE SPECIFIC NOTES FOR CULVERT CV216

AS INDICATED IN THE GENERAL CONSTRUCTION NOTES ON DWG. 002, THE SITE SPECIFIC NOTES ARE BASED ONLY ON A DESKTOP STUDY OF THE SITE; NO FIELD WORK WAS CARRIED OUT TO SUPPORT THIS WORK. AN INSPECTION OF THE SITE SHALL BE CARRIED OUT BY THE OWNER'S REPRESENTATIVE AND/OR GEOTECHNICAL ENGINEER PRIOR TO CONSTRUCTION. THE SITE SPECIFIC NOTES ARE INTENDED TO BE COMPREHENSIVE BUT NOT ALL-INCLUSIVE.

1. **WIDEN THE ROAD RUNNING SURFACE AT THE CULVERT LOCATION TO A MINIMUM WIDTH OF 10 m, MAINTAINING THE ROAD EMBANKMENT SIDE SLOPES NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL).**
2. **WIDEN THE ROAD RUNNING SURFACE TO A MINIMUM OF 10 m ON THE APPROACHES TO THE CULVERT LOCATION, MAINTAINING THE ROAD EMBANKMENT SIDE SLOPES NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL).**
3. **ADD/ SHAPE EMBANKMENT FILL TO FLATTEN THE ROAD EMBANKMENT SIDE SLOPES TO NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL), MAINTAINING THE ROAD RUNNING SURFACE WIDTH A MINIMUM OF 10 m.**
4. CAP THE ROAD SURFACE WITH SUITABLE RUNNING SURFACE MATERIAL (SEE TYPICAL SECTION ON DWG. 002).
5. PROVIDE SAFETY BERMS WHERE EMBANKMENT FILL IS GREATER THAN 3 m ABOVE EXISTING GROUND SURFACE.
6. PROVIDE RIP RAP PROTECTION AT THE CULVERT OUTLETS.
7. THE EXISTING CULVERT MAY BE PERCHED. REINSTALL CULVERTS TO DESIGN.
8. MARK THE CULVERT ENDS WITH DELINEATORS OF SUFFICIENT SIZE AND HEIGHT TO REDUCE THE RISK OF DAMAGE TO THE CULVERT PIPE ENDS BY SNOW PLOWING, SIDE SLOPING, OR OTHER MAINTENANCE OPERATIONS.

ROAD LAYOUT DETAILS

STATION (m)	TOP OF SUBGRADE			CENTRELINE CUT DEPTH* (TOP OF SUBGRADE TO EXISTING ROAD SURFACE) (m)	TOE OF EMBANKMENT SLOPE		
	CENTRELINE EASTING (m)	CENTRELINE NORTHING (m)	CENTRELINE ELEVATION (m)		OFFSET TO LEFT TOE** (m)	OFFSET TO RIGHT TOE** (m)	GRADIENT TO NEXT POINT (%)
0+000.0	542696.1	7921806.8	147.1	-0.1	5.1	5.4	0.7
0+020.0	542707.3	7921790.2	147.2	-0.2	5.9	6.1	0.7
0+034.2	542715.2	7921778.4	147.3	-0.1	5.9	6.1	0.4
0+039.7	542718.2	7921773.9	147.4	-0.1	5.9	6.0	0.1
0+040.0	542718.4	7921773.6	147.4	-0.1	5.9	6.0	-1.0
0+060.0	542730.2	7921757.5	147.2	-0.2	5.8	6.3	-3.2
0+078.7	542742.4	7921743.3	146.6	-0.2	6.3	5.9	-4.2
0+080.0	542743.3	7921742.4	146.5	-0.2	6.3	5.9	-4.2
0+082.7	542745.2	7921740.4	146.4	-0.3	6.3	6.0	-3.5
0+100.0	542757.6	7921728.3	145.8	-0.5	6.3	9.5	-2.0
0+117.3	542770.8	7921717.1	145.5	-0.2	5.9	9.2	-1.2
0+120.0	542772.9	7921715.5	145.4	-0.1	5.8	9.1	-1.1
0+120.0	542772.9	7921715.5	145.4	-0.1	5.8	9.1	-0.8
0+126.2	542777.8	7921711.8	145.4	-0.1	5.8	9.0	0.0

* NEGATIVE CUT DEPTH DENOTES FILL
** MEASURED ON GROUND SURFACE

REV	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2017-04-03	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 1 / REPORT REV. 0	CK/RAD	JJL	MJT	RAD
1	2017-03-24	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 0	CK/RAD	JJL	MJT	RAD
0	2017-03-10	ISSUED FOR CONSTRUCTION	CK/RAD	JJL	MJT	RAD
A	2017-03-06	ISSUED FOR CLIENT REVIEW	CK/RAD	JJL	MJT	RAD

PERMIT-TO-PRACTICE
GOLDER ASSOCIATES LTD.
Signature
Date 2017-04-05
PERMIT NUMBER: P 049
N.T./N.U. Association of Professional Engineers and Geoscientists

REGISTERED PROFESSIONAL ENGINEER
R.A. DOUGLAS
LICENSEE
2017-04-05
NWT/NU

Baffinland
CONSULTANT

Golder Associates

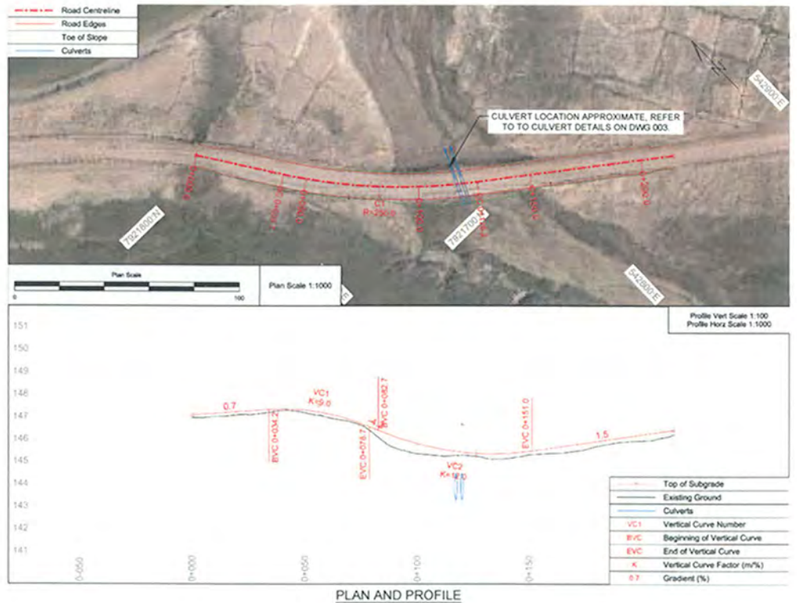
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6925 CENTURY AVENUE, SUITE 100
MISSISSAUGA, ON
CANADA
905-567-4444
www.golder.com

PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

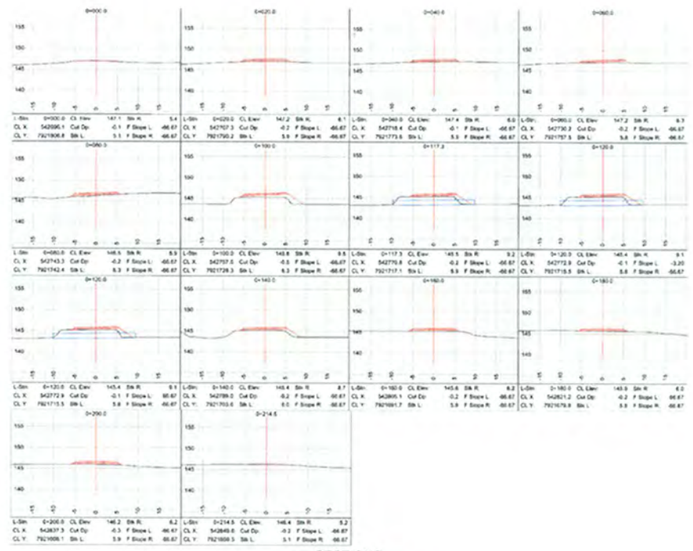
TITLE
CULVERT INSTALLATION DESIGN RECOMMENDATIONS & DESIGN TABLES - CV216

PROJECT NO	PHASE	REV	3 of 4	DRAWING
1667708	3000	2		003

Reduced Size
NOT TO SCALE



PLAN AND PROFILE



SECTIONS
(REFER TO GENERAL CONSTRUCTION NOTE 17)

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2017-04-03	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 1 / REPORT REV. 0	CK/RAD	JJL	MJT	RAD
1	2017-03-24	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 0	CK/RAD	JJL	MJT	RAD
0	2017-03-10	ISSUED FOR CONSTRUCTION	CK/RAD	JJL	MJT	RAD
A	2017-03-08	ISSUED FOR CLIENT REVIEW	CK/RAD	JJL	MJT	RAD

PERMIT-TO PRACTICE
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Date 17-04-03
PERMIT NUMBER: P 049
NT/NU Association of Professional Engineers and Geoscientists

PROFESSIONAL ENGINEER
R.A. DOUGLAS
LICENSEE
2017-04-03
NWT/NU

CLIENT: Baffinland

CONSULTANT: Golder Associates

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PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

TITLE
ROAD PLAN, PROFILE AND SECTIONS - CV216

PROJECT NO	PHASE	REV	4 of 4	DRAWING
1667708	3000	2		004

Reduced Size
NOT TO SCALE

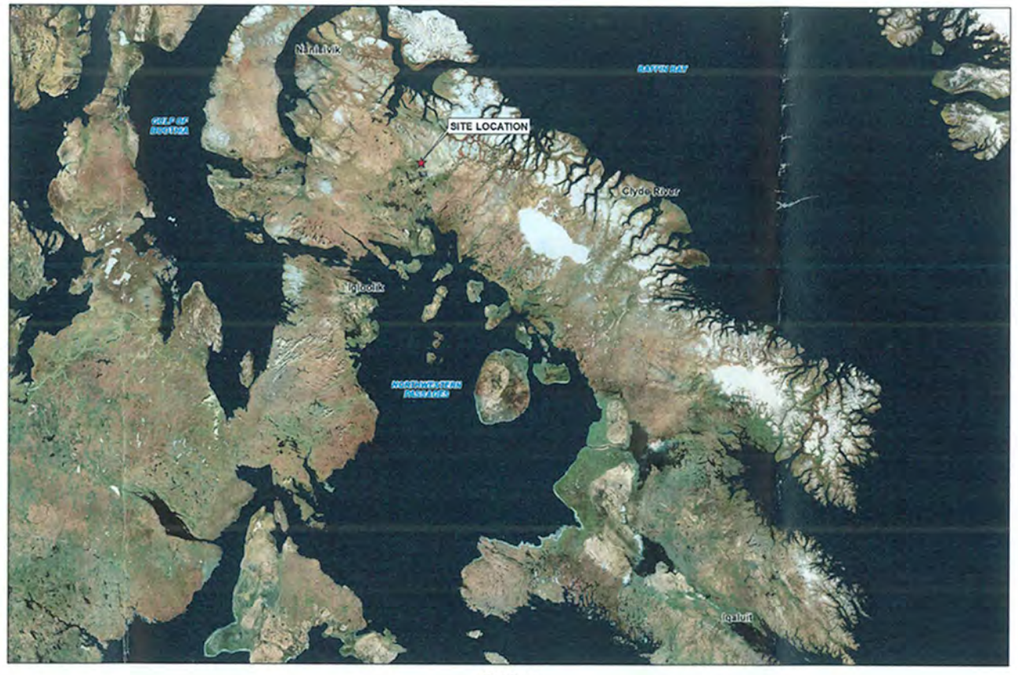
BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT
TOTE ROAD EARTHWORKS
CV224

INDEX OF DRAWINGS		
DRAWING NO.	DRAWING SHEET TITLE	REVISION NO.
001	TITLE SHEET - CV224	2
002	PIPE CROSSING TYPICAL DETAILS & GENERAL NOTES - CV224	2
003	CULVERT INSTALLATION DESIGN RECOMMENDATIONS & DESIGN TABLES - CV224	2
004	ROAD PLAN, PROFILE AND SECTIONS - 224	2

SPECIFICATIONS		
SPECIFICATION NO.	SPECIFICATION TITLE	REVISION NO.
1667708-S	TOTE ROAD EARTHWORKS	1

DESIGN REPORT		
REPORT NO.	REPORT TITLE	REVISION NO.
1667708	TOTE ROAD EARTHWORKS	0



KEY PLAN
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REV	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2017-04-03	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 1 / REPORT REV. 0	JJL	CK/RAD	MJT	RAD
1	2017-03-24	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 0	JJL	CK/RAD	MJT	RAD
0	2017-03-09	ISSUED FOR CONSTRUCTION	JJL	CK/RAD	MJT	RAD
A	2017-02-24	ISSUED FOR CLIENT REVIEW	JJL	CK/RAD	MJT	RAD

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Signature
Date 17-04-03
PERMIT NUMBER: P 949
NT/NU Association of Professional Engineers and Geoscientists

REGISTERED PROFESSIONAL ENGINEER
R.A. DOUGLAS
LICENSEE
2017-04-03
NORTHWEST TERRITORIES

CLIENT
Baffinland

CONSULTANT
Golder Associates

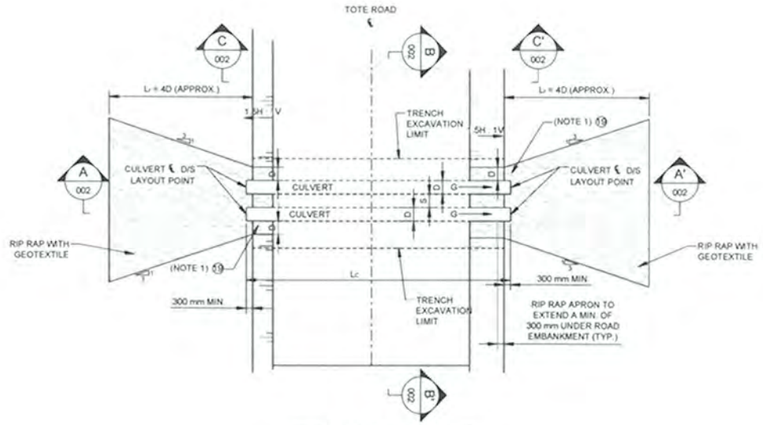
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PROJECT
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TOTE ROAD EARTHWORKS

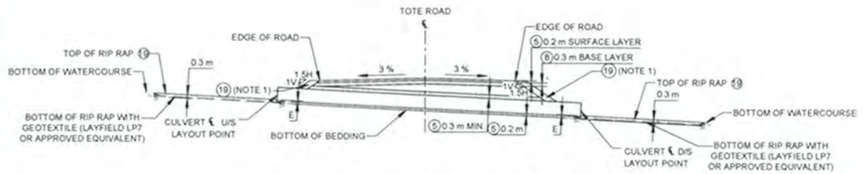
TITLE
TITLE SHEET - CV224

PROJECT NO	PHASE	REV	1 of 4	DRAWING
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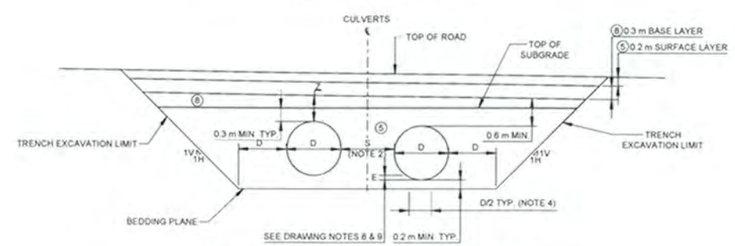
Reduced Size
NOT TO SCALE



PIPE CROSSING PLAN VIEW
SCALE 1:200 m



SCALE 1:200 m (A 002) PIPE CROSSING TYPICAL PROFILE



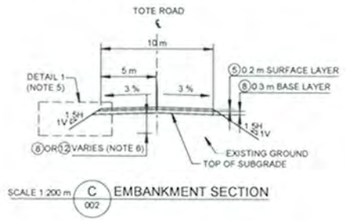
SCALE 1:50 m (B 002) PIPE CROSSING TYPICAL SECTION

LEGEND

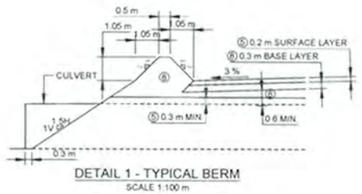
(5)	SCREENED MATERIAL	(12)	RUN OF QUARRY (ROQ)
(8)	JAW RUN	(19)	EROSION PROTECTION

DRAWING NOTES

1. EROSION PROTECTION SHALL BE PLACED AROUND THE CULVERT INLET AND OUTLET AS PER THE DIRECTION OF THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
2. THE MINIMUM SPACING (S) BETWEEN CULVERTS SHALL BE D, WHERE D IS THE CULVERT DIAMETER, OR 1.5 m, WHICHEVER IS GREATER.
3. THE MINIMUM COVER DEFINED AS THE DISTANCE BETWEEN THE TOP OF CULVERT TO THE TOP OF SUBGRADE SHALL BE 0.6 m OR D/4, WHERE D IS THE CULVERT DIAMETER, WHICHEVER IS GREATER.
4. THE BEDDING TO BE SHAPED TO RECEIVE PIPE.
5. SAFETY BERMS ARE REQUIRED FOR EMBANKMENTS GREATER THAN 3 m IN HEIGHT.
6. FOR EMBANKMENT FILL DEPTHS LESS THAN 0.6 m, TYPE 8 MATERIAL SHALL BE USED; FOR FILL DEPTHS GREATER THAN 0.6 m, AND DEPENDING ON THE FILL EXTENTS, TYPE 12 MATERIAL MAY BE USED.
7. DEFINITIONS AND VALUES OF D,Lc,Lr, AND G CAN BE FOUND IN DESIGN TABLES ON DRAWING 003.
8. FOR FISH BEARING CULVERT WITH MULTIPLE PIPES, ONLY ONE SHALL BE EMBEDDED BY "E" AND ALL OTHER PIPES SHALL BE PLACED ON GROUND / BOTTOM OF WATER COURSE.
9. AS PER CULVERT DETAILS (DWG 003)FOR FISH BEARING CULVERT, E = 0.1 D. FOR NON-FISH BEARING CULVERT E=0.



SCALE 1:200 m (C 002) EMBANKMENT SECTION



DETAIL 1 - TYPICAL BERM
SCALE 1:100 m

GENERAL CONSTRUCTION NOTES

1. IT IS THE RESPONSIBILITY OF THE USER OF THIS DRAWING TO ENSURE THE USE OF ITS MOST RECENT REVISION.
2. THE INFORMATION PROVIDED ON THE DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE MOST RECENT REVISION OF THE SPECIFICATIONS AND REPORT LISTED ON DWG. 001.
3. IN THE EVENT OF DISCREPANCY BETWEEN THE DRAWINGS AND THE SPECIFICATIONS, CLARIFICATION AND/OR DIRECTION SHALL BE PROVIDED AS OUTLINED IN THE SPECIFICATIONS.
4. PRIOR TO COMMENCING CONSTRUCTION ACTIVITIES, THE CONTRACTOR SHALL BE FAMILIAR WITH THE SCOPE OF WORK.
5. THE INFORMATION PRESENTED ON THESE DRAWINGS IS INTENDED TO CONVEY THE PIPE CROSSING CONSTRUCTION DETAILS AND ROAD EMBANKMENT DETAILS.
6. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE NOTED.
7. COORDINATE SYSTEM IS UTM (NAD 83) ZONE 17N.
8. CONTOUR INTERVAL IS 1 M WITH EXISTING TOPOGRAPHY.
9. THE DESIGN OF EACH INSTALLATION ARE BASED ON A DESK STUDY USING A DIGITAL ELEVATION MODEL AND SATELLITE IMAGERY PROVIDED BY BAFFINLAND, AND ARE NOT SUPPORTED BY FIELD STUDY.
10. THE GROUND SURFACE ELEVATIONS ARE CONSIDERED TO BE APPROXIMATE.
11. A DECISION ON WHETHER TO EXTEND OR REPLACE EACH CULVERT WILL BE MADE BY THE OWNER'S REPRESENTATIVE.
12. FIELD FITTING OF CULVERTS (INCLUDING LOCATIONS, LENGTHS, INVERT DEPTHS, GRADIENTS, AND SKEWS) TO ACTUAL CONDITIONS AT EACH SITE SHALL BE AS DIRECTED BY THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
13. FILL MATERIALS SHALL BE HANDLED, SORTED, PLACED AND COMPACTED AS SHOWN ON THE DRAWINGS, DESCRIBED IN THE SPECIFICATIONS AND TO THE SATISFACTION OF THE OWNER'S REPRESENTATIVE WITH INPUT FROM THE GEOTECHNICAL ENGINEER.
14. NO GEOTECHNICAL OR STRUCTURAL ANALYSIS OF THE CULVERT INSTALLATIONS HAS **BEEN CARRIED OUT. A MINIMUM CULVERT COVER OF 0.6 m OR D/4 (WHERE D IS THE** DIAMETER OF THE CIRCULAR CULVERT PIPE) HAS BEEN ASSUMED TO BE APPROPRIATE FOR 10 TONNE AXLE LOADS. USE OF HEAVIER TRUCKS WILL REQUIRE STRUCTURAL ANALYSIS OF THE CULVERT INSTALLATION.
15. FISH BEARING STATUS IN CULVERT DETAILS TABLE ON DWG. 003 TAKEN FROM HATCH TOTE ROAD CULVERT DATA SHEETS H349000-3000-10-088-0030 THROUGH H349000-3000-10-088-0034.
16. NO HYDROLOGIC OR HYDRAULIC ANALYSIS WAS CARRIED OUT. NUMBER OF CULVERTS, CULVERT DIAMETER(S), CULVERT LENGTH(S), EMBEDMENT DEPTH (E), AND REQUIREMENTS FOR RIP RAP FROM HATCH TOTE ROAD CULVERT DATA SHEETS H349000-3000-10-088-0030 THROUGH H349000-3000-10-088-0034.
17. IN SECTIONS, SKEWED CULVERTS ARE PROJECTED ONTO PLANE OF CROSS-SECTIONS.
18. AT LIMITS OF CONSTRUCTION NEW PAVEMENT THICKNESS NEEDS TO BE TAPERED TO MATCH EXISTING PAVEMENT SURFACE.
19. THE OWNER'S REPRESENTATIVE WILL CONFIRM THE REQUIREMENT FOR SAFETY BERMS ALONG THE ROAD EDGES BASED ON ENCOUNTERED FIELD CONDITIONS. TYPICAL BERM DETAILS ARE SHOWN ON DWG 002.
20. SITE SPECIFIC NOTES ON DWG. 003 MUST BE READ IN CONJUNCTION WITH THESE GENERAL NOTES, AND THE SPECIFICATIONS AND DRAWINGS LISTED ON DWG 001.
21. BAFFINLAND IS RESPONSIBLE FOR PERMITTING OF THE PROPOSED WORKS (IF REQUIRED).
22. PRIOR TO CONSTRUCTION, BAFFINLAND'S ENVIRONMENTAL REPRESENTATIVE WILL BE CONSULTED TO APPROVE THE REQUIRED EROSION CONTROL AND MITIGATION MEASURES ADJACENT TO WATER BODIES.

0 2 4
1:50 METRES

0 5 10
1:100 METRES

0 10 20
1:200 METRES

REV	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2017-04-03	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 1 / REPORT REV. 0	JJL	CK/RAD	MJT	RAD
1	2017-03-24	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 0	JJL	CK/RAD	MJT	RAD
0	2017-03-09	ISSUED FOR CONSTRUCTION	JJL	CK/RAD	MJT	RAD
A	2017-02-24	ISSUED FOR CLIENT REVIEW	JJL	CK/RAD	MJT	RAD

PERMIT-TO-PRACTICE GOLDER ASSOCIATES LTD.
Signature
Date 17-04-03
PERMIT NUMBER: P 049
NT/NU Association of Professional Engineers and Geoscientists

REGISTERED PROFESSIONAL ENGINEER
R.A. DOUGLAS
LICENSEE
2017-04-03
NWT/NU

CLIENT: Baffinland
CONSULTANT: Golder Associates

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PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

TITLE
TYPICAL DETAILS AND GENERAL NOTES - CV224

PROJECT NO.	PHASE	REV.	SHEET	DRAWING
1667708	3000	2	2 of 4	002

Reduced Size
NOT TO SCALE

CULVERT DETAILS†

STATION (m)	FISH BEARING STATUS (REFER TO NOTE 15 ON DWG. 002)	EXISTING CULVERT DIAMETER (D) (mm) (REFER TO NOTE 16 ON DWG. 002)	EXISTING CULVERT LENGTH (m) (REFER TO NOTE 16 ON DWG. 002)	EXISTING CULVERT GRADIENT (%) (REFER TO NOTE 16 ON DWG. 002)	EMBEDMENT DEPTH (E) (mm) (REFER TO NOTE 16 ON DWG. 002)	PROPOSED CULVERT LENGTH (m)	DEPTH FROM SUBGRADE TO TOP OF CULVERT AT CENTRELINE OF ROAD (Z) (m)	EASTING OF CENTRELINE OF PIPE AT CENTRELINE OF ROAD (m)	NORTHING OF CENTRELINE OF PIPE AT CENTRELINE OF ROAD (m)	INLET INVERT ELEVATION (m)	OUTLET INVERT ELEVATION (m)	CULVERT GRADIENT (G) (%)	CULVERT SKEW (deg)	INLET RIP RAP REQUIRED?	OUTLET RIP RAP REQUIRED?	RIP RAP APRON LENGTH (Lr) (m)
0+136.0	YES	1000	15	1.05		37.5	1.1	556232.2	7915055.6	154.8	154	2	122	N	N	

†CULVERT LOCATION DETAILS ARE BASED ON A DESK STUDY USING A DIGITAL ELEVATION MODEL AND SATELLITE IMAGERY PROVIDED BY BAFFINLAND, AND ARE NOT SUPPORTED BY FIELD STUDY (REFER TO GENERAL CONSTRUCTION NOTE 12 ON DWG. 002)

SITE SPECIFIC NOTES FOR CULVERT CV224

AS INDICATED IN THE GENERAL CONSTRUCTION NOTES ON DWG. 002, THE SITE SPECIFIC NOTES ARE BASED ONLY ON A DESKTOP STUDY OF THE SITE; NO FIELD WORK WAS CARRIED OUT TO SUPPORT THIS WORK. AN INSPECTION OF THE SITE SHALL BE CARRIED OUT BY THE OWNER'S REPRESENTATIVE AND/OR GEOTECHNICAL ENGINEER PRIOR TO CONSTRUCTION. THE SITE SPECIFIC NOTES ARE INTENDED TO BE COMPREHENSIVE BUT NOT ALL-INCLUSIVE.

1. **WIDEN THE ROAD RUNNING SURFACE AT THE CULVERT LOCATION TO A MINIMUM WIDTH OF 10 m, MAINTAINING THE ROAD EMBANKMENT SIDE SLOPES NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL).**
2. **WIDEN THE ROAD RUNNING SURFACE TO A MINIMUM OF 10 m ON THE APPROACHES TO THE CULVERT LOCATION, MAINTAINING THE ROAD EMBANKMENT SIDE SLOPES NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL).**
3. **ADD/ SHAPE EMBANKMENT FILL TO FLATTEN THE ROAD EMBANKMENT SIDE SLOPES TO NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL), MAINTAINING THE ROAD RUNNING SURFACE WIDTH A MINIMUM OF 10 m.**
4. **RAISE THE ROAD EMBANKMENT TO PROVIDE ADEQUATE CULVERT PIPE COVER, MAINTAINING THE ROAD EMBANKMENT SIDE SLOPES NO STEEPER THAN 1.5 : 1 (HORIZONTAL : VERTICAL) AND THE ROAD RUNNING SURFACE A MINIMUM WIDTH OF 10 m.**
5. CAP THE ROAD SURFACE WITH SUITABLE RUNNING SURFACE MATERIAL (SEE TYPICAL SECTION ON DWG. 002).
6. PROVIDE SAFETY BERMS WHERE EMBANKMENT FILL IS GREATER THAN 3 m ABOVE EXISTING GROUND SURFACE.
7. PROVIDE RIP RAP PROTECTION AT THE CULVERT INLET AND OUTLET.
8. MARK THE CULVERT ENDS WITH DELINEATORS OF SUFFICIENT SIZE AND HEIGHT TO REDUCE THE RISK OF DAMAGE TO THE CULVERT PIPE ENDS BY SNOW PLOWING, SIDE SLOPING, OR OTHER MAINTENANCE OPERATIONS.

ROAD LAYOUT DETAILS

STATION (m)	TOP OF SUBGRADE			CENTRELINE CUT DEPTH* (TOP OF SUBGRADE TO EXISTING ROAD SURFACE) (m)	TOE OF EMBANKMENT SLOPE		
	CENTRELINE EASTING (m)	CENTRELINE NORTHING (m)	CENTRELINE ELEVATION (m)		OFFSET TO LEFT TOE** (m)	OFFSET TO RIGHT TOE** (m)	GRADIENT TO NEXT POINT (%)
0+000.0	556108.8	7914999	159.8	-0.3	5.2	5.5	-1.1
0+020.0	556126.8	7915007.8	159.5	-0.5	6.1	6.5	-1.1
0+036.4	556141.5	7915014.9	159.3	-0.5	6.3	6.4	-1.2
0+040.0	556144.7	7915016.5	159.3	-0.4	6.3	6.2	-1.7
0+060.0	556162.7	7915025.3	159	-0.4	6.8	6.1	-2.2
0+063.7	556166	7915026.9	158.9	-0.4	6.9	6.1	-2.2
0+080.0	556180.7	7915034.1	158.5	-0.4	6.5	6.2	-2.2
0+095.0	556194.1	7915040.7	158.2	-0.3	6.5	6.1	-2.2
0+100.0	556198.7	7915042.8	158.1	-0.2	6.1	6.0	-2.2
0+113.0	556210.6	7915048	157.8	-0.5	6.3	6.3	-1.9
0+120.0	556217.1	7915050.5	157.6	-1.1	11.7	6.5	-1
0+136.0	556232.3	7915055.6	157.5	-2.7	14.5	7.2	-0.2
0+140.0	556236.1	7915056.7	157.5	-2.7	14.5	7.3	0.8
0+160.0	556255.6	7915061.3	157.7	-2.4	13.4	7.6	1.9
0+164.8	556260.3	7915062.2	157.7	-1.5	13.7	7.4	2.7
0+180.0	556275.3	7915064.9	158.2	-0.7	7.2	6.5	4.2
0+200.0	556295	7915068.4	159	-0.2	6.5	5.9	5.8
0+220.0	556314.7	7915071.8	160.2	-0.4	6.4	5.9	7.2
0+233.2	556327.6	7915074.1	161.1	-0.4	6.4	6.4	7.8
0+240.0	556334.4	7915075.3	161.6	-0.5	6.5	6.4	7.8
0+260.0	556354	7915078.8	163.2	-0.8	7.1	7.0	7.8
0+280.0	556373.7	7915082.3	164.8	-0.3	5.7	6.4	7.8
0+289.4	556383	7915083.9	165.5	-0.2	5.3	5.2	

* NEGATIVE CUT DEPTH DENOTES FILL
** MEASURED ON GROUND SURFACE

REV	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2017-04-03	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 1 / REPORT REV. 0	JJL	CK/RAD	MJT	RAD
1	2017-03-24	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 0	JJL	CK/RAD	MJT	RAD
0	2017-03-09	ISSUED FOR CONSTRUCTION	JJL	CK/RAD	MJT	RAD
A	2017-02-24	ISSUED FOR CLIENT REVIEW	JJL	CK/RAD	MJT	RAD

PERMIT TO PRACTICE GOLDER ASSOCIATES LTD.
Signature
Date 17-04-03
PERMIT NUMBER: P 049
NT/NU Association of Professional Engineers and Geoscientists

REGISTERED PROFESSIONAL ENGINEER R.A. DOUGLAS LICENSEE 2017-04-03 NWT/NU

CLIENT: Baffinland
CONSULTANT: Golder Associates

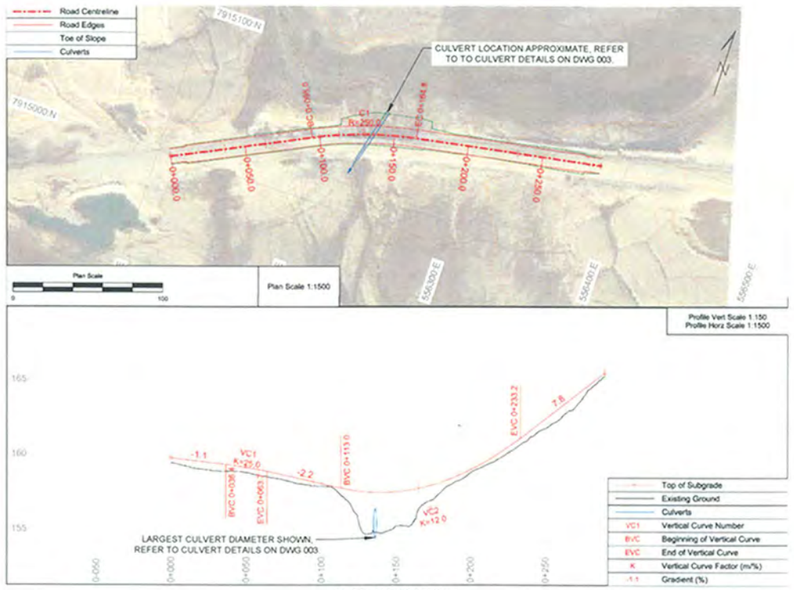
MISSISSAUGA OFFICE
6925 CENTURY AVENUE, SUITE 100
MISSISSAUGA, ON
CANADA
905-567-4444
www.golder.com

PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

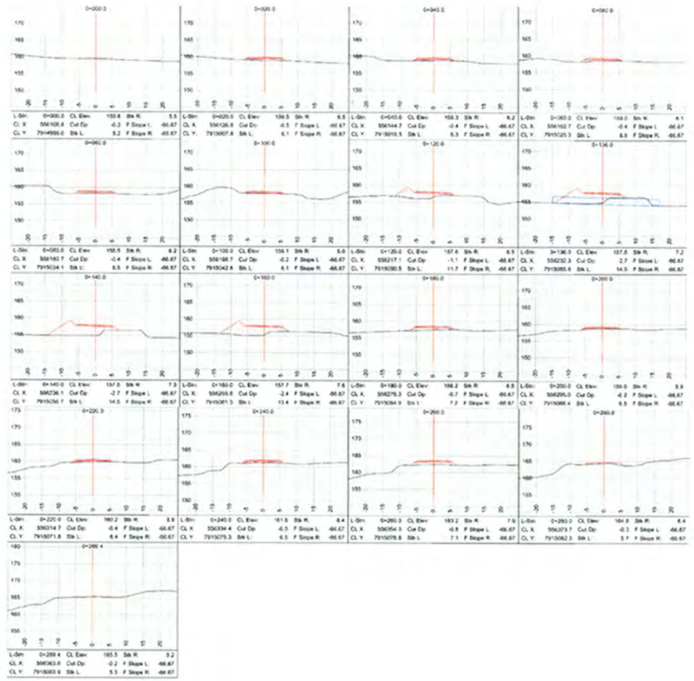
TITLE
CULVERT INSTALLATION DESIGN RECOMMENDATIONS & DESIGN TABLES - CV224

PROJECT NO	PHASE	REV	3 of 4	DRAWING
1667708	3000	2		003

Reduced Size
NOT TO SCALE



PLAN AND PROFILE



SECTIONS
(REFER TO GENERAL CONSTRUCTION NOTE 17)

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
2	2017-04-03	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 1 / REPORT REV. 0	JJL	CK/RAD	MJT	RAD
1	2017-03-24	ISSUED FOR CONSTRUCTION - SPECIFICATIONS REV. 0	JJL	CK/RAD	MJT	RAD
0	2017-03-09	ISSUED FOR CONSTRUCTION	JJL	CK/RAD	MJT	RAD
A	2017-02-24	ISSUED FOR CLIENT REVIEW	JJL	CK/RAD	MJT	RAD

PERMIT TO PRACTICE
GOLDER ASSOCIATES LTD.
Signature
Date 17-04-03
PERMIT NUMBER: P 049
NT/NU Association of Professional Engineers and Geoscientists

REGISTERED PROFESSIONAL ENGINEER
R.A. DOUGLAS CONSULTANT
LICENSEE
2017-04-03
NUNAVUT

Baffinland

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PROJECT
MARY RIVER PROJECT
TOTE ROAD EARTHWORKS

TITLE
ROAD PLAN, PROFILE AND SECTIONS - CV224

PROJECT NO	PHASE	REV.	4 of 4	DRAWING
1667708	3000	2		004

APPENDIX C

Specifications

SPECIFICATION

The document revision number is indicated below. Please replace all revised pages of this document and destroy the superseded copies.

PROJECT:	MARY RIVER PROJECT		SPECIFICATION NO.: 1667708-S				REV 1
PROJECT NO:	1667708		GOLDER REFERENCE NO.: 1667708-S				
TITLE:	TOTE ROAD EARTHWORKS PROJECT						
ISSUED FOR	REV No.	ORIGIN	DATE		ISSUED-PAGES/SECTIONS		INITIAL
			OUT	IN			
Client Review	A	RAD	3-Mar-17				
Issued for Construction	0	RAD	24-Mar-17				
Re-issued for Construction	1	RAD	3-Apr-17				

New Issue _____

Revised Sheet Only Attached _____

Entire Document Re-issued X

PERMIT TO PRACTICE
GOLDER ASSOCIATES LTD.
Signature **Original Signed**
Date _____
PERMIT NUMBER: P 049
NT/NU Association of Professional Engineers and Geoscientists

FINAL DOCUMENT APPROVAL

BAFFINLAND APPROVAL		GOLDER APPROVAL	
Mine Manager:		Senior Review:	**Original Signed and Sealed**
Date:		Date:	April 3, 2017
Environmental Manager:		Project Manager:	**Original Signed**
Date:		Date:	April 3, 2017
Engineering Lead:		Originator:	**Original Signed**
Date:		Date:	April 3, 2017

Table of Contents

1.0 SCOPE OF WORK 1

1.1 General 1

1.2 Definitions 2

1.3 Acronyms and Abbreviations 3

1.4 Protection 4

1.5 Drawings 5

1.6 Submissions 6

1.7 Dust Control 8

1.8 Inspection and Testing 8

1.9 Codes and Standards 10

1.10 Description of Items 11

1.11 Dimensional Tolerances 12

2.0 CARE OF WATER 13

3.0 TRENCH EXCAVATION 14

3.1 Work Sequence 14

3.2 Products 14

3.3 Execution 15

4.0 CULVERT PIPE SUPPLY AND INSTALLATION 16

4.1 General 16

4.2 Handling and Storage 16

4.3 Installation 16

5.0 PIPE CROSSING CONSTRUCTION 18

5.1 Work Sequence 18

5.2 Products 18

5.3 Execution 20

6.0 TOTE ROAD PAVEMENT CONSTRUCTION 23

6.1 Work Sequence 23

6.2 Products 23
6.3 Execution 24
7.0 GEOTEXTILE SUPPLY AND INSTALLATION 26
7.1 General 26
7.2 Non-Woven Geotextile Material Properties 26
7.3 Handling and Storage 27
7.4 Installation 27
8.0 CONSTRUCTION CHECKLISTS 29

1.0 SCOPE OF WORK

1.1 General

.1 This Specification defines the requirements for furnishing of all labour, equipment and materials required for construction of Tote Road Earthworks as specified herein for Baffinland Iron Mine Corporation's Mary River Project in the Nunavut Territory of Canada.

.2 Modifications or deviations from this Specification and/or the Drawings listed herein shall only occur with the written approval of Golder Associates Ltd.

.3 The Scope of Work (hereafter referred to as the Work) defined herein includes the construction of culvert improvements including installation/extension of culverts, placement of erosion protection material, construction of road realignments, and pavement improvement/construction on the Tote Road, as indicated on the Drawings. Phased construction in support of the construction timeline is planned. Phase limits of works will be at the direction of the Owner's Representative based on the work schedule, weather, availability of construction materials, and the like.

.4 The Tote Road will remain active for the duration of the Work. The Contractor shall coordinate with the Owner's Representative such that interruptions to hauling activities are minimized.

.5 The Contractor shall perform the Scope of Work such that no damage to existing infrastructure occurs unless otherwise approved by the Owner's Representative.

.6 All Work shall conform to the lines, grades, cross-sections, and details indicated in the Drawings listed in Table 1. Included in the work is: care and control of water, processing of materials as necessary, material stockpiling, loading, hauling, fill placement, fill compaction, and finishing of all materials classified as acceptable for fill material. Excavation and backfilling of materials shall include sorting or screening that may be necessary to produce the required gradations.

1.2 Definitions

.1 The definition of primary terms used on the Construction Drawings and in the Specification for this contract is listed below:

.a	*Owner:*	*Baffinland Iron Mines Corporation*
.b	*Owner's Representative:*	*Baffinland Iron Mines Corporation or named representative.*
.c	*Geotechnical Engineer:*	*Golder Associates Ltd.*
.d	*Contractor:*	*Baffinland Iron Mines Corporation or Nunavut registered Company contracted to successfully carry out the Scope of Work described herein.*
.e	*Project Site:*	*Mary River Project.*
.f	*Work Site:*	*Limits of Work which is generally defined by the Tote Road and adjacent areas as shown on the Drawings.*
.g	*Quality Control*	*The planned system of inspections carried out to standard specifications that are used to directly monitor and control the quality of the construction project. Construction quality control is required to ensure that the work is carried out in compliance with the Drawings and this Specification.*
.h	*Quality Assurance*	*The planned system of activities that provide the Owner, lending institutions and permitting agencies assurance that the facilities were constructed as specified in the design. Quality Control forms a subset of the Quality Assurance program. Quality Assurance comprises inspections carried out during Quality Control and includes verification, evaluations of materials and workmanship necessary to determine and document the quality of the constructed facility. Quality Assurance refers to measures taken by the Quality Assurance organization to assess if the Contractor is in compliance with the design, Drawings, and this Specification.*
.i	*Passes*	*A pass, for compaction specification purposes, is defined as the complete passing over, and return, of the specified compaction equipment over a section of material. Material which has been compacted in one pass will have the equipment roll over it twice.*

1.3 Acronyms and Abbreviations

.1 The acronyms and abbreviations commonly used in the Drawings and in the Specification for this contract are listed below:

.a	*2H:1V*	*Slope of 2 horizontal units to 1 vertical unit.*
.b	*%*	*Percent.*
.c	*ASTM*	*ASTM International; formerly known as American Society for Testing and Materials.*
.d	*CSP*	*corrugated steel pipe.*
.e	*CSA*	*Canadian Standards Association.*
.f	*m*	*metre.*
.g	*mm*	*millimetre.*
.h	*N*	*Newton.*
.i	*t*	*tonne.*

1.4 Protection

.1 The Contractor is responsible for the care and protection of all existing utilities, instrumentation and site development that may be located within the Work Site areas.

.2 Confirmation of existing functioning culvert locations shall be completed by the Contractor prior to the start of work. The Contractor shall exercise care including but not limited to marking and protecting the culverts, such that these culverts are not damaged. Any damage caused, or suspected to have been caused by the Contractor, its Subcontractors and/or Sub-subcontractors shall be immediately reported to the Owner's Representative. Any damage to culverts caused by Contractor and its Subcontractors shall be repaired to the satisfaction of the Owner's Representative, with input from the Geotechnical Engineer.

.3 In areas where construction activities are carried out in or adjacent to existing site development, the location, isolation, and/or relocation of buried utilities shall be completed before any excavation commences. Care shall be exercised during excavation to avoid damage to existing buried pipes, structures, ducts, power and grounding cables. If damage to any of these occurs, the Owner's Representative shall be notified immediately, and corrective action shall be taken by the Contractor according to the instructions of the Owner's Representative.

1.5 Drawings

.1 This Specification defines the requirements for performing the work as outlined on the most recent revision of the Drawings presented in Table 1 for the culvert sites listed in Table 2. In the event of a discrepancy between the Specification and the Drawings, the discrepancy shall be reported to Geotechnical Engineer in writing; the Geotechnical Engineer shall provide clarification to the Owner. The Contractor shall proceed only upon receipt of written clarification from the Owner.

Table 1: Tote Road Earthworks Project Drawings Set Per Culvert Site Listed in Table 2

Drawing Number	Drawing Title
001	Title Sheet
002	Pipe Crossing Typical Details and General Notes
003	Culvert Installation Design Recommendations & Design Tables
004	Road Plan, Profile and Sections

Table 2: Tote Road Earthworks Culvert Sites

Culvert Site	Drawing Set Revision No.
BG01	2
BG04	2
BG29	2
BG32	2
CV001	2
CV046 A&B	2
CV059	2
CV099	2
CV106	2
CV112	2
CV186	2
CV187	2
CV216	2
CV224	2

1.6 Submissions

.1 The Contractor shall prepare and submit a Work Plan to the Owner for review and approval within five days of receipt of a Notice to Proceed. The Contractor shall revise the Work Plan to the satisfaction of the Owner, following review. The Contractor shall commence with the Scope of Work only upon written authorization from the Owner.

.2 In general, the Work Plan shall contain the following:

.a A detailed Health, Safety and Environmental Plan for all the tasks within the Scope of Work. The Health, Safety and Environmental Plan shall satisfy all Project Site requirements and be to the satisfaction of the Owner.

.b The Contractor's understanding of the Scope of Work.

.c The Methods for performing the Scope of Work.

.d The list of equipment to be used to perform the Scope of Work, with the service records for all equipment for a two-year period prior to the start of the work.

.e A description of the Temporary Protection System to protect the stability and function of the Tote Road during construction.

.f A description of the dust control measures to be used.

.g A Quality Control Plan. The Contractor is responsible for controlling the quality of the Work including that performed by its Subcontractors, Sub-subcontractors, and Suppliers and for assuring that the specified quality is achieved. The Contractor, and its Subcontractors, Sub-subcontractors, and Suppliers shall be responsible for developing and maintaining a quality control program which is responsive to the requirements of the Specification.

.h A Schedule for performing the Scope of Work, including work activities and milestones. The schedule shall be revised and updated throughout the performance of the Work. Weekly updates of the Schedule shall be submitted by the Contractor in hardcopy and electronic formats for review and comment by the Owner.

.i *A list of Personnel for performing the Scope of Work.*

.j *A list of proposed Subcontractors, Sub-subcontractors, and Suppliers. Use of Subcontractors, sub-Subcontractors and/or Suppliers shall be made only upon approval by the Owner.*

.k *Inclusion of additional requirements presented in the Specification.*

.3 The Contractor shall submit weekly as-built survey information in hardcopy and electronic formats to the Owner for review and comment. All as-built survey information may be checked by the Owner with input provided by the Geotechnical Engineer. The Contractor will revise as-built survey information as directed by the Owner. All as-built information mutually agreed upon between the Contractor and Owner shall not thereafter be subject to dispute.

.a *For earthworks: At the direction of the Owner's Representative, with input provided by the Geotechnical Engineer, the Contractor shall survey the limits of prepared surfaces. Cross sections and longitudinal profiles shall be obtained to define the form and elevations of the prepared surfaces. In areas of fill placement, accurate surveying shall be performed to determine the limits of fill placement and presentation of cross sections at no less than 5 m spacing along the culvert axis and 20 m spacing along the road centreline. All survey information may be checked at any time during the Work by the Owner's Representative and/or the Geotechnical Engineer.*

.b *For geosynthetic materials: At the direction of the Owner's Representative with input provided by the Geotechnical Engineer, the Contractor shall survey the limits of the prepared surfaces prior to the placement of geosynthetic materials. During placement, the Contractor shall record the limits of placement for each panel of geosynthetic material and include the type and roll number. All survey information may be checked at any time during the Work by the Owner's Representative and/or the Geotechnical Engineer.*

.c *The Contractor may be directed by the Owner's Representative, with input from the Geotechnical Engineer, to collect and present survey information outside of the requirements presented in the Specification. The details of this survey information shall be mutually agreed between the Contractor and Owner's Representative prior to the start of activity.*

.4 The Contractor shall submit daily and weekly Construction Activity Reports including, but not limited to the following:

.a *A description of work activities performed.*

.b Lists of the equipment and personnel utilized.

.c Results and comments on quality of work performed.

.d A list of submissions.

.e A summary of progress relative to the schedule, and necessary updates and/or changes.

.f The quantities of materials placed, hauled and the like.

.g A summary of health and safety performance.

1.7 Dust Control

.1 The dust resulting from construction activities shall be controlled by the Contractor to prevent the spreading of dust and to avoid creation of a nuisance in the surrounding area. The requirement and judgment of acceptability of dust control measures shall be at the direction of the Owner's Representative.

.2 During fill placement, dust control, such as watering the upper surface of the fill to maintain a damp condition, may be utilized. Any use of dust suppression chemicals shall only be used with the approval of the Owner's Representative.

1.8 Inspection and Testing

.1 The Owner will provide Quality Assurance measures to monitor for compliance with the Drawings and Specification requirements with input from the Geotechnical Engineer. Quality Assurance monitoring will be performed throughout the Work activities.

.2 The Contractor shall perform activities to meet the requirements of the Quality Control Plan. The results of these activities shall be provided to the Owner's Representative and Geotechnical Engineer in hardcopy and electronic format.

.3 The minimum requirements for Quality Control testing are presented in Table 3. It is important to note that additional requirements are presented throughout this Specification. It is the responsibility of the Contractor to ensure that all Quality Control requirements are satisfied. The Owner's Representative and/or Geotechnical Engineer shall monitor all Quality Control testing and results; the Contractor shall cooperate accordingly.

.4 When Checklist items (Section 8.0) are completed, the Contractor shall submit written requests for Quality Assurance approvals to the Owner's Representative.

Table 3: Minimum Requirements for Quality Control Testing

Material	Test	Frequency
Screened Material – Type 5	Lift thickness	Measured continually
	Elevation of compacted lift	Measured continually
	Compaction effort including number of passes and equipment traffic pattern	Monitored continually
	Particle-size analysis (ASTM D422 and ASTM D1140)	One test for every 750 m^3 placed
Jaw Run Material – Type 8	Lift thickness	Measured continually
	Elevation of compacted lift	Measured continually
	Compaction effort including number of passes and equipment traffic pattern	Monitored continually
	Maximum particle size (visual inspection)	Measured continually
Run of Quarry – Type 12	Lift thickness	Measured continually
	Elevation of compacted lift	Measured continually
	Compaction effort including number of passes and equipment traffic pattern	Monitored continually
	Maximum particle size (visual inspection)	Measured continually
Erosion Protection Material – Type 19	Lift thickness	Measured continually
	Elevation of compacted lift	Measured continually
	Maximum particle size (visual inspection)	Measured continually

.5 The Contractor shall cooperate and assist with the Quality Assurance monitoring activities including, but not limited to the following:

.a *Obtaining samples of materials.*

.b *Providing and reviewing of documentation.*

.c *Surveying the sampling locations.*

.6 The Contractor and the Owner's Representative will be made aware of the Quality Assurance monitoring results. The Geotechnical Engineer shall provide recommendations, if appropriate, to the Owner's Representative regarding corrective measures required to be carried out by the Contractor. At the direction of the Owner's Representative, the Contractor shall make reasonable efforts to address the identified deficiencies.

.7 Construction checklist forms included at the end of this Specification are required for documenting the quality control and other aspects of the construction activities as detailed in the quality control plan(s). The checklists included in Section 8.0 shall be finalized and signed off by the Contractor, the Owner's Representative, and the Geotechnical Engineer for acceptance of the construction activities. If the Geotechnical Engineer is not on site, the Owner's Representative is required to provide the information to the Geotechnical Engineer.

1.9 Codes and Standards

.1 Work shall conform to, but not be limited to, the requirements of the most recent editions of the following standards and codes which are part of this Specification. It is important to note that additional standards may be referenced by those listed below; it is the responsibility of the user of this document to be familiar with all the applicable standards.

.a	ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
.b	ASTM D422	Standard Test Method for Particle-Size Analysis of Soils.
.c	ASTM D4355	Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.
.d	ASTM D4491	Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
.e	ASTM D4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
.f	ASTM D4632	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
.g	ASTM D4751	Standard Test Method for Determining Apparent Opening Size of a Geotextile.
.h	ASTM D6241	Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe.

.i	ASTM D5199	Standard Test Method for Measuring the Nominal Thickness of Geosynthetics.
.j	ASTM D5261	Standard Test Method for Measuring Mass per Unit Area of Geotextiles.
.k	CSA-G401	Corrugated Steel Pipe Products

.l Safety Act of Nunavut (Consolidation of Safety Act R.S.N.W.T. 1988,c.S-1)

.a Mine Health and Safety Act and Regulations for Nunavut.

1.10 Description of Items

.1 The Tote Road Culvert Improvement Project consists of the following:

.a *Pipe Crossing Construction – The work shall include the construction of trenches, the supply and placement of bedding, the supply and laying of pipes, joining of pipes, backfilling of trenches, construction of culvert inlet end rip rap protection, construction of culvert outlet end rip rap protection, construction of the granular pavement, and site reinstatement as specified, and the supply of all materials, labour, plant, transport and tools required for proper completion of the work*

.b *Tote Road Pavement Reinstatement/Construction – The work shall include the supply and placement of fills for the reconstruction of granular road pavements over pipe crossings and approaches, and the construction of new granular pavements on Tote Road realignments, and reinstatement as specified, and the supply of all materials, labour, plant, transport and tools required for proper completion of the work.*

.2 The Contractor is required to load and haul materials from the crusher, pits, quarries and other locations for placement at the Tote Road. These materials will be stockpiled by Others in locations as directed by the Owner's Representative. The Contractor shall load and haul from the stockpiles as directed by the Owner's Representative.

1.11 Dimensional Tolerances

.1 All excavations and fill shall be completed to be within 0.1 m horizontally and plus 0.1 m vertically of specified lines and grades unless otherwise approved by the Owner's Representative. Fill placement and/or removal to meet these tolerances to the lines and limits shown in the Drawings shall be performed by the Contractor at no additional cost to the Owner.

.2 Culvert pipe gradients shall be established within ±0.5% of those shown on the Drawings.

.3 Slopes shall not be steeper than those shown on the Drawings unless otherwise approved by the Owner's Representative with recommendations provided by the Geotechnical Engineer.

.4 Temporary excavation and fill slopes shall not be steeper than two horizontal to one vertical (2H:1V) unless otherwise approved by the Owner's Representative with recommendations provided by the Geotechnical Engineer.

.5 Temporary bedrock excavation slopes shall not be steeper than one tenth horizontal to one vertical (0.1H:1V) unless otherwise approved by the Owner's Representative with recommendations provided by the Geotechnical Engineer.

2.0 CARE OF WATER

.1 Excavation, fill and backfill work areas shall be continuously and effectively drained. Excessive water shall not be permitted to accumulate in excavations or areas for fill. The Contractor shall construct suitable dykes or drains, or provide pumping equipment, as required to divert water flows away from Work areas. The proposed points of discharge shall be approved by the Owner's Representative. The Contractor must also ensure that sediments contained in diverted water will not enter natural watercourses.

.2 The Contractor shall be responsible for the design and construction of all temporary diversion measures, dewatering systems, pumping facilities, siphons, snow/ice removal and the like, required for satisfactory management of water and ice on the Site. These shall be submitted for review and approval by the Owner's Representative prior to commencing construction.

.3 Backfill operations may not commence until all water and snow/ice has been drained or otherwise removed from the excavation and the Owner's Representative, with input from the Geotechnical Engineer, has approved the commencement of backfilling operations.

3.0 TRENCH EXCAVATION

3.1 Work Sequence

.1 The limits of works and elevations will be at the direction of Owner's Representative based on field conditions.

.2 The Contractor may start work after the following:

- Receipt of an Approval to Proceed from the Owner's Representative.
- Receipt of approval from the Owner's Representative of the as-built survey information submission for pre-work conditions.
- The implementation of the Temporary Protection System.
- Completion of the perimeter water control structures around the work area, thereby containing/diverting runoff.

3.2 Products

.1 Unsuitable Material includes topsoil, organic soils, vegetation, and boulders to a depth or in a location that will impede the placement and compaction of Competent Material. Unsuitable Material may be frozen in situ. Within the excavation limits of the pipe crossing, Unsuitable Material may include Mineral Soil that has high clay, silt, water, and/or ice content.

.2 Mineral Soil is the near-surface layer of earth materials generally composed of till-like soil, including but not limited to varying proportions of clay, silt, sand, gravel, cobbles, and boulders. Thawed Mineral Soil materials are normally suitable for mechanical excavation. Frozen Mineral Soil materials may require the use of drilling, blasting, ripping, and/or other techniques approved by the Owner's Representative with input from the Geotechnical Engineer to prepare the materials for excavation.

.3 Existing Fill is the soil and rock fill placed previously for the construction of the Tote Road. Thawed Existing Fill materials are normally suitable for mechanical excavation. Frozen Existing Fill materials may require the use of drilling, blasting, ripping and/or other techniques approved by the Owner's Representative (with input from the Geotechnical Engineer) to prepare the materials for excavation.

.4 Bedrock is the underlying rock formation composed of frost-shattered weathered bedrock and/or intact unweathered bedrock that will require the use of drilling, blasting, ripping, and/or other approved techniques to prepare the materials for excavation.

.5 Competent Material includes Mineral Soil, Existing Fill and the underlying Bedrock as determined by the Geotechnical Engineer.

.6 The determination of Unsuitable Material and Competent Material will be made by the Geotechnical Engineer. The Contractor may be required to assist during the determination by performing such work as proof rolling, test pit excavation, and sampling as directed by the Geotechnical Engineer.

3.3 Execution

.1 The Contractor shall ensure that the Temporary Protection System for the Tote Road is in place.

.2 The Contractor shall excavate Unsuitable Material, Mineral Soil, Existing Fill, and/or Bedrock for the pipe crossing construction in areas indicated in the Drawings and as directed by the Owner's Representative (with input from the Geotechnical Engineer).

.3 Excavation shall be to the lines, grades and dimensions specified in the Drawings and the Specifications.

.4 Excavations shall be kept stable and dry.

.5 Excavated Unsuitable Materials shall be disposed of at locations indicated by the Owner's Representative. Surfaces of disposed material shall be sloped such that no water ponds on the surface. Suitable erosion protection shall be installed to capture sediments (i.e. silt fencing) at the direction of the Owner's Representative.

.6 Excavated Mineral Soil, Existing Fill, and/or Bedrock which is considered by the Geotechnical Engineer suitable for reuse shall be stockpiled at locations indicated by the Owner's Representative. A determination of the acceptability of materials for reuse shall be made with input from the Geotechnical Engineer.

.7 The Contractor shall allow the Owner's Representative and the Geotechnical Engineer to review the excavation to evaluate conformance to the Drawings and Specifications. Acceptance of excavations shall be performed and recorded by the Owner's Representative.

.8 The disposal area for Unsuitable Material shall be shaped to smooth, uniform surfaces with side slopes not steeper than three horizontal to one vertical (3H:1V).

.9 The Contractor shall prepare and submit as-built information of excavation limits, disposal areas and stockpiles to Owner's Representative for review.

.10 The Contractor shall submit appropriate checklists according to Section 8.0.

4.0 CULVERT PIPE SUPPLY AND INSTALLATION

4.1 General

.1 The Owner shall provide CSPs for use in Pipe Crossing Construction as per the Drawings or as directed by the Owner's Representative.

.2 The Contractor shall be responsible for the installation of the CSP.

4.2 Handling and Storage

.1 Handling on site is the responsibility of the Contractor and/or Owner as directed by the Owner's Representative.

.2 The Contractor shall ensure the handling equipment used on the site is adequate and does not pose any risk of damage to the CSP. Any damage to a CSP shall be repaired by the Contractor as per Manufacturer's recommendations or shall be replaced, as directed by the Owner's Representative.

.3 Upon start-up of the Work, the Contractor and the Owner's Representative shall conduct a surface observation of all CSPs for defects and for damage.

.4 The Owner's Representative may identify the following:

.a CSPs or portions thereof, which should be rejected and removed from the site because they have severe flaws;

.b CSPs which include minor repairable flaws, which can be used follow repair.

.5 The Owner shall provide storage space in a location (or several locations) such that on-site transportation and handling are minimized.

4.3 Installation

.1 CSP shall be laid within the location, alignment, and grade tolerances specified in Section 1.11 and as per the Drawings.

.2 CSP shall be kept clean and dry as work progresses.

.3 CSPs shall be joined by means of steel couplers. Couplers shall be installed to lap approximately equal portions of the pipe being connected and such that the corrugations of the couplers properly engage the pipe corrugations. As the couplers are being tightened they shall be tapped with a mallet to take up the slack.

.4 The diameter or the span and rise of flexible culvert pipes shall not vary from the manufactured dimensions by more than 5% during cover and backfill placing operations.

.5 The Contractor shall submit checklists according to Section 8.0.

5.0 PIPE CROSSING CONSTRUCTION

5.1 Work Sequence

.1 The limits of works and elevations will be at the direction of Owner's Representative based on field conditions.

.2 The Contractor may start work after the following:

- Receipt of an Approval to Proceed from the Owner's Representative.
- Receipt of approval from Owner's Representative of the as-built survey information submission for pre-work conditions.
- Completion of Excavation, if applicable.

5.2 Products

.1 Pipe includes CSP as defined in Section 4.0.

.2 Fill Materials include excavated Mineral Soil or Existing Fill (as defined in Section 3.0), Screened Material – Type 5, Jaw Run Materials – Type 8, and/or other materials free from frozen lumps, ice, snow, cinders, ash, refuse, and cobbles and boulders over 150 mm approved by the Owner's Representative, with recommendations provided by the Geotechnical Engineer, for culvert construction.

.3 Screened Material – Type 5 consists of 32 mm minus material produced by a screening plant. This material will be stockpiled separately at the Crusher Site by Others. Placement of Screened Material – Type 5 will be within the areas as shown on the Drawings and/or as directed by the Owner's Representative. In general, the Screened Material will meet the gradation specifications shown in Table 4.

Table 4: Screened Material – Type 5 Gradation Specification

Sieve Designation	Percent Passing, by Weight
32 mm	100%
25 mm	70 – 100%
9.5 mm	40 – 70%
4.75 mm	30 – 55%
2.0 mm	22 – 42%
0.6 mm	15 – 30%
0.075 mm	4 – 8%

.4 Jaw Run Material – Type 8 consists of 150 mm minus material produced by the crusher. This material will be stockpiled separately at the Crusher Site by Others. Placement of Jaw Run Material will be within the areas as shown on the Drawings and/or as directed by the Owner's Representative. In general, the Jaw Run Material will meet the following gradation specifications (Table 5):

Table 5: Jaw Run Material – Type 8 Fill Gradation Specification

Sieve Designation	Percent Passing, by Weight
200 mm	100%
150 mm	95 - 100%
100 mm	50 - 100%
50 mm	30 - 60%
19 mm	15 - 35%
4.75 mm	10 - 25%
0.075 mm	0 - 5%

.1 Geotextile as defined in Section 7.0.

.2 Erosion Protection Material – Type 19 consists of selected Run of Quarry material. Erosion Protection Material will be stockpiled separately. The Contractor will be responsible for sorting the Run of Quarry material to meet the specifications for Erosion Protection Material. Placement of Erosion Protection Material will be within the areas shown on the Drawings and/or as directed by the Owner's Representative. In general, the Erosion Protection Material will meet the following gradation specification:

Table 6: Erosion Protection Material – Type 19 (D_{50} of 150 mm) Gradation Specification

Particle Diameter (mm)	Percent Passing, by Weight
300	100%
285	85 – 100%
240	65 – 85%
210	50 – 75%
150	25 – 50%
135	15 – 45%
75	0 – 15%

5.3 Execution

.1 Trench Excavation (Section 3.0) to be completed, if applicable.

.2 Culvert pipe trench is to be plane and uniform and to the lines and grades shown in the Drawings. No fill materials are to be placed on the prepared surface without approval from the Owner's Representative with input from the Geotechnical Engineer. The checklist (Section 8.0) shall be signed off by the Contractor, Owner's Representative and Geotechnical Engineer for acceptance of the surface before bedding or fill may be placed. The Owner's Representative is required to document and report observations to the Geotechnical Engineer.

.3 The Contractor shall develop and document a compaction equipment pattern to achieve required compaction of Fill Materials to the satisfaction of the Owner's Representative, with input from the Geotechnical Engineer.

.4 The Contractor shall haul materials to designated fill placement area(s) in the Pipe Crossing area and spread material in horizontal lifts starting from the lowest grade. The maximum loose lift thicknesses are as follows:

.a *0.2 m for Screened Material – Type 5.*

.b *0.3 m for all other Fill Materials.*

.c *0.3 m for Erosion Protection Material – Type 19.*

.d *Modifications to maximum loose lift thicknesses shall be at the direction of the Owner's Representative with recommendations provided by the Geotechnical Engineer. The Owner's Representative, with input from the Geotechnical Engineer, shall, with the cooperation of the Contractor, conduct field trials to assess material placement techniques and achieved placement densities to assess possible variations to the loose lift thicknesses.*

.5 Any Fill Materials which have become saturated, softened, loosened, or have undergone a reduction in density by precipitation, ponded water, construction traffic, or frost action are to be excavated and replaced with suitable material. The Owner's Representative with input from the Geotechnical Engineer shall identify areas in which material should be removed. This work shall be performed to the satisfaction of the Owner's Representative. The excavated material may be dried and/or thawed and used for fill upon approval from the Owner's Representative using recommendations provided by the Geotechnical Engineer.

.6 Before suspension of operations each day or before inclement weather, the in-place material shall be compacted and the surface smoothed and crowned to promote runoff of precipitation.

.7 Erosion Protection Material shall be placed around the culvert inlet and outlet at the direction of the Owner's Representative, with input from the Geotechnical Engineer.

.8 Geotextile is to be placed at areas shown on the Drawings or at the direction of the Owner's Representative (with input from the Geotechnical Engineer). Geotextile to be installed as per Section 7.4.

.9 Culvert pipe Bedding shall consist of Screened Material – Type 5 which shall be shaped to the dimensions specified in the Drawings, compacted and shaped to receive the shape of the pipe.

.10 Culvert Pipe to be installed as per Section 4.3.

.11 Screened Material – Type 5 placed in the pipe haunches must be compacted prior to continued placement of backfill material around the pipe.

.12 Screened Material – Type 5 shall be placed and compacted on both sides of the pipe simultaneously. At no time shall the levels of material on each side differ by more than 0.2 m.

.13 Cover material shall be placed so that damage to or movement of the pipe is avoided. Before allowing the movement of any construction equipment or vehicular traffic over the completed pipe culvert, the depth of cover over the pipe shall be at least 0.6 m or D/4 (where D is the pipe diameter) whichever is greater, and must be a sufficient depth required for protection.

.14 Oversize particles shall be removed from the fill. Where reduced lift thicknesses are required, particles larger than two-thirds (2/3) of the reduced lift thickness shall be removed prior to compaction. Requirements for reduced lift thicknesses shall be determined by the Owner's Representative with recommendations provided by the Geotechnical Engineer.

.15 Fill Materials shall be compacted using a vibratory plate tamper or other compaction equipment approved by the Geotechnical Engineer:

a. *Mineral Soil, Fill Materials, Erosion Protection Materials and other Materials shall be compacted using a performance-based requirement. It is expected that a minimum of 5 passes (see Section 1.2 for the definition of a "pass") of compaction equipment will be required for the Mineral Soil and Fill Materials. The compaction method and degree of compaction achieved in the field will be monitored by the Owner's Representative with input from the Geotechnical Engineer. The Contractor shall cooperate with the Owner's Representative and Geotechnical Engineer to develop methods to achieve a satisfactory degree of compaction for the Bedding and Fill Materials.*

.16 Pipe Crossings shall be constructed to the lines, grades and cross sections shown in the Drawings or as directed by the Owner's Representative with input from the Geotechnical Engineer.

.17 Stream bed approach to be re-trained to the satisfaction of the Owner's Representative, with input from the Geotechnical Engineer, if applicable.

.18 Fill Materials placed in the Trench shall be free from lenses, pockets, or layers of materials which are significantly different in gradation from the surrounding material. The Contractor shall employ methods to limit the amount and zones of segregated materials. The Contractor shall work with the Owner's Representative with input from the Geotechnical Engineer to develop such methods which may include, but not be limited to, the placement of parallel strips of Fill Materials within a given lift and/or material blending. The Geotechnical Engineer shall provide recommendations to the Owner's Representative as to the acceptability of the results of the placed materials. Fill Materials shall be placed and compacted to the satisfaction of the Owner's Representative.

.19 Sufficient survey control and records shall be maintained to provide the following:

.a *Layout of the work.*

.b *Measurement of in-place quantities of each product placed, including but not limited to, providing elevation of the prepared surface prior to fill placement.*

.c *Preparation of as-built information for hard copy and electronic submission to the Owner's Representative; the Contractor shall maintain as-built records suitable to update the Drawings upon completion.*

.d *Verification of the accuracy of the work.*

.e *Survey records which may be reviewed at any time by the Owner's Representative and/or Geotechnical Engineer.*

.f *Timely provision and quality of survey information to the satisfaction of the Owner's Representative with recommendations provided by the Geotechnical Engineer.*

.20 The Contractor shall submit appropriate checklists according to Section 8.0.

6.0 TOTE ROAD PAVEMENT CONSTRUCTION

6.1 Work Sequence

.1 The limits of works and elevations will be at the direction of Owner's Representative based on field conditions.

.2 The Contractor may start work after the following:

- Receipt of an Approval to Proceed from the Owner's Representative.
- Receipt of approval from Owner's Representative of as-built survey information submission for pre-work conditions.
- Completion of embankment filling operations and culvert installation as appropriate.

6.2 Products

.1 Fill Materials as defined in Section 5.2.

.2 Screened Material – Type 5 as defined in Section 5.2.

.3 Jaw Run Material – Type 8 as defined in Section 5.2.

.4 Run of Quarry – Type 12 consists of unsorted run of quarry material. This material will be stockpiled separately at the Quarry locations by Others. Placement of Run of Quarry Material will be within the areas as shown on the Drawings and/or as directed by the Owner's Representative. The Contractor will be responsible for removing oversized material. In general, the Run of Quarry Material will meet the gradation specification in Table 7:

Table 7: Run of Quarry Material – Type 12 Gradation Specification

Particle Diameter (mm)	Percent Passing, by Weight
1000	100%
600	95 – 100%
300	50 - 100%
150	0 – 80%
19	0 – 30%
4.75	0 – 10%

6.3 Execution

.1 Limits of Tote Road Pavements are shown on the Drawings.

.2 The pavement shall consist of a Surface layer 0.2 m thick, placed and compacted on a Base layer 0.3 m thick, placed and compacted on the new embankment fill or existing embankment.

.3 The Surface layer shall consist of Screened Material Type 5 material.

.4 The Base layer shall consist of Jaw Run Material Type 8 material.

.5 The Contractor shall haul materials to designated fill placement area(s) within the haul road area and spread material in horizontal lifts starting from the lowest grade. The maximum loose lift thicknesses will be:

.a 0.2 m for Screened Material – Type 5.

.b 0.3 m for Jaw Run Material – Type 8.

.c 1.0 m for Run of Quarry – Type 12.

.d Modifications to maximum loose lift thicknesses shall be at the direction of the Owner's Representative with recommendations provided by the Geotechnical Engineer. The Owner's Representative, with input from the Geotechnical Engineer, shall, with the cooperation of the Contractor, conduct field trials to assess material placement techniques and achieved placement densities to assess possible variations to the loose lift thicknesses.

.6 Surface layer and Base layer materials shall be compacted using equipment traffic approved by the Geotechnical Engineer.

.7 Surface layer and Base layer materials shall be compacted using a performance-based requirement. The Contractor shall cooperate with the Owner's Representative and the Geotechnical Engineer to develop methods to achieve a satisfactory degree of compaction for the Fill Materials: the Contractor shall develop and document a compaction equipment pattern to achieve required compaction of Fill Materials to the satisfaction of the Owner's Representative, with input from the Geotechnical Engineer. The compaction methods and degree of compaction achieved in the field will be monitored by the Owner's Representative with input from the Geotechnical Engineer.

.8 Sufficient survey control and records shall be maintained to provide the following:

.a Layout of the Work.

.b Measurement of in-place quantities.

.c Preparation of as-built information for hardcopy and electronic submission to the Owner's Representative.

.g Verification of the accuracy of the work.

.h Survey records which may be reviewed at any time by the Owner's Representative and/or Geotechnical Engineer.

.i Timely provision and quality of survey information to the satisfaction of the Owner's Representative with recommendations provided by the Geotechnical Engineer.

.9 The Contractor shall submit appropriate checklists according to Section 8.0.

7.0 GEOTEXTILE SUPPLY AND INSTALLATION

7.1 General

.1 The Work includes the handling and installation of non-woven needle-punched Geotextile for possible use in Ditch Repair/Construction, and/or Erosion Protection as directed by the Owner's Representative. The Contractor shall be responsible for the handling and installation of the Geotextile.

.2 The Owner will provide the Geotextile that meets the Specification.

7.2 Non-Woven Geotextile Material Properties

.1 The Owner shall furnish a Geotextile whose material properties meet or exceed the requirements of this Specification.

.2 The specific properties for non-woven Geotextile Layfield LP12 or its equivalent as listed in Table 8 shall be met.

Table 8: Property Specifications for Non-Woven Geotextile

Material Property	Qualifier	Unit	Specified Value	Test Method
Mass	minimum	g/m^2	407	ASTM D5261
Grab Tensile Strength	minimum	N	1330	ASTM D4632
Grab Elongation	minimum	%	50	ASTM D4632
Tear Resistance	minimum	N	511	ASTM D4533
Thickness	nominal	mm	3.0	ASTM D5199
CBR Puncture Strength	minimum	N	3510	ASTM D6241
Apparent Opening Size	maximum	mm	0.150	ASTM D4751
Permittivity	minimum	sec^{-1}	0.8	ASTM D4491
Water Flow Rate	minimum	$L/min/m^2$	2,650	ASTM D4491
UV Resistance	minimum	% @ 500 hr	70	ASTM D4355

7.3 Handling and Storage

.1 Handling on site is the responsibility of the Contractor and/or Owner as directed by the Owner's Representative.

.2 The Contractor shall ensure the handling equipment used on the site is adequate and does not pose any risk of damage to the Geotextile.

.3 Upon start-up of the Work, the Contractor and the Owner's Representative shall conduct a surface observation of all rolls or factory panels for defects and for damage. This inspection shall be conducted without unrolling rolls or unfolding factory panels unless defects or damages are found or suspected.

.4 The Owner's Representative may:

.a Identify rolls, factory panels, or portions thereof, which should be rejected and removed from the site because they have severe flaws; and

.b Identify rolls or factory panels which include minor repairable flaws.

.5 The Owner shall provide storage space in a location (or several locations) such that on-site transportation and handling are minimized.

.6 The Contractor shall ensure that storage of the Geotextile provides adequate protection against UV exposure, dirt, shock, and other sources of damage in accordance with the Manufacturer's recommendations.

7.4 Installation

.1 Geotextile sheet shall be installed with sufficient tension to preclude fold and wrinkles and the entire geotextile sheet shall be weighted with sandbags or equivalent to avoid wind damage until the Erosion Protection Material is placed.

.2 If weather damage should occur the Owner's Representative will determine if the geotextile shall be repaired or replaced. Weather damage to the geotextile will include tears and dirty fabric.

.3 All seams shall consist of minimum 0.6 m overlaps. Greater overlaps shall be provided if there is potential for the overlap to move.

.4 Overlaps shall be shingled in the direction of flow such that the upgradient sheet is installed on top of the downgradient sheet.

.5 Overlaps shall be arranged in the direction of slopes. Horizontal overlaps running across slopes are not acceptable.

.6 The Contractor shall ensure the handling equipment used on the site is adequate and does not pose any risk of damage to the Geotextile.

8.0 CONSTRUCTION CHECKLISTS

The following construction checklist forms documenting QA and QC and other aspects of the construction activities, by work activity, are attached:

- Tote Road Site Checklist – Pipe Crossing
  - Trench Excavation
  - Bedding and Pipe Installation
  - Trench Backfill
- Tote Road Site Checklist – Road Embankment Construction
- Tote Road Site Checklist – Granular Pavement Construction

The Contractor may propose alternative forms for approval by the Owner's Representative and the Geotechnical Engineer.

The checklists are to be signed by all parties prior to acceptance of each activity within the defined work area.

Tote Road Site Checklist – Pipe Crossing – Trench Excavation

CONTRACTOR:	DATE:	SHIFT: DAY - NIGHT
CULVERT ID:	STATION:	ROAD SIDE: LEFT - RIGHT

No.	ITEMS TO BE INSPECTED	INSPECTED BY CONTRACTOR	INSPECTED BY QA REPRESENTATIVE
1	Survey lines checked to ensure the locations conform with the Drawings.		
2	Storage areas planned for disposal/ stockpiling of removed materials.		
3	Occurrence of snow and removal method in place, if required.		
4	Occurrence of surface water and its impact mitigation, if required.		
5	Dewatering measures provided, if required.		
6	Pre-construction condition photographed (along alignment of planned excavation, both directions).		
7	Unsuitable materials, snow, ice, and saturated materials and Mineral Soils removed from area as indicated in the Drawings.		
8	Visual inspection during excavation performed and photographed (along alignment of excavation and sidewalls).		
9	Surface competent and free of major protrusions and photographed (along alignment of trench, both ways).		
10	Final surface conditions meets the Specification and photographed (along alignment of trench, both ways).		
11	As-built survey conducted pre- and post- excavation and disposal of Organic Material and Stockpiled Material.		

REMARKS:

DEVIATIONS: (Attach list if necessary)

DATE OF RECTIFICATION:

ACCEPTED BY QA REPRESENTATIVE	ACCEPTED BY CONTRACTOR	ACCEPTED BY OWNER'S REPRESENTATIVE
NAME: _____	NAME: _____	NAME: _____
SIGNATURE: _____	SIGNATURE: _____	SIGNATURE: _____
DATE: _____	DATE: _____	DATE: _____

Tote Road Site Checklist – Pipe Crossing – Bedding and Pipe Installation

CONTRACTOR:	DATE:	SHIFT: DAY - NIGHT
CULVERT ID:	STATION:	

No.	ITEMS TO BE INSPECTED	INSPECTED BY CONTRACTOR	INSPECTED BY QA REPRESENTATIVE
1	Survey lines and layout conform to the Drawings.		
2	Required visual inspection of existing condition before Fill Material placement (photographed after excavation).		
3	Required assessment of Fill Material before placement (Particle-size analysis for Type 5 – Screened Material).		
4	Unsuitable Materials, snow, ice and loose or saturated materials removed prior to placement.		
5	Dewatering measures provided, if required.		
6	Fill lift thickness according to Specifications.		
7	Fill materials contain no frozen lumps or Unsuitable Material.		
8	Bedding shaped to receive pipe and photographed.		
9	Pipe condition inspected prior to installation and photographed along pipe axis, both directions.		
10	Segregation of fill materials controlled during placement.		
11	Required visual inspection of placed materials performed.		
12	Weather conditions meet requirements during fill placement and compaction.		
13	As-built survey conducted pre- and post- construction. Final work photographed.		

REMARKS:

DEVIATIONS: (Attach list if necessary)

DATE OF RECTIFICATION:

ACCEPTED BY QA REPRESENTATIVE	ACCEPTED BY CONTRACTOR	ACCEPTED BY OWNER'S REPRESENTATIVE
NAME: _____	NAME: _____	NAME: _____
SIGNATURE: _____	SIGNATURE: _____	SIGNATURE: _____
DATE: _____	DATE: _____	DATE: _____

Tote Road Site Checklist – Pipe Crossing – Trench Backfill

CONTRACTOR:	DATE:	SHIFT: DAY - NIGHT
CULVERT ID:	STATION:	ROAD SIDE: LEFT - RIGHT

No.	ITEMS TO BE INSPECTED	INSPECTED BY CONTRACTOR	INSPECTED BY QA REPRESENTATIVE
1	Survey lines and layout conform to the Drawings.		
2	Required visual inspection of trench condition before Fill Material placement		
3	Required assessment of Fill Material before placement (particle- size analysis for Type 5 and visual inspection of Type 8 maximum particle size).		
4	Unsuitable Materials, snow, ice and loose or saturated materials removed prior to placement.		
5	Dewatering measures provided, if required.		
6	Fill lift thickness according to Specifications.		
7	Fill materials contain no frozen lumps or Unsuitable Material.		
8	Screened Material – Type 5 completed on each side of the pipe simultaneously. Material in the haunches placed and well compacted prior to continued fill placement.		
9	Segregation of fill materials controlled during placement.		
10	Required visual inspection of placed materials performed and photographed.		
11	Required compaction of fill materials performed.		
12	Weather conditions meet requirements during fill placement and compaction.		
13	As-built survey conducted pre- and post- construction. Final work photographed.		

REMARKS:

DEVIATIONS: (Attach list if necessary)

DATE OF RECTIFICATION:

ACCEPTED BY QA REPRESENTATIVE	ACCEPTED BY CONTRACTOR	ACCEPTED BY OWNER'S REPRESENTATIVE
NAME: _____	NAME: _____	NAME: _____
SIGNATURE: _____	SIGNATURE: _____	SIGNATURE: _____
DATE: _____	DATE: _____	DATE: _____

Tote Road Site Checklist – Road Embankment Construction

CONTRACTOR:	DATE:	SHIFT: DAY - NIGHT
CULVERT ID:	STATION:	ROAD SIDE: LEFT - RIGHT

No.	ITEMS TO BE INSPECTED	INSPECTED BY CONTRACTOR	INSPECTED BY QA REPRESENTATIVE
1	Survey lines and layout conform to the Drawings.		
2	Required visual inspection of condition of footprint of new embankment on existing road embankment or existing ground before Fill Material placement		
3	Required assessment of Fill Material before placement (visual inspection of particle size Type 8 and/or Type 12 maximum particle size).		
4	Unsuitable Materials, snow, ice and loose or saturated materials removed prior to placement.		
5	Dewatering measures provided, if required.		
6	Fill lift thickness according to Specifications.		
7	Fill materials contain no frozen lumps or Unsuitable Material.		
9	Segregation of fill materials controlled during placement.		
10	Required visual inspection of placed materials performed and photographed.		
11	Required compaction of fill materials performed.		
12	Weather conditions meet requirements during fill placement and compaction.		
13	Surface of fill left compacted, smooth, and graded to promote drainage at end of every fill operation or the end of each shift, whichever occurs sooner.		
14	As-built survey conducted pre- and post- construction. Final work photographed.		

REMARKS:

DEVIATIONS: (Attach list if necessary)

DATE OF RECTIFICATION:

ACCEPTED BY QA REPRESENTATIVE	ACCEPTED BY CONTRACTOR	ACCEPTED BY OWNER'S REPRESENTATIVE
NAME: _____	NAME: _____	NAME: _____
SIGNATURE: _____	SIGNATURE: _____	SIGNATURE: _____
DATE: _____	DATE: _____	DATE: _____

Tote Road Site Checklist – Granular Pavement Construction

CONTRACTOR:	DATE:	SHIFT: DAY - NIGHT
CULVERT ID:	STATION:	ROAD SIDE: LEFT - RIGHT

No.	ITEMS TO BE INSPECTED	INSPECTED BY CONTRACTOR	INSPECTED BY QA REPRESENTATIVE
1	Survey lines and layout conform to the Drawings.		
2	Required visual inspection of condition of completed compacted subgrade before Fill Material placement		
3	Required assessment of Fill Material before placement (particle- size analysis for Type 5 and visual inspection of Type 8 maximum particle size).		
4	Unsuitable Materials, snow, ice and loose or saturated materials removed prior to placement.		
5	Dewatering measures provided, if required.		
6	Fill lift thicknesses according to Specifications.		
7	Fill materials contain no frozen lumps or Unsuitable Material.		
8	Segregation of fill materials controlled during placement.		
9	Required visual inspection of placed materials performed and photographed.		
10	Required compaction of fill materials performed.		
11	Weather conditions meet requirements during fill placement and compaction.		
12	Surface of fill left compacted, smooth, and graded to promote drainage at end of every fill operation or the end of each shift, whichever occurs sooner.		
13	As-built survey conducted pre- and post- construction. Final work photographed.		

REMARKS:

DEVIATIONS: (Attach list if necessary)

DATE OF RECTIFICATION:

ACCEPTED BY QA REPRESENTATIVE	ACCEPTED BY CONTRACTOR	ACCEPTED BY OWNER'S REPRESENTATIVE
NAME: _____	NAME: _____	NAME: _____
SIGNATURE: _____	SIGNATURE: _____	SIGNATURE: _____
DATE: _____	DATE: _____	DATE: _____

END OF SECTION: 1667708-S

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APPENDIX D

Inspection Form

APPENDIX D
Inspection Form

INSPECTOR:	DATE:
LOCATION (CULVERT ID, STATION):	

No.	INSPECTION QUESTIONNAIRE	INSPECTOR ANSWERS	ADDITIONAL COMMENTS
Culvert Sites			
1	Is the culvert inlet free of debris/ sediment?	Y N N/A	
2	Is the culvert inlet in good condition (i.e. no signs of erosion, erosion protection in good condition)?	Y N N/A	
3	Are the culverts sitting on the stream bed or embedded in the streambed (i.e. not perched)?	Y N N/A	
4	Is the culvert outlet free of debris/ sediment?	Y N N/A	
5	Is the culvert outlet in good condition (i.e. no signs of erosion, erosion protection in good condition)?	Y N N/A	
6	Is the streambed downstream of the outlet in good condition?	Y N N/A	
7	Are the culverts free draining? Are they free from blockage?	Y N N/A	
8	Is the culvert in good structural condition? (i.e. ends are not damaged, no buckling, etc.)	Y N N/A	
9	Is the water discharging from the culvert clear? [if no, comment on the colouring of the water] Did you take a sample of the water?	Y N N/A Y N N/A	
10	Is the road above the culvert in good condition (i.e. no signs of settlement)?	Y N N/A	
11	If there are constructed ditches that drain to the culvert, are the ditches free draining? Are they free from blockage? Do the ditches have sufficient freeboard (0.3 m min.) from the top of the tote road? [If no, note the locations in the comments]. Is the erosion protection in the ditch in good condition (i.e. no signs of erosion/ movement)? [If no, note the locations in the comments and photograph.] Is the water in the ditch clear? [If no, provide comment on the colouring of the water and note the location of change.] Did you take a sample of the water?	Y N N/A Y N N/A Y N N/A Y N N/A Y N N/A	
12	If there are any cut slopes in the area, are they adequately protected with erosion protection? [If no, note the locations in the comments and photograph.]	Y N N/A	
13	Did you take a photos of the site, culvert inlet and outlet, cut slopes, ditches and any other relevant observations? Record the photograph ID and description of the photograph on next page.	Y N N/A	

INSPECTOR RATING OF OVERALL CONDITION OF CULVERT CROSSING:

VERY POOR POOR MODERATE GOOD VERY GOOD

INSPECTOR OVERALL COMMENTS:

REVIEWER'S COMMENTS ON INSPECTION:

ACCEPTED BY REVIEWER

NAME: _____ SIGNATURE: _____ DATE: _____

MAINTENANCE/ REPAIR RECOMMENDATIONS:

MAINTENANCE COMPLETED SIGNOFF:

NAME: _____ SIGNATURE: _____ DATE: _____

INSPECTOR:		DATE:
LOCATION (CULVERT ID, STATION):		
PHOTO ID.	**DATE OF PHOTO CAPTURE**	**BRIEF PHOTO DESCRIPTION**

ADDITIONAL/ MISCELLANEOUS COMMENTS:
(i.e. weather, recent precipitation, nearby earthworks, recent grading, recent site upgrades?):

As a global, employee-owned organisation with over 50 years of experience, Golder Associates is driven by our purpose to engineer earth's development while preserving earth's integrity. We deliver solutions that help our clients achieve their sustainable development goals by providing a wide range of independent consulting, design and construction services in our specialist areas of earth, environment and energy.

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Golder Associates

APPENDIX 15
MEMO: TRUCK TRANSPORTATION OF ORE (6 MTPA)

Baffinland

MEMO

File: Mary River Phase 2 Proposal Date: December 11, 2018

Reference: Truck transportation of ore (6 Mtpa)

Introduction

In mid-2018, Baffinland applied to increase its production to 6 Mtpa, and transport this quantity of ore on the Tote Road to Milne Port for shipping to market. Ministerial approval to transport 6 Mtpa on the Tote Road was granted until the end of 2019 only. The Phase 2 Proposal application includes continuing to truck 6 Mtpa of ore on the Tote Road as the North Railway is under construction; the schedule assumes that the northern half of the North Railway will be ready for operation in 2021. Accordingly, the environmental effects discussed in the Phase 2 Application include the implications of trucking 6 Mtpa beyond 2019. Trucking 6 Mtpa on the Tote Road is planned to continue until the northern half of the North Railway is operational. Once the northern half of the North Railway is operational, 12 Mtpa will be transported by truck to the temporary transfer station, where it will be loaded onto trains for transport to Milne Port; the temporary transfer station is expected to be used for 1-2 years until the southern half of the railway is complete and ore transportation will occur completely by train between the mine site and Milne Port. It is possible that construction of the northern half of the railway may extend to 2021 or 2022 if there are permitting or construction delays. Though this potential delay was contemplated at the time of the Phase 2 Proposal application, it was not explicitly discussed in the EIS. This memo provides additional clarification and information, including a discussion of the potential environmental effects of a delay in railway construction by up to 2 years (i.e., until 2022).

Potential Environmental Effects of Trucking 6 Mtpa until 2022

The Phase 2 Proposal EIS provided an assessment of the effects of 6 Mtpa trucking on the Tote Road. As the Tote Road is constructed and currently in use, effects are predicted to occur primarily due to dust generated by truck movements. If permitting or construction delays cause a delay in railway construction and thus an extension of 6 Mtpa trucking, the dust emissions predicted in the EIS from trucking in 2019 and 2020 would continue for 1-2 years. This would not change the conclusions presented in the EIS. Additional information for air quality and country foods is provided below.

Air Quality

TSD 7 modelled emissions of particulate matter and dustfall along the Tote Road. Road watering mitigation will potentially reduce PM10 concentrations at the HTO cabin to below indicator thresholds. Concentrations will be monitored, and additional mitigation measures will be considered, including moving the cabin, if air quality impacts are noted. It is important to note that TSD 7 considered 6 Mtpa trucking simultaneously with the construction of the railway. If construction of the railway were to be delayed, dust sources would be limited to truck traffic, and would be less than the totals assumed in the EIS. Figures F-1 to F-6 in TSD 7 present particulate matter and dustfall results for the Tote Road only. If railway construction were delayed, these figures show the expected concentrations from emissions from the use of the Tote Road only.

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Country Foods

TSD-11 modelled potential impacts to soil, berries, and lichen as a result of dustfall along the Tote Road. The assumptions modelled in TSD-11 included an assumed haul rate of 6 Mtpa in 2019 and 2020, with a subsequent increase in haul rate to 12 Mtpa in 2021 (See Table 3-1; TSD-11). Hauling was then anticipated to cease, due to the completion of the North Railway, and all ore would be transported by rail starting in 2022.

If permitting or construction were to result in delays to the schedule, such that hauling of 6 Mtpa would be required for a longer period of time than currently approved, Table 1 provides predictions of potential incremental change in soils as a result of two extended years of hauling along Tote Road (assumed to be years 2021 and 2022). As per TSD-11, the assumed deposition rate for this scenario was 55 g/m^2/year, and all other modelled assumptions were identical to those presented in TSD-11. The projected incremental increases are small, relative to baseline soil concentrations. The predicted increment from an additional 2 years of deposition was added to the total accumulated Baseline + Project soil concentration presented in TSD-11, and compared to ecologically-based and human health-based soil quality guidelines and maximum baseline concentrations, as per the methodology applied in TSD-11. The results indicate that all soil concentrations are less than soil quality guidelines, with the exception of iron, which is also exceeded in baseline (see Table 1). Only selenium exceeds maximum baseline concentrations and is not above soil quality guidelines (see Table 1). The added increments related to two additional years are not expected to have a pronounced effect on soil quality, or vegetation quality, based on the assumptions used. The predictive soil model was also run using a shallower soil mixing depth of 10 cm, and the conclusions related to soil and vegetation quality remain unchanged from those presented in TSD-11.

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Table 1: Incremental Increase to Soils as a Result of Dust Deposition Near Tote Road Based on an Assumed Additional Two Years of Hauling Ore by Truck at 6 MTpa

Metal/COPC	Baseline Surface Soil Concentration (90th %ile)	Total Accumulated Project + Baseline for all years (Table 5-3 and 6-3; TSD-11) years 2025 – 2035	Dust Deposition at 55 g/m²/year for two Additional years Predicted Incremental Change to Soils (Project alone)	Total Accumulated Project + Baseline including two Additional Years	Ecological Health Soil Quality Guideline[a]	Human Health Soil Quality Guideline[b]	Maximum Baseline Soil Concentrations
Aluminum	6515	6542	7.66	6549.7	pH < 5.5	15,400	39300
Antimony	<0.1	0.102	0.000629	0.103	20	7.5	0.85
Arsenic	1.24	1.4	0.0318	1.43	17	12	4.14
Barium	31.3	31.5	0.0621	31.6	390	750/500 (direct contact: 6800)	132
Cadmium	0.172	0.179	0.00215	0.181	3.8/10	1.4/14	0.275
Chromium	26.4	26.5	0.0198	26.52	64	220	55.7
Cobalt	4.72	4.73	0.00422	4.73	40	22	17.5
Copper	9.65	9.79	0.0418	9.83	63	1100	48.4
Iron	20500	20538	11	20549	pH 5-8	11000	90500
Lead	6.67	6.70	0.00863	6.71	70/300	140	31.7
Manganese	203.5	204.1	0.176	204.3	220/4000	360	416
Mercury	<0.05	0.0676	0.00507	0.073	12	6.6	0.152
Molybdenum	0.35	0.355	0.00133	0.356	6.9	110	2.53
Nickel	19.3	19.4	0.01600	19.4	50	330	39.4
Selenium	<0.5	0.520	0.00580	0.525	1	80	0.51
Silver	<0.05	0.0504	0.00011	0.051	20	77	0.198
Strontium	21.4	21.5	0.0238	21.5	NGA	9,400	83.3
Thallium	0.128	0.130	0.00060	0.131	1/1.4	1	0.435
Tin	0.585	0.591	0.00179	0.593	5[g]	9,400	2.66
Uranium	1.90	1.90	0.00122	1.90	33/500	23	6.13
Vanadium	28.8	28.8	0.0129	28.8	86[e]	86	83.9

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Metal/COPC	Baseline Surface Soil Concentration (90th %ile)	Total Accumulated Project + Baseline for all years (Table 5-3 and 6-3; TSD-11) years 2025 – 2035	Dust Deposition at 55 g/m²/year for two Additional years Predicted Incremental Change to Soils (Project alone)	Total Accumulated Project + Baseline including two Additional Years	Ecological Health Soil Quality Guideline[a]	Human Health Soil Quality Guideline[b]	Maximum Baseline Soil Concentrations
Zinc	25.6	25.8	0.0569	25.86	200	5600	118

[A] footnotes related to guideline sources are provided in TSD-11; Table 5-3.

[B] footnotes related to guideline sources are provided in TSD-11; Table 6-3.

Shading indicates exceedance of soil quality guideline; underline indicates exceedance of maximum baseline soil concentration

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Conclusion

The conclusions presented in the Phase 2 Proposal EIS consider continued trucking of 6 Mtpa past 2019 (to 2020) during the construction period, and would not be changed if the construction of the North Railway is delayed by 1 – 2 years. Mitigation measures, including dust suppression efforts along the Tote Road, would continue to be put in place as described in the EIS.