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February 6, 2020

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Via email: info@nirb.ca

**RE: Technical Review Comments on Baffinland Iron Mine Corporation
(Baffinland) Phase 2 Development Proposal Update (NIRB # 08MN053)**

Dear Mr. Barry,

Thank for providing the opportunity to submit technical comments on Baffinland's Phase 2 Development Proposal update (NIRB# 08MN053).

All participating federal departments have reviewed the updated Phase 2 development proposal documents provided by Baffinland to the Nunavut Impact Review Board (NIRB) on January 6, 2020. The Canadian Northern Economic Development Agency's Northern Projects Management Office (NPMO), on behalf of federal departments, is providing the following attached technical review comments:

- Technical Review Comments from Crown-Indigenous Relations and Northern Affairs Canada;
- Technical Review Comments from Environment and Climate Change Canada and accompanying cover letter;
- Technical Review Comments from Fisheries and Ocean and accompanying cover letter;
- Technical Review Comments from Parks Canada; and
- Technical Review Comments from Natural Resources Canada.



The Government of Canada relies on the NIRB and its robust environmental assessment process to discharge the duty to consult, and where necessary, accommodate as required under section 35 of the *Constitution Act, 1982*. We look forward to continued participation in NIRB's environmental assessment processes. If you have any questions or concerns, please contact Adrian Paradis, Senior Project Manager, NPMO, Adrian.paradis@canada.ca, (867-669-2595)

Sincerely,

Lisa Dyer
Director General
Northern Projects Management Office

Attachment

Cc:

David Rochette, Regional Director General, Crown-Indigenous Relations and Northern Affairs Canada

Mary Taylor, Environmental Protection Operations Directorate, Environment and Climate Change Canada

Tom Hoggarth, Director General, Ecosystems Management Fisheries and Oceans Canada, Central and Arctic Region

Shari Currie, Regional Director General, Prairie and Northern Region, Transport Canada

Patrick O'Neill, Director General, Explosives, Safety and Security Branch, Natural Resources Canada

Chantal Roberge, Director Environmental Health and Internationally Protected Persons, Health Canada

Mark Hopkins, Director General, Crown-Indigenous Relations and Northern Affairs

Jenna Boon, Nunavut Field Unit Superintendent, Parks Canada

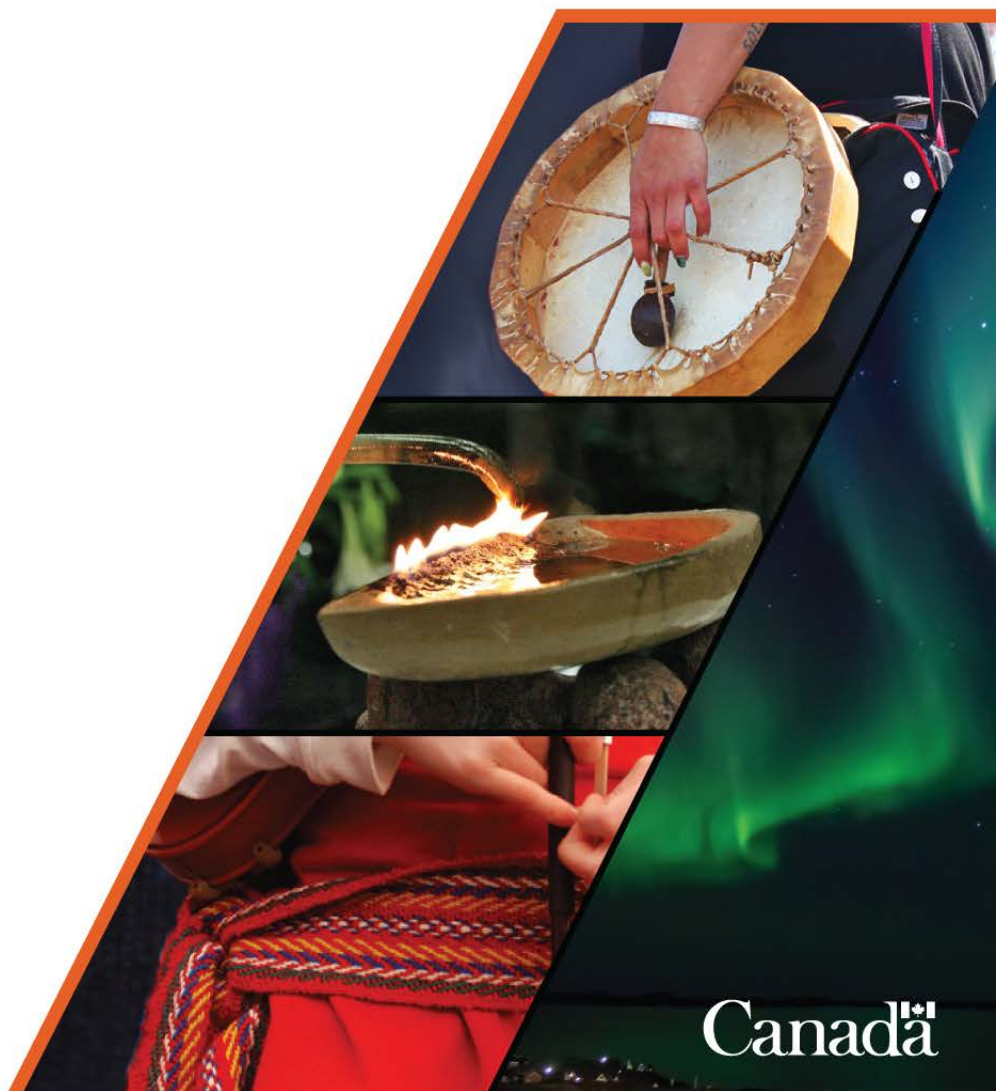


Technical Comments

Baffinland Iron Mines Corporation

Mary River Project Phase 2 Proposal

February 06, 2020



EXECUTIVE SUMMARY

Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) has undertaken a review of documents submitted by Baffinland Iron Mines Corporation (Baffinland) to the Nunavut Impact Review Board (NIRB) in support of their application for the Mary River Phase 2 Project Amendment (the Project). The review process included Information Requests (IRs) and a Technical Review submission, two Technical Meetings and an adjourned Public Hearing.

During the Review phase for the Project, CIRNAC identified a series of potential concerns related to the Project's impacts on the biophysical environment and socio-economic matters. In most instances, these concerns have been sufficiently resolved for the purposes of the Environmental Assessment. Based on the evidence considered to date, CIRNAC has concluded that, for aspects within CIRNAC's mandate, the proposed Project is not likely to cause significant adverse environmental effects with the exception of issues related to the Acid Rock Drainage and Metal Leaching (ARD/ML) characterization within the ore body and waste rock from Deposit 1.

Baffinland committed to develop a Thermal Model of the Waste Rock Facility (WRF), revise the potentially acid generating (PAG) rock identification criteria and incorporate the new criteria in an updated *Waste Rock Management Plan* and *Interim Closure and Reclamation Plan*. The updated *Waste Rock Management Plan* and other supporting documents were submitted for review in December 2019 and January 2020.

Thermal Modeling

CIRNAC has reviewed the WRF Thermal Model and confirms that, in general, the approach adopted for instrumentation and modelling is acceptable. Based on the review of the information presented, the following items need further consideration:

- Clarify if the WRF internal heat generation correlates with the exothermic reaction of PAG waste rock deposited.
- Clarify if a WRF oxygen balance has been performed and if the oxygen consumption correlates with the extent of oxidation process.
- Assess if the WRF water balance reflects that the dry piezometers are a result of infiltration rainfall that percolates through the waste rock.
- Ensure installation of additional relevant instrumentation (e.g. further thermistors, moisture probes) and update the thermal modeling to account for three dimensional variations.
- Develop a detailed site wide program to monitor the thaw consolidation and soil deformation under the structures/embankments constructed as part of the Project. The monitoring results shall be compared with the FEIS Addendum predictions and appropriate mitigation measures shall be identified and incorporated into the adaptive management approach.

Acid Rock Drainage and Metal Leaching

CIRNAC acknowledges efforts made by Baffinland to address ARD/ML issues, however there are still outstanding concerns regarding ARD/ML characterization. These concerns are discussed in details in subsequent sections of this report. CIRNAC makes the following recommendations for Baffinland:

- Confirm the origin of elevated concentrations of aluminum, mercury and copper in Shake Flask Extraction test results for rock materials sourced from quarry and borrow pits for road / railway construction, and develop and implement an appropriate water quality monitoring and management strategy for railway corridor rock quarries.
- Compare the water quality monitoring results with the FEIS Addendum predictions, identify and implement the appropriate mitigation measures.
- Demonstrate the origin of the soluble sulphates, estimate possible spatial extent and a tonnage estimate of waste rock containing significant soluble sulphates.



- Demonstrate that waste rock associated with the greater life of mine deposit does not have significant soluble sulphate content.
- Provide further justification for the retention of 0.2% total sulphur cut-off threshold for identification of Non-PAG waste rock and using NPR of 2 as a cut-off for PAG identification considering the absence of Calcium /Magnesium carbonate mineral content.
- Provide information on the variation and uncertainty in ARD/ML behavior of the different types of waste rock.
- Develop effective criteria for identification of PAG rock following industry best practice and incorporate these criteria in an updated Waste Rock Management Plan and Interim Closure and Reclamation Plan.
- Confirm adequate capacity of the WRF pond, including the sufficient contingency to prevent a potential of uncontrolled/untreated discharge to the environment.



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LIST OF ACRONYMS

| | |
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| ARD | Acid Rock Drainage |
| CIRNAC | Crown-Indigenous Relations and Northern Affairs Canada |
| EA | Environmental Assessment |
| ECCC | Environment and Climate Change Canada |
| EIS | Environmental Impact Statement |
| FC | Final Comment |
| FEIS | Final Environmental Impact Statement |
| ICRP | Interim Closure and Reclamation Plan |
| IR | Information Request |
| ML | Metal Leaching |
| Non-PAG | Not Potentially Acid Generating |
| NIRB | Nunavut Impact Review Board |
| NPC | Nunavut Planning Commission |
| NPR | Neutralization Potential Ratio |
| NuPPAA | Nunavut Planning and Project Assessment Act |
| NWB | Nunavut Water Board |
| PAG | Potentially Acid Generating |
| TRC | Technical Review Comment |
| TSD | Technical Support Document |
| WRMP | Waste Rock Management Plan |
| WRF | Waste Rock Facility |
| wt% | Weight percent |



1.0. INTRODUCTION

Baffinland Iron Mines Corporation's (Baffinland) "Mary River Phase 2 Project Amendment" (the Project) proposal is currently undergoing review by the Nunavut Impact Review Board (NIRB File No. 08MN053). Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) has participated throughout the Environmental Assessment process and is pleased to submit this Technical Comments for consideration by the NIRB. CIRNAC has a broad mandate for the co-management of land and water resources in Nunavut, as well as the management of Crown land under the following applicable acts and regulations:

- The Department of Crown-Indigenous Relations and Northern Affairs Act
- The Nunavut Land Claims Agreement Act and the Nunavut Agreement (NA);
- The Nunavut Planning and Project Assessment Act (NuPPAA);
- The Arctic Waters Pollution Prevention Act (AWPPA) and Regulations;
- The Nunavut Waters and Nunavut Surface Rights Tribunal Act (NWNSTRA) and Regulations; and
- The Territorial Lands Act and Regulations.

As set out under NuPPAA, CIRNAC's Minister, in concurrence with other responsible Ministers, will have a decision-making role on the proposed project's approval to proceed based on the NIRB's assessment. If the proposed Project is approved to proceed, CIRNAC will be responsible for inspecting and enforcing conditions contained within the Project Certificate and Water Licence associated with the project.

As part of the NIRB's review, CIRNAC, along with other stakeholders, acts as an intervenor in the process, providing advice and expertise to NIRB by way of this submission. Based on CIRNAC's regulatory mandate and decision-making roles, CIRNAC is participating in the review by providing expertise in the following mandate areas related to Mary River Phase 2 Project Amendment proposal works, activities, and plans:

- Environmental impact assessment methodology and best practices, including cumulative effects assessment;
- Crown land contamination/degradation, particularly closure and reclamation planning;
- Surface water quality and quantity;
- Groundwater quality and quantity;
- Marine water quality only as affected from land;
- Permafrost;
- Waste management and
- Socio-economic impact assessment and monitoring;

CIRNAC has completed its review of Baffinland's Final Environmental Impact Statement (FEIS) Addendum and supporting documentation to assess whether environmental and socioeconomic impacts, cumulative impacts and alternative means to carry out the Project, have been adequately identified and evaluated. CIRNAC has also reviewed any related management, mitigation and monitoring plans to ensure that they are appropriate at a conceptual level.

This submission summarizes CIRNAC's technical comments regarding outstanding issues related to the Thermal Model of the Waste Rock Facility (WRF) and Acid Rock Drainage and Metal Leaching (ARD/ML) characterization within ore and waste rock from Deposit 1.



2.0. TECHNICAL COMMENTS

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| Review Comment Number | CIRNAC- Technical Comment #1 |
| Subject | Thermal Modelling of Key Infrastructure |
| Reference | <ul style="list-style-type: none"> • TSD-06 Climate Change Assessment • TSD-08 Landforms, Soil and Permafrost • TSD-28 Management Plans, Appendix H-Phase 1 Waste Rock Management Plan • Baffinland IR Responses, Response to CIRNAC-IR #14 • Hatch, April 26, 2019, Geotechnical Recommendations for Northern Railway. Reference # H353004-30000-229-230-0001, Rev. 0 • Baffinland, Interim Closure and Reclamation Plan, Appendix D, updated May 1, 2019. • Baffinland, Phase 1 Waste Rock Management Plan Rev 2, December 31, 2019, Mary River Project. • CIRNAC. Final Written Submission for Baffinland Iron Mines Corporation Mary River Project Phase 2 Proposal, September 23, 2019. Final Comment #5. |
| Summary | <p>Baffinland provided a summary of the results of the thermal analyses in several structure-specific geotechnical recommendations reports, including thermal modelling for port infrastructure. Baffinland submitted the updated Waste Rock Management Plan for review in December 2019.</p> <p>Following review of these documents, CIRNAC concluded that there are still outstanding concerns for Thermal Model of the Waste Rock Facility (WRF) and additional efforts are required to demonstrate that WRF design assumptions are appropriate.</p> <p>Based on the information provided, it is not clear whether a heat balance has been performed and whether the internal heat generation correlates with the heat generation associated with the exothermic reaction of PAG waste rock. It is not clear if the oxygen consumption correlates with the extent of oxidation process taking place and if the water balance reflects that the dry piezometers are a result of infiltration rainfall that percolates through the waste rock.</p> |
| Importance of issue to impact assessment | <p>Considering that the project site contains areas with continuous permafrost with massive ground ice, thermal modelling results are important for the environmental impact assessment in order to determine if permafrost conditions during and post-construction will affect the Project infrastructure. Management of WRF relies on freeze-back to mitigate acid rock drainage/ metal leaching (ARD/ML) issues. Thermal modeling is required to demonstrate that the proposed management approach is appropriate.</p> |
| Detailed Review Comment | <p>During the Technical Review, CIRNAC requested Baffinland to develop and implement a site-wide program to monitor the thaw consolidation and soil deformation under the structures/ embankments.</p> <p>In response, Baffinland provided the document titled: <i>Geotechnical Recommendations for Northern Railway, Hatch, April 26, 2019</i>, which addresses the</p> |



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| | <p>concerns regarding the North Railway and associated infrastructure. The thermal modelling and analysis for the area of the WRF was not included in that document. In the <i>Interim Closure and Reclamation Plan, Appendix D</i>, updated May 1, 2019, Baffinland stated that a thermal model of the WRF will be completed once sufficient data have been collected for model calibration. The results of the available thermal modelling have been included as Thermal Model Memorandum in the updated <i>Waste Rock Management Plan, Appendix A2</i> submitted in December 2019.</p> <p>The thermal assessment was undertaken by Baffinland to characterize the freezing patterns of deposited waste rock and assess the WRF thermal performance. The instrumentation program implemented for the thermal assessment included three vertical thermistors, two vertical oxygen sensor strings, two vertical thermistors to monitor the WRF pond liner and foundation, three horizontal thermistors, a barometer and two vibrating wire piezometers.</p> <p>The data from these sensors was used for the calibration and development of a thermal model used to assess the time for waste rock placed during the summer and the subsequent winter months to freeze back. The Memorandum presents the results of laboratory testing of waste rock thermal properties and describes the model boundary conditions, the calibration and the model results for the waste rock deposition phase during summer and summer plus winter scenarios.</p> <p>CIRNAC has reviewed the WRF Thermal Model and confirms that, in general, the approach adopted for instrumentation and modelling is acceptable. Based on the review of the information presented, the following items need further consideration:</p> <p>1. Internal heat generation</p> <p>It appears that there is some internal heat generation taking place within the waste rock deposit. Baffinland states that the internal heat may be resulting from geochemical reactions taking place within the waste rock deposit.</p> <p>Based on the information provided, it is not clear whether a heat balance has been performed and whether the internal heat generation correlates with the heat generation associated with the exothermic reaction of PAG waste rock. Greater understanding of heat balance is particularly important in light of the following:</p> <ul style="list-style-type: none"> • Presence of soluble iron sulphate minerals is likely to result in a significantly different magnitude of heat generation as compared to oxidation of iron sulphide minerals; and • Relevance and limitation of thermistor monitoring since it may be limited to providing an indication of the depth at which water is likely to be frozen rather than the presence of waste rock where soluble iron sulphate minerals are readily dissolving. <p>CIRNAC notes that the thermal model incorporated some heat flux of 30 kJ/d to match the observed temperature profile with the predicted profile, however, it is not clear at what depth and to what horizontal extent the heat flux was introduced and for how long.</p> <p>2. Oxygen consumption</p> <p>Baffinland indicates that air flow within the pile associated with barometric pumping, temperature-driven air convection and/or other processes are likely influencing the observed temperature variation within the waste rock deposit.</p> <p>The data from oxygen sensors measured at different depths in various areas of the pile during May, June, July and August is presented. However, it is not clear if an oxygen balance has been performed and if the oxygen consumption correlates with the extent of oxidation process or oxidation volume taking place. This is particularly relevant in the presence of soluble sulphates as there is likely to be a significantly</p> |
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| | <p>lower oxygen demand as compared to the presence of oxidizing sulphides.</p> <p>Oxygen depletion has been observed below the maximum active depth. This does not support the basic assumption of the management of the WRF to maintain the deposited waste rock in a frozen state and to address the ARD challenges.</p> <p>3. Vibrating Wire Piezometers data</p> <p>The Vibrating Wire Piezometers (VWP) data from March through September 2019 did not report any standing water (piezometers have remained dry).</p> <p>Baffinland should assess whether the water balance reflects the infiltration rate and seepage quantity/timing. It is unclear if the results indicate that rainfall percolates through the waste rock or the dry piezometers are a result of poor functioning of the VWP instrumentation.</p> <p>This trend of the VWP data needs to be compared with the chemical load of the seepage and runoff in order to obtain a general appreciation of the results.</p> <p>4. Waste rock layer</p> <p>The Thermal Model Memorandum recommends as a model prediction that a 5 m thick lift of waste rock deposited in summer, covered by a 5 m thick layer of waste rock layer of waste rock in winter, would freeze prior to the following summer in most scenarios. However due to heat exchange between layers of waste rock it was recommended to delay the winter deposition or reducing the thickness of summer deposition. This would decrease freezing times and reduce or eliminate the possible extent of thawed portions within the WRF.</p> <p>5. Continued monitoring</p> <p>CIRNAC is of the view that, this recommendation should be confirmed by continued monitoring of the temperature and oxygen concentrations within the waste rock. Further, the Proponent should conduct periodic review of the data and observe if any trends exist requiring any changes in deposition strategy. This is particularly relevant as the presence of soluble sulphates may require alteration of the design concept (e.g. the WRF may need to adopt means to control rainfall infiltration through the dump during spring and summer rather than long term establishment of permafrost).</p> |
| Recommendation / Request | <p>CIRNAC recommends that Baffinland:</p> <ul style="list-style-type: none"> • Internal heat generation: Provide a heat balance to clarify if the internal heat generation correlates with the heat generation associated with the exothermic reaction of PAG waste rock deposited. Such a heat balance needs to account for the expected effects of soluble sulphates. • Oxygen consumption: Clarify if an oxygen balance has been performed and if the oxygen consumption correlates with the extent of oxidation process or oxidation volume taking place. Such an oxygen balance needs to account for the expected effects of soluble sulphates. • Vibrating Wire Piezometers data: Assess if the water balance reflects that the dry piezometers are a result of infiltration rainfall that percolates through the waste rock or indicate poor functioning of the VWP instrumentation. • Continued monitoring: Ensure installation of additional relevant instrumentation (e.g. further thermistors, moisture probes) and update the thermal modeling to account for three dimensional variations (where required, particularly if there needs to be an alteration to the design of the WRF). |



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| | <p>CIRNAC also recommends Baffinland to develop a detailed site wide program to monitor the thaw consolidation and soil deformation under the structures/ embankments constructed as part of the Project. The monitoring results shall be compared with the FEIS Addendum predictions and appropriate mitigation measures shall be identified and incorporated into the adaptive management approach.</p> |
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| Review Comment Number | CIRNAC- Technical Comment #2 |
| Subject | Acid Rock Drainage and Metal Leaching (ARD/ML) Potential of Railway Cut Material, Quarry and Pit Walls |
| Reference | <ul style="list-style-type: none"> • NIRB Amended EIS Guidelines for the Mary River Phase 2 Development Proposal, Sections 8.1.7 and 9.4.12 • TSD-02 Project Description • TSD-28 Management Plans, Appendix B - Borrow Pit and Quarry Management Plan • Mary River Project, 2018 Annual Report to NIRB, March 2019, Section 3.2.3 • Baffinland IR Responses, Response to CIRNAC-IR # 8 and #10 • Additional Information provided by Baffinland: <ul style="list-style-type: none"> ○ Hatch 2017 Geotechnical Investigations - Acid Rock Drainage Assessment ○ Baffinland Mary River Project - Trucking Feasibility Study Interim ML/ARD Assessment of Tote Road Quarry and Borrow Pit Samples Rev1 - Issued for FEIS (AMEC 2010) (Phase 1)] ○ Hatch, April 26, 2019 Borrow Source Investigation Factual Data Report ○ Baffinland, Memo Clarification related to Environment and Climate Change Canada (ECCC) 3.20, May 14, 2019 ○ Baffinland, Memo Statement on Waste Rock and ARD, July 3, 2019 ○ Hatch, July 24, 2019 Borrow Source Investigation Factual Data Report. • CIRNAC. Final Written Submission for Baffinland Iron Mines Corporation Mary River Project Phase 2 Proposal, September 23, 2019. Final Comment #7. |
| Summary | <p>Baffinland earlier submitted Borrow Source Investigation Factual Data Report (April 26, 2019) to address potential ARD/ML issues for construction of the Northern Railway. During the technical review, CIRNAC noted that this report was substantially deficient in the rock sampling and representative test work in the southern section of the intended Northern Railway corridor, south-west of Deposit 4, which leads to uncertainty in assessment of the ARD/ML potential of the railway cut material, quarries and pit walls. To address this deficiency Baffinland submitted an <i>additional Borrow Source Investigation Factual Data Report (July 24, 2019)</i> and committed to avoidance, mitigation and monitoring of ARD/ML at all rail corridor quarries.</p> |
| Importance of issue to impact assessment | <p>Rail corridor rock surfaces and quarries in this area that come into regular contact with rainfall / snowmelt may become sources of adverse water quality due to ARD/ML. Assessment of the ARD/ML potential is required to better understand any potential adverse environmental impacts and develop appropriate mitigation measures.</p> <p>Adequate interpretation and investigation of ARD/ML material, particularly leachate results is an important part of predicting probable drainage water</p> |



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| | quality from rail quarries and construction materials. |
| Detailed Review Comment | <p>During the Review of the Project proposal, CIRNAC noted that there was uncertainty in ARD/ML potential of the railway cut material, quarries and pit walls.</p> <p>CIRNAC requested Baffinland perform a representative sampling program and geochemistry test work program in the area of the Northern railway corridor south-west of Deposit 4.</p> <p>In response, Baffinland issued a Memo (July 3, 2019) committing to avoidance, mitigation and monitoring of ARD/ML at all rail corridor quarries. The detailed and specific mitigation measures were earlier presented in <i>Baffinland's Memo to ECCC (May 14, 2019)</i>. These include water monitoring for ARD/ML parameters, water diversion, covering PAG materials with crushed carbonate rock and / or engineered covers and contingency for passive / active water treatment prior to discharge. Baffinland also provided both the original project and Phase 2 ARD/ML test work program results, which is representative of the majority of potential quarry locations along the rail route.</p> <p>In light of completion of the Phase 2 ARD/ML test work program, sampling locations appear to be significantly more representative of rock types that will be encountered along the railway corridor than prior investigations (including the deviation between Tote Road and the rail route immediately south-west of the mine).</p> <p>Overall, the results suggest that rock materials sourced from quarry and borrow pits for road / rail construction represent a low risk in terms of ARD. These rock materials appear to have negligible potential for generating acidity as a result of low sulphur content and an abundance of carbonate minerals. However Shake Flask Extraction (SFE) results suggested that some rock materials may leach certain metals at concentrations greater than the adopted Canadian Water Quality Guidelines for Aquatic Life, specifically aluminum, mercury and copper. The origin of these exceedances (dissolved phase vs suspended solids) and implications for drainage water quality is yet to be determined.</p> |
| Recommendation / Request | <p>CIRNAC recommends that Baffinland:</p> <ul style="list-style-type: none"> • Confirm the origin of elevated concentrations of aluminum, mercury and copper in Shake Flask Extraction test results for rock materials sourced from quarry and borrow pits for road / railway construction, and develop and implement an appropriate water quality monitoring and management strategy for railway corridor rock quarries. • Compare the monitoring results with the FEIS Addendum predictions, identify and implement the appropriate mitigation measures. |



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| Review Comment Number | CIRNAC- Technical Comment #3 |
| Subject | ARD/ML Characterization within Ore and Waste Rock from Deposit 1 |
| Reference | <ul style="list-style-type: none"> • NIRB Amended EIS Guidelines for the Mary River Phase 2 Development Proposal, Section 6.5.3.1; 6.5.3.2; 6.5.3.3 and 6.5.13 • TSD-02 Project Description • TSD-28 Management Plans, Appendix H - Phase 1 Waste Rock Management Plan, Section 5.3 • TSD-28 Management Plans, Appendix I - Interim Waste Rock Management Plan • Mary River Project, 2018 Annual Report to NIRB, March 2019, Section 3.2.3 • Baffinland IR Responses, Responses to CIRNAC-IR # 9 • Baffinland, Memo Statement on Waste Rock and ARD, July 3, 2019 • Baffinland, Memo Outstanding questions related to ECCC 3.19, May 01, 2019 • Table 4-1 of Section 4-1 of Hatch, July 24, 2019 Borrow Source Investigation Factual Data Report (in relation to NPR threshold to identify non-PAG materials). • Baffinland, Phase 1 Waste Rock Management Plan Rev 2, December 31, 2019, Mary River Project. • CIRNAC. Final Written Submission for Baffinland Iron Mines Corporation Mary River Project Phase 2 Proposal, September 23, 2019. Final Comment #8. |
| Summary | <p>PAG waste rock stored within the WRF at the Mary River mine site currently generates ARD/ML that is collected and treated before discharge. Baffinland has been conducting sampling and test work to better understand the nature of ARD/ML associated with the PAG waste rock. Key findings of the test work are incorporated into the updated Waste Rock Management Plan.</p> <p>The current method of identifying PAG waste rock that may generate ARD/ML relies on measuring the total sulphur content. Baffinland considers rock with total sulphur content below 0.2 weight percent (wt%) to be non-generating ARD/ML. The 0.2 wt % criteria is based upon a neutralization potential ratio (NPR) criteria of 2 which, according to the Mine Environment Neutral Drainage (MEND) program (MEND. 2009), can only be used where acid potential is associated with pyrite and there is readily available neutralization potential provided by Ca/Mg carbonate minerals (e.g. calcite and dolomite).</p> <p>CIRNAC is of the view that the lack of Ca/Mg carbonate minerals and presence of soluble sulphates, implies that an NPR value of 2 and associated 0.2 wt% total sulphur criteria may not be appropriate for identifying PAG waste rock at the mine site.</p> <p>In addition to 0.2wt% total sulphur criteria Baffinland proposed using paste pH test to identify rocks with soluble sulphates (paste pH<6).</p> <p>The proposed 0.2wt% S (plus NPR>2) and paste pH are inadequate because of the absence of Ca/Mg mineral carbonates, lack of clarity on the origin of soluble sulphates as well as estimates of soluble sulphate content of deposits, and lack of info on variation and uncertainty in ARD/ML behavior of different waste rock types.</p> |



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| Importance of issue to impact assessment | <p>Clear and adequate derivation of appropriate PAG identification criteria is critical for effective management of waste rock at the mine site. If the NPR value and associated total sulphur wt% criteria are not suitably conservative (i.e. account for an absence of Ca/Mg carbonate minerals), Baffinland may substantially underestimate tonnages of PAG in the Block Model for Deposit 1. Greater than expected tonnages of PAG may result in the WRF design and water treatment sizing not being sufficiently adequate to prevent short or longer term adverse impacts to the watershed in which the WRF is located.</p> |
| Detailed Review Comment | <p>CIRNAC's review of the Phase 2 Project proposal and relevant documents indicated the following key uncertainties related to the derivation of an appropriate set of PAG identification criteria:</p> <ul style="list-style-type: none"> • Effect of an absence of Ca/Mg carbonate minerals; • Effect of the presence of soluble sulphate minerals; and • Variation and uncertainty in ARD/ML behaviour of the different types of waste rock at Deposit 1. <p>Both <i>Appendix E.6 and E.7 Mary River Project 2018 QIA and NWB Annual Report for Operations, March 31, 2019</i>, clearly demonstrate lack of Ca/Mg carbonate mineral content in waste rock (including PAG waste rock). The bulk Neutralization Potential is relatively low and at least twice as great as Carbonate Neutralization Potential, suggesting a predominance of Neutralization Potential being provided by silicate minerals rather than Ca/Mg carbonate minerals. The implication is that if PAG rock releases ARD/ML there will be no effective neutralisation capacity to maintain non-acidic conditions (i.e. above pH 6) and loadings of acidity and metals will readily seep from the WRF.</p> <p>The Mine Environment Neutral Drainage (MEND) program¹ clearly advocates adjustment of the NPR value to a suitable value greater than 2 to account for a lack of Ca/Mg carbonate minerals (noting the current 0.2 wt% total sulphur cut-off is based upon an NPR value of 2). On that basis the current PAG identification criteria (NPR of less than 2 and 0.2 wt% total sulphur content) needs to be thoroughly reviewed and potentially adjusted in a manner that clearly demonstrates consideration of the effect of an absence of Ca/Mg carbonate minerals and presence of soluble sulphate minerals.</p> <p>Prior to the adjourned Public Hearing, Baffinland suggested that evaluation of correlations between NPR and total sulphur for different waste rock lithologies will be completed for the geochemistry test work dataset that is currently being developed as well as pre-existing datasets. In their Memo of May 01, 2019 (reply to ECCC comment 3.19) Baffinland stated that <i>"Reassessment of the total sulphur content cut-off for PAG characterization will be completed, as appropriate, following an improved understanding of the concentration of soluble sulphates within the waste rock. If the 2019 geochemical investigation finds that soluble sulphates in waste rock with less than the 0.2% total sulphur content cut-off has the potential to produce poor seepage water quality, then additional geochemical testing will likely be required as part of the waste rock segregation practices to define PAG versus non-PAG during blasthole sampling. The additional geochemical testing requirements, if required, will be defined after reviewing the 2019 geochemical investigation results."</i></p> |

¹ MEND. 2009. Page 14-11, Chapter 14, Prediction Manual for Drainage Chemistry from Sulphidic Materials. MEND Report 1.20.1. December 2009. Report prepared by William A. Price. CANMET – Mining and Mineral Sciences Laboratories. Smithers, British Columbia. V0J 2N0



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| | <p>Baffinland submitted the updated Waste Rock Management Plan for review in December 2019. The Geochemical Memorandum submitted as part of the updated Waste Rock Management Plan provides a chronology of geochemical characterization programs from the original AMEC work to present, as well as an explanation of key aspects that may have changed in terms of ARD/ML identification criteria. The provided background, a summary of the geochemical characterization completed by AMEC in 2014 for the revised 5 year mine plan, suggested a cut-off of sulphur content > 0.2 wt% was the most appropriate approach to prevent PAG waste rock being identified as not potentially acid generating.</p> <p>In order to assess the presence of sulphate minerals in material with low total sulphur that would have implications for the current waste rock segregation criteria, the 2019 geochemistry test work program involved drilling investigation of the WRF and sampling the drill cuttings of the open pit to expand the geochemical database for samples with total sulphur above and below 0.2 wt%.</p> <p>A total of 29 samples were collected from WRF and a total of 40 samples were collected from drill cuttings. Test work included acid base accounting, bulk metals analysis and a shake flask extraction (SFE) leach. SFE leach results were intended to provide an indication of the readily soluble fraction and potentially problematic parameters were identified via screening against the Metals and Diamonds Mining Effluent Regulations Schedule 4 (MDMER, 2018).</p> <p>Key findings of the work included establishing an explanation for why soluble sulphates were not encountered in the 2014 AMEC geochemical characterization program (samples were not taken from the current 5 year pit envelope) and the establishment of a paste pH threshold of 6 to identify PAG waste rock with significant soluble sulphate content.</p> <p>After review of the update Waste Rock Management Plan, CIRNAC has the following outstanding concerns regarding ARD/ML characterization.</p> <p>1. Origin of the Soluble Sulphate minerals</p> <p>Detailed analysis has been provided around the differences between acid-base accounting, elemental and Shake Flask Extraction results of the 2019 set of samples and both the 2014 and prior historical data set. However, the following aspects have not been addressed:</p> <ul style="list-style-type: none"> • The possible geological origin of the soluble sulphates. • The possible spatial extent of waste rock containing significant soluble sulphates. • Tonnage estimates of potential soluble sulphate containing rock have not been provided. <p>2. ARD/ML identification criteria</p> <p>There is still no discussion on how the ARD/ML identification criteria suggested in AMEC 2014 report or the present Geochemistry Memorandum accounts for the absence of calcium/magnesium carbonates.</p> <p>The current report acknowledges the relatively low neutralization potential and the negligible contribution of carbonates present as they are iron carbonate minerals, but there is still no explanation as to how the current and now proposed 0.2% total S threshold for the effective segregation of materials is affected by virtually no net reactive Calcium /Magnesium carbonate mineral content. The AMEC 2014 report where the 0.2% total S threshold was derived, most certainly uses an NPR threshold of 2 to identify PAG materials and then asserts that the 0.2% total sulphur threshold is sufficiently conservative as it results in the identification of significantly more PAG</p> |
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| | <p>material than use of an NPR threshold greater than 2 (109.5 Mt vs 62.7 Mt). However the report does not consider the scenario if comparison against an NPR of 2 is not sufficient, in the first place, to account for absence of Calcium /Magnesium carbonate mineral content and associated neutralization potential.</p> <p>Chapter 14 of <i>MEND. 2009. Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials. Report 1.20.1. Mining Environment Neutral Drainage (MEND) Program, Natural Resources Canada. December 2009</i> states:</p> <p><i>"Material categories for future drainage pH are potentially acidic drainage generating (PAG) and not potentially acidic drainage generating (Non-PAG). For cases where [acid production potential] AP and [neutralization potential] NP are equally exposed and AP generates acid identical to pyrite and NP neutralizes acid like calcite, samples with an NPR less than 1.0 are PAG and samples with an NPR greater than 2.0 are non-PAG"</i></p> <p>This is clearly not the case, since neutralization relates to predominantly silicate minerals which are unlikely to provide neutralization potential at a rate to maintain pH greater than 6.</p> <p>The current memo does not include information on the statistical variation and uncertainty in ARD/ML behavior of the different types of waste rock at Deposit 1.</p> <p>3. Site based methods for identification of ARD/ML</p> <p>Baffinland indicated that site based methods for identification of ARD/ML will be determined in consideration of the afore-mentioned aspects and would likely include a range of techniques (e.g. potentially paste pH, total S, Non-PAG pH). Regardless these techniques need to be supported by appropriate correlations and degrees of uncertainty.</p> <p>The ARD/ML criteria has been updated, however there still remains the issues with the 0.2% total sulphur cut-off for identification of Non-PAG waste rock and there does not appear to be incorporation of any degrees of uncertainty in the Geochemistry Memorandum of the Waste Rock Management Plan.</p> <p>4. Design and operation of the WRF pond</p> <p>In addition CIRNAC reviewed the Water Balance Technical Memorandum supporting the updated Waste Rock Management Plan and has the following clarification questions related to the design and operation of the WRF pond:</p> <ul style="list-style-type: none"> • Baffinland should confirm if the 65,000 m³/month inflow indicated in the Memorandum was the total monthly accumulation or it included any release via the water treatment plant. • Baffinland should confirm if there is sufficient contingency within the pond, to prevent the potential of uncontrolled/untreated discharge to the environment if treatment is ineffective or a longer retention time in the pond is required. |
| Recommendation / Request | <p>To assess the potential significant adverse effects associated with ARD/ML, CIRNAC recommends that Baffinland:</p> <ul style="list-style-type: none"> • Demonstrate the origin of the soluble sulphates, estimate possible spatial extent and a tonnage estimate of waste rock containing significant soluble sulphates. • Demonstrate that waste rock associated with the greater life of mine deposit |



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| | <p>does not have significant soluble sulphate content.</p> <ul style="list-style-type: none"> • Provide further justification for the retention of 0.2% total sulphur cut-off threshold for identification of Non-PAG waste rock and using NPR of 2 as a cut-off for PAG identification considering the absence of Calcium / Magnesium carbonate mineral content. • Provide information on the variation and uncertainty in ARD/ML behavior of the different types of waste rock. • Develop effective criteria for identification of potentially acid generating rock following industry best practice and incorporate these criteria in an updated Waste Rock Management Plan and Interim Closure and Reclamation Plan. • Confirm adequate capacity of the WRF pond, including the sufficient contingency within the pond to prevent a potential of uncontrolled/untreated discharge to the environment. |
|--|---|



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ECCC File: 6100 000 011/001
NIRB File: 08MN053



February 6, 2020

via online registry

Tara Arko
Director, Technical Services
Nunavut Impact Review Board
P.O. Box 1360
Cambridge Bay, NU X0B 0C0

Dear Tara Arko:

**RE: 08MN053 – Baffinland Iron Mines Corporation – Mary River Project – Phase 2
Proposal Additional Technical Comments**

Environment and Climate Change Canada (ECCC) has reviewed the additional information submitted to Nunavut Impact Review Board (NIRB) regarding the above-mentioned Phase 2 Proposal. This additional information refers to the information provided by Baffinland Iron Mines Corporation (the Proponent) during and after the adjourned final hearing held November 2-6, 2019. This includes the Phase 2 Proposal Updated Information Package, presentations submitted at the hearing and documents provided by way of commitments following the hearing.

This letter and the attached Additional Technical Comments Submission provides ECCC's specialist advice is based on our mandate pursuant to the *Canadian Environmental Protection Act*, the pollution prevention provisions of the *Fisheries Act*, the *Migratory Bird Convention Act* and the *Species at Risk Act*.

If you would like more information, please contact Gabriel Bernard-Lacaille at (867) 669-4746 or Gabriel.Bernard-Lacaille@Canada.ca

Sincerely,


Andrea McLandress
Regional Director

Attachment:

cc: John Olyslager, Acting Head, Environmental Assessment North (NT and NU)





ENVIRONMENT AND CLIMATE CHANGE CANADA'S ADDITIONAL TECHNICAL SUBMISSION TO THE NUNAVUT IMPACT REVIEW BOARD

RESPECTING THE MARY RIVER PROJECT – PHASE 2 PROPOSAL (08MN053) BY BAFFINLAND IRON MINES CORPORATION

February 6, 2019



Executive Summary

Baffinland Iron Mines Corporation (the proponent) is proposing an expansion to its existing Mary River Project (the Project), known as the Phase 2 Proposal. The Project is located on Baffin Island, Nunavut. The Phase 2 Proposal includes an increase in iron ore production along the northern transportation corridor to 12 million tonnes per year (Mtpa). To accommodate this increase, the proponent proposes to construct and operate a 110 km railway from the Mine Site to the port facilities at Milne Inlet, as well as expand the port facilities to accommodate 'Cape Size' vessels and expand the mine camp. The Phase 2 Proposal is a tiered approach, where the increase in production to 12 Mtpa and transportation via the northern transportation corridor will lead to the development of the southern transportation corridor via Steensby Inlet. Steensby Inlet is currently approved for an iron ore production of 18 Mtpa. The total authorized production of the mine would be 30 Mtpa once both railways are operational.

Environment and Climate Change Canada (ECCC) has participated in the environmental impact assessment review process by providing specialist advice to the Nunavut Impact Review Board (NIRB). This current additional technical comment submission is in addition to our September 2019 Final Submission. It provides a review of materials provided during and after the final hearing, adjourned in November 2019.

This additional technical submission summarizes the results of ECCC's technical review of the proponent's recent black carbon significance determination, and of the Phase 1 Waste Rock Management Plan. ECCC provides the following technical comments pertaining to the Phase 2 Proposal and its potential impacts on air quality and water quality. Specifically, ECCC comments and recommendations pertain to the following:

- The submission by the proponent of a detailed rationale on how black carbon emissions related to marine vessels is not a significant impact and their consideration of mitigation measures which had been suggested by Canada to the International Maritime Organization.
- A revision to the general definition of Potentially Acid Generating (PAG) rock.
- A modification to the waste rock characterization protocol, such as assessing a wider range of samples without relying on the 0.2 wt. % Sulphur(S) cut off and that samples be submitted for Acid Base Accounting and Shake Flask Extraction.
- Using criteria other than sulphide content to classify PAG and non-Acid Generating (AG) rock.
- Verify if there are layers that are not frozen within the waste rock facility.
- Clarification on the thickness of the rock cover proposed for the waste rock facility closure
- Clarification on the potential treatment or mitigation of high levels of sulphate in water from the ditch, pond and runoff of the waste rock storage facility.

List of Abbreviations

| | |
|--------|--|
| ABA | Acid Base Accounting |
| AMAP | Arctic Monitoring and Assessment Programme |
| AQNAMP | Air Quality and Noise Abatement Management Plan |
| ARD | Acid Rock Drainage |
| CEPA | <i>Canadian Environmental Protection Act</i> |
| DFO | Fisheries and Oceans Canada |
| ECCC | Environment and Climate Change Canada |
| ERP | Early Revenue Phase |
| FEIS | Final Environmental Impact Statement |
| HFO | Heavy Fuel Oil |
| IMO | International Maritime Organizations |
| MBCA | <i>Migratory Birds Convention Act</i> |
| MDMER | <i>Metal and Diamond Mining Effluent Regulations</i> |
| ML | Metal Leaching |
| Mtpa | Million Tonnes Per Year |
| NAG | Non-Acid Generation |
| Non-AG | Non Acid Generation |
| NP/AP | Neutralization Potential/Acid Potential |
| NIRB | Nunavut Impact Review Board |
| NTI | Nunavut Tunngavik Incorporated |
| PAG | Potentially Acid Generating |
| SARA | <i>Species at Risk Act</i> |
| SFE | Shake Flask Extraction |
| WRF | Waste Rock Facility |
| WRMP | Waste Rock Management Plan |

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1.0 Introduction

Baffinland Iron Mines Corporation (the proponent) is proposing an expansion to its existing Mary River Project (the Project), known as the Phase 2 Proposal. The Project is located on Baffin Island, Nunavut, near the community on Pond Inlet. The Phase 2 Proposal consists of an expansion of the Project infrastructure, as well as an increase in iron ore production and transportation along the northern transportation corridor. The proposed increase would see the mine's production increase from 4.2 to 12 million tonnes per year (Mtpa) via the northern transportation corridor. The Phase 2 Proposal is a tiered approach, where the increase in production to 12 Mtpa and transportation via the northern transportation corridor will lead to the development of the previously approved southern transportation corridor via Steensby Inlet. Steensby Inlet is currently approved for an iron ore production of 18 Mtpa (the 'Approved Project'). The total authorized production of the mine would be of 30 Mtpa once both railways are operational.

To accommodate the increase to 12 Mtpa, the proponent proposes to construct and operate a 110 km railway in the northern transportation corridor from the Mine Site to the port facilities at Milne Inlet. Further, the increase in production requires an expansion of the port facilities, which would include the construction of a second dock with the ability to receive 'Cape Size' vessels. The shipping season would then be extended in order to cover from July 1 to November 15. The mine camp would also need to be expanded in order to accommodate a peak of 1050 workers during the construction period of the Phase 2 Proposal.

The Phase 2 Proposal builds upon the Early Revenue Phase (ERP) and "original" Mary River Project. The Mary River Project was approved in 2012, and consisted of a southern transportation corridor (including a railway) to transport up to 18 Mtpa of iron ore through Steensby Inlet with year-round shipping (the Approved Project). In 2014, the ERP was approved to permit the production of up to 4.2 Mtpa of iron ore that would be transported from the Mine Site via the Tote road and shipped via Milne Inlet. The ERP was approved in October 2018 to temporarily increase the iron ore production to 6.0 Mtpa until December 31, 2019.

On October 12, 2018, the Nunavut Impact Review Board (NIRB) initiated the technical review of the Final Environmental Impact Statement (FEIS) Addendum for the Phase 2 Proposal. ECCC participated in the final hearing held in Iqaluit November 2 to 6, 2019. This hearing was adjourned on November 6 following the consideration of a motion put forward by Nunavut Tunngavik Incorporated (NTI). In December, NIRB confirmed it had decided to suspend the continuation of the hearing for several months in order to accommodate another in-person Technical Meeting, Pre-Hearing Conference and Community Roundtable. These meetings will be held in Iqaluit in March 16 to 25, 2020. The additional technical meeting and Community Roundtable provide opportunities for parties to submit additional technical comments as part of review process.

This submission summarizes the results of ECCC's technical review of the additional information provided to us during and after the adjourned Final Hearing held in Iqaluit November 2 to 6. ECCC is

providing additional technical comments in regards to the Phase 1 Waste Rock Management Plan, and in regards to Black Carbon.

A summary of ECCC's mandate and legislation is provided in Section 2.0. ECCC's technical comments and recommendations are provided in Section 3.0. These technical comments are based on our technical review of proponent's information provided to date, including commitments made by the proponent throughout the review process, additional information provided by the proponent after the Technical Meetings and ongoing discussions with the proponent throughout this process.

2.0 Environment and Climate Change Canada's Mandate, Roles and Responsibilities

The mandate of ECCC is determined by the statutes and regulations under the responsibility of the Minister of Environment and Climate Change. ECCC's mandate covers matters such as the preservation and enhancement of the quality of the natural environment (including water, air and soil quality and the coordination of the relevant policies and programs of the Government of Canada), renewable resources (including migratory birds and other non-domestic flora and fauna), meteorology, and the enforcement of rules and regulations. ECCC's specialist advice is provided in the context of the Canadian Environmental Protection Act (CEPA), the pollution prevention provisions of the *Fisheries Act*, the *Species at Risk Act* (SARA), and the *Migratory Birds Convention Act* (MBCA).

ECCC administers the pollution prevention provisions of the *Fisheries Act*, which prohibits the deposit of a deleterious substance into fish-bearing waters. ECCC also participates in the regulation of toxic chemicals and the development and implementation of environmental quality guidelines pursuant to CEPA.

ECCC is responsible for protecting and conserving migratory bird populations and individuals under the MBCA. ECCC also administers SARA in cooperation with Fisheries and Oceans Canada (DFO) and the Parks Canada Agency, in order to prevent wildlife species from becoming extirpated or extinct, provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity and to manage species of special concern to prevent them from becoming threatened, endangered or extirpated.

Additional information on ECCC's mandate can be found at: <https://www.canada.ca/en/environment-climate-change/corporate/mandate.html>.

3.0 Environment and Climate Change Canada's Technical Review Comments

This submission summarizes the results of ECCC's technical review of the additional information provided to us during and after the adjourned Final Hearing held in Iqaluit November 2 to 6. The newly reviewed information was presented in the proponents Atmospheric Assessment presentation materials provided to parties during the final hearing, even though the presentation was not given prior to the adjournment of the hearing. ECCC has also reviewed the Phase 1 Waste Rock Management Plan (WRMP) provided December 31, 2019.

Section 3.1 outlines the current status of ECCC's comments provided during the final hearing, identifying comments that have been resolved and those that remain outstanding.

3.1 Prior Final Hearing Comments Status

ECCC's prior Final Submission was submitted to NIRB on September 23, 2019. A portion of ECCC's final comments were addressed in the proponents Final Written Comment Responses submitted to the NIRB on October 15, 2019. Remaining comments were discussed with the proponent prior to the final hearing, and the proponent provided commitments to ECCC in order to resolve these issues. See Table 1 below for a summary of prior comments and their resolution. The Proponent committed to either updating and implementing existing documents, such as management plans or the Project Certificate, or providing additional information after the final hearing for ECCC to review.

Table 1. Current status of all of ECCC's prior Final Comments submitted to the NIRB on September 23, 2019.

| ECCC No. | Topic | Current Status | Notes |
|----------|---|----------------|--|
| ECCC-FC1 | Canadian Ambient Air Quality Standards and Reporting of Monitoring Data | Resolved | Proponent responses to comments was sufficient. Commitment to update existing AQNAMP and open to Project Certificate modification. |
| ECCC-FC2 | Nitrogen Dioxide, Power Generation, and Mobile Equipment Engine Tier | Resolved | Proponent responses to comments was insufficient. Proponent committed to additional investigation to be reported in the 2020 annual Air Quality Report. |
| ECCC-FC3 | Air Quality and Noise Abatement Management Plan | Resolved | Proponent responses to comments was sufficient. Commitment to update existing AQNAMP and open to Project Certificate modification. |
| ECCC-FC4 | Black Carbon Emissions | Resolved | Proponent responses to comments was insufficient. Proponent committed to additional investigation to be reported in the 2020 annual Air Quality Report. This investigation will include the possibility of |

BAFFINLAND IRON MINES CORPORATION'S MARY RIVER PROJECT – PHASE 2 PROPOSAL (08MN053)
Environment and Climate Change Canada
Additional Technical Comments Submission to the Nunavut Impact Review Board

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| | | | using distillate fuels as a mitigation measure for black carbon. |
| ECCC-FC5 | Acid Rock Drainage and Metal Leaching at the Waste Rock Pile, Quarries and Rail Line Rock Cuts | Partially-resolved – Phase 1 Waste Rock Management Plan currently under review | Proponent responses to comments were previously insufficient, because parties were awaiting the Phase 1 Waste Rock Management Plan. This plan was subsequently submitted in December 2019, and has been reviewed for this current submission. |
| ECCC-FC6 | Arctic Diesel Fuel Spill Modelling | Resolved | Proponent responses were sufficient. |
| ECCC-FC7 | Shipping in the Northwest Passage | Resolved | Proponent responses were sufficient. |

3.2 Additional Technical Comments

The technical comments outlined in this section pertain to additional information submitted during or after the public hearing. A detailed discussion of these issues, along with ECCC's recommendation is included below.

3.2.1 ECCC-1: Proponent's Black Carbon Significance Determination

Reference(s):

- AMAP Assessment. 2015: *Black carbon and ozone as Arctic climate forcers*. Arctic Monitoring and Assessment Programme (AMAP), Oslo, Norway. vii + 116 pp.
- Baffinland Iron Mines Corporation. 2019. Technical Memo – Black Carbon Emissions for the Phase 2 Project (August 22, 2019).
- Bond, T. C., Doherty, S.J., Fahey, D.W., Forster, P.M., Berntsen, T., DeAngelo, B.J., Flanner, M.G., Ghan, S., Karcher, B., Koch, D., Kinne, S., Kondo, Y., Quinn, P.K., Sarofim, M.C., Schultz, M.G., Schulz, M., Venkataraman, C., Zhang, H., Zhang, S., Bellouin, N., Guttikunda, S.K., Hopke, P.K., Jacobson, M.Z., Kaiser, J.W., Klimon, Z., Lohmann, U., Schwarz, J.P., Shindell, D., Storelvmo, T., Warren, S.G., and Zender, C. 2013. *Bounding the role of black carbon in the climate system: A scientific assessment*, J. Geophys. Res. Atmos., 118, 5380–5552, doi:10.1002/jgrd.50171.
- Environment and Climate Change Canada (ECCC). 2019a. *Canada's Black Carbon Inventory Report 2013 – 2017*. 2019. Available at: http://publications.gc.ca/collections/collection_2019/eccc/En81-25-2019-eng.pdf
- ECCC. 2019b. *Environment and Climate Change Canada's final submission to the Nunavut Impact Review Board Respecting the Mary River Project – Phase 2 Proposal (08MN053) by Baffinland Iron Mines Corporation*. September 23, 2019.
- Flanner, M.G., C.S. Zender, J.T. Randerson and P.J. Rasch. 2007. *Present day climate forcing and response from black carbon in snow*. Journal of Geophysical Research: Atmospheres, 112:D11202, doi:10.1029/2006JD008003

- International Maritime Organization (IMO). 2019a. PPR 7/8. *Reduction of the Impact on the Arctic of Black Carbon Emissions From International Shipping – The need for an urgent switch to distillates for ships operating in the Arctic*. Available at: <https://www.transportstyrelsen.se/contentassets/50c7b4bb5b894a31b7892f0f379fe2db/7-8-2.pdf>
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- P. Winiger, T. E. Barrett, R. J. Sheesley, L. Huang, S. Sharma, L. A. Barrie, K. E. Yttri, N. Evangeliou, S. Eckhardt, A. Stohl, Z. Klimont, C. Heyes, I. P. Semiletov, O. V. Dudarev, A. Charkin, N. Shakhova, H. Holmstrand, A. Andersson, Ö. Gustafsson, *Source apportionment of circum-Arctic atmospheric black carbon from isotopes and modeling*. Sci. Adv. 5, eaau8052 (2019))
- Lack, 2017 – *An Update to Investigation of appropriate control measures (abatement technologies) to reduce Black Carbon emissions from international shipping (BLG17/INF.7)*, submitted by Canada to the IMO's Pollution Prevention and Response Subcommittee – 5th meeting, document number PPR 5-INF.7
- Sand, M., T. K. Berntsen, Ø. Seland, and J. E. Kristjansson. 2013. *Arctic surface temperature change to emissions of black carbon within Arctic or midlatitudes*, J. Geophys. Res. Atmos., 118, 7788–7798, doi:10.1002/jgrd.50613

Proponent's Conclusion(s):

The proponent provided hard copies of the presentations it planned to give during the course of the November Final hearing. On Slide 17 of the Atmospheric Environment presentation, it states, "*The Project's contribution to regional greenhouse gas emissions and black carbon is rated not significant.*"

The proponent reported that its shipping operations have the potential to emit 65.3 tonnes of black carbon during peak shipping when the mine output will be 30 Mtpa (consisting of 12 Mtpa from this Phase 2, plus cumulatively from the 18 Mtpa of the previously Approved Project). This is an 11% increase of the total black carbon emitted from land and marine sources in Canadian Arctic (Yukon, Northwest Territories, and Nunavut) in 2017 (Baffinland, 2019).

ECCC Comment:

Black carbon is a type of particulate matter that absorbs radiation both in the atmosphere and when it lands on surfaces such as snow. As a short-lived climate pollutant, it increases the air temperature while in the air, and contributes to Arctic warming due to the ice-albedo effect and may accelerate snow and ice melting (Bond et al., 2013; Flanner et al., 2007). The ice-albedo effect is the effect that ice and snow have on reflecting solar radiation. The albedo is the measure of how much light that hits the surface is reflected without being absorbed. Black surfaces absorb most wavelengths of light and convert them into heat, whereas white surfaces reflect most wavelengths of light so there is minimal conversion to heat. When black carbon particles settle on snow and ice, they darken the surface and

enhance absorption of solar radiation, thus increasing the temperature and the rate of melting (ECCC, 2019a).

The Arctic Council - under its Arctic Monitoring and Assessment Programme (AMAP) - concluded that a mass of black carbon emitted within the Arctic is likely to warm the Arctic several times more than the same mass of black carbon emitted outside the Arctic (AMAP, 2015). It has been found that black carbon emitted within the Arctic has been estimated to have an almost five times larger Arctic surface temperature response (per unit of emitted mass) compared to emissions at mid-latitudes (Sand et al., 2013).

Black carbon is emitted from the combustion of fuels as well as from burning of biomass (fires). The amount of black carbon emitted from the burning of fuels depends on the fuel type, fuel quality, engine design, engine load, etc. Distillate fuels result in less black carbon emissions than heavy fuel oil. A recent study concluded that 70% of the black carbon in the Arctic currently comes from fossil fuel burning in Northern countries (Winiger et al., 2019).

Table 1 presents the total black carbon emissions estimated by the proponent for peak production in year 2025 (Baffinland, 2019) and the total and marine-only black carbon emissions reported for the Canadian Arctic in *Canada's Black Carbon Inventory Report 2013 – 2017* (ECCC, 2019a). The proponent (2019) defines the Canadian Arctic as Yukon, Northwest Territories, and Nunavut. Table 2 shows percent comparisons of the proponent's estimated black carbon emissions to the total and marine-only black carbon emissions in the Canadian Arctic.

Table 1: Black Carbon Emissions (tonnes per year)

| | Baffinland Peak Production (2025, 30 Mtpa) Marine Vessel Black Carbon Emissions ^a | Total 2017 Black Carbon Emissions from the Canadian Arctic ^b | 2017 Black Carbon Emissions from Canadian Arctic Marine Vessel Sources ^c |
|--------------------|---|--|--|
| Tonnes/year | 63.5 | 574 | 41.5 |

Notes:

^a Total emissions reported by Baffinland (2019) response memo, as derived from the 12 Mtpa from this Phase 2, plus cumulatively from the 18 Mtpa of the previously Approved Project

^b Total emissions reported for 2017 from Yukon, Northwest Territories, and Nunavut. Includes all land and marine emissions reported in ECCC (2019).

^c Marine only emissions reported for 2017 from Yukon, Northwest Territories, and Nunavut (ECCC 2019a)

Based on Canada's Black Carbon Inventory Report (ECCC, 2019a), 574 tonnes of black carbon was emitted from the Canadian Arctic in 2017, including 23 tonnes from sources in the Yukon, 330 tonnes from sources in the NWT and 221 tonnes from sources in Nunavut. The sources of the black carbon emissions included marine transportation (1 tonne from Yukon, 8.5 tonnes from NWT and 32 tonnes from Nunavut; total of 41.5 tonnes in the North in 2017). Other sources of emissions include mining activities, electric power generation, and other modes of transportation.

Table 2: Percentage Comparison of Baffinland's Black Carbon Emissions to the Canadian Arctic Emissions

| | Percent <i>Increase of Total 2017 Black Carbon Emissions from the Canadian Arctic Due to Baffinland's Peak Operation in 2025</i> ^a | Baffinland's <i>Percent Increase above 2017 Black Carbon Emissions from Canadian Arctic Marine Vessel Sources</i> ^b | Baffinland's <i>Percent contribution to Black Carbon Emissions from Canadian Arctic Marine Vessel Sources</i> ^c |
|---|--|---|---|
| Percent (%) | 11 | 157 | 61 |
| Notes: ^a Baffinland (2019) Memo on Black Carbon Emissions: "The estimated total BC emissions after maximum shipping is reached, would increase the 2017 Canadian North BC emissions by 11%": This 11% is calculated as Baffinland Total / Canadian Arctic Total x 100 (65.3/574=0.11=11%) ^b The total marine emission in 2025 would be 41.5 tonnes (ECCC 2017) + 65.3 (Baffinland 2025) = 106.8 tonnes. Comparing 106.8 tonnes to 41.5 tonnes, results in 157% increase (106.8 - 41.5 / 41.5=157%). ^c The percent contribution to the total black carbon shipping emissions in 2025 is the percentage of 65.3 tonnes of the total 106.8 tonnes (Baffinland in 2025 + ECCC 2017 inventory Arctic marine sources). This 61% is calculated as Baffinland total / (Baffinland total + ECCC 2017 inventory Arctic marine sources) x100 (65.3/(65.3+41.5)=0.61=61%) | | | |

Based on the ECCC inventory (ECCC 2019a), the total black carbon estimates for the Canadian North are 574 tonnes in 2017, of which 41.5 tonnes are from marine vessels. The proponent is projecting that during maximum production years (starting in 2025), the total black carbon from the proponent's shipping components is an additional 65.3 tonnes per year of black carbon, which is approximately an additional 157% black carbon emissions from shipping in the Canadian Arctic. Similarly, after maximum shipping is reached (2025), the Project would represent 11% increase of the 2017 Canadian North black carbon emissions, and would be a 61% contribution to black carbon emissions from shipping as compared to the 2017 ECCC inventory.

As noted above, the proponent concluded that the project's contribution to regional black carbon emissions is rated as not significant. The proponent also infers that this means that they will not have a significant adverse effect on the Arctic environment. However, they have not provided the analysis or any other information that demonstrates the validity of these conclusions.

Given the sensitive nature of the Arctic and the climate impacts of increased black carbon emissions associated with project-related shipping, ECCC concludes that based on the information provided by the proponent there remains uncertainty on the magnitude or significance of the effects of the project's contribution to black carbon in the Arctic. .

During the November 2019 hearing, the proponent stated that an effect to the environment is not significant with the implementation of mitigation. For the topic of black carbon, the proponent has listed possible mitigations (Baffinland, 2019). However, as ECCC concluded in its prior September Final

Submission (ECCC, 2019b), the proponent's list of mitigations are unlikely to be effective in reducing the Project's contribution of black carbon emissions to the Canadian Arctic. The proponent's proposed mitigations have not been identified among top internationally recognized mitigation measures. Such top measures include liquefied natural gas, diesel particulate filter, Water-in-Fuel-Emulsion, scrubber, switch from Heavy Fuel Oil (HFO) to distillate, and slow steaming¹. Distillate fuels result in a reduction in black carbon emissions by at least 33% compared to HFO¹. (Lack 2017).

On January 1, 2020, new regulation on the global fuel sulphur limit under the International Maritime Organization (IMO) came into effect, including in Canada. This regulation limits the amount of sulphur in fuel oil to 0.5% sulphur. As stated at previous NIRB technical meetings, this regulation does not act to reduce black carbon emissions. In response to the new sulphur regulation, industry has come up with options including but not limited to, installing scrubbers or using new blended fuels. The proponent has stated that "[scrubber] technology may not be required in the long term, and that its value from an economic and environmental stand point is uncertain" (Baffinland, 2019).

In November 2019, after the November Final Hearing, a new study (by a consortium under contract to the German government) was submitted to the IMO regarding these new blended fuels. This study indicates that some new fuel blends created to comply with the 0.5% Sulphur requirement will result in a significant increase in black carbon emissions relative to the prior fuel blends. Specifically, these can contain high proportions of aromatic compounds, which result in a 10-85% increase in black carbon emissions when compared to conventional HFO (IMO, 2019a and IMO, 2019b). If the Project vessels are to use these new higher aromatic blended fuels to comply with the sulphur limit then there is the potential for Baffinland's emissions of black carbon to be higher than calculated in Baffinland's 2019 memo. Therefore, the proponent's black carbon estimates may be underestimated.

Recommendation:

As per Table 2 data above, and according to the proponent's estimates, at peak production (12 Mtpa from this Phase 2 Project, plus the 18 Mtpa from the previously Approved Project) the Project will contribute a high proportion of the total black carbon emissions in the Canadian Arctic.

ECCC recommends that the proponent provide further description and analysis on how they came to the conclusion that the emissions of black carbon from Project-related marine vessels is not a significant impact.

Given the sensitive nature of the Arctic, ECCC also recommends that the proponent consider using black carbon mitigation measures as suggested by Canada to the IMO (Lack, 2017). For example, the proponent could consider low aromatic distillate fuels, or other alternative low aromatic fuels.

¹ Lack, 2017: "An update to investigation of appropriate control measures (abatement technologies) to reduce Black Carbon emissions from international shipping"

3.2.2 ECCC-2: Potentially Acid Generating Rock Definition

References

- Baffinland Iron Mines Corporation. 2019. Phase 1 Waste Rock Management Plan Rev 2, Section 3 Definitions.

Proponent's Conclusion(s)

The proponent has provided the following definition for Potentially Acid Generating (PAG) rock:

“Potentially acid generating (PAG): rock-containing minerals, which potentially can produce acid or acidic water, with a total sulphur content greater than 0.2 wt% as S [Sulphur].”

ECCC's Conclusion(s)

The generally accepted definition of PAG rock does not contain the percentage of sulphide minerals content (wt% as S). PAG rock is defined as a rock that, when oxidized by surface weathering, may form acid that can then leach metals. PAG rock can also be defined as rock with a neutralization potential/acid potential (NP/AP) ratio of less than 2, determined by static tests, as defined by Mine Environment Neutral Drainage (2009). PAG rock can also be defined operationally based on the results of static testing such as Acid Base Accounting (ABA) and Non-Acid Generating (NAG) testing.

ECCC's Recommendation(s)

ECCC recommends that the proponent revise the definition of PAG rock.

3.2.3 ECCC-3 Waste Rock Characterization

References:

- Baffinland Iron Mines Corporation. 2019. Phase 1 Waste Rock Management Plan Rev 2, Section 6 Waste Rock Characterization, 6.1 and 6.2 Deposit Geology and Geochemical Sampling Program.
- Golder Associates. 2019. Phase 1 Waste Rock Management Plan Rev 2, Appendix A : Waste Rock Management Plan Report for 2020 to 2021, Section 4.0 Waste Rock Characterization and Geochemistry Review.

Proponent's Conclusion(s)

The proponent included samples of drill cuttings from the boreholes used for blasting (“blastholes”) in the open pit in order to expand the geochemical database for samples with total sulphur slightly above and below 0.2 wt% as S in the 2019 geochemistry program. The inclusion of the borehole drill cuttings was done to assess the presence of soluble sulphate minerals in material with low total sulphur to inform the current waste rock segregation criteria.

The proponent goes on to state that the geochemical results suggest that the overall existing waste rock pile design and placement, as presented in the December 2018 WRMP (Golder, 2018b), remains valid for the purpose of reducing potential for acid rock drainage (ARD) and metal leaching (ML), provided that the non-acid generating (Non-AG) material does not contain stored acidity. However, the proponent also recognizes that stored acidity within the waste rock pile is related to localized conditions in the ore currently mined in Deposit 1:

“The geochemistry of the current WRF may be localized within the current area of Deposit 1. Stored acidity, particularly within material currently classified as Non-AG waste rock, appears to be primarily within the current Deposit 1 area and the potential appears to decrease based on available historical data”.

The proponent also indicated that

“7% of the 2019 geochemical samples with less than 0.20 wt% as S total sulphur had acidic pH values (<6) in either the paste pH from ABA or final pH from SFE.”

In appendix A of the WRMP, it is stated that:

“when applied to the current dataset, the addition of paste pH to the PAG classification criteria would reduce the amount of low sulphur, Non-AG waste rock with potential to release stored acidity to less than 2% of the samples tested (1 of 55 samples)”.

ECCC's Conclusion(s)

The proponent's above conclusions suggest that based on the classification method selected and the test conducted on potential samples, between 2 and 7% of the non-AG materials placed into the waste rock pile could be PAG.

ECCC suggests that the proponent consider assessing all samples rather than using the 0.2 wt. % S criteria to segregate waste rocks samples as stated in section 6.2. This would alleviate potential bias caused by using only samples near the 0.2 wt. % S.

ECCC has concluded that stored acidity and localized ARD and ML activities within the current waste rock facility is due to misclassification of PAG as non-AG rock. ECCC notes that even when the quantities of soluble sulphate to produce ARD and ML are predominately constrained to material with a total sulphur content greater than 0.20 wt. % as S, this does not mean that materials with less than 0.2 wt. % of S will not produce ARD/ML. This is the case where there is not enough neutralization potential (materials) to neutralize the acid. The fact that 7% of the 2019 geochemical samples with less than 0.20 wt. % as S total sulphur had acidic pH values (<6) in either the paste pH from ABA or final pH from SFE, means that the 0.2 wt% as S cut off for Sulphur is not adequately segregating materials that have potential to generate acid.

A wider range of samples could be assessed to alleviate the possibility that up to 7% of samples could be misclassified using the 0.2 wt % as S cutoff and therefore reduce the risk for stored acidity hotspots within the waste rock facility.

Table 1 from Appendix A, Waste Rock Management Plan Rev 2 also indicates that even with the additional paste pH test, 1 out of 55 samples may be misclassified as non-AG rock. Hence, even with the addition of the paste pH test, about 2% of the entire waste rock could have been misclassified as non-AG. There is also no indication what the results (% misclassification) would be if the cut off is reduced to 0.1 wt % as S or less.

ECCC supports the recommendation by Golder Associates Ltd, submitted by the proponent, that:

“In addition to altering the PAG classification criteria, it is also recommended that supplemental blast hole samples of both PAG and Non-AG material be submitted for ABA and SFE testing on an ongoing basis opposed to the current practices of ABA analysis of PAG samples only”

and

“The supplemental samples should be representative of the material mined, including a representative range of sulphide content. A frequency of 10 samples per month (five of each PAG and Non-AG) is recommended through 2020 with the results and sample frequency reviewed on a six-month basis.”

The adoption of these recommendations would allow the proponent to develop a comprehensive geochemical database for the waste rock, and to diminish or eliminate the risk of PAG rock misclassification.

ECCC's Recommendation(s)

ECCC recommends that:

- the proponent assess all samples with Acid Base Accounting (ABA) and Shake Flask Extraction (SFE);
- the proponent assess a wide range of samples without relying on the 0.2 wt. % S cut off, in order to ensure that no PAG rock is misclassified as non-AG rock and
- the Proponent adopt Golder's recommendation that all samples be submitted for ABA and SFE testing on an ongoing basis.

3.2.4 ECCC-4: Thermal Assessment of the Waste Rock Pile

References

- Baffinland Iron Mines Corporation. 2019. Phase 1 Waste Rock Management Plan Rev 2, Section 7 Thermal Assessment
- Golder Associates. 2019. Phase 1 Waste Rock Management Plan Rev 2, Appendix A : Waste Rock Management Plan Report for 2020 to 2021, Section 5.0 Thermal Assessment

Proponent's Conclusion(s)

A thermal assessment was undertaken to characterize the freezing patterns of deposited waste rock and to assess the Waste Rock Facility (WRF) thermal performance. A thermal model was run to assess the time that it takes for waste rock placed during summer and the subsequent winter to freeze back. The proponent's main conclusions from the thermal assessment are as follows:

- *“Review of data obtained from the site thermistors indicate that the WRF is almost entirely frozen, with exception of a 2- 3m thick active zone subject to seasonal freeze and thaw cycles.*
- *Temperatures within the WRF are affected not only by air temperature, but also potentially by airflow, air convection and by internal heat generation connected to airflow through the WRF and variation in the geochemical behavior of the waste rock. Progressive increase in air temperatures slowly impacts ground temperature, while airflow and/or internal heat generation lead to sudden, localized and temporary variations in temperatures.*
- *Results from thermal models suggest that between 5 m and 7m of waste rock could be placed in summer and the entire thickness of material would freeze during the following winter, assuming the summer placed material was not covered over during the winter. However, depending on the existence of heat sources within the WRF, a 7 m thick waste rock summer deposition could cause the development of a thawed zone in portions of waste rock previously deposited. Limiting the thickness of summer placed waste rock to 5 m would reduce the risk of creating a thawed zone at depth within the WRF.*
- *If no internal heat source is present, the models indicate that the entire waste rock layer deposited in summer would freeze within a year, with or without additional deposition of waste rock in winter and the extent of the thawed zone in the interior of the pile would be very limited.”*

As part of their modelling, the proponent conducted field work and installed thermistors inside the waste rock pile to obtain temperatures measurements. The readings from the thermistors showed that abrupt and localized temperatures changes were observed in the waste rock pile.

ECCC's Conclusion(s)

The proponent's conclusions from modelling and thermistor readings would indicate that internally, some portions of the WRF are not frozen due to possible hot spots within the WRF. These hot spots could have arisen because of misclassification of PAG as non-AG by using the 0.2 wt % as S cut-off. Sulphide oxidation is an exothermic reaction that generates heat. The generation of heat within the waste rock facility occurs when PAG rock is misclassified as non-AG rock. ECCC assumes that this is likely what was meant by the proponent when they referred to “*existence of heat sources within the WRF*”.

ECCC's Recommendation(s)

ECCC recommends that the proponent:

- not use sulphide content only to classify Potentially Acid Generation and non-Acid Generating rock;
- verify whether there are layers of the lifts that are not frozen within the Waste Rock Facility.

3.2.5 ECCC 5 Waste Rock Facility Closure

Reference:

- Golder Associates. 2019. Phase 1 Waste Rock Management Plan Rev 2, Appendix A : Waste Rock Management Plan Report for 2020 to 2021, Section 10.3 WRF Closure

Proponent's Conclusion(s)

In section 10.0 WRF Development Strategy, the proponent noted that stockpile exterior faces would have PAG waste rock placed at a minimum 4 m under a non-AG rock cover. The placement of PAG rock under 4 m of non-AG cover was recommended by Golder until more data points are obtained to define the permafrost active zone. Section 10.3, of the WRF Development Strategy mentions that the non-AG out layer during closure could be up to 50 m thick to ensure that the interior of the WRF remains frozen year-round.

ECCC's Conclusion(s)

Given the statements in sections 10.0 and 10.3 of the WRF Development Strategy, it is not clear whether the proposed cover thickness over PAG rock would be 4 m or 50 m.

ECCC's Recommendation(s)

ECCC recommends that the proponent provide clarification on the thickness of the cover proposed in the waste rock facility closure.

3.2.6 ECCC-6 Sulphate concentrations in discharge

References

- Baffinland Iron Mines Corporation. 2019. Phase 1 Waste Rock Management Plan Rev 2, Appendix A4 Water Quality Memorandum & Appendices A-E – Water Quality Data

Proponent's Conclusion(s)

The proponent provided water quality data measurements from 2019 in table format in Appendices A-D, and Water Quality Modeling Results in Appendix E. Measured values for sulphate were as high as 72,187 mg/L in waste rock facility runoff and up to 3654 mg/L in the pond. Sulphate concentrations are modeled to average 3429 mg/L in 2019/2020 in the effluent. Appendix E presents predictions, but the table does not have a title which indicates what the predictions represent. Based on the text on page 11 of Appendix A4 Water Quality Memorandum it appears that these numbers represent runoff quality from the WRF with precipitation of metals taken into account. It's unclear if they are post-treatment, given that they are compared to the *Metal and Diamond Mining Effluent Regulations* (MDMER).

ECCC's Conclusion(s)

Current water quality measured in the ditch, pond and runoff have high levels of sulphate which for some species could be considered high enough to cause acute toxicity. Clarification on potential treatment and mitigation options for sulphate are required, as well as clarification on the predictions table from Appendix E.

ECCC's Recommendation(s)

ECCC recommends that the proponent provide clarification on potential treatment or mitigation measures for high sulphate, given the high levels of sulphate measured in the Waste Rock Facility in 2019 and given the use of ferric sulphate in the currently used treatment process.

4.0 Acknowledgements

ECCC thanks the NIRB for this opportunity to provide input to the review process for the Mary River Project – Phase 2 Proposal (08MN053) and looks forward to continuing its participation in this process.

5.0 End Note

ECCC's technical review comments and recommendations are not to be interpreted as any type of acknowledgement, compliance, permission, approval, authorization, or release of liability related to any requirements to comply with federal or territorial statutes and regulations.



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NIRB File : 08MN053
DFO File : 07-HCAA-CA7-00050

Nunavut Impact Review Board
Attention: Tara Arko, A/Director Technical Services
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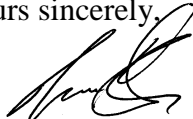
Dear Tara Arko,

Subject: Baffinland Iron Mines Corporation (Baffinland) Mary River “Phase 2 Development” Project Proposal (NIRB File No: 08MN053) – Updated Technical Comments

Fisheries and Oceans Canada - Fish and Fish Habitat Protection Program (DFO-FFHPP) has conducted a technical assessment of Baffinland Iron Mines Corporation's updated documentation related to the Mary River “Phase 2 Development” Project Proposal. DFO-FFHPP is providing updated technical comments in response to Baffinland's updated Phase 2 documentation, as directed by the Nunavut Impact Review Board's (NIRB) Record of Proceedings and Disposition of Motions Report, dated December 16, 2019.

DFO-FFHPP's assessment and recommendations are based on our departmental mandate under the *Fisheries Act*, specifically the management and protection of fish and their habitat in both the freshwater and marine environments.

If you or any other parties have any questions, please contact Laura Watkinson at 867-669-4920, or by email at Laura.Watkinson@dfo-mpo.gc.ca. Please refer to the file number referenced above when corresponding with the Program.

Yours sincerely,


C. Thomas Hoggarth
Regional Director – Ecosystems Management
Central and Arctic Region
Fisheries and Oceans Canada

Cc: Alexandra Sorckoff – FFHPP Biologist, DFO
Laura Watkinson – Senior FFHPP Biologist, DFO
Alasdair Beattie – Team Lead, DFO
Stephanie Martens – Regional Manager, DFO
Martyn Curtis – Director, Fish and Fish Habitat Protection and Species at Risk



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Updated Technical Comments

Baffinland Iron Mines Corporation
Mary River “Phase 2 Development” Project Proposal

Submitted to: Nunavut Impact Review Board

February 6, 2020

DFO File No.: 07-HCAA-CA7-00050

NIRB File No.: 08MN053

Canada 

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Executive Summary

The Mary River "Phase 2 Development" Project proposal (the Project) proposes a modification to an approved iron ore mine operated by Baffinland Iron Mines Corporation (Baffinland or the Proponent) located on Baffin Island approximately 100 km south of Pond Inlet, Nunavut within the Qikiqtani Region of Nunavut. The Project is focused on an increase in production to 12 Mpta (million Tonnes per annum), the transportation of ore to Milne Port via the construction of a new railway running largely parallel to the existing Tote Road, and the construction and operation of a second ore dock which will support increased shipping activities.

On behalf of Fisheries and Oceans Canada (DFO), the Fish and Fish Habitat Protection Program (FFHPP) has reviewed the application and supporting documents related to the Project, as it relates to the departmental mandate under the *Fisheries Act*, to maintain the sustainability and ongoing productivity fisheries, including marine mammals and their habitat. DFO-FFHPP's primary focus of this review was to ensure that works, undertakings and activities are conducted in compliance with the applicable provisions of the *Fisheries Act*.

The fish and fish habitat protection and pollution prevention provisions of the *Fisheries Act* (2019), specifically subsections 34.4(1) and 35(1), state that "*No person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish*" and "*No person shall carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat.*" However, under paragraphs 34.4(2)(b) and 35(2)(b) of the *Fisheries Act*, the Minister of Fisheries and Oceans may issue an authorization with terms and conditions in relation to a proposed work, undertaking or activity that may result in death of fish or the harmful alteration, disruption or destruction (HADD) of fish habitat.

Fisheries and Oceans Canada, in partnership with Inuit, Parks Canada, Transport Canada, and the Government of Nunavut is, under Schedule 1 of the *Canada National Marine Conservation Areas Act*, in the process of establishing Tallurutiup Imanga National Marine Conservation Area (Tallurutiup Imanga NMCA) in Lancaster Sound; The Act, and the Tallurutiup Imanga Inuit Impact and Benefit Agreement, provide the foundation for the framework under which Tallurutiup Imanga NMCA will be managed. Key elements include: Tallurutiup Imanga NMCA must be "protected and conserved" (s. 4(1), CNMCAA; p. 4, IIBA), Tallurutiup Imanga NMCA must be "managed and used in a sustainable manner that meets the needs of present and future generations without compromising the structure and function of the ecosystems" (s. 4(3), CNMCAA; p. 4, IIBA), and the "principles of ecosystem management and the precautionary principle" will be a primary consideration (s. 9(3), CNMCAA; p.4, IIBA). Tallurutiup Imanga NMCA is approximately 108,000 km² in size and includes the waters of Eclipse Sound, Milne Inlet (excluding Milne Port), Navy Board Inlet, and Pond Inlet. Parks Canada, Qikiqtani Inuit Association, Fisheries and Oceans/Canadian Coast Guard, Transport Canada, and Environment and Climate Change Canada/Canadian Wildlife Service and other partners will continue to work together to achieve the purpose and management objectives of Tallurutiup Imanga NMCA.

DFO-FFHPP is providing the following final submission in response to the Nunavut Impact Review Board's (NIRB) correspondence dated July 25, 2019.

DFO Recommendations:

Marine Mammals

DFO suggests that shipping during the shoulder seasons and ice-breaking may have serious implications for marine mammals. Icebreaking activities particularly during the shoulder seasons may impede the formation of ice across the inlets (e.g., ice type, lack of formation, rubble) and result in narwhal ice entrapments during the fall migration. Icebreaking may also negatively impact marine mammals by causing displacement, separation of mothers and pups, vessel-seal collisions, and crushing of seals by moving sea ice. The large number of vessels transiting from the Milne Port and those awaiting entry may deter whales from entering Eclipse Sound. Spring icebreaking could result in a change in migratory patterns and lead to a lack of immigration into the area. Based on the information provided by Baffinland to date it is still unclear when shipping season begins and ends, and, there is not sufficient data from literature or the current monitoring efforts to support their conclusions that effects from ice breaking will be not significant. Further, marine acoustic noise will have a negative impact on marine mammals.

DFO is concerned that the lack of defensible information makes the assessment of the effect of shipping on pinnipeds and cetaceans difficult and highly uncertain. As such DFO recommends that, for the time being, Baffinland maintain the current level of shipping and avoid shipping during the shoulder seasons and ice-breaking activities.

Ballast Water

The amount of ballast water to be discharged as a result of this project is estimated to be the third largest in Atlantic Canada and the fourth largest nationally. The increased number of vessels that will be continuously discharging ballast at the port will impact the physical, chemical, and biological characteristics of the marine environment (e.g., fish, fish habitat, and invertebrates). Biofouling, as well as ballast discharge, has high risk/potential to introduce non-indigenous species and aquatic invasive species. Temperature, salinity, and organisms (type and number) in both ballast water and the environment should be regularly monitored using scientifically rigorous sampling design. Monitoring will allow Baffinland to assess efficacy and risk associated with management strategies as well as ensure vessel compliance with mitigation measures.

Freshwater

DFO is of the opinion that impacts on freshwater can be mitigated. Outstanding information can be obtained during the regulatory phase, if the project is approved.

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Recommandations du MPO:

Mammifères marins

Eaux de ballast

Eau douce

1 Introduction

This updated technical comment submission summarizes Fisheries and Oceans Canada (DFO) – Fish and Fish Habitat Protection Program’s (FFHPP) assessment and recommendations concerning the Baffinland Iron Mines Corporation’s (Baffinland) Mary River Project, Phase 2 Development Proposal (the Project). The purpose of these comments is to provide expert advice to the Nunavut Impact Review Board (NIRB) regarding Baffinland’s proposed modifications and identify potential impacts to fish and fish habitat associated with the project changes.

This submission focuses on a technical assessment of the Project. The objective being to analyse the updated plans and/or revised information presented by Baffinland in support of the proposed modifications, and reflects DFO-FFHPP’s mandate.

As directed by the NIRB in their letter dated December 16, 2019, this submission provides an updated analysis of information presented by Baffinland Iron Mines Corporation (Baffinland or the Proponent) as part of the Project application, including the Project proposal and technical supporting documents.

2 Mandate, Relevant Legislation and Policy

The *Constitution Act* (1982) provides the Federal Government with exclusive authority for coastal and inland fisheries within Canada’s territorial boundaries. DFO exercises this power through, the administration of the *Fisheries Act* and some aspects of the *Species at Risk Act*. Under the *Fisheries Act*, DFO is responsible for the management, protection and conservation of fish (which include marine mammals as defined by the *Fisheries Act*) and their habitats. The Minister of Fisheries, Oceans and the Canadian Coast Guard is one of the competent ministers under the *Species at Risk Act* (SARA).

In general, DFO-Fish and Fish Habitat Protection Program (DFO-FFHPP) undertakes the review of proposed project in and around fisheries waters to ensure that works, activities and undertakings are conducted in such a way that the proponents are in compliance with the applicable provisions of the *Fisheries Act*.

Bill C-68

On February 6, 2018, the Government of Canada introduced in Parliament Bill C-68, *An Act to Amend the Fisheries Act and other Acts in Consequence*. On **June 21, 2019** the new *Fisheries Act* received Royal Assent and became law.

The Fish and Fish Habitat Protection Provisions, of the new Act, did not come into force until **August 28th, 2019**. As such this project assessment began under the older *Fisheries Act* (2012) but will be assessed in the regulatory phase under the new *Fisheries Act* (2019).

The new *Fisheries Act* (2019): As of **August 28th, 2019**, new Fish and Fish Habitat Protection Provisions (FFHPP) of the *Fisheries Act* came into force. From the provisions, there are two key prohibitions:

- **Subsection 34.4(1)** of the *Fisheries Act* (2019) prohibits the carrying on of any work, undertaking or activity, other than fishing, that results in the death of fish, and
- **Subsection 35(1)** of the *Fisheries Act* (2019) prohibits the carrying on of any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat.

The new *Fisheries Act* (2019) includes the following definitions:

- *“fish” includes (a) parts of fish, (b) shellfish, crustaceans, marine animals and any parts of shellfish, crustaceans or marine animals, and (c) the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals.*
- *“fish habitat” means water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas.*
- *“Death of Fish” means any action that results in the end of life of fish. Furthermore, No person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish.*
 - *“Work” means a physical thing that has been created through labour or the exercise of creative process that has some degree of permanency or lasting quality;*
 - *“Undertaking” means to take upon oneself a task;*
 - *“Activity” means physical task incidental to a work or undertaking as well as physical tasks that may not qualify as works or undertakings.*
- *“Harmful Alteration, Disruption and Destruction of fish habitat” is defined as follows:*
 - *Harmful alteration of fish habitat is any permanent change to fish habitat that reduces its capacity to support one or more life processes of fish but does not permanently eliminate the fish habitat.*
 - *Disruption of fish habitat is any change to fish habitat occurring for a limited period that reduces its capacity to support one or more life processes of fish for a limited period.*
 - *Destruction of fish habitat is any permanent change to fish habitat that completely eliminates its capacity to support one or more life processes of fish.*

Under paragraphs 34.4(2)(b) and 35(2)(b) of the *Fisheries Act*, the Minister of Fisheries, Oceans and the Canadian Coast Guard (the Minister) may issue an authorization with terms and conditions in relation to a proposed work, undertaking or activity that may result in death of fish or harmful alteration, disruption or destruction of fish habitat. Factors that the Minister must consider prior to recommending

to the Governor-in-Council regulations or the Minister exercising powers related to authorizations, permits, orders or Ministerial regulations include:

- (a) the contribution to the productivity of relevant fisheries;
- (b) fisheries management objectives;
- (c) whether there are measures and standards;
- (d) the cumulative effects;
- (e) any fish habitat banks;
- (f) whether any measures and standards to offset the harmful alteration, disruption or destruction of fish habitat give priority to the restoration of degraded fish habitat;
- (g) Indigenous knowledge of the Indigenous peoples of Canada that has been provided to the Minister; and
- (h) any other factor that the Minister considers relevant.

DFO-FFHPP is guided by the new “Fish and Fish Habitat Protection Program Policy Statement (2019)”. This Policy provides guidance on undertaking effective measures to offset death of fish and the harmful alteration, disruption or destruction of fish habitat, consistent with the fish and fish habitat protection provisions of Canada’s *Fisheries Act*.

The “Policy for Applying Measures and Standards to Offset Impacts to Fish and Fish Habitat Under the Fisheries Act (2019)” was prepared by DFO to provide an overview of how to apply measures and standards to offset for impacts to fish and fish habitat. Furthermore this policy is intended to support the conservation and protection of fish and fish habitat, including objectives, guiding principles and types of measures; and describes step-by-step procedures for developing an offsetting plan.

The *Species at Risk Act* (SARA) is intended to prevent Canadian indigenous species, subspecies and distinct populations of wildlife from being extirpated or becoming extinct. SARA facilitates the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity and manage species of special concern (to prevent them from becoming endangered or threatened). The Minister is the competent minister for listed aquatic species that are fish as defined in the *Fisheries Act* Section (2) and for marine plants as defined in the *Fisheries Act*, Section 47.

Environmental and Climate Change Canada (ECCC) is responsible for the administration and enforcement of the pollution prevention provisions of the *Fisheries Act*, Sections 34 and 36-42 on behalf of DFO.

For more information, see: <http://www.dfo-mpo.gc.ca/pnw-ppe/pol/index-eng.html>

3 Technical Review Comments

3.1 Marine Vessel Traffic

| | |
|------------------------------|---|
| Review Comment Number | 3.1 Vessel Traffic |
| Subject/Topic | Proposed cumulative vessel traffic and marine operations |
| References | <ul style="list-style-type: none"> • Marine Mammal Effects Assessment (TSD 24): Appendix B, Underwater Acoustic Modelling Report (entire document) • IR Responses Phase 2 Proposal – Mary River Project: DFO 3.2.1 (p. 59); Appendix 12, Overview of Marine Operations, page 4 • Draft Revised Project Certificate No. 005 for Phase 2, August 23, 2019, Project Certificate Condition No. 179a, page 87 • Final Submission – Baffinland Iron Mines Corporation Mary River “Phase 2 Development” Project Proposal, DFO, September 23, 2019 • Final Written Comment Responses Phase 2 Proposal – Mary River Project, Baffinland Iron Mines Corporation, October 15, 2019, page 39 |
| Summary | <p>In Baffinland’s responses to DFO’s information requests, on page 4 of Appendix 12, Baffinland provided the definitive numbers for vessels that were used for assessment purposes, stating:</p> <p><i>“a) 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.</i></p> <p><i>b) An estimate of 24 voyages for other vessels (e.g. wet/dry re-supply) has been considered. For resupply vessels, efforts are currently underway to increase the cubic capacity of vessels employed by BIM, meaning number of voyages might be reduced.</i></p> <p><i>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.</i></p> <p><i>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.</i></p> <p><i>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.”</i></p> |

Information provided in TSD 24, Appendix B, Section 3.2, also states: “we determined that within any 24-h period, the Northern Shipping Route (Figure 1) will be transited at most by two PP carriers (one inbound and one returning from the ore dock) for Scenarios 5-11 (Phase 2A). Once both docks are operational (Phase 2B), two additional CS carriers (one inbound and one returning from the ore dock) are expected, for a total of four carriers transiting the shipping route” (emphasis added). DFO notes contradicting information provided in the Advance Technical Comment Responses, to DFO 3.2.2: “Based on the Phase 2 Proposal shipping schedule, a maximum of two ship transits per day is anticipated” (emphasis added).

DFO notes that Baffinland has provided a ‘Revised Project Certificate No. 005 for Phase 2’ document on August 23, 2019, proposing changes to Project Certificate conditions. Baffinland requests a change to Project Certificate Condition No. 179a on page 87 as follows: “Unless otherwise approved by the NIRB, in any given calendar year, the total number of ore carriers calling on Milne Port should not exceed 176” with the rationale: “To date the quantity limits on transport in 179(a) and 179(b) have been a difficult to comply with as any overage, however minimal, is an immediate compliance issue, and b) not necessarily reflective of the environmental limits established through the relevant assessments (i.e. effects have been within predictions)” and “The proposed changes would provide clarity that Baffinland may operate at a certain level without automatically requiring a project certificate reconsideration process. Baffinland believes a maximum of 176 ore carriers will provide the operational flexibility it requires.”

In DFO’s final submission to the NIRB on September 23, 2019, DFO recommended Baffinland clarify: “The rationale for the maximum of 176 ore carrier transits.”

In Baffinland’s response to final submissions to the NIRB on October 15, 2019, Baffinland responded: “An estimated 176 ore carrier round trips was provided as an upper limit estimate in Table 2.4 of TSD 24 (provided below for reviewer reference). This table is based on a reasonable mix of vessel types calling on Milne Port between July and October to transport approximately 12 Mt [...] In these shipping schedules Baffinland has given consideration to historical ice conditions, operating experience and the need to have both predictably (i.e. start and end shipping dates) and

| | <p><i>operational flexibility to allow for contingency due to things like weather, operational malfunctions etc. [...]</i></p> <p><i>Table 2.4: Maximum Number of Ore Carrier Calls (Round-trips) at Milne Port during Phase 2 Operations</i></p> <table><tr><th><i>Vessel Type</i></th><th><i>Vessel Size</i></th><th><i>July</i></th><th><i>August</i></th><th><i>September</i></th><th><i>October</i></th></tr><tr><td><i>Total</i></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td><i>Supramax</i></td><td><i>50,000 DWT</i></td><td><i>10</i></td><td><i>5</i></td><td><i>5</i></td><td><i>10</i></td></tr><tr><td><i>30</i></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td><i>Panamax</i></td><td><i>65,000 DWT</i></td><td><i>9</i></td><td><i>45</i></td><td><i>45</i></td><td><i>34</i></td></tr><tr><td><i>133</i></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td><i>Capesize</i></td><td><i>150,000 DWT</i></td><td><i>0</i></td><td><i>6</i></td><td><i>5</i></td><td><i>2</i></td></tr><tr><td><i>13</i></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td><i>Total</i></td><td></td><td><i>19</i></td><td><i>56</i></td><td><i>55</i></td><td><i>46</i></td></tr><tr><td><i>176</i></td><td></td><td></td><td></td><td></td><td></td></tr></table> <p><i>DWT = Dead Weight Tonnage.</i></p> <p><i>Note – Above schedule assumes all shipping will occur between July and October, although the original proposal anticipated some shipping into November.”</i></p> | <i>Vessel Type</i> | <i>Vessel Size</i> | <i>July</i> | <i>August</i> | <i>September</i> | <i>October</i> | <i>Total</i> | | | | | | <i>Supramax</i> | <i>50,000 DWT</i> | <i>10</i> | <i>5</i> | <i>5</i> | <i>10</i> | <i>30</i> | | | | | | <i>Panamax</i> | <i>65,000 DWT</i> | <i>9</i> | <i>45</i> | <i>45</i> | <i>34</i> | <i>133</i> | | | | | | <i>Capesize</i> | <i>150,000 DWT</i> | <i>0</i> | <i>6</i> | <i>5</i> | <i>2</i> | <i>13</i> | | | | | | <i>Total</i> | | <i>19</i> | <i>56</i> | <i>55</i> | <i>46</i> | <i>176</i> | | | | | |
|--|--|--------------------|--------------------|------------------|----------------|------------------|----------------|--------------|--|--|--|--|--|-----------------|-------------------|-----------|----------|----------|-----------|-----------|--|--|--|--|--|----------------|-------------------|----------|-----------|-----------|-----------|------------|--|--|--|--|--|-----------------|--------------------|----------|----------|----------|----------|-----------|--|--|--|--|--|--------------|--|-----------|-----------|-----------|-----------|------------|--|--|--|--|--|
| <i>Vessel Type</i> | <i>Vessel Size</i> | <i>July</i> | <i>August</i> | <i>September</i> | <i>October</i> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Total</i> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Supramax</i> | <i>50,000 DWT</i> | <i>10</i> | <i>5</i> | <i>5</i> | <i>10</i> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>30</i> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Panamax</i> | <i>65,000 DWT</i> | <i>9</i> | <i>45</i> | <i>45</i> | <i>34</i> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>133</i> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Capesize</i> | <i>150,000 DWT</i> | <i>0</i> | <i>6</i> | <i>5</i> | <i>2</i> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>13</i> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>Total</i> | | <i>19</i> | <i>56</i> | <i>55</i> | <i>46</i> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>176</i> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Importance of issue to the impact assessment | Increased shipping has the potential to cause negative impacts to marine mammals and the marine environment. It’s important to fully understand the proposed vessel traffic at Milne Port, throughout Milne Inlet and along the shipping route, in order to adequately evaluate impacts associated with the project. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Detailed Review Comment 1. Gap/Issue 2. Disagreement with Addendum/TSD conclusion 3. Reasons for disagreement with Addendum conclusion | <p>DFO notes that Baffinland has proposed to change project certificate condition 179a. DFO agrees that changing to limiting number of ships instead of ore, will be a clearer way to track as stated by Baffinland. However, DFO is unclear how Baffinland arrived at the number of voyages at 176. DFO notes that this is only limiting ore ships and does not include other vessel traffic. DFO notes that it is important, before changing the project certificate to accommodate this revision, that this change has been adequately assessed by interveners.</p> <p>DFO acknowledges Baffinland’s response and provided rationale regarding the 176 ore carrier voyages, noting that 176 voyages is equal to 352 transits and doesn’t include other non-ore carrying vessels. DFO is concerned that what has been assessed for the majority of the Phase 2 environmental assessment, has been based on ore limitations rather than limiting transiting ships. DFO is unclear what changes this alteration will result in and requires more information to accept the changes at this late stage. Further, DFO believes that some consideration should be given to</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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| | the additional vessels not accounted for as part of “ <i>the total number of ore carriers calling on Milne Port should not exceed 176.</i> ” |
| Recommendation / Request | <p>Recommendation 3.1:</p> <p>3.1.1 DFO recommends Baffinland provide a brief review and assessment of how changing the limitation from the amount of ore to number of voyages will alter any of the provided assessments and models provided to this point in the assessment process.</p> <p>3.1.2 DFO recommends Baffinland provide consideration for vessels, in addition to ore carriers, in determining the potential for impacts due to increased production.</p> |

3.2 Marine Environment: Shipping Season

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| Review Comment Number | 3.2 Shipping Season |
| Subject/Topic | Timing of shipping in the shoulder seasons and associated assessments |
| References | <ul style="list-style-type: none"> • Ice Conditions Report (TSD 16), Appendix I: Ice navigation in the Canadian Arctic, p.1 • IR Responses Phase 2 Proposal – Mary River Project: Appendix 11, Commitment Register, Commitment 156 (p. 24 of 27); Appendix 12 (p.3, Section 4,) • DFO Technical Review Comments to the NIRB, March 2019, Technical Comment 3.3, Recommendation 3.3.1 • Baffinland Iron Mines Corporation. March 26, 2019. Technical Comment Responses, Phase 2 Proposal – Mary River Project: page 17 • Golder Associates Ltd. May 17, 2019, Assessment of Icebreaking Operations during Shipping Shoulder Seasons on Marine Biophysical Valued Ecosystem Components (VECs), page 4 & 49 • Knight-Piésold Consulting. May 17, 2019. Socio-economic Assessment of Icebreaking Operations during Shipping Shoulder Seasons: Table 2.2: Timing of Ice Events on the Northern Shipping Route • Final Submission – Baffinland Iron Mines Corporation Mary River “Phase 2 Development” Project Proposal, DFO, September 23, 2019 • Final Written Comment Responses Phase 2 Proposal – Mary River Project, Baffinland, October 15, 2019, page 41 • Baffinland Iron Mines Corporation, DFO Final Written Submission Disposition Table, received by DFO on October 31, 2019. |

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| | <ul style="list-style-type: none"> • Baffinland Iron Mines Corporation, Phase 2 Proposal Updated Information Package, Attachment 2 – Commitments and terms and condition following the Public Hearings, January 6, 2020 • In-person meeting between Baffinland and DFO on January 23, 2020. |
| Summary | <p>In relation to the proposed shipping season, Baffinland has stated: <i>“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.”</i> Further: <i>“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.”</i> Baffinland also states <i>“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)”</i> and <i>“The actual operational season will vary from year to year”</i> (IR Responses, Appendix 12, p.3).</p> <p>In determining the start and end date of the shipping season, Baffinland stated the following: <i>“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)”, which “uses a four-step process that includes defining the ice regime, obtaining ice multipliers, calculating ice numerals, and obtaining permission” and “Land Use –” ... [and]... “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”</i> (IR Responses, Appendix 12, p.3).</p> <p>In recommendation 3.3.1, from DFO’s March Technical Review Comments, DFO recommended <i>“Baffinland provide clarification on the roles that both environmental conditions and ecological factors will play in determining start and end dates for the shipping season and how will this be monitored to determine if ice-breaking in the fall season will have an impact on ice formation.”</i> Baffinland responded to this recommendation in their ‘Technical Comments Responses’ on page 17, stating: <i>“Baffinland is preparing a stand-alone effects assessment of icebreaking activities that addresses icebreaking during the shoulder seasons. This effects assessment addresses the information requested in this technical comment (DFO 3.3.1). The stand-alone icebreaking effects assessment is scheduled for delivery to the NIRB in Q1 2019, prior to the Phase 2 Proposal Technical Meetings in Iqaluit.”</i> Baffinland provided the ‘Assessment of Icebreaking</p> |

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| | <p>Operations’ and the ‘Socio-economic Assessment of Icebreaking Operations’ in May, 2019.</p> <p>Recommendation 3.4 of DFO’s final submission stated: <i>“In order for DFO to properly assess the impact of the shipping season on ice formation, DFO recommends that Baffinland provide environmental conditions and ecological factors criteria used to determine yearly opening and closing of the shipping season, along with the monitoring plan to determine if ice-breaking in the shoulder season will have an impact on ice formation and that Baffinland report annually on the determination of opening and closing the shipping season.”</i> Baffinland responded as follows: <i>“The environmental conditions present along the shipping route in terms of ice formation in the Fall are described in Section 4.3 of the Ice Study (TSD-16) for Phase 2. Mid-November is the average date that fastice has formed in Milne Inlet since 1997 and its presence would trigger the end of the shipping season from a technical (vessels receiving positive ice numerals) and environmental (commitment not to break landfast ice) perspective. Baffinland is committed to undertaking an end-of-season aerial survey of the LSA, following the end of shipping operations, to confirm no narwhal entrapment events have occurred. During this survey observations will be taken of the ship track and how it has influenced ice formation.”</i></p> <p>DFO further notes that in Baffinland’s disposition table, Baffinland further added: <i>“The following clarifications will be added to the Shoulder Season Shipping Operational Guide to reflect the environmental and ecological conditions for closing the shipping season.</i> <i>Environmental - The formation of fastice along the shipping route will trigger the end of the shipping season.</i> <i>Ecological - <u>There are no ecological triggers to close the shipping season,</u> however, monitoring and adaptive management will be applied to ensure no significant impacts occur”</i> (emphasis added).</p> |
| Importance of issue to the impact assessment | Shipping during the shoulder seasons, including ice breaking activities, has the potential to cause negative impacts to marine mammals. It’s important to fully understand when and how activities will occur over the shoulder seasons in order to adequately review impacts. |
| Detailed Review Comment Gap/Issue Disagreement with Addendum/TSD conclusion | DFO notes it’s important understand the specific criteria that will be used to inform/ Baffinland’s decision to stop and resume shipping activities in the shoulder seasons. Although Baffinland provides a summary of factors that will influence the start and close of the shipping season; DFO is still not clear what specific criteria or thresholds will be used to determine when each individual seasons begins and ends. DFO has requested |

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| Reasons for disagreement with Addendum conclusion | <p>Baffinland provide consideration to ecological factors in past submissions and notes that it remains a gap in the updated Phase 2 development plans. While ice, weather, economic and land use are considered, DFO asserts that ecological criteria are also vitally important for consideration. Ideally the decision would take into consideration ecological factors, such as key life history stages for marine mammals that utilize the ice habitat and consideration of the risk of entrapment during the freeze-up period.</p> <p>While DFO recognizes reports may be provided to the MEWG, DFO is of the opinion that Baffinland commit to annually reporting on the determination of opening and closing the shipping season and what factors were considered in this determination. DFO notes that as part of a recent meeting between Baffinland and DFO on January 23, 2020, Baffinland agreed to provide a summary of monitoring that is being completed during the opening and closing of the shipping season each year. In addition, Baffinland and DFO discussed Baffinland reporting annually on the determinations for opening and closing of the shipping season each year</p> |
| Recommendation / Request | <p>Recommendation 3.2: DFO is concerned with Baffinland's determination of the start and end of the shipping season, as the operational season can vary year-to-year. In relation to the opening and closing of the shipping season, DFO recommends Baffinland provide the following:</p> <p>3.2.1. A summary of monitoring conducted during the opening and closing of the shipping season.</p> <p>3.2.2. Consideration for marine mammal behaviours or additional ecological factors in their determination of shipping season opening and closing, such as the mentioned outmigration of narwhal, and a commitment to reporting annually on the determination of the opening and closing of the shipping season.</p> |

3.3 Marine Acoustic Modelling & Disturbances

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| Review Comment Number | 3.3 Acoustic Modelling & Disturbances |
| Subject/Topic | Acoustic modelling and impacts due to acoustic disturbance |
| References | <ul style="list-style-type: none"> Marine Mammal Effects Assessment (TSD 24): Appendix B, Underwater Acoustic Modelling Report (entire document); |

- Cumulative and Transboundary Assessment (TSD 27): Section 1.4.14 (p. 42), Section 1.4.14.3 (p.44-45)
- IR Responses Phase 2 Proposal – Mary River Project: DFO 3.2.1 (p. 59-60); Appendix 12, Overview of Marine Operations (entire document)
- Advance Technical Comment Responses Phase 2 Proposal – Mary River Project: 3.2.2 (p. 6-7)
- Golder Associates Ltd. May 17, 2019, Assessment of Icebreaking Operations during Shipping Shoulder Seasons on Marine Biophysical Valued Ecosystem Components (VECs), Figures D-31 & D-38; Appendix D, section D.2, Figures D-39 – D-76; pg. 49, p. i-ii , page 45-46, 51, 53, 71
- DFO Technical Review Comments to the NIRB, March 2019
- JASCO Applied Sciences. May 10, 2019. Technical Memorandum: Baffinland Phase 2 Acoustic Modelling: Responses to Technical Comment DFO 3.5.4; page 1.
- Knight Piésold Consulting Memorandum TSD27 – Cumulative Effects Assessment: sections 4.3.2, 4.3.3 & 4.3.4, pg. 20-23.
- Hemmera Envirochem Inc. (Hemmera). 2019. Review of the Mary River Phase 2 Assessment Conclusions on the Effects of Icebreaking to Narwhal. Project No. 103182-01. October 11, 2019.
- Final Submission – Baffinland Iron Mines Corporation Mary River “Phase 2 Development” Project Proposal, DFO, September 23, 2019, Technical Review Comment 3.7 (recommendations 3.7.2 and 3.7.4); Technical Review Comment 3.8 (recommendation 3.8.3)
- Final Written Comment Responses Phase 2 Proposal – Mary River Project, Baffinland, October 15, 2019, pages 49-52
- Final Written Comment Responses Phase 2 Proposal – Mary River Project, Baffinland, Appendix N, Attachment 2: Technical Memo Analysis of 2018 Narwhal Tagging Data during Fall Shoulder Season, October 15, 2019
- Baffinland Iron Mines Corporation, Phase 2 Proposal Updated Information Package, Attachment 2 – Commitments and terms and condition following the Public Hearings, January 6, 2020

Publications:

DFO. 2019a. Science Review of the Phase 2 Addendum to the Final Environmental Impact Statement for the Baffinland Mary River Project. DFO Can. Sci. Advis. Sec. Sci. Resp. 2019/015.

Gervaise, C., Simard, Y., Roy, N., Kinda, B., and Ménard, N. 2012. Shipping noise in whale habitat: Characteristics, sources, budget, and impact on belugas in Saguenay-St. Lawrence Marine Park hub. J. Acoust. Soc. Am. 132(1): 76–89.

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| | <p>Elliott, R.E., Raborn, S., Smith, H.R., and Moulton, V.D. 2015. Marine mammal aerial surveys in Eclipse Sound, Milne Inlet, Navy Board Inlet, and Pond Inlet, 31 August – 18 October 2013. Final LGL Report No. TA8357-3. Prepared by LGL Limited, King City, ON for Baffinland Iron Mines Corporation, Oakville, ON. 61 p.</p> <p>Lesage, V., Barrette, C., Kingsley, M.C.S., and Sjure, B. 1999. The effect of noise on the vocal behavior of Belugas in the St. Lawrence River Estuary, Canada. Mar. Mamm. Sci. 15(1): 65–84.</p> <p>NAMMCO (North Atlantic Marine Mammal Commission). 2010. Report on the Joint NAMMCO/JCNB Scientific Working Group – narwhal. In: NAMMCO Annual Report 2009. NAMMCO. Tromsø, Norway. 291–296</p> <p>NRC (National Research Council). 2003. Ocean Noise and Marine Mammals. National Academies Press, Washington, DC. 220 p. https://doi.org/10.17226/10564.</p> <p>Pine, M.K., Hannay, D.E., Insley, S.J., Halliday, W.D., and Juanes, F. 2018. Assessing vessel slowdown for reducing auditory masking for marine mammals and fish of the western Canadian Arctic. Mar. Pollut. Bull. 135: 290–302. doi:10.1016/j.marpolbul.2018.07.031</p> <p>Radford, A.N., Kerridge, E., and Simpson, S.D. 2014. Acoustic communication in a noisy world: can fish compete with anthropogenic noise? Behav. Ecol. 25(5): 1022–1030. doi:10.1093/beheco/aru029</p> <p>Thomas, T.A., Raborn, S., Elliott, R.E., and Moulton, V.D. 2015. Marine mammal aerial surveys in Eclipse Sound, Milne Inlet, Navy Board Inlet, and Pond Inlet, 1 August – 22 October 2014. Final LGL Report No. FA0024-2. Prepared by LGL Limited, King City, ON for Baffinland Iron Mines Corporation, Oakville, ON. 70</p> |
| Summary | <p>In Appendix 12 of Baffinland’s IR Responses, Baffinland noted that their shipping model: <i>“does not allow for any delays on site, delays discharging in Europe, weather delays or any downtime between vessels”, “...assumes a consistent flow of vessels to the port”,</i> further indicating under ‘Vessel Communication’ that <i>“<u>24 hours of operation</u> can be expected”</i>. In the Advance Technical Comment Response to DFO 3.2.2, Baffinland concludes <i>“all ship transits along the Northern Shipping Route would likely emit a <u>masking zone that extends shoreline to shoreline</u> (around the immediate vicinity of the vessel)”</i> (emphasis added).</p> <p>DFO notes that Baffinland repeatedly states in Sections 4.3.1 (Ringed Seal), 4.3.2 (Narwhal), 4.3.3. (Beluga Whale), and 4.3.4 (Bowhead Whale) of Knight Piésold Consulting’s Memorandum TSD27 – Cumulative Effects Assessment, that <i>“However, the cumulative sound level (‘loudness’) is not predicted to increase when multiple vessels are present in the same area – it would remain roughly equivalent to that of the single (larger) vessel at any single point within the zone of acoustic overlap. This is due to the logarithmic nature of sound underwater (i.e.,</i></p> |

the cumulative effect of multiple co-occurring noise sources is not linear in scale)" (pg. 20–23). DFO notes that in the Assessment of Icebreaking Operations, on page 49, Baffinland states *"Based on a maximum-case icebreaker transit scenario (2 icebreakers escorting 2 capesize carriers)"*. Further, in TSD 27, under section 1.4.14, on page 42: *"Therefore, [...] it is not expected that marine mammals including species at risk would be affected at the population level"* (emphasis added).

DFO notes from Baffinland Iron Mines Corporation Mary River Project - Phase 2 Proposal section 5.3.3 Acoustic Masking: *"For the scenario of two icebreakers escorting two capesize carriers in Pond Inlet, a stationary narwhal in this area could be exposed to a 50% or more reduction in listening space for a period up to ~6 hours per day for transits at 9 knots, and up to ~12 hours per day for vessels travelling at 4.6 knots."*

Baffinland states that *"Based on acoustic modelling results, it is predicted that narwhal will demonstrate avoidance of the icebreaker at distances ranging from 2.2 to 12.5 km from the source based on a maximum-case icebreaker transit scenario...The estimated range (R95%) for narwhal avoidance (135 dB re 1 μ Pa SPL) at the floe edge is 0.5 km from the source"* (Assessment of Icebreaking Operations, p. 46).

In the Assessment of Icebreaking Operations document, on page 51, Baffinland states *"Given the degree of frequency overlap between icebreaker noise and narwhal hearing, animals that do occur within the modelled disturbance zones are predicted to experience masking caused by icebreakers on a local and short-term scale"*. Further: *"narwhals have shown avoidance of icebreakers when first detected (LGL and Greeneridge 1986; Finley et al. 1990; Cosens and Dueck 1988), so individuals are unlikely to get close enough for effects such as masking to occur"*. On page 53, it states *"Given that sounds important to narwhal are predominantly at much higher frequencies than icebreaker noise, it is considered unlikely that masking would have a significant effect on narwhal. The residual environmental effect of masking on narwhal due to icebreaking noise is therefore predicted to be not significant (Table 5.7)"*.

Baffinland provided a Technical Memorandum produced by JASCO in response to DFO technical comment 3.5.4 on May 10, 2019. On page 12 of this Technical Memorandum, it states that LSR *"was computed for underwater sound levels recorded during the 2018 shipping season (Frouin-Mouy and Maxner, 2018) at a typical recording location (AMAR-1) as well as the quietest location (AMAR-3)"* in Koluktoo Bay.

In recommendation 3.7.2 in DFO's final submission, submitted to NIRB on September 23, 2019, DFO recommended: *"Baffinland conduct a modelling exercise to calculate the LSR associated with the proposed increased transits. Including modelling in other parts of the Regional Study Area including Milne Inlet and Eclipse Sound."*

Baffinland's response to DFO recommendation 3.7.2 included the following: *"Under a Phase 2 scenario, one can assume that narwhal would be subject to a similar proportional loss of listening space during each vessel exposure, only the number of exposures in a given day would roughly double."* Further, in Baffinland's Updated Phase 2 package, on page 3 of Attachment 2 - Commitments and terms and conditions following the Public Hearings, Baffinland committed to the following in response to DFO recommendation 3.7.2: *"Empirical data on ship noise levels have now been collected as part of JASCO's passive acoustic monitoring program for the Project. These data have been analyzed to calculate LRR for these additional areas in the RSA (Eclipse Sound, North Milne Inlet, Koluktoo Bay). Calculations of LRR associated with ship transits at these representative locations will be presented in a 'technical memorandum' or 'technical response', scheduled for delivery to DFO on February 17, 2020. The technical memorandum will include an analysis to estimate the LRR estimations for Phase 2 shipping operations based on the empirical results calculated for 2018 and 2019 shipping operations."*

Baffinland's response to DFO recommendation 3.8.2 included the following: *"The conclusions made by Baffinland in the Phase 2 assessment that the effect of acoustic masking from shipping during both the shoulder and open water season is non-significant for narwhal was also independently supported by the results of the peer review of Baffinland's Mary River Phase 2 Assessment Conclusions conducted by Hemerra (Appendix N)" and "While uncertainties exist, Baffinland is of the opinion that this will be addressed by the proposed mitigation [...] and via ongoing and follow-up monitoring programs looking specifically at masking effects, and via adaptive management measures integrated into the Project."*

In recommendation 3.8.3 from DFO's Final Submission provided to the NIRB on September 23, 2019, DFO recommended Baffinland *"Re-evaluate the impact of masking on narwhal noting the evidence that narwhals will get close enough to vessels to experience masking effects."* Baffinland's response to DFO recommendation 3.8.3 included the following: *"There is no call masking model developed in the literature that is narwhal-specific and no research is available on the hearing ability (i.e., audiogram) of narwhal (Erbe et al. 2016)" and "More research is needed to understand the process and biological significance of*

masking, as well as the risk of masking by various anthropogenic activities, before masking can be incorporated into regulation strategies or quantitatively within an effects assessment (Erbe et al. 2016)."

On page 10 of the Mary River Phase 2 Assessment Conclusions report, conducted by Hemmera, it states *"Preliminary tagging data of two narwhal during Fall 2018 indicate that neither tagged narwhal showed "freeze" responses, abandonment of the RSA, or large scale displacement behaviour when exposed to icebreaker noise and close icebreaker or ship approaches (Golder 2019 pers. comm.). Rather, narwhal response to Project vessels appear to be localized, small-scale changes in behaviour (e.g., swimming speed, travel direction), which is aligned with what is presented in the IOA"*.

On page 48 of the Mary River Phase 2 Assessment Conclusions report, conducted by Hemmera, it states: *"Based on the professional opinion on the authors of this review, the following evidence would support a magnitude ranking of 2 rather than 1" specifically noting the second point: "Relatively large areas of the RSA will experience underwater noise levels capable of masking from icebreaking (e.g., >90% acoustic masking is predicted within ~25 km from the sound source for burst pulse calls) and for periods of ~6 hours per day (depending on icebreaking activity/speed)"*.

In recommendation 3.7.4 from DFO's Final Submission provided to the NIRB on September 23, 2019, DFO recommended: *"Baffinland provide long term monitoring plan to verify the prediction of the sound propagation modelling and its potential effects on the populations of marine mammals."* Baffinland's response included the following: *"Additional AMARs have been deployed and will collect data during the Fall 2019 and Spring 2020 seasons. We are confident that the model provides a conservative estimate of the sound field, allowing for a precautionary assessment of the potential acoustic impacts. Monitoring data to date indicate that the narwhal are not showing pronounced reactions to the current levels of vessel activities."*

DFO notes that in the Updated Phase 2 package, on page 3 of Attachment 2 - Commitments and terms and conditions following the Public Hearings, Baffinland committed to the following in response to DFO recommendation 3.7.4: *"An analyses will be conducted using data collected during the 2019 shipping season to characterize the degree of conservatism in the sound propagation modelling that has been conducted. Additional AMARs have been deployed and will collect data during the Fall 2019 and Spring 2020 seasons to further this analysis."*

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| Importance of issue to the impact assessment | Increased shipping activities, including those occurring during ice conditions, may increase acoustic disturbances and negative impacts to marine mammals. Adequate modelling must be provided in order to fully assess these impacts. |
| Detailed Review Comment Gap/Issue Disagreement with Addendum/TSD conclusion Reasons for disagreement with Addendum conclusion | <p>DFO notes Baffinland's assessment of cumulative sound levels, however, DFO notes that an increase of 3dB is equivalent to doubling the perceived noise level. In addition, the total area with sound disturbance would be greater since the ships will be spaced apart. This could result in noise disturbance across the entire Inlet. Baffinland states that the cumulative sound level of multiple vessels would remain roughly equivalent to the sound level of one vessel. However, DFO asserts that the sound pressure level of two vessels of the same acoustic signature is louder than the sounds pressure from one vessel and results in an increase of 3dB. Noise propagation modelling including the cumulative noise of two cape-size carriers, would be appropriate to represent this potential increase.</p> <p>DFO notes that the LSR performed by JASCO in the May 2019 'Technical Memorandum' is based on the current noise from the shipping traffic recorded in 2018. DFO notes that Baffinland is proposing to increase shipping to 420 annual transits in Milne Inlet (including estimates for supply vessels, tugs, etc.). Given the significant increase in shipping traffic expected with Phase 2, DFO notes that it would be more appropriate to conduct a modelling exercise to calculate the LSR associated with the increased transits. Additionally, in order to properly assess the LSR, Baffinland should conduct similar modelling in other parts of the Regional Study Area including Milne Inlet and Eclipse Sound. DFO acknowledges that Baffinland has committed to providing an additional updated technical memorandum on February 17 and DFO will review the new information, once it is provided.</p> <p>DFO is unclear on what Baffinland defines as "short-term" when discussing impacts due to masking. DFO notes that a total of 10 daily hours over a period of 4.5 months represents a considerable proportion of time the Eclipse Sound narwhal stock resides in the LSA. Further, in Baffinland's Responses to Final Written Submissions on October 15, 2019 (Appendix N, Attachment 2), Baffinland has demonstrated that narwhal will get close enough to vessels to experience masking effects, which is supported by modelling results that showed narwhal demonstrated avoidance of icebreakers at distances ranging from 2.2 and 12 km from the source and 0.5 km at the floe edge. This is much closer than the 14 to 71 km range where masking is predicted to occur. Baffinland recognizes that icebreaking might reduce narwhals' communication space by more than 50% for up to 12 hours. Based on two studies of beluga, Baffinland states that narwhals might change their call frequency to overcome the masking effect. In the same</p> |

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| | <p>studies, it was also observed that belugas reduced their calling rate in the presence of shipping noise and that a decrease in calling rate is likely to have an impact on the efficiency of beluga communication (Lesage et al. 1999). Therefore, masking from icebreaking is likely to impact narwhals' ability to communicate, for up to 12 hours per day. Given this, DFO does not agree with Baffinland's conclusion that <i>"the residual environmental effect of masking on narwhal due to icebreaking noise is therefore predicted to not be significant"</i> (Assessment of Icebreaking Operations, pg. 51).</p> <p>DFO does not agree with Baffinland's assessment that effects to marine mammals due to noise will be "not significant", as stated previously (DFO 2019a). DFO is unclear what information exists to suggest noise effects are fully reversible. Further, DFO supports Hemmera's suggestion to change the level of magnitude of masking to a 2, given that <i>"relatively large areas of the RSA will experience underwater noise levels capable of masking from icebreaking"</i>. DFO continues to be of the opinion that Baffinland should re-evaluate the level of magnitude of masking to 2, based on the Hemmera report.</p> <p>DFO notes Baffinland's statement that <i>"AMARs have been deployed and will collect data during the Fall 2019 and Spring 2020 seasons"</i>, however, DFO believes that Baffinland should commit to collect data with the AMARs every year. It's important, with the current level of uncertainty, to adequately monitor the soundscape through the shipping route. DFO further notes that data should be collected in the same fashion for multiple years in order to have defensible data with appropriate statistical power. Additionally, while the ship track will remain the same, the conditions will never be exactly the same year to year. DFO believes it would be best to deploy the AMARs every year, or at an agreed upon frequency, which will ensure real time data is collected while shipping increases with the Phase 2 development. DFO notes that once an appropriate data set has been collected, the frequency can be reduced for the rest of the life of the project, or until any future changes to the project.</p> |
| Recommendation / Request | <p>Recommendation 3.3: DFO is concerned that the Baffinland provided acoustic modelling does not fully allow DFO to assess cumulative sound level and the assessment of the effect of the sound on marine mammals.</p> <p>DFO recommends that Baffinland:</p> <p>3.3.1 Provide the committed to technical memorandum which include calculations for the LSR associated with the proposed increased transits and modelling in other parts of the RSA including Milne Inlet, Eclipse Sound and Koluktoo Bay, for DFO's review.</p> |

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| | <p>3.3.2 DFO recommends that, before the Project is approved, Baffinland re-evaluate the impact of masking on narwhal to a magnitude of 2.</p> <p>3.3.3 Commit to collect data with AMARs at an appropriate frequency (eg. yearly) and develop a long term monitoring plan, which is provided to MEWG members and approved by DFO, prior to the start of the Phase 2 increased shipping season.</p> |
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3.4 Impacts to Marine Mammals: Shoulder Season Shipping and Ice-breaking

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| Review Comment Number | 3.4 Impacts to Marine Mammals: Shoulder Season Shipping and Ice-breaking |
| Subject/Topic | Environmental impacts to marine mammals from shoulder season shipping and ice-breaking activities |
| References | <ul style="list-style-type: none"> • Baffinland Iron Mines Corporation Final Environmental Impact Statement, Volume 2, Table 2.3.4 • Marine Mammal Effects Assessment (TSD 24): Section 2.5. Table 2.3 (p. 20); Section 2.5.2.2 (p. 26); Appendix A: Marine Mammal Baseline report (entire document) • Cumulative and Transboundary Assessment (TSD 27): Section 1.4.14 (p. 42-46) • IR Responses Phase 2 Proposal – Mary River Project: Appendix 11, Commitment Register, Commitment 156 (p. 24 of 27) • Knight Piésold Consulting Memorandum TSD27 – Cumulative Effects Assessment, p. 20-21). • Golder Associates Ltd. November 1, 2016. Peer Review: Marine Mammal Aerial Surveys in Eclipse Sound, Milne Inlet and Pond Inlet, 1 August - 17 September 2015 (15 March 2016). Report Number: 1663724-002-R-RevA • Golder Associates Ltd. November 15, 2016. Integration Report: Marine Mammals in Eclipse Sound, Milne Inlet and Pond Inlet, Table 1, p.ii. Report Number: 1663724-006-R-RevA • DFO Technical Review Comments to the NIRB, March 2019, Technical Comment 3.4 • Baffinland Iron Mines Corporation. March 26, 2019. Technical Comment Responses, Phase 2 Proposal – Mary River Project: DFO 3.4.4, pg. 21, DFO Recommendation 3.4.1, pg. 19 |

- Golder Associates Ltd. May 17, 2019, Assessment of Icebreaking Operations during Shipping Shoulder Seasons on Marine Biophysical Valued Ecosystem Components (VECs): Section 1.3, pg. 13; p. 48; pg. 77–80, section 5.6.3, pg. 42; pages 50, 53, 54 & 56.
- Knight-Piésold Consulting. May 17, 2019. Socio-economic Assessment of Icebreaking Operations during Shipping Shoulder Seasons: section 5.6.3, pg. 13 & pg. 42, pg. 46-47, pg. 50
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- Hemmera Envirochem Inc. (Hemmera). 2019. Review of the Mary River Phase 2 Assessment Conclusions on the Effects of Icebreaking to Narwhal. Project No. 103182-01. October 11, 2019.
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- Final Written Comment Responses Phase 2 Proposal – Mary River Project, Baffinland, October 15, 2019, pages 42, 46, 48
- Baffinland Iron Mines Corporation, Phase 2 Proposal Updated Information Package, Attachment 2 – Commitments and terms and condition following the Public Hearings, January 6, 2020

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| | Inlet, Nunavut: implications for potential ice-breaking activities. Arctic Sci. 5(1): 54–61. |
| Summary | <p>Within the Socio-economic Assessment of Icebreaking Operations (Section 5.6.3, p. 42), there are several statements regarding the residual effects on several marine mammals as “<i>Not Significant</i>” (e.g., ringed seals, beluga, bowhead, narwhal habitat loss/fragmentation, ice entrapment and ship strikes).</p> <p><u>Pinnipeds</u></p> <p>In the ‘Assessment of Icebreaking Operations’ document, provided by Baffinland provides a sufficient overview of the possible impacts of vessel strikes on ringed seal, “...serious injury or mortality by means of blunt force trauma from direct impact with the hull of a vessel, or from lacerations due to contact with rotating propellers...” and “Observed impacts included displacement, separation of mothers from pups, breakage of birth or nursery sites, and vessel-seal collisions” (Assessment of Icebreaking Operations, p. 78–80). Baffinland also summarizes literature on the correlation of vessel strikes with vessel speed in the assessment, stating “Icebreaking in the early shoulder season (July/August, October/November) will overlap with the end of the moulting period when ringed seal are engaged in basking behaviour. Seals hauled out on ice floes during this time are likely to show a greater response to vessels than seals in-water. Fleeing behaviour has been observed in seals when approached within 0.4 to 0.8 km by a ship (Richardson et al. 1995b).” Baffinland then goes on to state “adult ringed seal have more than enough mobility <u>under the ice</u> to avoid the close approach of an icebreaker, and that it was considered unlikely that icebreaking vessels would strike <u>adult seals</u> and cause mortality” (emphasis added) and “Since the start of operations at Milne Port in 2015, no vessel strikes on pinnipeds (or near misses) have been reported along the Northern Shipping Route” (p. 78–80). Baffinland presents mitigation measure 10 that “All icebreaking, ice management and ice escort activities will be conducted outside of the period of ringed [seal] parturition, nursing, and breeding periods”. This is presented in both the Operational Icebreaking Assessment (p. 48) and the Socio-economic Icebreaking Assessment (p. 13).</p> <p>Baffinland states that “The habitat change [for ringed seal] was estimated at 4% to 6% of the available landfast ice in Section 1.4.14.2, which is less than the 10% threshold applied in the ringed seal habitat loss assessment in the FEIS (Volume 8, Section 5.6.2.1)” (Knight Piésold Consulting Memorandum TSD27 – Cumulative Effects Assessment, p. 20-21). Further:</p> |

“For icebreaking operations, if it is assumed that approximately 70 to 200 ringed seal in Milne Inlet and Eclipse Sound will exhibit avoidance of the icebreaking noise source per icebreaker transit” and “Based on these estimates, the residual effects of disturbance on ringed seal from icebreaking activities is predicted to be not significant (Table 5.16)” (Assessment of Icebreaking Operations, p. 77).

In DFO’s Final Submission provided to the NIRB on September 23, 2019, DFO recommendation 3.5 stated: *“DFO is concerned about the impacts to pinnipeds and disagrees with Baffinland’s conclusions that effects will be non-significant. As such, DFO overall recommends Baffinland implement the most conservative mitigation measure and avoid shipping during the shoulder seasons and ice-breaking activities; only ship during the open water season.”* In response to DFO’s recommendation 3.5, Baffinland’s response included the following: *“Based on the effective application of the proposed mitigation, residual effects of Project shipping on pinnipeds is predicted to be limited to short-term localized disturbance from vessel noise exposure. Considering the commitments from Baffinland to effectively mitigate and monitor over the long-term, the residual effects of shipping on pinnipeds is characterized as not significant. While uncertainties exist, Baffinland is of the opinion that these can be addressed via follow-up monitoring and adaptive management.”*

In the disposition table provided to DFO on October 31, 2019, in reference to DFO recommendation 3.6.5, Baffinland provided the following as a commitment: *“Baffinland will updated the Marine Monitoring Program to make it clear what behavioural indicators are recorded during the Ship Board Observer Program. These indicators include breaching, flipper slapping, lobtailing, diving, fluking, blowing, resting, looking, feeding, hauled-out, milling, swimming, surfacing. Other recorded information includes initial distance from vessel, minimum distance from vessel (i.e. closest point of approach), and bearing from vessel and movement direction. These methods and indicators are currently described in annual Ship Board Observer Reports.”*

Cetaceans

Baffinland states *“It is considered plausible that narwhal may habituate to non-threatening icebreaking transits”* (Assessment of Icebreaking Operations, p. 50). Further: *“Any avoidance behavior [by narwhal] is predicted to be temporary”* (Knight Piésold Consulting Memorandum TSD27 – Cumulative Effects Assessment, p. 21). Baffinland states *“Based*

on these estimates and in light of proposed mitigation measures during the shoulder seasons, the residual effects of disturbance on narwhal from icebreaking activities is predicted to be not significant” (Assessment of Icebreaking Operations, Residual Effects Section, Page 50).

On page 53 of the ‘Assessment of Icebreaking Operations’ document, Baffinland states that *“There is concern that artificially opened water channels can be problematic for marine mammals, who may confuse them for polynyas and can get trapped too far from the ice edge as the channel eventually refreezes”*. DFO notes that Baffinland acknowledges that *“Mortality can occur through drowning if open water is no longer accessible or if narwhal fail to leave an area before freeze-up occurs in late autumn and the ice is too thick for them to break through (Laidre et al. 2011)”* (p. 53), and also acknowledges that *“narwhals were also observed using old icebreaking tracks”* (p. 53).

However, Baffinland states *“With the effective implementation of mitigation, it is predicted that the residual effects of ice entrapment on narwhal due to icebreaking activities will be of low magnitude (Level I), confined to the LSA (Level I), infrequent in occurrence (Level I), medium-term (Level II) in duration, and fully reversible (Level I). The residual environmental effect of ice entrapment on narwhal is predicted to be not significant (Table 5.7)”* (Assessment of Icebreaking Operations, p. 56). Baffinland states that *“The passage of an icebreaker in the early summer is not expected to result in an ice entrapment because the ice is breaking up at this time and there are multiple open leads narwhal could use”* and *“By mid-October, most narwhal have left the Eclipse Sound complex and the limited number of individuals still present in the RSA are in the Eclipse Sound East and Pond Inlet area and heading east out of the study area (Elliott et al. 2015; Thomas et al. 2015). The residual environmental effect of ice entrapment on narwhal is predicted to be not significant (Table 5.7)”* (Assessment of Icebreaking Operations, p. 54).

Baffinland acknowledges that *“Narwhal is particularly sensitive when congregating at the floe edge in July, as mothers are carrying calves, and narwhal represent a significant proportion of the community’s country food harvest.”* (Socio-economic Assessment of Icebreaking Operations, p. 50). Baffinland then concludes that *“with application of the mitigation measures summarized in Section 2.8, the local population of narwhal is not expected to abandon the area as a result of icebreaking during the shoulder season, and effects to narwhal will be Not Significant.”* (Socio-

economic Assessment of Icebreaking Operations, p. 46–47 and repeated on p. 50).

In Golder’s Integration Report from 2016, Table 1 p.ii, there is a clear statement regarding the results of the shore-based monitoring that *“Results are inconclusive because of the high spatial and temporal variability in abundance and distribution of narwhal. Some of the highest abundances of narwhals were observed in conjunction with some large vessel transits. At other times the narwhals appear to have left Milne Inlet, but the causal link to vessel transits is unclear”*.

According to Thomas et al. 2015: *“The primary objective of the aerial surveys in 2014 was to document distribution, abundance and movements of narwhals during the open-water season in Eclipse Sound, Milne Inlet and Pond Inlet”* (pg. 2). Further: *“This report marks the second time that a statistical model has been used to quantify the spatial-temporal pattern of narwhal distribution and abundance in and adjacent to Baffinland’s northern shipping route”* (pg. 55).

In DFO’s Final Submission provided to the NIRB on September 23, 2019, DFO recommendation 3.6 stated: *“DFO is concerned that the lack of defensible information makes the assessment of the effect of shipping on cetacean difficult and highly uncertain. As such DFO recommends that, for the time being, Baffinland maintain the current level of shipping and avoid shipping during the shoulder seasons and ice-breaking activities. Before any increase in shipping is considered, Baffinland should provide further information and provide further mitigation options in an updated shipping management plan”*. In response, Baffinland stated: *“Baffinland contracted Hemmera to undertake a third-party peer review of the icebreaking operations effects assessment.”* Baffinland also adds that they have *“developed a number of key mitigation measures to effectively eliminate and/or greatly minimize any adverse impacts on narwhal from shipping operations under the Phase 2 Proposal”* and that *“Baffinland will include the above mitigation options in an updated version of the Shipping and Marine Wildlife Management Plan (SMWMP) prior to initiation of Phase 2 shipping operations.”*

In recommendation 3.6.2 in DFO’s final submission, submitted to NIRB on September 23, 2019, DFO recommended Baffinland provide *“Mitigation measures to address this concern that frequency of entrapments will increase over natural levels due to icebreaking in the fall shoulder season*

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| | <p><i>(e.g., no icebreaking while narwhal migrate into and out of Eclipse Sound)."</i> Baffinland's response included the following: <i>"'Natural' levels of narwhal entrapment are presently unknown. Regardless, Baffinland is committed to undertaking an end-of-season aerial survey of the LSA, following the end of shipping operations, to confirm no narwhal entrapment events have occurred. Baffinland will work directly with the Mittimatilik HTO in implementation of this survey."</i></p> <p>In Baffinland's Updated Phase 2 Package, on page 1 of Attachment 2, referencing DFO 3.6.2, Baffinland provided the following commitment <i>"Baffinland is committed to undertaking an end-of-season aerial survey of the LSA for each year shoulder season shipping occurs, to confirm no narwhal entrapment events have occurred. Baffinland will work directly with the Mittimatilik HTO in implementation of this survey. Baffinland will describe how survey results will be reported and analyzed in an aerial survey monitoring plan. This plan will be provided to MEWG members prior to carrying out the fall aerial surveys for review and comment, with sufficient time to implement changes to the survey plan, if necessary. This plan will include provisions for adaptive management, should repetitive ice entrapments occur."</i></p> <p>As stated by Hemmera memorandum to Baffinland, section 8.1 p.8 <i>"In addition, there are perceptions that shipping is causing shifts in narwhal abundance and distribution in the RSA. This concern was particularly amplified in 2018, where narwhal numbers in the RSA appeared to be at record lows and where Project-related icebreaking was introduced for the first time during the spring season"</i></p> <p>In recommendation 3.6.5 in DFO's final submission, submitted to NIRB on September 23, 2019, DFO recommended Baffinland provide a <i>"Re-evaluation of the extent beyond the local study area (LSA) and within the RSA, the magnitude and the reversibility of the impacts of ice entrapment on narwhals."</i> Baffinland responded as follows: <i>"The area outside the marine mammal LSA and inside the marine mammal RSA is restricted to the northern half of Navy Board Inlet and waters off the north coast of Bylot Island. There is no Project shipping undertaken in these areas and they are outside the acoustic zone of influence for Project shipping. Therefore, Baffinland does not feel that a re-evaluation of the effect of entrapment on narwhal is warranted in these areas."</i></p> |
| Importance of issue to the impact assessment | Shipping and Ice breaking activities on the shoulder seasons are likely to cause negative impacts to marine mammals. |

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| <p>Detailed Review Comment Gap/Issue Disagreement with Addendum/TSD conclusion Reasons for disagreement with Addendum conclusion</p> | <p>DFO continues to be concerned about impacts from increased shipping and ice-breaking activities on the shoulder seasons. DFO is concerned about shipping and ice breaking on the shoulder seasons, as these shoulder periods are vital for migration of Narwhals both into (in July) and out of Milne Inlet (in October). Further, the ice platform is habitat for ice-dependent pinniped species and that ice-breaking represents a serious potential threat for marine mammals utilizing the ice.</p> <p>Within the Socio-economic Assessment of Icebreaking Operations (Section 5.6.3, p. 42), there are several statements regarding the residual effects on several marine mammals as “Not Significant” (e.g., ringed seals, beluga, bowhead, narwhal habitat loss/fragmentation, ice entrapment and ship strikes). DFO notes that Baffinland has not presented adequate data to support their conclusion that residual effects from icebreaking is predicted to be not significant. DFO also notes that the assessed impacts to date are confined to the RSA.</p> <p><u>Pinnipeds</u></p> <p>Wilson et al. (2017) discuss icebreaking activities and their effect on seals including an assessment of impacts and potential mitigation for icebreaking vessels transiting areas of an ice-breeding seal. DFO notes that Wilson et al. (2017) reported 13 seal collisions, all except one occurred with vessel speeds exceeding 4 knots. DFO further notes that Wilson et al. (2017) reported that seal collisions and mortalities were much more likely at speeds ≥ 4 knots. Further, Wilson et al. (2017) reported deaths within 10 m of the vessel on either side, not only seals occurring in the direct physical path of the vessel. In addition, DFO notes that Baffinland is using distance buffers and justifications from Wilson et al. (2017). However, DFO notes that the ice-breakers used in the Caspian Sea are approximately half the size of Arctic ice-breakers. Therefore, the Arctic ice-breakers would likely have a larger effect on sea ice and in turn cause higher mortality within 10 m of the vessel on either side than in Wilson et al. (2017). Baffinland states that no vessel strikes on pinnipeds have been reported in the area, however, Baffinland also reports that local Inuit recount finding dead seals attributed to vessel encounters, in section 1.3: ‘Inuit Community and Stakeholder Comments’ of Baffinland’s ‘Assessment of Icebreaking Operations’ (p. 13). DFO remains concerned that seals may be killed due to icebreaking activity.</p> <p>Yurkowski et al. (2019b) provides a summary of key ringed seal behavior and life-history parameters by month during the ice-covered winter and</p> |
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spring seasons (i.e., January to July) (Table 2) and shows that Western Eclipse Sound and Milne Inlet is an important pupping area. DFO recognizes that shipping will be conducted outside of “*parturition, nursing, and breeding periods*” (Assessment of Icebreaking Operations, p. 48), however, notes that young seals in July will remain near their birth site. The pups are naïve and susceptible to ship strikes and moving chunks of brash sea ice created from icebreaking activity. All seals on the ice would be at risk (more so the young) as they could easily be crushed by moving ice. DFO notes this may occur less so because of the actual icebreaker and more due to the movement of ice caused by the icebreaker. DFO is concerned that resting on ice, following the moulting stage will occur as long as sea ice persists. Juveniles and pups moult last and they could be reluctant to go into the water with an icebreaker breaking up the fast ice. Additional impacts may include the incidence of displacement, separation of mothers and pups, and increase of destruction of resting and birth lairs, and potential changes to the prey base for seals.

DFO is also concerned that ice-breaking activities at the end of the shipping season have the potential to impede the formation of ice across the inlets (e.g., ice type, lack of formation, rubble). DFO considers sea ice as critical habitat for seals and notes that an increase in wave action would be heightened as a result of increased shipping and during times of ice-breaking vessel activity. This increased wave action has the potential to delay the formation of a solid ice platform and delay the ability to use the land fast ice. Additionally, icebreaking during the ice formation season in autumn may cause ringed and bearded seals to avoid setting up mating territories during landfast ice formation in areas of vessel traffic and icebreaking such as Milne Inlet. DFO notes this may reduce overall seal density, shift distribution, and could potentially cause overcrowding in alternative habitat nearby.

DFO notes that overall there continue to be uncertainties with conducting icebreaking and shipping during the shoulder season and the impacts to pinnipeds along the icebreaker’s shipping route. Within the *Socio-economic Assessment of Icebreaking Operations* (Section 5.6.3, p. 42), there are several statements regarding the residual effects on several marine mammals as “*Not Significant*” (e.g., ringed seals, beluga, bowhead, narwhal habitat loss/fragmentation, ice entrapment and ship strikes). DFO disagrees with the conclusions made by Baffinland that overall the impacts will be insignificant. As discussed throughout the DFO Science review of past and present Baffinland FEIS documents, Baffinland has not provided

information, references, data and/or analyses to support the “*Not Significant*” rating (DFO 2012a,b, DFO 2014, DFO 2019a). DFO finally notes that the most conservative mitigation measure would be to avoid shipping during the shoulder seasons and ice-breaking activities altogether.

DFO notes that Baffinland has committed to updating the Marine Monitoring Program. However, DFO is of the opinion that Baffinland should provide the updated program or summary of updates to be incorporated, to DFO, and other relevant parties for review, within a timeframe that includes sufficient time in advance of initiating ice breaking activities to discuss, provide comments and make necessary changes and alterations to the program. The provided material should include the indicators Baffinland intends to use and rationale for the selection of said indicators.

Cetaceans

Entrapment

DFO notes that shipping in the late fall may also prevent Narwhal from moving out of the sound, due to avoidance, and lead to ice entrapments. DFO is concerned that frequency of entrapments will increase over natural levels due to icebreaking in the fall shoulder season. Icebreaking activities during the fall may impede the formation of ice across the inlets (e.g., ice type, lack of formation, rubble) and result in ice entrapments during the fall migration of narwhal.

As quoted in the summary above, Baffinland states in the Assessment of Icebreaking document, that “*most narwhals have left the Eclipse Sound complex*” by mid-October and that the limited number of individuals still present in the RSA are in the Eclipse Sound East and Pond Inlet area and heading east out of the study area. Matthews et al. (2019) estimated that there were 11,756 and 3,053 narwhals in Pond Inlet on October 17 and 22, 2014, respectively. This represents a large proportion of the Eclipse Sound narwhal stock still present during the proposed icebreaking period based on the two recent stock estimates (10,489, DFO 2015a; 12,039, Marcoux et al. 2019). DFO is further concerned that Baffinland’s statements and conclusions are based on one year (2014) of aerial survey data (Thomas et al. 2015). Given the large proportion of narwhals that may still be present in October, and the uncertainty related to the reaction of narwhals to icebreaking in the fall, DFO disagrees with Baffinland’s conclusion that the residual environmental effect of ice entrapment on narwhal is predicted to be not significant.

Baffinland's cited information supports the fact that narwhals might use icebreaker tracks to navigate in late fall, which may increase their chance of getting ice entrapped. However, DFO notes that Baffinland concluded *"that the residual effects of ice entrapment on narwhal due to icebreaking activities will be of low magnitude (Level I)"* (Assessment of Icebreaking Operations, p. 56). Narwhal ice entrapments tend to be large, sometimes numbering more than a thousand individuals, and the residual effects of an entrapment of that magnitude might not be reversible. DFO is of the opinion that an ice entrapment would better correspond to what Baffinland defines as a Magnitude of Level II. Additionally, Baffinland continues to conclude that the predicted residual environmental effects of disturbance on narwhal from icebreaking activities will be fully reversible (Level I). DFO is unclear on what information was used to suggest that disturbance on narwhal is fully reversible and DFO is concerned with Baffinland's conclusion.

DFO notes that recommendation 3.6.5 from DFO's final submission to the NIRB on September 23, 2019, contained three parts. DFO acknowledges that Baffinland will not be using the alternative shipping routes and that the first part of 3.6.5 is resolved. However, the recommendations to re-evaluate the magnitude and the reversibility of ice entrapments, are not subject to the geographic scoping of the first part of the recommendation, and have not yet been addressed by Baffinland. DFO is of the opinion that Baffinland should provide consideration towards re-evaluating the levels for magnitude and reversibility, as previously recommended.

Aerial Surveys

DFO is concerned with the use of some of the aerials surveys to estimate the abundance of narwhals in Eclipse Sound. DFO has noted problems with the data collected during survey that makes these data not compatible with the estimation of abundance (Matthews et al. 2019, BIM 1663724-002-R-Rev0). Further, DFO notes that reports for the 2007 and 2008 surveys only provide densities of narwhal without any measure of variation (coefficient of variation or confidence intervals). DFO is unclear on the ability of the aerials surveys to detect significant adverse changes to the Eclipse Sound narwhal stock. Aerial surveys tend to have very large confidence intervals that makes the detections of any changes very difficult. For example, the confidence intervals for the survey on August 15 2016 are from 6,449 to 104,339 (coefficient of variation of 56.58%) and on

August 21 2016, the confidence interval is from 7,245 to 23,166 (coefficient of variation of 15.93%).

While DFO supports Baffinland's commitment proposal for the end of season aerial survey, specific detailed information should be provided on how survey results will be reported and analysed in an aerial survey monitoring plan. This plan should be provided to DFO and other relevant parties, leaving sufficient time in advance of the fall aerial survey to review, comment and implement changes to the survey plan. This plan should include action level triggers with outlined planned responses should an ice entrapment occur, and further if more frequent ice entrapments occur.

Displacement

Spring icebreaking could also result in a change in narwhal migratory patterns and lead to a lack of immigration into the area. Shipping to Milne Port may cause Narwhal to display avoidance behaviour. This impact is to migrating Narwhal, and their decision as to whether to enter the Eclipse Sound area or to continue on to Admiralty Inlet or Prince Regent Inlet. At the NIRB's Marine Monitoring and Marine Mitigation Workshop in Pond Inlet for the Mary River Project on May 1-2, 2019, participants had discussions around recent Inuit Qaujimajatuqangit, noting that narwhals were present in very low numbers in the RSA in 2018. One hypothesis is that the narwhals were displaced because of icebreaking in the spring. It's important for Baffinland to provide adequate data and information to support conclusions that the mitigation measures summarized will prevent narwhal from abandoning the area. DFO notes that Baffinland acknowledges "*Narwhal is particularly sensitive when congregating at the floe edge in July*" (Socio-economic Assessment of Icebreaking Operations, p. 50), however, Baffinland does not expect narwhals to be negatively impacted. As this is a sensitive time for them, noise pollution and habitat destruction is highly likely to lead to displacement of narwhals.

DFO notes that two narwhals were equipped with satellite tags in Eclipse Sound during the summer of 2018 and further that 2018 was a year when narwhals numbers were low, indicating that most Eclipse Sound narwhals spent their summer in a different summering location than Eclipse Sound. DFO is concerned about using the results from these two female narwhal to generalize to the entire Eclipse Sound stock. Narwhals are likely to show a range of reaction to ships and the behaviour of two narwhals is not enough to represent the entire stock or sensitivity to shipping activity.

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| | <p>Baffinland states “that narwhal may habituate to non-threatening icebreaking transits” (Assessment of Icebreaking Operations, p. 50), however hasn’t provide any information to support whether it is plausible that narwhal may habituate to non-threatening icebreaking transits. DFO is currently unaware of any existing studies on narwhal ability to “habituate” to icebreaking transits, noise, etc. DFO notes there could additionally be energetic and long-term costs associated with habituation such as stress, and reduced reproductive rates, with subsequent declines in abundance and fitness declines.</p> <p><u>Conclusion</u></p> <p>DFO reiterates from DFO’s Final Submission to the NIRB on September 23, 2019, recommendation 3.5, that “the most conservative mitigation measure, would be to avoid shipping during the shoulder seasons and ice-breaking activities altogether.” Further, if the project is to proceed at these critical times, as proposed, then extensive and robust monitoring and mitigation strategies should be implemented along the full shipping route.</p> |
| <p>Recommendation / Request</p> | <p>Recommendation 3.4: DFO is concerned about the impacts to marine mammals from shoulder season shipping and ice-breaking and disagrees with Baffinland’s conclusions that effects will be non-significant.</p> <p>3.4.1 DFO recommends that Baffinland prepare a monitoring plan, with an appropriate survey methodology, for the purpose of documenting and reporting any impacts due to icebreaking and shoulder season shipping activities, which includes the indicators Baffinland intends to use and rationale for the selection of said indicators. Baffinland should provide this plan or an adequate outline of the proposed plan to DFO for review and approval prior to any addition of ice breaking activities.</p> <p>3.4.2 DFO recommends Baffinland provide consideration for the re-evaluation of the magnitude and the reversibility of the impacts of ice entrapment on narwhals.</p> <p>3.4.3 DFO recommends Baffinland commit to producing a response plan in the event of ice entrapments, as determined by the committed to multi-year aerial surveys. This plan should include action level triggers and associated outlined response actions, in the event of an ice entrapment and subsequently an increase in frequency of</p> |

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| | ice entrapments. This plan should be developed in discussion with DFO and other parties and provided to DFO for review and approval. |
| | 3.4.4 Overall, DFO reiterates the recommendation that Baffinland implement the most conservative mitigation measure and avoid shipping during the shoulder seasons and ice-breaking activities; only ship during the open water season. |

3.5 Marine Mammal Observation

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| Review Comment Number | 3.5 Marine Mammal Observation |
| Subject/Topic | Marine Mammal Observation and Ship-board observation programs |
| References | <ul style="list-style-type: none"> • Marine Mammal Effects Assessment (TSD 24);; Section 2.3 (p. 14-15) • TSD28, Appendix V, Section 5.3, Table 2, p. 166; Draft Shipping and Marine Wildlife Management Plan, p. 72 • IR Responses Phase 2 Proposal – Mary River Project: GN 67 (p. 29) • Advance Technical Comment Responses Phase 2 Proposal – Mary River Project: 3.2.3 (p. 6-7) • Golder Associates Ltd. November 15, 2016. Integration Report: Marine Mammals in Eclipse Sound, Milne Inlet and Pond Inlet, Table 1, p.ii. Report Number: 1663724-006-R-RevA • Nunavut Impact Review Board Mary River Project Certificate 005 – Amended October 31, 2018, Term and Condition No. 106, page 53 • DFO Technical Review Comments to the NIRB, March 2019, Technical Comment 3.7, recommendation 3.7.1 • Baffinland Iron Mines Corporation. March 26, 2019. Technical Comment Responses, Phase 2 Proposal – Mary River Project: DFO 3.7.1, pg. • Golder Associates Ltd. May 17, 2019, Assessment of Icebreaking Operations during Shipping Shoulder Seasons on Marine Biophysical Valued Ecosystem Components (VECs): pg. 70; Shipping Mitigation Measures • Knight-Piésold Consulting. May 17, 2019. Socio-economic Assessment of Icebreaking Operations during Shipping Shoulder Seasons: pg. 14 • Final Submission – Baffinland Iron Mines Corporation Mary River “Phase 2 Development” Project Proposal, DFO, September 23, 2019, Technical Review Comment 3.3 (recommendation 3.3); Technical Review Comment 3.9 (recommendation 3.9.1) |

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| | <ul style="list-style-type: none"> • Hemmera Envirochem Inc. (Hemmera). 2019. Review of the Mary River Phase 2 Assessment Conclusions on the Effects of Icebreaking to Narwhal. Project No. 103182-01. October 11, 2019. • Final Written Comment Responses Phase 2 Proposal – Mary River Project, Baffinland, October 15, 2019, pages 39-40, 52-53 • Baffinland Iron Mines Corporation, Phase 2 Proposal Updated Information Package, Attachment 2 – Commitments and terms and condition following the Public Hearings, January 6, 2020 <p><u>Publications:</u></p> <p>DFO. 2019a. Science Review of the Phase 2 Addendum to the Final Environmental Impact Statement for the Baffinland Mary River Project. DFO Can. Sci. Advis. Sec. Sci. Resp. 2019/015.</p> <p>Higdon, J.W., and Ferguson, S.H. 2009. Loss of Arctic sea ice causing punctuated change in sightings of killer whales (<i>Orcinus orca</i>) over the past century. <i>Ecol. Appl.</i> 19(5): 1365–1375.</p> <p>Higdon, J.W., Hauser, D.D.W., and Ferguson, S.H. 2011. Killer whales in the Canadian Arctic: distribution, prey items</p> <p>Lawson, J.W. and Lesage, V. 2013. A draft framework to quantify and cumulate risks of impacts from large development projects for marine mammal populations: A case study using shipping associated with the Mary River Iron Mine project. DFO Can. Sci. Advis. Sec. Res. Doc. 2012/154. iv + 22 p.</p> <p>Reeves, R.R., Rosa, C., George, J.C., Sheffield, G., and Moore, M. 2011. Implications of Arctic industrial growth and strategies to mitigate future vessel and fishing gear impacts on bowhead whales. <i>Mar. Policy</i> 36(2): 454–462.</p> <p>Sheldon, K. E. W., Hobbs, R. C., Sims, C. L., Vate Brattstrom, L., Mocklin, J. A., Boyd, C., and Mahoney, B. A. 2017. Aerial surveys of beluga whales (<i>Delphinapterus leucas</i>) in Cook Inlet, Alaska, June 2016. Alaska Fish Science Centre Processed Report 2017–09, NOAA, Seattle, WA, USA.</p> |
| Summary | <p>In TSD 24, Section 2.8.4, on page 48, Baffinland states: <i>“Bowhead whale mortality is not expected to occur as a result of the Phase 2 Proposal activities. All available information suggests that bowhead will actively avoid vessels transiting in the LSA (Section 2.8.1). With the effective implementation of mitigation, the potential residual effects of bowhead mortality due to vessel strikes is predicted to be negligible. The residual environmental effect on bowhead is expected to be “Not Significant””</i>.</p> |

In the Assessment of Icebreaking Operations, Baffinland presents a lengthy rationale for why bowhead are susceptible to vessel strikes (p. 70). They go on to say that *“North Atlantic right whales have been found to exhibit no avoidance response when presented with sounds of approaching vessels (either real or play-back recordings) (Nowacek et al. 2004) and have been the subject of numerous vessel strike casualties in the last few years”* but that *“The difference between North Atlantic right whale and bowhead is that bowheads are more prone to exhibit avoidance of vessels”* (p. 70) and that *“All available information indicates that bowhead are likely to avoid vessels under way in the RSA”* (p. 71).

Recommendation 3.3 in DFO’s final submission, submitted to NIRB on September 23, 2019, states: *“DFO is concerned that the present level of assessment may not be adequate to fully assess the effects of the vessels strikes on whales and other marine mammals. In order for DFO to adequately assess the effects of vessel strikes on marine mammals, Baffinland, working cooperatively with DFO, shall re-assess the impact of vessel strikes on bowhead whales and re-evaluate the significance of ship strikes related to the project (including inside and outside the RSA) and should consider other marine mammals (e.g., Killer whale, Sperm whale, Fin whale) that would potentially be entering the RSA in summer during the open water shipping season and risk of vessel strikes. The assessment shall include the knowledge and observation of Inuit hunters and trappers.”*

In response to DFO recommendation 3.3, Baffinland’s response included the following: *“The physiological attributes of toothed whales (narwhal, beluga, killer whale) make them relatively less vulnerable to ship strikes compared to baleen whales, as they use echolocation to perceive their environment and can maneuver out of the way of oncoming vessels”* and *“The critical ship speed threshold above which strikes on marine mammals have a higher potential to occur is 13 knots, and this is largely applicable to baleen whales (e.g. bowhead whales) as they spend a considerable more amount of time at the surface feeding, do not have echolocation ability to detect ships as well at a distance, and are generally less mobile/maneuverable.”* Further: *“no ship strikes on marine mammals are anticipated to occur as a result of the Phase 2 Proposal. This is consistent with monitoring data available to date; there has been no evidence of ship strikes on the Project following four consecutive years of shipping and despite extensive marine mammal monitoring undertaken in the area*

(multiple programs). Ship speed restrictions as a mitigation are demonstrated to be effective.”

In Baffinland’s Updated Phase 2 Package, on page 1 of Attachment 2, referencing DFO 3.3, Baffinland provided the following commitment: *“Baffinland will implement a system where any bowhead whale observations will be reported to the Port Captain, who will send a notification to all incoming and outgoing ships to proceed with caution in the designated area.”*

In TSD 24, under section 2.3, on pages 14-15, it states: *“A marine mammal surveillance monitoring program was [...] discontinued in 2016 as it was determined that very few marine mammals were visible to observers on board the vessels, and there were safety concerns regarding observers boarding the vessels at sea.”* In the IR Response to GN 67 (p. 29), Baffinland indicates that *“the Ship-based Observer (SBO) marine mammal monitoring program ran in 2018 aboard the MSV Botnica during the shoulder seasons”*.

In the Advance Technical Comment Responses to DFO 3.2.3 (p. 6), Baffinland provide details regarding the marine mammal surveillance monitoring program conducted onboard the Project ore carriers in 2014 and 2015, including: *“In 2018, the ship-based monitoring program was implemented using an ice management vessel during the shipping shoulder seasons. The 2018 program mitigated BIM’s health and safety concerns by boarding Inuit MMOs at Milne Inlet and provided greater survey time since MMOs could remain aboard the vessel for multiple days”* and *“Continued Project monitoring of marine mammal-vessel strikes will reduce uncertainty regarding marine mammal-vessel strikes and will inform on the accuracy of assessment predictions and mitigation effectiveness.”*

DFO notes that Baffinland’s current Project Certificate, term and condition number 106 to 108 specifically relate to Shipboard Observers. Particularly, term and condition 106 states: *“The Proponent shall ensure that shipboard observers are employed during seasons where shipping occurs and provided with the means to effectively carry out assigned duties. The role of shipboard observers in shipping operations should be taken into consideration during the design of any ore carriers purpose-built for the Project, with climate controlled stations and shipboard lighting incorporated to permit visual sightings by shipboard observers during all seasons and conditions. Any shipboard lighting incorporated should be in*

accordance with the Canada Shipping Act, 2001's Collision Regulations, and should not interfere with safe navigation of the vessel."

Baffinland's response to recommendation 3.7.1 from DFO's March technical review comments included the following: *"An updated monitoring plan is not required to address Term and Condition 107. In 2018, a Ship-Based Observer (SBO) Program was conducted from on-board the MSV Botnica, an Ice Management Vessel (IMV) that was commissioned by Baffinland to serve as an escort vessel to ore carriers during the spring and fall shoulder seasons."* Further, *"Currently there are limited opportunities to run the ship board observer program throughout the entirety of the season. The MSV Botnica (or similar type vessel) provides a safe and appropriate vessel for conducting the ship-board observer program unlike the ore carriers or fuel/re-supply vessels because the MSV Botnica provided a safe climate-controlled viewing platform 20 m above sea level, where port and starboard-stationed Marine Wildlife Observers (MWOs) could comfortably and more effectively observe marine mammals and birds and record observations"* and *"Baffinland has been working with the MEWG to investigate other opportunities or options to employ the SBO program throughout the shipping season, including holding dedicated meetings in 2017 and 2018 on the subject. No other viable options were put forward in those discussions."*

In addition, in Golder's Integration Report, Table 1 p.ii, there is a clear statement regarding the results of the shore-based monitoring that *"Results are inconclusive because of the high spatial and temporal variability in abundance and distribution of narwhal. Some of the highest abundances of narwhals were observed in conjunction with some large vessel transits. At other times the narwhals appear to have left Milne Inlet, but the causal link to vessel transits is unclear"*.

In DFO's final submission to the NIRB on September 23, 2019, in recommendation 3.9.1, DFO recommended that: *"all project related vessels (e.g., icebreakers, escort vessels, ore carriers) have MWOs present for the entire shipping season (e.g., port to port). If this not logistically possible, an alternative plan should be developed by Baffinland to monitor presence and behavior of marine mammals."*

In response to DFO recommendation 3.9.1 as quoted above, Baffinland responded stating: *"Placing marine wildlife observers on ore carriers as they enter the RSA is not an option due to safety and logistical limitations."*

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| | <p><i>It is also unfeasible to place MWOs on each vessel from their originating and terminating ports, which would be required as Milne Port is not equipped to process such arrivals to enter Canada from another country [...] The ship-based observer (SBO) program was re-instituted when a safe and logistically feasible opportunity presented itself [...] However, potential effects of shipping on marine mammals during the open water season are collected through other ongoing monitoring programs implemented by Baffinland including marine mammal aerial surveys, the Bruce Head Shore-based Monitoring Program, the Passive Acoustic Monitoring (PAM) program and the Narwhal Tagging Program. These programs collectively provide for data evaluation of potential interactions of vessels with marine mammals during the entire shipping period."</i></p> <p>In Baffinland's Updated Phase 2 Package, on page 3 of Attachment 2, referencing DFO 3.9.1, Baffinland provided the following commitment: <i>"Baffinland will implement an incidental marine mammal monitoring program with vessel operators calling on Milne Port, which will request incidental observations of marine mammals to be recorded and relayed to Baffinland. In support of this program, Baffinland will develop educational materials for vessel crew to assist in marine mammal identification and data recording. Baffinland will provide a draft of the materials and program for review by the MEWG before they are finalized."</i></p> |
| Importance of issue to the impact assessment | It is important to have experienced Marine Mammal Observers aboard ore carriers to monitor reactions and provide localized measures of marine mammal densities along the shipping route. |
| Detailed Review Comment Gap/Issue Disagreement with Addendum/TSD conclusion Reasons for disagreement with Addendum conclusion | <p>With the proposed introduction of increased shipping, it is likely that the risk and incidence of Arctic bowhead whale injury and mortality from vessel traffic will increase. DFO notes that Bowhead face similar risks as North Atlantic Right Whale in terms of ship strikes. Vessel strikes and fishing gear trauma have been documented in bowhead, but at a much lower rate than in Right Whales (see Reeves et al. 2011), likely due to the lower amount of vessel traffic and fishing activities in the Arctic. Ship strikes typically go undocumented, largely due to the fact that <u>most whales are negatively buoyant and sink rather than wash ashore or float</u> (Allison et al. 1991 in Lawson and Lesage 2013). Additionally, in the Arctic there is a lowered capacity to detect whales or collisions from ships or icebreakers as a result of prevailing light and weather conditions (Lawson and Lesage 2013). Lawson and Lesage (2013) also highlight the characteristics that make Bowhead vulnerable to ship strikes (e.g., low degree of escape response).</p> |

DFO notes there is still a risk of ship strike and mortality related to strike when vessels go below 9 knots, although decreased. For the north Atlantic right whales, there was no reported mortality in Canada in 2018, but there were 9 mortality in Canada in 2019, 3 of them have evidence compatible with a vessel strike, the cause of the other 6 mortality have yet to be determined. There was no 10 knt limit in 2017, but there was a limit in 2018 and 2019. Whales strikes occurred between mid-June and mid-July and it appears that it is a distribution/behaviour factor in 2017 and 2019 that made the whales more susceptible to ship strikes. Therefore, DFO notes the slow down mitigation reduces the risk of mortality but does not eliminate it.

The impact of vessel strikes on bowhead whales is likely underestimated based on the current level of marine mammal ship based observing effort and assessment. Although there are few bowhead sighted within the LSA and at the Milne Port site, the proportion of bowhead within the RSA in Baffin Bay and along the alternate route in Lancaster Sound would be greater. Additionally, the seasonality of when bowhead would be impacted by the Project does not temporally correlate with when the monitoring took place.

Although beluga and narwhal would be expected to be less vulnerable to ship strikes than bowhead whales, there is still a risk, particularly based on the increases in voyages, ship size and expanding the season into the shoulder seasons when whales have begun their migrations. In addition, as the ice environment continues to change from climate change, the removal of sea-ice choked points means that other whales are venturing farther north into the Canadian Arctic, including Baffin Bay to take the advantage of the productive summer months (e.g., Killer whale, Sperm whale, Fin whale)(Higdon and Ferguson 2009, Higdon et al. 2011, Sheldon et al. 2017). The Baffinland shipping corridor crosses perpendicularly to the migration corridor for many of these summer species.

DFO notes that the shore-based program was designed to monitor the behaviours and group structure of narwhals in presence/absence of ship as well as their direct reactions to ship and not designed to provide abundance. The results from the 2014-2017 Bruce Head shore-based Monitoring Program indicate that the relative abundance of narwhal in the Bruce Head area has remained relatively constant over the four years of sampling, despite the relative increase in shipping over this period (page 9-10 Hemmera memorandum to BIM October 15, 2019). DFO isn't confident

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| | <p>in the statistical power to detect changes in relative abundance based on the shore-based observation.</p> <p>DFO notes that Baffinland's statement that "<i>Data indicates that a dedicated observer could be effective in reducing the risk of colliding with a whale</i>" (Assessment of Icebreaking Operations, p. 70), supports DFO's recommendation that an MWO should be on board on every vessel related to the project and its activities, even outside of the shoulder seasons (DFO 2019a). DFO notes the 2018 program; only saw marine mammal observers for the shoulder seasons aboard the ice-breaking vessel and that data collected during the open water season, is vital for monitoring effects to marine mammals.</p> <p>DFO would like to discuss further with Baffinland about using technological observation techniques, such as video, infrared or heat sensing to further support the data currently being collected.</p> |
| Recommendation / Request | <p>Recommendation 3.5: DFO reiterates if having MWOs present for the entire shipping season on all project related vessels (e.g., icebreakers, escort vessels, ore carriers) is not logistically possible, an alternative plan should be developed by Baffinland to monitor presence, behavior and potential ship strikes of marine mammals.</p> |

3.6 Marine Environment: Ballast Water and Non-indigenous Species

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| Review Comment Number | 3.6 Ballast Water and Non-indigenous Species |
| Subject/Topic | Impacts of increased shipping related to aquatic invasive species (AIS) and non-indigenous species (NIS) |
| References | <ul style="list-style-type: none"> • Marine Environmental Effects Assessment (TSD 17): Section 3.7.3 (p. 65) • TSD 21, Risk Assessment for Introduction of Aquatic Invasive Species from Ballast Water, Summary; Section 4 • DFO Technical Review Comments to the NIRB, March 2019, Technical Comment 3.8 • Baffinland Iron Mines Corporation. March 26, 2019. Technical Comment Responses, Phase 2 Proposal – Mary River Project: DFO 3.8.1, DFO 3.8.2, DFO 3.8.3, • Baffinland Iron Mines Corporation. March 31, 2019. Ballast Water Management Plan: Section 4, pg. 13–14, pg. 8; pg. 7; Section 2, pg. 9; Section 3.2, pg. 13 |

- Baffinland Iron Mines Corporation. May 13, 2019. Draft Shipping and Marine Wildlife Management Plan (SMWMP): Page 11; Section 6.6, pg. 76
- Final Written Comment Responses Phase 2 Proposal – Mary River Project, Baffinland, Appendix N, Attachment 3: Golder Associates Ltd. 2019. Technical Report - Ballast Water Dispersion Modelling - Ballast Water Model Validation. Submitted to Baffinland Iron Mines Corporation. 1663724-154-R-Rev0. 09 October 2019.
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- Final Written Comment Responses Phase 2 Proposal – Mary River Project, Baffinland, October 15, 2019, pages 53-54
- Baffinland Iron Mines Corporation, DFO Final Written Submission Disposition Table, received by DFO on October 31, 2019.
- Baffinland Iron Mines Corporation, Phase 2 Proposal Updated Information Package, Attachment 2 – Commitments and terms and condition following the Public Hearings, January 6, 2020

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| | <p>Goldsmith, J., Nudds, S.H., Stewart, D.B., Higdon, J.W., Hannah, C.G., and Howland, K.L. 2019. Where else? Assessing Zones of Alternate Ballast Water Exchange in the Canadian Eastern Arctic. <i>Mar. Pollut. Bull.</i> 139:74–90.</p> <p>Laget, F. 2017. Transport d'espèces de dinoflagellés non-indigènes dans l'Arctique Canadien, suite au déversement des eaux de ballast par un navire domestique. M.Sc. Thesis. Université du Québec à Rimouski. 130 p.</p> <p>Locke, A., Mandrak, N.E., and Therriault, T.W. 2011. A Canadian rapid response framework for Aquatic Invasive Species. DFO Can. Sci. Advis. Sec. Res. Doc. 2010/114. vi + 30 p.</p> <p>Stewart, D.B., Nudds, S.H., Howland, K.L., Hannah, C.G., and Higdon, J.W. 2015. An ecological and oceanographical assessment of alternate ballast water exchange zones in the Canadian eastern Arctic. DFO Can. Sci. Advis. Sec. Res. Doc. 2015/037. vi + 75 p.</p> <p>Tremblay, P. 2017. Évaluation du risque potentiel d'introduction d'espèces non-indigènes de mésozooplancton suite au déversement des eaux de ballast d'un navire domestique dans l'Arctique Canadien. M.Sc. Thesis. Université du Québec à Rimouski. 126 p.</p> |
| <p>Summary</p> | <p>In TSD 17, under section 3.7.3 on page 65, Baffinland states: <i>“There is a potential of introduction of invasive species and harmful bacteria and parasites that may negatively affect Arctic char health and conditions. The AIS risk assessment and mitigation measures are discussed in Section 3.6.4. As the result of the mitigation measures implemented by Baffinland, the residual effect from AIS introduced with ballast water will be negligible (Table 3-12).”</i></p> <p>In TSD 21 Summary, Baffinland states: <i>“The study determined that, with the large volume of ballast water discharged, the probability of AIS being introduced at Milne Port is very high. However, the risk assessment does not take into account potential mitigation measures against the introduction of AIS.” [...] “In addition, Baffinland’s Shipping and Wildlife Management Plan, and Aquatic Invasive Species Monitoring Programs will be updated to address the increase in ballast water discharge volume as well as ballast water treatment options and monitoring.”</i></p> <p>Baffinland states that <i>“the Proponent shall develop and implement an effective ballast water management program that may include the treatment and monitoring of ballast water discharges in a manner consistent with applicable regulations and/or exceed those regulations if</i></p> |

they are determined to be ineffective for providing the desired and predicted results.” (Ballast Water Management Plan, p. 8).

Modelling

In recommendation 3.10.1 in DFO’s final submission, submitted to NIRB on September 23, 2019, DFO recommended: *“In order to DFO properly assess the ballast release, DFO recommends [...] The ballast water dispersion model and analyses be complete.”* Baffinland responded with the following: *“Comparison with 2018 seasonal data has been completed and provided in a Technical Report (Appendix N) with appendices.”*

On page 1 of the Golder Ballast Water dispersal Technical report, referenced in Baffinland’s response to DFO recommendation 3.10.1, it states: *“Golder performed the tasks described...1) validated the ballast water dispersion model to observed 2018 oceanographic data and updated the model with improved wind data, estimates of discharge from Phillips Creek, and more spatially resolved heat-flux inputs (i.e., air temperature and humidity)”*. Further, on pg. 26, it states *“Based on the conclusions and under the current ballast water disposal methods, Golder believes that re-running the Phase 2 model is not warranted as the anticipated Phase 2 conditions are not expected to alter the ballast water dispersion results”*. On page 27 of the report, it states: *“Estimates of ballast water discharge volumes and characteristics (i.e., salinity and temperature) were based on available 2018 ballast water discharge records”* (a total of 71 vessels).

Baffinland reports ballast water dispersion results as minimum dispersion over the three-month simulation. *“Figure 24 presents the minimum ballast water dilution at each horizontal location over the 3-month simulation..... The larger the dilution factor the lower the concentration value and so the minimum dilution is a proxy for the highest ballast water concentration. In the immediate vicinity of the discharge point at the Milne Port Ore Dock the ballast water is diluted by 1 to 50 times...”* (p. 23) and that *“The ballast water Box Model Analysis addresses the potential incremental increase and/or decrease in ambient water temperature and salinity as a result of ballast water discharge at Milne Port”* (p. 25).

Exchange and Treatment

In recommendation 3.10.2 in DFO’s final submission, submitted to NIRB on September 23, 2019, DFO recommended: *“All project vessels use ballast water treatment plus exchange strategy.”*

In response to DFO recommendation 3.10.2, Baffinland states: *“Baffinland has put into place additional measures that exceed regulatory and industry standards to include the requirement for all vessels calling on Milne Port that treat their ballast under the D2 Standard to also perform a ballast water exchange prior to treatment.”*

In Baffinland’s Updated Phase 2 Package, on page 3 of Attachment 2, referencing DFO 3.10.2, Baffinland provided the following commitment: *“Baffinland will revise the Ballast Water Management Plan to include a requirement for all vessels to conduct ballast water exchanges (with or without D2 treatment systems) prior to calling on Milne Port, until such a time that ballast water treatment systems are compliant with the D2 standards set by the IMO. Should Baffinland wish to discontinue the practice of exchange plus treatment, Baffinland will provide updated ballast water modelling that reflects the range of salinity that may be present in the ballast water tanks where no exchange occurs.”*

D2

In recommendation 3.10.3 in DFO’s final submission, submitted to NIRB on September 23, 2019, DFO recommended: *“Monitoring of all ballast water discharges for compliance with Regulations D-1 and D-2, which includes a provision requiring the ballast water of each ship is tested to confirm that it meets Canadian requirements for salinity (at least 30 ppt) and number of viable organisms (Regulation D-2) prior to discharging.”*

In response to DFO recommendation 3.10.3, Baffinland states: *“Baffinland has committed to implementing a pilot ballast water biological monitoring program for ships currently only subject to the D1 standard (open water exchange). This program has been designed to reflect a more appropriately scoped form of a ballast water sampling protocol provided by DFO to Baffinland in 2017 and will include sampling from one ballast tank on a total of five vessels per shipping season. Baffinland remains committed to continue conducting temperature and salinity test sampling of one randomly selected ballast water tank for all vessels calling to Milne Port, and biological sampling in the marine receiving environment to monitor for non-native species in Milne Port and at Ragged Island. The Ballast Water Management Plan will be updated post-Phase 2 Proposal approval to reflect the commitments described above.”*

Sampling Programs

In the disposition table provided to DFO on October 31, 2019, in reference to DFO recommendation 3.10.3, Baffinland provided the following as a commitment: *“Baffinland will implement a pilot ballast water biological monitoring program for ships calling on Milne Port. This program will be designed to reflect a more appropriately scoped form of a ballast water sampling protocol provided by DFO to Baffinland in 2017. This program will include sampling from one ballast tank on a total of five vessels per shipping season.”*

In response to DFO recommendation 3.10.4, Baffinland states: *“See response to DFO-3.10.3”*.

As provided under the commitment heading in the distribution table provided to DFO by Baffinland on October 31, 2019, in relation to DFO recommendation 3.10.4, Baffinland indicated that they *“cannot implement biological sampling program. Biological growth is typically limited to the deepest sections of the hull, so the only way to collect samples in these areas is to use divers. This would require ‘lock out’ of the vessel, which is not possible on our ore carriers. We do collect biological AIS data for hull biofouling via high definition ROV video surveys of the hulls – this is undertaken on a subset of the vessels calling to port each summer (this occurred in 2018 and 2019, and will be the plan moving forward).”*

Species of Concern

In recommendation 3.10.5 from DFO’s Final Submission to the NIRB on September 23, 2019, DFO recommended that Baffinland conduct *“An assessment of potential biological and ecological effects of ballast discharge and identification of the high risk species or groupings of species of concern. These species may include, but not be limited to any NIS/AIS that have been detected in the course of past AIS/MEEMP monitoring, and should be updated in the event that new NIS/AIS are detected in future monitoring.”* In response, Baffinland stated: *“Identification of high-risk biological species or groupings of species of concern is the responsibility of DFO. Baffinland will continue to share all results of the Marine Environment Effects Monitoring Program and AIS Monitoring Program with DFO to assist in this regard.”*

In Baffinland’s updated Phase 2 package, on page 4 of Attachment 2, in relation to DFO recommendation 3.10.5, it states: *“Baffinland will update the AIS monitoring program to describe the process it follows for*

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| | <p><i>identifying high-risk biological species discovered through its sampling programs.”</i></p> <p><u>Early Response Plans</u></p> <p>In DFO’s final submission to NIRB on September 23, 2019, recommendation 3.10.6, DFO recommended: <i>“An early response plan (similar to an oil spill response plan) be developed with applicable regulators and local communities so that, should an NIS/AIS be detected, significant environmental effects or major change to species composition could be avoided”</i>. Baffinland responded as follows: <i>“ In Baffinland’s March 2019 response to Technical Comment DFO 3.8.2, Baffinland has committed to the following: “Should it be confirmed that an AIS has become established in the Project area and that this introduction was a direct result of Baffinland shipping operations, Baffinland is committed to working with DFO to develop management actions for control of the AIS in accordance with DFO’s Canadian Action Plan to Address the Threat of AIS. The level of intervention would correspond proportionally to the level of threat of the AIS.” This commitment was reiterated to DFO following the June technical meetings with the following “Baffinland will work with DFO to develop a management and response approach in the event a non-indigenous species is identified during monitoring.” It is also noted that Baffinland’s management of AIS is focused on prevention through regular ship inspections and on-board ballast water testing (as outlined in Baffinland’s BWMP) and through comprehensive AIS monitoring in the marine receiving environment as outlined in the Marine Environment Effects Monitoring Program and AIS Monitoring Program Annual Reports.”</i> In their updated Phase 2 package, on page 4 of Attachment 2, in relation to DFO recommendation 3.10.6, Baffinland committed to: <i>“Baffinland will work with DFO to develop a management and response approach in the event a nonindigenous species is identified during monitoring. This response approach will be added an attachment to the AIS monitoring program.”</i></p> |
| Importance of issue to the impact assessment | <p>Introduction of aquatic invasive species may result in high risk negative impacts to the natural environment including fish and marine mammals and their habitat, and it’s important to adequately assess and mitigate the risks of spreading unwanted species to the project area.</p> |
| Detailed Review Comment Gap/Issue | <p>There are concerns that domestic ballast water release could result in the spread of species to non-native areas as well as the secondary spread of non-native species across Canada. DFO notes that Baffinland has concluded that with implementation of mitigation plans and continuing aquatic invasive species (AIS) monitoring, the residual effect from AIS</p> |

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| <p>Disagreement with Addendum/TSD conclusion</p> <p>Reasons for disagreement with Addendum conclusion</p> | <p>introduced with ballast water, will be negligible. However, DFO notes the increase in shipping activity, number of ballast discharges, and size of vessels will increase the risk of species introductions. Even with the use of ballast water exchange, there is a potential for some number of new species to be introduced by ballast water. DFO notes that it's important not to overlook the fact that the risks of AIS arrival are high and emphasizes the importance of implementing appropriate mitigation and monitoring to reduce the risk of introducing AIS and non-indigenous species (NIS). DFO reiterates concerns about the need for a commitment from Baffinland to provide an updated Ballast Water Management Plan.</p> <p><u>Modelling</u></p> <p>Based on the information provided in Golder's 2019 'Technical Report - Ballast Water Dispersion Modelling - Ballast Water Model Validation', DFO understands that ballast water discharge is occurring at the Milne Port dock and anchorages. DFO is unclear if discharge is also occurring at the Ragged Island anchorages, and how this is incorporated into the model. Knowledge of locations where vessels discharge ballast prior to ore loading is of fundamental importance for modelling areal extent and magnitude of effects from ballast discharge on the marine environment. It is also important for informing where monitoring of marine species including AIS should be carried out. DFO requests confirmation as to where vessels have been discharging ballast to date and how Baffinland tracks and validates this information.</p> <p>DFO is satisfied that available quantitative metrics were included in the model validation section of Golder's 2019 'Technical Report - Ballast Water Dispersion Modelling - Ballast Water Model Validation'. However, DFO notes that the model used overestimates the current speed and underestimates the stratification of the water column, which would result in overestimating the dispersion of ballast water close to the discharge location and that the hydrodynamic model does not perform well close to Milne Port.</p> <p>DFO notes that the biological importance of the modelled results is most relevant with respect to the extent of the plume and what that may mean for the spread of organisms including non-indigenous species (NIS) and aquatic invasive species (AIS) that could be entrained in ballast (i.e., simulated particles). The dispersion of ballast water, with or without simulated particles (i.e., proxy NIS/ AIS), is mainly driven by advection (currents) and a dispersion model requires reasonable representation of</p> |
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the currents (speed and direction). Specialized instrumentation is required to accurately measure the currents, in particular the direction of the currents, at high latitudes. Baffinland acknowledges that precautions were not taken to ensure accurate measurements of the currents and an estimate of the uncertainty in the current direction is not provided. As a result, the model's ability to simulate ballast water dispersion is inconclusive, however it is useful in identifying gaps and inadequacies with data collected to date.

Additionally, DFO is unclear if the reported dilution "*at the Milne Port Ore Dock the ballast water is diluted by 1 to 50 times*" is at the end of the 3-month simulation or if it represents the minimum dilution (or maximum concentration) predicted at any one time over the 3 month simulation period. DFO suggests that a time-series of concentration for a selection of locations could be used to see how this metric is changing throughout the simulation. A minimum dispersion of 1 (maximum concentration) for an extended period of time at a given location could have adverse effects on the marine ecosystem. Additionally, DFO is concerned that only the results at the end of a 3-month shipping season is presented. Potential impacts are likely to occur when there are higher concentrations discharged over short time frames (i.e., discharge 'event'). DFO notes that it is difficult to evaluate the impact of the events without having the results of the entire 3-month simulation.

Section 3.2 of Golder's 2019 'Technical Report - Ballast Water Dispersion Modelling - Ballast Water Model Validation' provides estimates for the amount of ballast water discharged in 2018, with the assumption that each of the 71 vessels discharged 24,000 m³, over a period of one day, for a total of 1,740,000 m³ (metric tonnes) for 2018. DFO notes that shipping under the Phase 2 scenario is expected to be approximately 2.5 times this amount, for a total of 176 ore carriers and using the current modelling results is an inappropriate extrapolation/application from the present study. DFO is unclear what the expected Phase 2 conditions will be and how they are expected to compare to the statistics used from 2018. In DFO's opinion, re-running the simulation with the expected Phase 2 conditions is warranted given the uncertainty in the present results, and the expected increase in shipping and ballast volume.

Exchange and Treatment

Research has demonstrated that vessels moving ballast water between ports within Canadian waters, particularly between different regions (e.g.,

Atlantic and Arctic) can pose a significant risk for introduction of AIS (Chan et al. 2012, Casas-Monroy et al. 2014, Laget 2017, Tremblay 2017). Risk for these vessels can be reduced substantially by all vessels be required to conduct exchange and treatment as a combination method.

DFO commends Baffinland on their commitment to require all vessels calling on Milne Port that treat their ballast, to also perform a ballast water exchange prior to treatment. However, DFO notes the order with which exchange and treatment will be carried out has implications for efficacy of these ballast management measures. DFO believes Baffinland should additionally commit to exchange being carried out prior to treatment for all vessels, as this combination is expected to have higher efficacy (DFO 2019c).

DFO notes that risk for introduction of AIS can be reduced further through vessels conducting exchange in appropriate locations, such as proposed alternate ballast exchange zones for the eastern Arctic that were identified through science-based risk assessment (DFO 2015b, Stewart et al. 2015, Goldsmit et al. 2019a).

Further, DFO is unclear on what would trigger Baffinland to discontinue exchange plus treatment practices. Given that reliability of systems are known to vary depending on environmental conditions and that performance in colder, polar conditions is not well understood, DFO believes that continued testing will ensure that project vessels are operating in a manner to minimize the risk of introducing AIS.

D2

DFO is unclear how Baffinland intends to verify compliance with D2 standards for all vessels that will be calling on Milne Port.

DFO notes that sampling of 5 out of the 176 expected vessels/year is not expected to be representative given the range of ballast management measures, source ports, exchange locations, and transit times, all of which are known to affect quantity and types of biota in tanks. Additionally, DFO does not support sampling of only 1 tank per vessel since compliance monitoring on the Great Lakes indicates that when noncompliance occurs, it is typically only one or two tanks per vessel that are noncompliant. Tanks within a single ship are rarely managed identically, with individual tanks having ballast sourced from different locations or being exchanged at different positional coordinates. Sampling should be conducted in a

more comprehensive manner to improve the probability of detecting non-compliant tanks across a variable population of tanks. This should also provide representative sampling and buffer against chances of sampling a single outlier.

Sampling Programs

DFO notes that in order to assess the marine fish community in relation to water masses, more intensive seasonal sampling for marine fish and invertebrates should be undertaken. DFO notes that a proper monitoring and sampling plan would allow ship owners, as well as Baffinland, to evaluate the level of risk for species introductions, develop appropriate mitigation strategies to reduce risk, and inform if a potential introduction occurs.

Biofouling of vessels is an important vector for the transfer of species. DFO previously provided an example of a potential ballast sampling protocol, which could be adapted as needed and notes there are also a variety of examples of different sampling methods for sampling ballast in the scientific literature which could be considered. Baffinland indicated that they cannot implement a biological program due to locations of biological growth on vessels, the need to use divers and the associated requirements of 'lockout' during collections. DFO is aware of the required lockout safety procedures when diving around commercial vessels, however, this type of sampling of cargo vessels with divers has been successfully carried out (Chan et al. 2015). Further, DFO notes that ore carriers generally spend extended periods at anchor at both Ragged Island and Milne Port.

Baffinland has also indicated that they collect biological AIS (Aquatic Invasive Species) data for biofouling via high definition ROV video surveys of the hulls for a subset of vessels. DFO would like to confirm what annual proportions of vessels has been surveyed to date, what proportion Baffinland proposes to survey in the future, and how vessels would be selected for sampling. DFO notes that niche areas of vessels, such as sea chests, propellers or anchor chains, should be examined as part of these surveys. It's necessary to know how many organisms were identified to species level in past surveys and Baffinland proposes to assess identities and quantities of different biofouling organisms, including non-native species that are potentially being transported on project vessels, using video-based approaches, given that a number of these taxa require dissection or microscopic methods to distinguish one species from another.

Species of Concern

DFO notes that Baffinland does not assess what potential biological and ecological effects may occur and the risk of AIS establishment and that a proper assessment of ballast discharge, which identifies the high risk species or groupings of species of concern, should be conducted. These species may include, but not be limited to any NIS/AIS that have been detected in the course of past AIS/MEEMP monitoring, and should be updated in the event that new NIS/AIS are detected in future monitoring. Conducting this assessment would be a proactive approach that can help in determining geographic locations where monitoring for NIS/AIS should be focused and if there should be more rigorous surveillance for particular species with a high risk for introduction. DFO maintains that it should be Baffinland's responsibility to obtain information on what types of organisms the Mary River Project could potentially introduce through project shipping activities and to conduct risk assessments to determine which of those species may be of higher risk for introduction/impact. This information will enable Baffinland to determine if certain species should be more intensively screened/monitored for, whether on vessels, in ballast, or in the receiving environment and can also inform development of species-specific early response plans.

Early Response Plans

With the information developed from the above suggestion, Baffinland could develop targeted rapid response plans for these high risk species/groups of concern. Species specific response plans can be developed and tailored based on aspects of an organism's life history and knowledge of eradication or control measures that have been successful for that species or similar species in other locations.

DFO is concerned that the monitoring program proposed by Baffinland, will not be sufficient, to test and assess the mitigation measures for release of NIS/AIS into the aquatic environment. DFO notes an early response plan (similar to an oil spill response plan), developed with applicable regulators and local communities is essential to mitigate environmental effects or major change to species composition could be avoided, should an NIS/AIS event occur. DFO notes that the early response framework developed by Locke et al. (2011), may be a good reference for developing this type of plan. Additional examples of response plans are the United States Parks Service, the Grand Portage Band of Lake Superior Chippewa's Emergency Prevention and Response Plan for Viral

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| | Hemorrhagic Septicemia and the International Joint Commission's Aquatic Invasive Species Rapid Response Policy Framework Work Group's policy framework. |
| Recommendation / Request | <p>Recommendation 3.6: In order to DFO properly assess the ballast release, DFO recommends that, prior to initiating increased shipping for the Phase 2 development, Baffinland provide the following:</p> <p><u>Modelling</u></p> <p>3.6.1 Clarification on where vessels have been discharging ballast to date and how Baffinland validates/tracks this information.</p> <p>3.6.2 A commitment to including discharge coordinates in ballast reporting.</p> <p><u>Exchange and Treatment</u></p> <p>3.6.3 A commitment that exchange will be carried out prior to treatment for all vessels conducting exchange plus treatment procedures.</p> <p>3.6.4 Clarify what would trigger Baffinland to discontinue exchange plus treatment practices</p> <p><u>D2</u></p> <p>3.6.5 Clarification on how Baffinland intends to monitor ballast water discharges for compliance with D2 regulations</p> <p><u>Sampling Programs</u></p> <p>3.6.6 A commitment to develop of a biofouling sampling program, approved by DFO and completed prior to increase shipping activities for Phase 2, which specifically includes physical collection of organisms in a representative, standardized and comprehensive manner (sampling of hull and niche areas) that will allow for identification of non-native species that may be transported through project shipping.</p> <p>3.6.7 A commitment to update the monitoring plan, to include more intensive sampling, which includes greater seasonal and spatial coverage, increased sample sizes to address concern related to statistical power for detection, clear protocols for determining identity and status of species (native, non-indigenous or cryptogenic).</p> <p><u>Species of Concern</u></p> |

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| | <p>3.6.8 An assessment of potential biological and ecological effects of ballast discharge and identification of the high risk species or groupings of species of concern. These species may include, but not be limited to any NIS/AIS that have been detected in the course of past AIS/MEEMP monitoring, and should be updated in the event that new NIS/AIS are detected in future monitoring.</p> <p><u>Early Response Plans</u></p> <p>3.6.9 A commitment to develop an appropriate early response plan with a clear sequence of events to be followed in the event that a non-indigenous species is introduced and/or becomes established.</p> <p>3.6.10 A commitment to develop taxa-specific response plans for high risk species or groups of species identified through species level risk assessments. These could be informed by known vessel origins prior to arrival at the project.</p> |
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3.7 Marine Cumulative Effects

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| Review Comment Number | 3.7 Cumulative Effects |
| Subject/Topic | Cumulative effects assessment and impacts resulting from cumulative project impacts |
| References | <ul style="list-style-type: none"> • TSD 27 • Knight Piésold Consulting's Memorandum to TSD27 – Cumulative Effects Assessment, Section 4.3, p. 19–23. • Disposition Table from the June 2019 Technical Meeting for the Mary River Project Phase 2 Development • Revised Addendum to Technical Supporting Document 27 - Cumulative Effects Assessment. August 26, 2019. Section 4.3.3, Pg. 36 • DFO. 2019a. Science Review of the Phase 2 Addendum to the Final Environmental Impact Statement for the Baffinland Mary River Project. DFO Can. Sci. Advis. Sec. Sci. Resp. 2019/015. • Baffinland Iron Mines Corporation. August 15, 2019. Animation of Simulated Vessel Movements with Estimated Sound Field |
| Summary | Baffinland presents information on the cumulative effects to marine mammals in TSD 27 and Knight Piésold Consulting's Memorandum to TSD27 – Cumulative Effects Assessment, Section 4.3, p. 19–23. |

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| | <p>DFO notes that in the Disposition Table from the second Technical Meeting in June 2019, Baffinland committed to “review Section 4.3.2 of the Cumulative Effects Assessment and if necessary, provide more detailed references, literature and monitoring program details leading to conclusions on potential for Narwhal cumulative effects.” Baffinland then provided the ‘Revised Addendum to Technical Supporting Document 27 - Cumulative Effects Assessment’ on August 26, 2019.</p> <p>Page 36 of the Revised Addendum to TSD 27 under section 4.3: Cumulative Effects to marine mammals, Baffinland concludes that “With the effective implementation of mitigation, the residual disturbance effects on narwhal from cumulative underwater noise sources are predicted to be moderate in magnitude (Level II), confined to the LSA (Level I), intermittent (Level II) in frequency, short-term (Level I) for pile driving and medium-term (Level II) for shipping, and fully reversible (Level I). The residual environmental effect is predicted to be not significant.”</p> <p>Baffinland’s contracted third party reviewer, Hemmera, noted that it is “unknown whether continued exposure to shipping and icebreaking operations over time will result in habituation (i.e., a decrease in response to stimuli despite continual exposure) or whether narwhal will experience increased stress levels (because they are unwilling to abandon the area), with potential fitness consequences”, (p.12 section 3.1.1.2).</p> <p>In recommendation 3.11.2 from DFO’s Final Submission to the NIRB on September 23, 2019, DFO recommended that Baffinland “conduct a thorough cumulative effects analysis and assessment examining all the combined impacts of all the Project activities inside and outside the study areas. This should include a final assessment on the expected available quiet time during the shipping season and whether the Phase 2 development will in fact result in continuous noise through the shipping route.”</p> <p>Baffinland’s response included the following: “The Phase 2 development will not result in continuous noise along the shipping route. Table 1 presents the aggregate number of vessels in the RSA per month, based on both Project and estimated known non-project related vessel traffic” and “The predicted ‘cumulative daily’ noise exposure period for disturbance is predicted to be, on average, up to 11.4 h (48% of the day), equivalent to > 12 h of quiet time (52% of the day), and under a ‘worst case’ scenario, up to 16.2 h (68% of the day), equivalent to ~8 h of quiet time (32% of the</p> |
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| | <p>day). Again, these estimates are based on acoustic modelling results, and are therefore considered to be conservative.” Further, “For the early shoulder season, it is assumed that only Project vessels would be active in the RSA. Therefore, daily noise exposure periods presented for the early shoulder season in Baffinland’s response to DFO-3.8.1 would apply” and “Baffinland is confident that these cumulative daily noise exposure periods are, in reality, considerably shorter.”</p> |
| Importance of issue to the impact assessment process | <p>It’s important to have a cumulative combined impact assessment on marine mammals, to fully understand and review project impacts.</p> |
| Detailed Review Comment <ol style="list-style-type: none"> 1. Gap/Issue 2. Disagreement with conclusion 3. Reasons for disagreement with conclusion | <p>DFO notes that noise will have a negative impact on marine mammals. The large number of vessels transiting from the Milne Port and those awaiting entry may deter whales from entering Eclipse Sound. This highlights the concern that narwhal will be impacted by continuous noise. The cumulative noise soundscape is a necessary component of the cumulative effects assessment. Before making a proper review of the noise due to vessel traffic in the area, DFO notes that additional sources should be incorporated to adequately address the total noise along the shipping route. DFO notes the vessels included in the animation are all related to the project, but it is not reflective of the total noise.</p> <p>Baffinland provides information on how noise might impact marine mammals in the RSA including injury, disturbance, and communication masking. However, DFO is concerned that Baffinland does not consider the effect of all project related noise on marine mammal habitat and other ecosystem components. For example, Baffinland does not consider the impact of noise on fishes (e.g., Radford et al. 2014) which are the prey of marine mammals. A change to marine mammal prey abundance and availability in addition to the other project related impacts could adversely impact marine mammal stocks. DFO notes that impacts of noise on fishes as this is a gap in Baffinland’s assessment.</p> <p>Baffinland’s conclusion of cumulative impacts to narwhal reads: “<i>residual disturbance effects on narwhal from cumulative underwater noise sources</i>” (Revised Addendum to TSD 27, s.4.3.3, pg. 36). DFO is concerned that marine mammals will be impacted by noise from shipping and project construction, but also by icebreaking, potential oil spills, etc. and not only in the RSA. DFO is concerned that the project effects were not evaluated as a whole. Baffinland assessed that none of the project effects are significant taken separately but when all the effects are taken additively, the overall project may have significant impacts to narwhal, bowhead and</p> |

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| | seals. DFO further notes that in response to DFO recommendation 3.11.2, Baffinland only mentioned impacts related to noise. A cumulative or combined effects assessment should consider all project impacts including but not only including noise. It's important that Baffinland provide a thorough analysis and assessment examining all the combined impacts, not individual (DFO 2019a), of all the project activities inside and outside the study areas. |
| Recommendation/Request | Recommendation 3.7: DFO recommends that Baffinland conduct a thorough analysis and assessment examining all the combined impacts of all the Project activities inside and outside the study areas. |

3.8 Freshwater Watercourse Crossings

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| Review Comment Number | 3.8 Watercourse crossings |
| Subject/Topic | Locations and types of proposed watercourse crossings |
| References | <ul style="list-style-type: none"> • DFO Technical Review Comments to the Nunavut Impact Review Board (NIRB), March 7, 2019. Technical comments 3.10.1 and 3.10.3. • Updated Application for Amendment No. 2 of Type A Water Licence, Attachment 13.2: North Railway Freshwater Habitat Survey, Appendix 1, Table A1-1 • Updated Application for Amendment No. 2 of Type A Water Licence, Attachment 13.1, Appendix 2: List of North Rail Infrastructure Interactions with Fresh Water, Table A2-1 • Updated Application for Amendment No. 2 of Type A Water Licence, Attachment 13.3: North Railway Catchments • Updated Application for Amendment No. 2 of Type A Water Licence, Attachment 13.1 appendices: Project Infrastructure Interactions With Fresh Water Streams and Ponds • Updated Application for Amendment No. 2 of Type A Water Licence, Attachment 13.8: North Railway Bridge Drawings, pg. 7-10 of 32 (Adobe PDF) • DFO Information Requests (IRs) to the Nunavut Water Board (NWB), May 14, 2019. DFO IR 1b. • Baffinland Iron Mines Technical Meeting No. 2 Disposition Table as of July 3, 2019, Appendix A of the July 4, 2019 correspondence to NIRB. DFO 3.10.3, page 8 of 23 (Adobe PDF) • DFO Technical Review Comments to the NWB, July 2019, Technical Comment 3.1, recommendation 3.1.1 |

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| | <ul style="list-style-type: none"> • Baffinland Iron Mines Corporation. August, 2019. Technical Comment Responses, Application to Amend Type A Water Licence 2AM-MRY1325, Phase 2 Proposal – Mary River Project: DFO 3.1.1 • Baffinland Iron Mines Corporation. January 6, 2020. Phase 2 Proposal Updated Information Package, Section 2.2.2. |
| Summary | <p>In DFO's technical review comments submitted to the Nunavut Impact Review Board (NIRB) (Technical Comment 3.10.1), DFO recommended <i>"Baffinland clarify when they will provide the short-list of crossings that are better suited to alternatives to CSP culverts, and provided specific details on what the short list will contain (e.g. method for the ranking and selection of options)."</i> DFO notes that Baffinland has provided an updated list of crossing in: Table A1-1 (Appendix 1 of the North Railway Freshwater Habitat Survey: attachment 13.2) of the Updated Application for Amendment No. 2 of Type A Water Licence <i>"list of crossings, cuts, encroachments/infills and bridges and 2018 fish habitat designations"</i> and Table A2-1 (Appendix 2 of the Project Infrastructure Interactions with Fish Habitat: attachment 13.1) of the Updated Application for Amendment No. 2 of Type A Water Licence: <i>"List of North Rail Infrastructure Interactions with Fresh Water."</i></p> <p>In DFO technical comment recommendation 3.1.1 to the Nunavut Water Board, DFO recommended that <i>"Baffinland provide rationale for the selection of crossing infrastructure for fish bearing watercourses. DFO-FFHPP notes this can be provided to DFO as part of the Proponent's 'DFO Request for Review' submission and/or Application for Fisheries Act authorization, during DFO's regulatory phase."</i></p> <p>Baffinland's response to DFO technical comment 3.1.1 as part of the NWB process, states <i>"As follow-up to the June 2019 NIRB technical meetings, Baffinland issued a July 2, 2019 memo by Knight Piésold (Additional Information on Fish Habitat Interactions), provided as Attachment 03 to this response."</i></p> <p>On page 4 of Attachment 2 of Baffinland's updated Phase 2 package in response to DFO-3.12, Baffinland has committed the following: <i>"Baffinland will provide rationale for the selection of crossing infrastructure for fish bearing watercourses, as part of the application for an authorization under the Fisheries Act for the railway."</i></p> <p>In reference to the North Railway alignment in section 2.2.2.1 of Baffinland's Phase 2 Proposal Updated Information Package, it is indicated</p> |

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| | that “Based on engagement with Inuit, alternatives to the deviation proposed in the Phase 2 FEIS Addendum have been subject to ongoing investigation based on community preferences identified during the review process.” Baffinland later confirms that “it would move forward with Route 3 as its preferred alignment should Phase 2 be approved.” The alternate routes for the North Railway alignment are illustrated in Figure 2.2 on page 8 of the Phase 2 Proposal Updated Information Package. |
| Importance of issue to the impact assessment process | Watercourse crossings of fish bearing waters have the potential to create a HADD. |
| Detailed Review Comment <ol style="list-style-type: none"> 1. Gap/Issue 2. Disagreement with conclusion 3. Reasons for disagreement with conclusion | <p>DFO acknowledges that Baffinland has provided an updated crossing list in Table A2-1 in Appendix 2 of the Project Infrastructure Interactions with Fish Habitat: attachment 13.1. However, DFO notes that Baffinlands method for the ranking and selection of options have not yet been provided. DFO submits that having a full understanding how options were ranked to inform the crossing-type selection assist in the determination of the necessity and adequacy of watercourse crossings over fish bearing watercourse crossings.</p> <p>DFO recognizes that Baffinland has selected culvert sizing based on the 1:200 year flood event and freeboard, with culverts over fish-bearing watercourses having a minimum culvert diameter of 1 m. However, DFO notes that for culverts constructed in the location of the Mary River project, considering the potential for extreme flows during freshet and the high level of difference between culverts, that culvert selection will need to be based on site specific conditions. Using the 1:200 year flood event return period will not necessarily be appropriate for all culverts.</p> <p>DFO recognizes that the final alignment and crossing designs for the North Railway are subject to change based on continued engagement with Inuit communities and applicable agencies, and will be further informed by field assessments and hydrologic modelling. The final alignment, selection of crossing infrastructure, and fish passage criteria can be discussed during DFO’s regulatory phase and submitted as part of Baffinland’s ‘DFO Request for Review’ submission and/or Application for <i>Fisheries Act</i> authorization, should the project be approved. DFO further notes that Baffinland has committed to providing rationale for the selection of crossing infrastructure for fish bearing watercourses, during DFO’s regulatory phase.</p> |
| Recommendation/Request | Recommendation 3.8: If the Project is approved, DFO recommends Baffinland provide decision criteria and decision matrix for the selection of |

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| | water crossing methods for fish bearing watercourses in support of any regulatory applications made to DFO. |
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3.9 Freshwater Fish Passage

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| Review Comment Number | 3.9 Fish Passage |
| Subject/Topic | Watercourse crossings: high velocity predictions and impacts to fish passage |
| References | <ul style="list-style-type: none"> • Surface Water Assessment (TSD 13): Section 2.5.2. (p. 16); Section 2.5.3 (p. 19); Section 2.6 (p. 21 Appendix D, (p. 1 -6; D-1 to D-6); Appendix D, Figure 1 (p. D-7); Appendix D, Appendix A, Figures A9-A12 (pages D-18 to D-21); Appendix D, Appendix B (p. B-1 to B-2) • Freshwater Biota and Habitat Assessment (TSD 14): Section 2.2.2 (p. 7-8); Section 2.5, Table 2-3 (p. 14); Section 2.5.1.2 (p. 19- 24); Appendix 1: Table 2-1 (p. 7); Section 4.2.3.2 (p. 31-32); Attachment 3, Table A3-1 (p. 117 to 120) • Conceptual Freshwater Offsetting Plan (TSD 15): Section 5.3.2 (p. 19) • DFO Technical Review Comments to the Nunavut Impact Review Board (NIRB), March 7, 2019. Technical comments 3.10.4 and 3.11.2. • Baffinland Iron Mines Technical Comment Responses, March 25, 2019. DFO 3.10.4 on page 40, DFO 3.11.2 on page 42, DFO 3.10.1 on page 37. • Email Correspondence from Baffinland to the Nunavut Water Board, April 30, 2019. • Updated Application for Amendment No. 2 of Type A Water Licence, Attachment 7.2: North Railway Design Criteria, page 23, sections 7.1.1, 7.2.1.5, 7.2.1.6, and 7.2.3. • Updated Application for Amendment No. 2 of Type A Water Licence, Attachment 13.7: North Railway Arch Bridges Hydraulic Assessment, section 8.6, page 32 • DFO Information Requests (IRs) to the Nunavut Water Board (NWB), May 14, 2019. DFO IR 1a. • DFO Technical Review Comments to the NIRB, March 2019, Technical Comment 3.10, recommendation 3.10.4 • DFO Technical Review Comments to the NWB, July 2019, Technical Comment 3.1, recommendation 3.2.1, DFO 3.2.4 • Baffinland Iron Mines Corporation. August, 2019. Technical Comment Responses, Application to Amend Type A Water Licence 2AM-MRY1325, Phase 2 Proposal – Mary River Project: DFO 3.2.1, DFO 3.2.4 |

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| <p>Summary</p> | <p>Baffinland has identified several potential fish passage issues associated with the proposed watercourse crossings, diversions, and encroachments that are a part of the Project. For example: <i>“Of 145 stream crossings in known or potential Arctic char habitat,124 crossings may present barriers to fish passage.”</i> (TSD 13, Section 2.5.2 Increased Flow Velocity at North Railway Watercourse Crossings (p. 16). With respect to the Tote Road watercourse crossing issues Baffinland also states: <i>“Most fish passage issues identified in the annual monitoring surveys was effectively mitigated. However, issues at some crossings have persisted and will require additional mitigation to rectify, including persistent perches and excessive road sedimentation”</i>, further stating in TSD 14, section 2.5.1.2 (p. 23): <i>“for long culverts, especially in combination with high gradients, maintaining water velocities that fish can manage for the time it takes to pass through a culvert <u>may not be possible</u>”</i> (emphasis added). This contradicts Baffinlands conclusion : <i>“With implementation of design and mitigation measures, effects of culvert installations on fish passage are assumed to be negligible”</i> (TSD 15, s.5.3.2, p. 19).</p> <p>In DFO’s technical review comments to the NIRB (TC 3.10.4), DFO recommended that <i>“Baffinland clarify when they will provide updated hydrological modelling, and provide specific details on what updated modelling will entail.”</i> Baffinland responded that <i>“This information will be provided in the supplemental information package to support water licensing and an application for a Fisheries Act authorization referenced in response to DFO 3.10.1 (in this submission).”</i> (Response to DFO comment 3.10.4).</p> <p>In an email correspondence from Baffinland on April 30 Baffinland noted <i>“Additional information necessary for fisheries offset authorizations but not necessary for water licensing will be available by May 31st and includes:</i></p> <ul style="list-style-type: none"> • <i>Updated Hydrological Assessment – An updated hydrological assessment is being completed for any remaining stream diversions, and culverts will be re-assessed for fish passage using actual rather than the previously assumed gradients”</i> <p>In DFO technical comment recommendation 3.2.1 to the Nunavut Water Board, DFO recommended that <i>“Baffinland clarify when they will provide updated hydrological modelling.”</i></p> |
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| | <p>Baffinland's response to DFO technical comment 3.2.1 as part of the NWB process, states <i>"Updated hydrological modelling is presented in a June 18, 2019 memo by Knight Piésold provided as Attachment 04 (Fish Passage Risk Assessment of Water Crossings and Stream Diversions). Baffinland is undertaking an engineering review of crossings assessed by KP to be high risk of being a barrier to fish passage, and the outline of a fish passage monitoring program is provided as Attachment 05 (Proposed North Railway Aquatic Monitoring Programs)."</i></p> <p>DFO notes that Baffinland has identified the potential cumulative aspects of their assorted works, undertakings and activities. In TSD 14 (s.2.5, p. 22), Baffinland states: <i>"In some instances, the road and rail crossings will effectively become one installation. In these cases, fish passage may be impeded by the cumulative effect of the road and rail crossings".</i></p> <p>In DFO technical comment recommendation 3.2.4 to the Nunavut Water Board, DFO recommended that <i>"Baffinland provide further information in regard to the potential cumulative impacts of all crossings on flow and fish passage (short-term and permanent; Tote Road, North Rail and Temporary Access Roads), including clear identification of crossings that occur on the same waterbody."</i></p> <p>Baffinland's response to DFO technical comment 3.2.4 as part of the NWB process, states <i>"North/South Consultants Inc. conservatively assumed in Attachment 13.1 of the Application that rail crossings that are located <20 m from an existing Tote Road culvert are locations where two culverts in proximity could be a potential barrier to fish passage. Within Attachment 04 of this response (Additional Information on Fish Habitat Interactions), these locations are identified in Table 1 and are shown on the detailed railway figures (Figures 4 to 36)."</i></p> |
| Importance of issue to the impact assessment process | Fish require access to habitat and the ability to move among habitat types to complete one or more life processes, as such, it's important that all crossings or other structures allow for fish passage, for all flow scenarios and all life stages. |
| Detailed Review Comment 4. Gap/Issue 5. Disagreement with conclusion | <p>DFO notes that fish-passage issues have previously occurred along the Tote Road, for example resulting from high-velocities in undersized culverts or from insufficient number of culverts (TSD 14, s.2.2.2; p. 7-8). In the absence of a comprehensive "lessons learned" (for the tote road crossings) and/or a strategic analysis of what will be done differently to ensure the fish-passage issue will be mitigated, avoided and addressed, DFO remains concerned that fish passage issues will not be adequately</p> |

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| <p>6. Reasons for disagreement with conclusion</p> | <p>avoided or mitigated for the proposed watercourse crossings, diversions, and encroachments.</p> <p>Baffinland has also indicated their intent to incorporate baffles in areas where fish passage is a concern. DFO is not clear what circumstances/criteria will be used by Baffinland to determine when fish passage is a concern, and when baffles (or other mitigations) are needed. DFO is concerned that fish passage issues may not be identified in time to develop and implement appropriate mitigation measures to prevent impacts to migrating fishes/fish requiring movement within the watercourse to complete life history strategies. DFO therefore submits that watercourse crossings need to be designed to ensure site-specific fish passage for all species of fishes requiring migration within watercourses. This also includes having an robust field-based monitoring and mitigation implementation plan.</p> <p>DFO notes that some of Baffinland's proposed the diversions, such as CV-1-7 to CV-1-9 diversion in attachment 4 of Baffinland's responses to NWB technical comments, will likely result in impacts to fish habitat by removing connectivity to ponds and other watercourses that may provide important seasonal habitat for resident fish. These habitat impacts should be quantified, and flow modeling for the channel diversions needs to be provided. DFO notes that should the project be approved to proceed, DFO will require complete flow and velocity modelling / predictions and accurate accounting of all habitat losses as part of Baffinland's Request for Review or Application for <i>Fisheries Act</i> Authorization.</p> <p>DFO remains concerned about the cumulative impacts of multiple water crossings on the same waterbodies and the particular concern of increased velocity through these multiple crossings. DFO notes that in response to DFO technical comment to the NWB, recommendation 3.2.4, Baffinland provides information on watercourses that have culverts within 20 m of each other. DFO notes this information does not fully consider all watercourse crossings, nor does it identify clear cumulative impacts other than potential for fish passage issues for crossings in close proximity.</p> |
| <p>Recommendation/Request</p> | <p>Recommendation 3.9:</p> <p>If the Project is approved, DFO recommends that, during the Regulatory phase, Baffinland:</p> <p>3.9.1 Analyze monitoring reports related to the Tote Road existing watercourses crossings and provide comprehensive "lessons</p> |

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| | <p>learned” report (for the Tote Road crossings) that would include strategic analysis of what will be done differently to ensure the fish-passage issue will be mitigated, avoided and addressed</p> <p>3.9.2 Provide updated hydrological assessment of proposed watercourses crossings that includes, but is not limited to, crossing selection and design criteria, flow rates, velocities and discharge, and fish passage.</p> |
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3.10 Freshwater Water Withdrawal

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| Review Comment Number | 3.10 Water Withdrawal |
| Subject/Topic | Proposed new water withdrawal sites from various lakes and streams along the North Railway |
| References | <ul style="list-style-type: none"> • FEIS addendum, Surface Water Assessment (TSD 13); Sections 2.1.1, 2.4, 2.5 & 4.0 of Appendix C • FEIS addendum, Surface Water Assessment (TSD 13); Appendix D, Figure 1, p. D-7 • DFO Technical Review Comments to the Nunavut Impact Review Board (NIRB), March 7, 2019. Technical comment 3.12.2 • Baffinland Iron Mines Technical Comment Responses, March 25, 2019. DFO 3.12.2, page 43 • Fresh Water Supply, Sewage, and Wastewater Management Plan, attachment 23 of the Updated Application for Amendment No. 2 of Type A Water Licence, Document #: BAF-PH1-830-P16-0010. Section 4.2, pg. 18. • DFO Technical Review Comments to the NWB, July 2019, Technical Comment 3.1, recommendation 3.3.2, 3.3.3, 3.3.4 • Baffinland Iron Mines Corporation. August, 2019. Technical Comment Responses, Application to Amend Type A Water Licence 2AM-MRY1325, Phase 2 Proposal – Mary River Project: DFO 3.3.2, DFO 3.3.3, DFO 3.3.4 |
| Summary | <p>Baffinland has indicated their monthly cumulative water withdrawal (Section 4.2, page 18 of the updated Fresh Water Supply, Sewage, and Wastewater Management Plan, attachment 23 of the Updated Application for Amendment No. 2 of Type A Water Licence) stating “<i>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 bearing habitat (i.e. Camp Lake).</i>”</p> |

DFO notes the following in regard to the proposed new water withdrawal locations: *“Thresholds were identified and applied for fish-bearing and non-fish-bearing waters (KP, 2014). For fish-bearing streams, the removal of 20% of the 10-year dry unit runoff (1.03 L/s/km²) was identified as an environmentally protective threshold” and “Streams confirmed not to be fish habitat typically feed a downstream reach or collecting stream that is fish habitat. In these instances, the subject stream is only one contributor to the flow in the downstream fish habitat stream. Therefore, a higher threshold of 40% of the 10-year dry unit runoff (1.03 L/s/km²) was used.”*(TSD 13, App. C, s.2.4, p. 5)

In DFO technical comment recommendation 3.3.3 to the Nunavut Water Board, DFO recommended that *“Baffinland conduct a thorough localized assessments on the waterbodies selected for water withdrawal in order to adequately assess the potential impacts on the fish habitat resulting from 20% of the 10-year dry unit runoff water withdrawal on fish-bearing watercourses and connecting waterbodies. This assessment should include, but not be limited to, an assessment of the effects to littoral/shore/riparian areas from the proposed water withdrawal, the specific withdrawal locations proposed for each waterbody including fish habitat in the area and updated rationale on how this level of withdrawal will be environmentally protective threshold. DFO-FFHPP notes this information can be provided as part of the Proponent’s ‘DFO Request for Review’ submission and/or Application for Fisheries Act authorization, during DFO’s regulatory phase.”*

In DFO technical comment recommendation 3.3.4 to the Nunavut Water Board, DFO recommended that *“Baffinland provide additional rational/assessment to support the assertion that 40% of the 10-year dry unit runoff water withdrawal from non-fish-bearing streams will not negatively affect downstream fish-bearing waterbodies. DFO-FFHPP notes this information can be provided as part of the Proponent’s ‘DFO Request for Review’ submission and/or Application for Fisheries Act authorization, during DFO’s regulatory phase.”*

Baffinland’s response to DFO technical comment 3.3.3 and 3.3.4 referenced the response to 3.3.1 as part of the NWB process, states *“At the second NIRB technical meeting in June 2019, Baffinland committed to providing more details on fish habitat features and potential effects to littoral areas at proposed water withdrawal locations (DFO technical review*

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| | <p><i>comment 3.12.2 in NIRB review process). A detailed water withdrawal plan will be provided that includes fish habitat information and that considers the DFO's 2013 Environmental Flow Requirements guideline as part of Baffinland's Request for Review and/or Application for a Fisheries Act authorization."</i></p> <p>In DFO technical comment recommendation 3.3.2 to the Nunavut Water Board, DFO recommended that <i>"Baffinland clarify what site specific conditions would indicate, that a greater water withdrawal than 10% in proposed withdrawal lake sites, would not be significant in the context of fish bearing habitat."</i></p> <p>Baffinland's response to DFO technical comment 3.3.2 as part of the NWB process, states <i>"Each of the identified lakes will meet the threshold of 10% reduction of outflow under all flow conditions including 10-year return period low flow conditions that can be experienced during the month of September. The only exception to this is Camp Lake, which meets the 10% reduction of outflow threshold under mean flow conditions but not under low flow conditions. Under the 10-year low flow condition, however, a reduction of up to 27% of lake outflows could occur (Table 4), warranting further evaluation and consideration of potential effects to fish and fish habitat. While the proposed water withdrawal in Camp Lake will exceed the 10% lake outflow reduction threshold under the 10-year low flow condition, there are site-specific conditions to be considered. The outflow stream of Camp Lake reports to Mary Lake. The stream is broad and shallow and has been observed on multiple occasions (and various flow conditions) to lack connectivity. The proposed water withdrawal can be expected to increase the frequency at which natural lack of connectivity occurs between the two lakes. Limited movement of adult Arctic Char occurs through this stream, and consequently, this stream was not identified as critical fish habitat (North/South Consultants Inc., 2012). As such, a reduction in flow of 27% of the 10-year low flow is not expected to cause fish stranding or meaningful effects to fish or fish habitat (North/South, 2014)."</i></p> |
| Importance of issue to the impact assessment process | Water withdrawal from water bodies has the potential to cause a HADD to fish and fish habitat. |
| Detailed Review Comment 1. Gap/Issue | Decreases in waterbodies have the potential to have negative impacts on fish and fish habitat by potentially reducing littoral zones and under-ice over wintering habitat; these are important habitats for various life stages of many fishes. Decreasing flows/discharge in streams/watercourses has |

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| <p>2. Disagreement with conclusion</p> <p>3. Reasons for disagreement with conclusion</p> | <p>the potential to impact affect the downstream catchment areas, regardless if the source streams are non fish-bearing as supported by Baffinland's statement: <i>"Streams confirmed not to be fish habitat typically feed a downstream reach or collecting stream that is fish habitat"</i> (TSD 13, App. C, s.2.4, p. 5). DFO will require a detailed water withdrawal plan that includes an in- depth risk analysis informed by site specific fish and fish habitat features for the waterbodies chosen for water withdrawal as part of any 'DFO Request for Review' submission, in order to properly assess the potential impacts.</p> <p>DFO notes that Baffinland has committed to providing an updated water withdrawal plan, DFO will await this plan in order to review. DFO notes this can be provided as part a Request for Review or Application for Fisheries Act Authorization, should the project be approved.</p> <p>DFO continues to be concerned with the use of 20% and 40% thresholds for water withdrawal and the limited data available to support the conclusion that these thresholds are environmentally protective as stated by Baffinland: <i>"removal of 20% of the 10-year dry unit runoff (1.03 L/s/km2) was identified as an environmentally protective threshold"</i> (TSD 13, App. C, s.2.4, p. 5). DFO refers to the 2013 Canadian Science Advisory Secretariat (CSAS) report (DFO 2013) 'Framework For Assessing the Ecological Flow Requirements to Support Fisheries in Canada.</p> <p>DFO notes Baffinland's statement that <i>"The stream is broad and shallow and has been observed on multiple occasions (and various flow conditions) to lack connectivity. The proposed water withdrawal can be expected to increase the frequency at which natural lack of connectivity occurs between the two lakes. Limited movement of adult Arctic Char occurs through this stream, and consequently, this stream was not identified as critical fish habitat"</i>. DFO notes that although fish use of the stream may be limited or seasonal, connectivity of these two lakes may prove to be important depending on habitat availability and cumulative impacts from having so many watercourses impacted. Additionally, even if not deemed critical fish habitat, Baffinland will be required to ensure that fish habitat is not further impacted by increased water withdrawals. Unless fish use of Camp Lake is none or if fish habitat in the lake is actually marginal, 27% water withdrawal is not appropriate. DFO notes that DFO will work with Baffinland during DFO's regulatory phase, to ensure no additional impacts to fish habitat occur due to water withdrawal.</p> |
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| Recommendation/Request | <p>Recommendation 3.10: DFO recommends that Baffinland:</p> <p>3.10.1 Provide detailed water withdrawal plan that includes an in-depth risk analysis informed by site specific fish and fish habitat features for the waterbodies chosen for water withdrawal as part of any 'DFO Request for Review' submission.</p> <p>3.10.2 Conduct a thorough localized assessments on the waterbodies selected for water withdrawal in order to adequately assess the potential impacts on the fish habitat resulting from 20% of the 10-year dry unit runoff water withdrawal on fish-bearing watercourses and connecting waterbodies. This assessment should include, but not be limited to, an assessment of the effects to littoral/shore/riparian areas from the proposed water withdrawal, the specific withdrawal locations proposed for each waterbody including fish habitat in the area and updated rationale on how this level of withdrawal will be environmentally protective threshold.</p> <p>3.10.3 Provide additional rationale/ assessment to support the assertion that 40% of the 10-year dry unit runoff water withdrawal from non-fish-bearing streams will not negatively affect downstream fish-bearing waterbodies.</p> |
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3.11 Additional References

- Cott, P. and Hanna, B. 2005. Monitoring Explosive-Based Winter Seismic Exploration in Waterbodies, NWT 2000-2002. Department of Fisheries and Oceans. Offshore Oil and Gas Environmental Effects Monitoring: Approaches and Technologies. P. 493-510.
- DFO (Fisheries and Oceans Canada). (2010). DFO Protocol for Winter Water Withdrawal from Ice-Covered Waterbodies in the Northwest Territories and Nunavut. 3 p.
- DFO. 2013. Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2013/017.
- DFO. 2019a. Science Review of the Phase 2 Addendum to the Final Environmental Impact Statement for the Baffinland Mary River Project. DFO Can. Sci. Advis. Sec. Sci. Resp. 2019/015.
- DFO. 2019b. Science Review of Additional Documents submitted May 13–June 17, 2019 for the Second Technical Review of the Final Environmental Impact Statement Addendum for the Baffinland Mary River Project Phase 2. DFO Can. Sci. Advis. Sec. Sci. Resp. 2019/031.

- DFO. 2019c. Science Review of Additional Documents Submitted June 18–August 29, 2019 for the Final Environmental Impact Statement Addendum for the Baffinland Mary River Project Phase 2. DFO Can. Sci. Advis. Sec. Sci. Resp. 2019/038.
- IMO (International Marine Organization). Adopted on July 15, 2011. ANNEX 26, RESOLUTION MEPC.207(62). 2011 Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species. 25 p.

4 Summary of Recommendations

| Marine Environment | | |
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| 1. Marine Vessel Traffic | | |
| 1 - 2 | Ref. 3.1.1 | Recommendation 3.1: |
| | | <p>3.1.1 DFO recommends Baffinland provide a brief review and assessment of how changing the limitation from the amount of ore to number of voyages will alter any of the provided assessments and models provided to this point in the assessment process.</p> <p>3.1.2 DFO recommends Baffinland provide consideration for vessels, in addition to ore carriers, in determining the potential for impacts due to increased production.</p> |
| 2. Marine Environment: Shipping Season | | |
| 3 - 4 | Ref. 3.2.1 & 3.2.2 | Recommendation 3.2: DFO is concerned with Baffinland’s determination of the start and end of the shipping season, as the operational season can vary year-to-year. In relation to the opening and closing of the shipping season, DFO recommends Baffinland provide the following: |
| | | <p>3.2.1. A summary of monitoring conducted during the opening and closing of the shipping season.</p> <p>3.2.2. Consideration for marine mammal behaviours or additional ecological factors in their determination of shipping season opening and closing, such as the mentioned outmigration of narwhal, and a commitment to reporting annually on the determination of the opening and closing of the shipping season.</p> |
| 3. Marine Acoustic Modelling & Disturbances | | |
| 5 - 7 | Ref. 3.3.1, 3.3.2 | Recommendation 3.3: DFO is concerned that the Baffinland provided acoustic modelling does not fully allow DFO to assess cumulative sound level and the assessment of the effect of the sound on marine mammals. |

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| | & 3.3.3 | <p>DFO recommends that Baffinland:</p> <p>3.3.1. Provide the committed to technical memorandum which include calculations for the LSR associated with the proposed increased transits and modelling in other parts of the RSA including Milne Inlet, Eclipse Sound and Koluktoo Bay, for DFO's review.</p> <p>3.3.2. DFO recommends that, before the Project is approved, Baffinland re-evaluate the impact of masking on narwhal to a magnitude of 2.</p> <p>3.3.3. Commit to collect data with AMARs at an appropriate frequency (eg. yearly) and develop a long term monitoring plan, which is provided to MEWG members and approved by DFO, prior to the start of the Phase 2 increased shipping season.</p> |
| 4. Impacts to Marine Mammals: Shoulder Season Shipping and Ice-breaking | | |
| 8 - 11 | Ref. 3.4.1, 3.4.2, 3.4.3 & 3.4.4 | <p>Recommendation 3.4: DFO is concerned about the impacts to marine mammals from shoulder season shipping and ice-breaking and disagrees with Baffinland's conclusions that effects will be non-significant.</p> |

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| | | <p>3.4.1. DFO recommends that Baffinland prepare a monitoring plan, with an appropriate survey methodology, for the purpose of documenting and reporting any impacts due to icebreaking and shoulder season shipping activities, which includes the indicators Baffinland intends to use and rationale for the selection of said indicators. Baffinland should provide this plan or an adequate outline of the proposed plan to DFO for review and approval prior to any addition of ice breaking activities.</p> <p>3.4.2. DFO recommends Baffinland provide consideration for the re-evaluation of the magnitude and the reversibility of the impacts of ice entrapment on narwhals.</p> <p>3.4.3. DFO recommends Baffinland commit to producing a response plan in the event of ice entrapments, as determined by the committed to multi-year aerial surveys. This plan should include action level triggers and associated outlined response actions, in the event of an ice entrapment and subsequently an increase in frequency of ice entrapments. This plan should be developed in discussion with DFO and other parties and provided to DFO for review and approval.</p> <p>3.4.4. Overall, DFO reiterates the recommendation that Baffinland implement the most conservative mitigation measure and avoid shipping during the shoulder seasons and ice-breaking activities; only ship during the open water season.</p> |
| 5. Marine Mammal Observation | | |
| 12 | Ref. 3.5 | <p>Recommendation 3.5: DFO reiterates if having MWOs present for the entire shipping season on all project related vessels (e.g., icebreakers, escort vessels, ore carriers) is not logistically possible, an alternative plan should be developed by Baffinland to monitor presence, behavior and potential ship strikes of marine mammals.</p> |
| 6. Marine Environment: Ballast Water and Non-indigenous Species | | |
| 13 - 22 | Ref. 3.6.1, 3.6.2, 3.6.3, 3.6.4, 3.6.5, 3.6.6, 3.6.7, 3.6.8, | <p>Recommendation 3.6: In order to DFO properly assess the ballast release, DFO recommends that, prior to initiating increased shipping for the Phase 2 development, Baffinland provide the following:</p> <p><u>Modelling</u></p> <p>3.6.1. Clarification on where vessels have been discharging ballast to date and how Baffinland validates/tracks this information.</p> <p>3.6.2. A commitment to including discharge coordinates in ballast reporting.</p> <p><u>Exchange and Treatment</u></p> |

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| | 3.6.9, 3.6.10 | <p>3.6.3. A commitment that exchange will be carried out prior to treatment for all vessels conducting exchange plus treatment procedures.</p> <p>3.6.4. Clarify what would trigger Baffinland to discontinue exchange plus treatment practices</p> <p><u>D2</u></p> <p>3.6.5. Clarification on how Baffinland intends to monitor ballast water discharges for compliance with D2 regulations</p> <p><u>Sampling Programs</u></p> <p>3.6.6. A commitment to develop of a biofouling sampling program, approved by DFO and completed prior to increase shipping activities for Phase 2, which specifically includes physical collection of organisms in a representative, standardized and comprehensive manner (sampling of hull and niche areas) that will allow for identification of non-native species that may be transported through project shipping.</p> <p>3.6.7. A commitment to update the monitoring plan, to include more intensive sampling, which includes greater seasonal and spatial coverage, increased sample sizes to address concern related to statistical power for detection, clear protocols for determining identity and status of species (native, non-indigenous or cryptogenic).</p> <p><u>Species of Concern</u></p> <p>3.6.8. An assessment of potential biological and ecological effects of ballast discharge and identification of the high risk species or groupings of species of concern. These species may include, but not be limited to any NIS/AIS that have been detected in the course of past AIS/MEEMP monitoring, and should be updated in the event that new NIS/AIS are detected in future monitoring.</p> <p><u>Early Response Plans</u></p> <p>3.6.9. A commitment to develop an appropriate early response plan with a clear sequence of events to be followed in the event that a non-indigenous species is introduced and/or becomes established.</p> <p>3.6.10. A commitment to develop taxa-specific response plans for high risk species or groups of species identified through species level risk assessments. These could be informed by known vessel origins prior to arrival at the project.</p> |
| 7. Marine Cumulative Effects | | |
| 23 | Ref. 3.7 | Recommendation 3.7: DFO recommends that Baffinland conduct a thorough analysis and assessment examining all the combined impacts of all the Project activities inside and outside the study areas. |

| Freshwater Environment | | |
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| 8. Watercourse Crossings | | |
| 24 | Ref. 3.8 | Recommendation 3.8: If the Project is approved, DFO recommends Baffinland provide decision criteria and decision matrix for the selection of water crossing methods for fish bearing watercourses in support of any regulatory applications made to DFO. |
| 9. Fish Passage | | |
| 25 - 26 | Ref. 3.9.1 & 3.9.2 | <p>Recommendation 3.9: If the Project is approved, DFO recommends that, during the Regulatory phase, Baffinland:</p> <p>3.9.1 Analyze monitoring reports related to the Tote Road existing watercourses crossings and provide comprehensive “lessons learned” report (for the Tote Road crossings) that would include strategic analysis of what will be done differently to ensure the fish-passage issue will be mitigated, avoided and addressed</p> <p>3.9.2 Provide updated hydrological assessment of proposed watercourses crossings that includes, but is not limited to, crossing selection and design criteria, flow rates, velocities and discharge, and fish passage.</p> |
| 10. Water Withdrawal | | |
| 27 - 30 | Ref. 3.10.1, 3.10.2 & 3.10.3 | <p>Recommendation 3.10: DFO recommends that Baffinland:</p> <p>3.10.1 Provide detailed water withdrawal plan that includes an in-depth risk analysis informed by site specific fish and fish habitat features for the waterbodies chosen for water withdrawal as part of any ‘DFO Request for Review’ submission.</p> <p>3.10.2 Conduct a thorough localized assessments on the waterbodies selected for water withdrawal in order to adequately assess the potential impacts on the fish habitat resulting from 20% of the 10-year dry unit runoff water withdrawal on fish-bearing watercourses and connecting waterbodies. This assessment should include, but not be limited to, an assessment of the effects to littoral/shore/riparian areas from the proposed water withdrawal, the specific withdrawal locations proposed for each waterbody including fish habitat in the area and updated rationale on how this level of withdrawal will be environmentally protective threshold.</p> <p>3.10.3 Provide additional rationale/ assessment to support the assertion that 40% of the 10-year dry unit runoff water withdrawal from non-fish-bearing streams will not negatively affect downstream fish-bearing waterbodies.</p> |



Nunavut Impact Review Board
P.O. Box 1360
Cambridge Bay, NU
XoB oCo
Via e-mail: info@nirb.ca

06 February, 2020

Re: Parks Canada technical submission to the NIRB on Baffinland Iron Mines Corporation's (Baffinland) Phase 2 Development Proposal (file o8MN053)

Dear Mr. Barry,

Parks Canada is pleased to provide the Nunavut Impact Review Board (NIRB) with this letter, in lieu of a technical submission, for its review of Baffinland's Phase 2 Development Proposal for the Mary River Project (the Project).

Parks Canada provided a technical submission for this Project to the NIRB on March 7, 2019, a final written submission on September 23, 2019, and has been actively participating in technical discussions with Baffinland and fellow Intervenors throughout the Phase 2 assessment. We note that aspects of the following comments from both submissions remain outstanding:

From technical submission:

- 1 (Confirmation/clarification of information related to the management of shipping in an ecologically sustainable manner),
- 2 (Information regarding effects, including cumulative effects, related to icebreaking and ice management),

From final written submission:

- 2 (Functioning of the Marine Environmental Working Group),
- 3 (Issues related to ballast water and introduction of aquatic invasive species), and
- 4 (Effects to marine mammals and effects from ice-breaking)

Progress on these issues is being tracked in the various versions of Baffinland's commitment list. Parks Canada has collaborated extensively with other expert federal authorities to conduct the technical analysis of this project; those technical concerns are



presented in the respective federal government submissions and comments on Baffinland's commitment list. Parks Canada has no new technical comments at this time.

Parks Canada recommends to the NIRB that technical information for this project be assessed in light of the following management principles for Tallurutiup Imanga NMCA:

- Tallurutiup Imanga NMCA must be "protected and conserved" (s. 4(1), *Canada National Marine Conservation Act* [CNMCAA]; p. 4, Tallurutiup Imanga Inuit Impact and Benefit Agreement [IIBA]);
- The NMCA must be "managed and used in a sustainable manner that meets the needs of present and future generations without compromising the structure and function of the ecosystems" (s. 4(3), CNMCAA; p.4 IIBA),
- the "principles of ecosystem management and the precautionary principle" will be a primary consideration (s. 9(3), CNMCAA; p. 4, IIBA), and;
- The ecologically sustainable use of marine resources in the NMCA is for the lasting benefit of coastal communities (preamble, CNMCAA; p.4, IIBA).

We look forward to continuing to work with the NIRB, Intervenors, and the Proponent throughout the remainder of the review. Please contact Allison Stoddart at 819-420-9188 or Allison.Stoddart@canada.ca if you have any questions regarding Parks Canada's submission.

Sincerely,

Jenna Boon
Nunavut Field Unit Superintendent



Natural Resources
Canada

Ressources naturelles
Canada

NIRB file # - 08MN053

NRCan file # - NT- 098

February 4, 2020

Nunavut Impact Review Board
PO Box 1360
Cambridge Bay, NU, X0B 0C0

Via electronic mail to: info@nirb.ca

**Re: Natural Resources Canada's Updated Technical Comments for the NIRB's Review of
Baffinland Iron Mines Corporation's "Phase 2 Development" Proposal**

Natural Resources Canada (NRCan) has been participating in the review of the "Phase 2 Development" Proposal for the Mary River Mine under the *Nunavut Planning and Project Assessment Act*. NRCan is submitting this letter as an update of its previous technical comments in anticipation of the Technical Meeting scheduled for March 16-22, 2020.

As the Board is aware, following the November 2019 Public Hearings, NRCan received a list of updated commitments from the Proponent with respect to permafrost and geotechnical conditions in the Northern Railway Corridor in response to NRCan's questions and recommendations. The commitments are described in more detail in the attached summary.

NRCan's technical experts have reviewed the commitments, and the department is satisfied with the Proponent's approach regarding permafrost and terrain stability in relation to the Northern Railway. Within the scope of the department's areas of expertise, NRCan continues to regard the conclusions presented in the Final EIS to be reasonable.

NRCan has no further comments on Baffinland Iron Mines Corporation's Phase 2 Development Proposal at this time. NRCan appreciates this opportunity to provide comments and, should you have any questions, please do not hesitate to contact me at peter.unger@canada.ca.

Sincerely,

Peter Unger
Senior Environmental Assessment Officer
Office of the Chief Scientist

cc: Rob Johnstone (LMS)
Danny Wright (LMS)



Attachment

Summary of Natural Resources Canada Participation in the “Phase 2 Development” Proposal for the Mary River Mine under the *Nunavut Planning and Project Assessment Act*

November 23, 2018 - NRCan submitted four information requests (IRs) on permafrost and terrain stability, primarily related to the Northern Railway Corridor, for the NIRB’s consideration.

December 19, 2018 - NRCan received responses to these information requests.

March 7, 2019 - NRCan reviewed the Proponent’s responses and submitted technical comments related to permafrost and terrain conditions as well as thermal modelling and analysis.

September 23, 2019 - NRCan submitted a Final Submission in anticipation of the Final Public Hearing. In this submission, NRCan stated that it is generally satisfied with the information provided for this phase of the project development, and, within the context of the department’s areas of expertise, NRCan finds the conclusions presented in the final EIS to be reasonable.

NRCan maintained its specific recommendations with respect to permafrost and terrain stability, which were as follows:

- In relation to geotechnical and permafrost conditions in the Northern Railway Corridor, NRCan recommended that the Proponent follow through on the plans outlined in their response to NRCan to support detailed design and environmental monitoring and management programs. Specifically, NRCan recommended the Proponent:
 - Conduct the summer 2019 mapping program in areas where the railway corridor deviates from the road
 - Conduct the winter 2019/20 drilling program, described in their response, to obtain additional subsurface data to support design
 - Conduct the pre-drilling program, described in their response, to improve delineation of ice-rich areas to support implementation of appropriate measures to deal with permafrost conditions prior to cuts or embankment construction
 - Install thermistors during the 2019/20 and pre-drilling programs to establish baseline conditions along the corridor prior to construction.
- In relation to thermal analysis/modelling to support railway design, NRCan recommended that the Proponent implement the recommendations provided by Hatch in the design memo and the plans for further analysis and instrumentation as outlined in their response to NRCan to support detailed design and environmental monitoring and management programs. Specifically, NRCan recommended the Proponent:
 - Implement the recommendations made by Hatch to accommodate the 30-year design life including those related to pile length embedment and number of piles required for foundations.
 - Continue to refine the thermal, stability and creep analysis incorporating new data collected during geotechnical investigations and from instrumentation along the railway corridor to support final design of embankments and bridges.



- Consider local factors (such as snow accumulation and presence of water bodies) in the 2D thermal modelling to support final design of embankments, cuts and bridges.
- Establish instrumentation as outlined in their response, prior to and during construction to improve characterization of baseline ground conditions, support final design, evaluate impacts due to construction and railway performance, and to inform the implementation of mitigation/maintenance measures when triggers are reached.

November 2-5, 2019

Before the adjournment of the Hearing in Iqaluit in, NRCan asked the proponent whether it selected the route for the Northern Railway based on favourable geotechnical conditions. NRCan also asked whether the new route affects any of the previous commitments made with respect to the Northern Railway, and whether the recommendations from the Hatch Geotechnical Recommendations for the Northern Railway report would be followed. NRCan also sought clarity on whether the team described at the hearing as performing geotechnical studies at the end of November 2019 was the “pre-drilling” program referred to in previous discussions between the Proponent and NRCan, and whether this team would be installing thermistors to document baseline conditions.

The Proponent responded that the newly selected route was chosen based on favourable geotechnical conditions, and that this does not affect previous commitments made with respect to the Northern Railway. The proponent further responded the team scheduled for the end of November 2019 was the “pre-drilling” program referred to previously, but that the team would not be installing thermistors for documenting baseline conditions. The Proponent then committed to providing a more fulsome answer in writing.

November 12, 2019

NRCan received the following commitments from the Proponent:

- Conducting the summer 2019 mapping program in areas where the railway corridor deviates from the Tote Road, including along the Route 1 deviation alignment. This summer mapping program was completed in summer 2019.
- Conducting the winter 2019/2020 drilling program along the deviation route, following the proposed Route 3 deviation alignment, and near the port terminus to obtain additional information on subsurface conditions to inform the final design.
- Conducting a pre-drilling program, to be completed by the railway contractor and supervised by BIM’s Engineer during the construction period. Boreholes will be advanced into permafrost along the rail alignment prior to the railway earthworks. Boreholes will be used to delineate zones of ice-rich permafrost and to determine the required permafrost treatment prior to making cuts and placing fill for the embankments.
- Installing thermistors and other monitoring instruments along the rail alignment including along the Route 3 deviation during the pre-drilling programs to establish baseline conditions prior and during rail construction.
- Implementing the recommendations to accommodate the 30-year design life provided in the project memorandum ‘Analysis of Proposed Rail Line Cut Sections and Port Area Structures



Considering a Mine Life of 30 Years' (Hatch, 2019) including those related to pile length embedment and the number of piles required for foundations.

- Continue to refine the thermal, stability and creep analysis incorporating new data collected during geotechnical investigations and from instrumentation along the railway corridor, along the Route 3 deviation alignment as well the rail alignments outside the rail deviation, to support final design of embankments and bridges.
- Consider local factors (such as snow accumulation and presence of water bodies) in the 2D thermal modelling to support final design of embankments, cuts and bridges.
- Establish instrumentation along the rail alignment, including along the Route 3 deviation alignment, prior to and during construction to improve characterization of baseline ground conditions, support final design, evaluate impacts due to construction and railway performance, and to inform the implementation of mitigation /maintenance measures when triggers are reached.