



Technical Comment Responses
Application to Amend Type A Water Licence 2AM-MRY1325
Phase 2 Proposal – Mary River Project

Baffinland Iron Mines Corporation
Mary River Project
NWB File No. 2AM-MRY1325



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CROWN-INDIGENOUS RELATIONS AND NORTHERN AFFAIRS CANADA

ID#	Document Reference	Recommendations/Requests	Response	Attachment
CIRNAC TR#1	Mary River Phase 2 Proposal Update (Knight Piésold, May 2, 2019); Section 4.3 and Attachment 29 Interim Waste Rock Management Plan (Golder 2019); Section 2	1) CIRNAC maintains our request that the updated Phase 1 Waste Rock Management Plan that BIMC committed to developing by the end of December 2019 be provided to CIRNAC for review. 2) CIRNAC recommends that the Phase 1 Waste Rock Management Plan be finalized and approved prior to initiating the increased ore production rate associated with Phase 2. 3) In addition, CIRNAC requests that BIMC continue to provide CIRNAC frequent updates on other research plans and activities that directly or indirectly relate to predictions of waste rock geochemistry, seepage and water quality as they become available.	Baffinland will submit the updated Phase 1 Waste Rock Management Plan in December 2019. Baffinland maintains that this is an operational document, and that approval of this plan is independent of the Phase 2 process and will be required regardless of the permitting timeline for Phase 2. Updates on the investigation and strategy to address the Waste Rock Facility have been regularly provided to all stakeholders, and Baffinland will continue to engage all interested parties to provide updates.	
CIRNAC TR#2	Mary River Phase 2 Proposal Update (Knight Piésold, May 2, 2019); Section 4.3 and Attachment 29 Attachment 29 - Interim Closure and Reclamation Plan (BIMC 2018e); Sections 5.2.1.1 to 5.2.1.9 and Appendix D1 and D2 Research Plans CIRNAC Information Requests to BIMC for the Phase 2 Amendment of the Mary River Project under Type “A” Water Licence No. 2Am-MRY1325 Amendment No. 1 (IR #3; CIRNAC, November 23, 2018)	4) CIRNAC recommends that prior to commencing work on the advancement of the open pit, BIMC demonstrate a thorough understanding of the future pit conditions including methods and timelines for pit flooding, geochemistry and ARD/ML potential of waste rock and pit walls based on information/data obtained through the numerous research commitments stated in the ICRP. Periodic updates to the ICRP will need to be completed to include the results of research programs and their implications with respect to pit development and closure planning.	Deposit 1 remains a hilltop outcrop, and development of the pit was projected to occur after 10 years of full scale production for the Approved Project. Baffinland has committed to reclamation research through the most recent revision of the ICRP so that prior models on pit flooding, geochemistry and ARD/ML potential presented in the FEIS can be validated with observations from active mining of the deposit and further assessment of local hydrology. Results of the reclamation research programs will be incorporated into future versions of the ICRP, as intended.	
CIRNAC TR#3	Mary River Phase 2 Proposal Update (Knight Piésold, May 2, 2019); Attachment 29 - Interim Closure and Reclamation Plan (BIMC 2018e)	5) CIRNAC requests that BIMC update the ICRP to appropriately address the issue of information gaps by including missing information, or updating contradictory or outdated information, in the sections identified in TR#3.	Baffinland appreciates the review and feedback provided by CIRNAC on the ICRP, and will incorporate these comments into the updated draft of the ICRP to be provided in advance of the Technical Meeting.	
CIRNAC TR#4	Mary River Phase 2 Proposal Update (Knight Piésold 2019, May 2, 2019)	6) CIRNAC requests that the Blasting Management Plan and the Quarry Management Plan QMR2 are submitted for review in advance of the Technical Review meeting.	The QMR2 Quarry Management Plan will be updated if the quarry limits require expansion. Updates to Quarry Management Plans for quarries on Inuit-Owned Land are managed under Baffinland's Commercial Lease. The Blasting Management Plan will be reviewed to determine its adequacy for rail construction, and if updated, will be provided for review in advance of the technical meeting.	

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CIRNAC TR#5	Mary River Phase 2 Proposal Update (Knight Piésold 2019, May 2, 2019) Railway Emergency Response Plan (Baffinland, May 13, 2019) Railway Operation and Maintenance Management Plan (Baffinland, May 13, 2019); Section 9.2 Attachment 28 - Environmental Protection Plan (Baffinland, May 1, 2019); Section 2.26	7) CIRNAC recommends that the Railway Emergency Response Plan be further updated to include the following information: a. Procedures identifying the medical services that should be contacted in the event of injuries, the first aid responses that should be executed at the site of the accident, and the modes of transportation that should be used for injured persons depending upon the location of the accident and ambient conditions; b. Company personnel and government departments that require advisories of an accident/incident; c. Type and location of emergency equipment and the procedures to be followed in the event of a derailment, including check lists and accident reports; and d. Information on health and safety emergencies.	A revised version of the Railway Emergency Response Plan is provided in Attachment 01. This draft Plan will be updated further prior to the commencement of railway operations.	Attachment 01 - Revised Draft Railway Emergency Response Plan
CIRNAC TR#6	Modification Request No. 12 – Milne Port Stockpile #1 and Water Management Expansion (Baffinland, May 3, 2019); Attachments 3, 4 and 5 Modification No.12 Attachment 5 – Civil Design Philosophy (Hatch 2018); Section 6.6	8) CIRNAC recommends that BIMC revise its design storm criteria from the 1:10yr 24 hour to a minimum of 1:25 year storm for the design of the new sedimentation ponds at the Milne Port associated with the expansion of the stockpile facilities. 9) CIRNAC recommends that BIMC revise its Civil Design Philosophy design storm criteria from the 1:10yr 24 hour to a minimum of 1:25 year storm for the design of any future permanent Life of Mine sedimentation ponds.	Sedimentation ponds designed for the Approved Project have utilized the 1:10 24 hr storm presented in the Civil Design Philosophy. Application of this design criteria for new infrastructure is consistent with its previous application.	
CIRNAC TR#7	Mary River Phase 2 Proposal Update (Knight Piésold 2019, May 2, 2019) Railway Operation and Maintenance Management Plan (Baffinland, May 13, 2019); Section 3.3	10) CIRNAC requests that dust monitoring data and any other relevant information, if available, are provided to assess potential environmental impacts to surface water/snow from dust generation along the northern transportation corridor from the railway and truck traffic.	Information on the low potential for ore dusting from rail cars is provided in an email to the GN following a Terrestrial Environment Working Group meeting on Phase 2 management plans, dated Feb 14, 2019, and provided as Attachment 02. Baffinlands ore dusting exposure assessment (TSD 11) reviewed the chemistry of dustfall from stations along the Tote Road and at the Mine and Port, and this demonstrated that while the ore dust at the Project sites have the chemistry resembling the ore, the dust generated by the Tote Road does not have chemistry resembling the ore. Dust monitoring data is reported annually to the NIRB through the Terrestrial Environment Annual Monitoring Report, which can be found in the NIRB public registry or on Baffinlands document portal (http://www.baffinland.com/document-portal-new/?cat=5&archive=1)	Attachment 02 - Email and Paper on Ore Dusting from Rail Cars
CIRNAC TR#8	Mary River Phase 2 Proposal Update (Knight Piésold, May 2, 2019); Attachment 29 - Interim Closure and Reclamation Plan (BIMC 2018e)	11) CIRNAC requests that BIMC update the ICRP to appropriately address the concerns raised in TR#8 surrounding insufficient financial security by updating the ICRP to increase Interim Care and Maintenance and Post Closure Monitoring time as suggested by CIRNAC. 12) Given current measured acidity in waste rock seepage, CIRNAC recommends that a cost for open pit water treatment be included in the security until such time that treatment is shown to not be needed.	Baffinland appreciates the review and feedback provided by CIRNAC on the ICRP, and will incorporate these comments into the updated draft of the ICRP to be provided in advance of the Technical Meeting. Baffinland does not believe an adjustment to security is required for the open pit, as the deposit remains a hilltop outcrop and not an open pit. As security for the project is currently revised on an annual basis, there is no need to assess and hold security for a scenario that has not yet occurred and will not in the coming year.	

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CIRNAC TR#9	Nunavut Water Board Water Licence No. 2AM-MRY1335 – Amendment No. 1, Baffinland Iron Mines Corporation, Mary River Iron Mine, Signed by Thomas Kabloona on July 21, 2015.	13) CIRNAC proposes that all parties use the opportunity for any future amendments to Water Licence 2AM-MRY1325 – Amendment No. 1 to change the procedure for the Annual Security Review to one of the following options: a. A phased approach with security applied in tranches, as is used on other mining projects; b. Decreasing the frequency of the security review to occur every 5 years rather than every year; or c. Other suggestions made by interested parties.	Baffinland agrees with CIRNAC that the current amendment to the Type A Water Licence provides an opportunity to review current practice for setting and updating security for the project and is open to considering changes, subject to further review and discussion with all parties. Baffinland recognizes that QIA as the landowner will ultimately need to approve any changes to the security review process. Baffinland will engage QIA on this matter and any agreed upon path forward will be presented to the Board.	

FISHERIES AND OCEANS CANADA

ID#	Document Reference	Recommendations/Requests	Response	Attachment
DFO 3.1.1	Various	Recommendation 3.1.1: DFO-FFHPP recommends 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.	As follow-up to the June 2019 NIRB technical meetings, Baffinland issued a July 2, 2019 memo by Knight Piésold (<i>Additional Information on Fish Habitat Interactions</i>), provided as Attachment 03 to this response. This memo is not listed in the referenced DFO documents. The document provides supplemental fisheries information, including a discussion regarding the basis of selecting crossing types in Section 5.	Attachment 03 - Additional Information on Fish Habitat Interactions
DFO 3.1.2	Various	Recommendation 3.1.2: DFO-FFHPP reiterates the recommendation that Baffinland provide the full scope and visual of catchment areas associated with fish-bearing water crossings.	Catchments of fish-bearing crossings along the Tote Road and proposed North Railway are shown on Figures 1 and 2 of Attachment 03 (<i>Additional Information on Fish Habitat Interactions</i>).	Attachment 03 - Additional Information on Fish Habitat Interactions
DFO 3.1.3	Various	Recommendation 3.1.3: DFO-FFHPP recommends the Proponent provides maps for the entirety of the road and label all crossings, which includes the locations of proposed changes to existing Tote Road crossings (as currently provided) and the locations for crossings that are expected to remain as they are.	An updated version of the detailed railway figures that appeared as Attachment 10 of the May 2019 water licence amendment application appear as Figures 4 to 36 of the July 2, 2019 memo provided as Attachment 03 to this response (<i>Additional Information on Fish Habitat Interactions</i>). This updated version shows the entirety of the Tote Road including water crossing labels and proposed changes.	Attachment 03 - Additional Information on Fish Habitat Interactions
DFO 3.2.1	Various	Recommendation 3.2.1: DFO-FFHPP recommends that Baffinland clarify when they will provide updated hydrological modelling.	Updated hydrological modelling is presented in a June 18, 2019 memo by Knight Piésold provided as Attachment 04 (<i>Fish Passage Risk Assessment of Water Crossings and Stream Diversions</i>). 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 (<i>Proposed North Railway Aquatic Monitoring Programs</i>).	Attachment 04 - Fish Passage Risk Assessment of Water Crossings and Stream Diversions; Attachment 05 - Proposed North Railway Aquatic Monitoring Programs
DFO 3.2.2	Various	Recommendation 3.2.2: DFO-FFHPP recommends that Baffinland provide the flow volumes referenced as section 7.1.5.3 on page 23, in section 7.2.1.5 of attachment 7.2 of the updated application: North Railway Design Criteria, or provide the appropriate reference.	Section 7.1.2.5 of the Rail Design Criteria document (Attachment 7.2 of the Updated Water Licence Amendment Application) includes an incorrect reference: "The flow volumes calculated in 7.1.5.3 will be used to determine the ultimate sizing of the culvert structure in terms of number and size of barrels." DFO is correct that there is no Section 7.1.5.3, and flows are not presented elsewhere in the same document. Catchment areas and mean monthly flows for July and August are presented for fish-bearing crossings in the updated fish passage assessment presented as Attachment 04 (<i>Fish Passage Risk Assessment of Water Crossings and Stream Diversions</i>).	Attachment 04 - Fish Passage Risk Assessment of Water Crossings and Stream Diversions
DFO 3.2.3	Various	Recommendation 3.2.3: DFO-FFHPP recommends Baffinland clarify which flood return period is intended for use for the hydrologic analysis.	The design return period is the 1:200-year flood, and the reference to the 1:100-year flood in Section 7.2.3 is incorrect.	
DFO 3.2.4	Various	Recommendation 3.2.4: DFO-FFHPP recommends 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.	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 (<i>Additional Information on Fish Habitat Interactions</i>), these locations are identified in Table 1 and are shown on the detailed railway figures (Figures 4 to 36).	Attachment 03 - Additional Information on Fish Habitat Interactions

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DFO 3.2.5	Various	Recommendation 3.2.5: DFO-FFHPP recommends the Proponent clarify the intent of the statement: <i>“mitigation measures, specific to bridges along the rail corridor, will be applied if flow velocities are found to restrict fish passage”</i> , and respond with clarification why the proposed bridges will not incorporate appropriate fish passages in the initial design	The aquatic considerations cited in Section 8.6 of Attachment 13.7 of the Application are adopted from a generic list of mitigation measures for water crossings. Preliminary bridge drawings are presented in Attachment 13.8. of the Application. The final bridge designs included with the application for a <i>Fisheries Act</i> authorization will maintain fish passage.	
DFO 3.3.1	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.	Recommendation 3.3.1: DFO-FFHPP recommends Baffinland provide a detailed water withdrawal plan, which 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.	At the second NIRB technical meeting in June 2019, Baffinland committed to providing more details on fish habitat features and potential effects to litoral areas at proposed water withdrawal locations (DFO technical review 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 <i>Fisheries Act</i> authorization. .	

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DFO 3.3.2	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.	Recommendation 3.3.2: DFO-FFHPP recommends 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.	The referenced text from page 18 of the FWSSWMP stated as follows, "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)." This is in reference to circumstances such as described in the 2014 water take assessment, (July 16, 2014 letter report by Knight Piésold, <i>Hydrology Assessment of Water Sources for Dust Suppression along the Tote Road - Mary River Project - Early Revenue Phase</i>; Ref. No. NB19-00376): "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)."	DFO 3.3.2
DFO 3.3.3	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	Recommendation 3.3.3: DFO-FFHPP recommends 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.	As per Baffinland's response to DFO 3.3.1, a detailed water withdrawal plan will be provided in advance of the NWB technical meeting.	DFO 3.3.3

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	Amendment No. 2 of Type A Water Licence, Document #: BAF-PH1-830-P16-0010. Section 4.2, pg. 18.			
DFO 3.3.4	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.	Recommendation 3.3.4: DFO-FFHPP further recommends 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.	As per Baffinland's response to DFO 3.3.1, a detailed water withdrawal plan will be provided in advance of the NWB technical meeting.	DFO 3.3.4
DFO 3.4.1	Updated Application for Amendment No. 2 of Type A Water Licence, attachment 27: Aquatic Effects Monitoring Plan, Document #: BAF-PH1-830-P16-0039. Section 2.4.4, pg. 37.	Recommendation 3.4.1: DFO-FFHPP recommends that Baffinland revise their instantaneous pressure threshold limit of 100 kPa to 50 kPa when calculating setback distances and update their conclusions as necessary.	<i>Baffinland will adopt the lower threshold of 50 kPa as a precautionary measure. Applicable draft management plans for Phase 2 will be revised accordingly when next updated in advance of the NWB technical meeting.</i>	DFO 3.4.1

ENVIRONMENT AND CLIMATE CHANGE CANADA

ID#	Document Reference	Recommendations/Requests	Response	Attachment
ECCC 3.1	Baffinland Iron Mines Corporation. May 2019. Mary River Project – Phase 2 Proposal Updated Application for Amendment No. 2 of Type A Water Licence 2AM-MRY1325, Attachment 23 (Part 1): Fresh Water Supply, Sewage, and Wastewater Management Plan, Section 5.4.1 and Appendix F: Polishing Waste Stabilization Ponds (PWSP) Effluent Discharge Plan. Baffinland Iron Mines Corporation. May 2019. Mary River Project – Phase 2 Proposal Updated Application for Amendment No. 2 of Type A Water Licence 2AM-MRY1325, Attachment 18.2: Milne Port Water and Sewage Schematic	ECCC’s Recommendation(s): Clarify whether there would also be a treatment system for the Polishing Waste Stabilization Ponds (PWSP) at Milne Port (similar to what is at the Mine Site), and, if so, provide details on the system. Update the PWSP Effluent Discharge Plan (Appendix F).	The Port Site PWSP has a treatment system that is used to treat the contents of the PWSP to meet the applicable discharge requirements, before being discharged to Milne Inlet. As at the Mine Site PWSPs, a portion of the treatment occurs naturally, through the growth of algae through the summer season. The treatment system consists of a dissolved air floatation unit (DAF), housed inside an insulated and heated seacan, with an air injection system, sludge removal system, coagulant dosing, and flocculant dosing. There is also provision in the system for acid or caustic dosing, if required for pH adjustment. During the summer season, algae grows in the PWSP, consuming any remaining nutrients in the off-spec water, leaving behind TSS in the form of algae solids. The DAF system uses a saturated air-water mixture, injected into the influent stream, to remove solids through floatation. The influent stream is first dosed with a coagulant and flocculant, to promote the formation of large floc solids. These solids nucleate around the microscopic air bubbles formed by the saturated air-water mixture, and rise to the surface of the main tank. The “float” sludge is then skimmed from the surface of the tank, and pumped to totes for disposal. Clarified effluent overflows from the system into a break tank, which is then pumped to Milne Inlet if it meets the discharge criteria. The PWSP Effluent Discharge Plan is being updated as part of ongoing operations. The updated plan will be included in the next revision of Baffinland's Fresh Water Supply, Sewage, and Wastewater Management Plan.	
ECCC 3.2	Baffinland Iron Mines Corporation. May 2019. Mary River Project – Phase 2 Proposal Updated Application for Amendment No. 2 of Type A Water Licence 2AM-MRY1325, Attachment 22: Surface Water, Aquatic Ecosystem Management Plan, Sections 10.2.3.1 and 10.2.3.2.	ECCC’s Recommendation(s): ECCC recommends that the Proponent provide a detailed description of proposed construction monitoring for the Phase 2 activities.	A detailed outline of construction monitoring is provided as Attachment 05 (<i>Proposed North Railway Aquatic Monitoring Programs</i>).	Attachment 05 - Proposed North Railway Aquatic Monitoring Programs
ECCC 3.3	Baffinland Iron Mines Corporation. May 2019. Mary River Project – Phase 2 Proposal Updated	ECCC’s Recommendation(s): ECCC recommends that the Proponent:	The need to update discharge criteria and references to the MDMER is acknowledged (Sections 7.1 and 7.2 including Table 7-2; Appendix A of Appendix J; Appendix H). These changes will be completed in the next update to the Fresh Water Supply, Sewage, and Wastewater Management Plan, to be submitted in advance of the NWB technical meetings.	

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	Application for Amendment No. 2 of Type A Water Licence 2AM-MRY1325, Attachment 23 (Part 1): Fresh Water Supply, Sewage, and Wastewater Management Plan, Section 7.1, Table 7-2, and Appendix J: Waste Pond Water Treatment Plant Operations – Appendix A. Government of Canada. June 2019. Metal and Diamond Mining Effluent Regulations (SOR/2002-222). Available at: https://laws-lois.justice.gc.ca/eng/regulations/SOR-2002-222/nifnev.html	Update references from the MMER to MDMER. Provide clarification on the discharge criteria that will be applicable.		
ECCC 3.4	Baffinland Iron Mines Corporation. May 2019. Mary River Project – Phase 2 Proposal - Updated Application for Amendment No. 2 of Type A Water Licence 2AM-MRY1325, Attachment 23 (Part 5): Fresh Water Supply, Sewage, and Wastewater Management Plan.	ECCC’s Recommendation(s): ECCC recommends that the Proponent clarify pdf pages 52 to 57.	Baffinland appreciates ECCC's thorough review of the Fresh Water Supply, Sewage, and Wastewater Management Plan. Pages 52-58 of Attachment 23 FSWWP (Part 5) have been reviewed and the following clarifications are provided: Page 52: This figure is the final page of Appendix F. It is noted that this figure is upside down in the PDF. Page 53: This is the flysheet for Appendix G - Mobile Oily Water Separator (OWS) Manual. Appendix G has been added to the FWSSWMP - Part 5 file that was included in the Application, provided as Attachment 06 to this response. Page 54: This is the flysheet for Appendix H - MDMER Sampling and Reporting Requirements Memo (Minnow). This Appendix can be found in pages 59-67 of the PDF. Pages 55-56: These pages were erroneously included and have been removed from the FWSSWMP - Part 5 file provided as Attachment 06 of this submission. Pages 57-58: These pages are appendices to Appendix G of the FWSSWMP; see Attachment 06 of this submission. All required changes will be made in the next update to the FWSSWMP which will be submitted prior to the technical meeting.	Attachment 06 - FWSSWMP Part 5 file

QIKIQTANI INUIT ASSOCIATION

ID#	Document Reference	Recommendations/Requests	Response	Attachment
QIA 1.1	190502-2AM-MRY1325-Amend2-Applic-Att-29-ICRP	1.1 - Baffinland’s May 2019 submission of the Interim Reclamation and Closure Plan (ICRP) has not yet been approved by QIA through the Commercial Lease. QIA can provide an update on this approval process as requested by the NWB; however, QIA will manage the ICRP through the Commercial Lease and not the Water Licence Process.	Baffinland will continue to engage QIA on the updates to the ICRP, to meet the conditions of both the Commercial Lease and the Type 'A' Water Licence.	
QIA 2.1	190502-2AM-MRY1325-Amend2-Applic-Att-29-ICRP	2.1 - QIA will work with Baffinland through the Commercial Lease on all matters related to security for Inuit Owned Land. QIA can provide an update on this approval process as requested by the NWB.	Baffinland will continue to engage QIA on the updates to security held for the Project, to meet the conditions of both the Commercial Lease and the Type 'A' Water Licence.	
QIA 3.1	190502-2AM-MRY1325-Amend2-Applic-Att-2-Applic	3.1 - Baffinland should be required to come to a new agreement with QIA prior to the amendment being issued as per Article 20.3.1 of the Nunavut Agreement.	Baffinland believes that an amended Water Compensation Agreement is required, and has provided QIA with draft revisions to the Water Compensation Agreement to reflect the Phase 2 Project.	
QIA 4.1	08MN053_BAF-PH1-830-P16-0022_railway-ops-maint-DRAFT-PHASE-2 08MN053_BAF-PH1-830-P16-0008_Environment-Protection-Plan-DRAFT-PHASE-2 190506 2AM-MRY1325 Amend2 Applic Att-22-SWAEMP-ILAE 190502 2AM-MRY1325 Amend2 Applic-Att-27-AEMP-ILAE	4.1 - Provide the specifics of how Inuit Qaujimagatuqangit was and will be used and considered in the development of the North Railway, its location, the crossings, and the relevant management and monitoring plans.	The proposed alignment of the North Railway follows the existing Milne Inlet Tote Road for the majority of the distance between the Mine Site and Milne Port, which limits the footprint of the Project and the need for additional access road construction. The section of the North Railway alignment that deviates from the Milne Inlet Tote Road was subject to an exhaustive technical feasibility study, which determined the preferred alignment was the most technically and economically feasible, as well as the safest in terms of operations (grade and distance from water) and Inuit and wildlife crossings (least steep cuts). Based on these considerations Baffinland advanced the preferred alignment for public reviews to be administered by the Nunavut Planning Commission (NPC), Nunavut Impact Review Board (NIRB), and the Nunavut Water Board (NWB). The proposed alignment of the North Railway, as with the Tote Road, does overlap with a primary travel route. The proposed railway deviation does additionally overlap with the travel route to Igloolik. No other important values were identified in the IQ work that resulted in the map book presented as TSD 5. The proposed alignment of the North Railway occurs entirely within the Mary River Transportation Corridor as defined in Appendix P of the North Baffin Regional Land Use Plan. The modification (Modification No. 3) to this Corridor was subject to a thorough public review process, facilitated by the NPC, and culminated in a Public Hearing in Pond Inlet in December 2017. Issues with the proposed North Railway alignment raised by Inuit through this process were used by Baffinland to identify gaps in existing IQ collection and modify its Phase 2 engagement planning in relation to the NIRB Project Certificate Reconsideration. The primary addition was a series of Community Risk Assessment Workshops, which were intended to identify and integrate Inuit generated mitigations and monitoring measures into Baffinlands environmental management plans relating to the North Railway. The location of special built crossings to facilitate travel by Inuit and caribou across the North Railway was the subject of a Crossing Selection Workshop, held July 29-August 2, 2019 at the Mary River Mine Site. At the Workshop Inuit from the communities of Pond Inlet and Igloolik were asked to identify areas along the proposed North Railway alignment that intersect known travel routes between the two communities or from their communities to known hunting grounds. The results of this Workshop will be provided in a report to the NIRB and NWB before the Public Hearings. The relevant operational (Snow Management Plan and Railway Operations and Maintenance Plan) and environmental (Terrestrial Environment Monitoring and Mitigation Plan) management plans will be updated based on IQ collected through a series of Community Risk Assessment Workshops (January - May 2019) as well as a Crossing Selection Workshop (July 2019). Reports from these two workshops will be provided to the NIRB and NWB before the Public Hearings. Should the North Railway be approved and constructed, the applicable environmental management plans will be subject to the newly developed Adaptive Management Plan and IQ Collection Framework, which will systematically collect and integrate Inuit input and IQ into Baffinlands decision making processes. Further details on this process will be released prior to the Technical Meetings for review and discussion.	

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QIA 4.2	08MN053_BAF-PH1-830-P16-0022_railway-ops-maint-DRAFT-PHASE-2 08MN053_BAF-PH1-830-P16-0008_Environment-Protection-Plan-DRAFT-PHASE-2 190506 2AM-MRY1325 Amend2 Applic Att-22-SWAEMP-ILAE 190502 2AM-MRY1325 Amend2 Applic-Att-27-AEMP-ILAE	4.2 - Provide monitoring locations along the proposed North Railway that align with Inuit use.	Road and rail dust are not expected to affect the quality of water in nearby streams and lakes in regard to a potential source of drinking water. Baffinland's IQ study did not identify waters important to Inuit in the vicinity of the Tote Road and Railway (KP Letter dated November 30, 2018; Ref. No. NB18-00785; Appendix A of Attachment 2 of Baffinland's January 2019 response to NIRB advanced technical review comment HC 02 in January 2019). It was acknowledged in that report that it is reasonable to assume that watercourses close to areas used by Inuit may be used as sources of drinking water, including Phillips Creek and the lakes within the Phillips Creek catchment. On June 14, 2019, Baffinland received a copy of the QIA's Tusaqtavut Study for Pond Inlet, which identified approximately 14 values within the Project areas that are used for subsistence (either fishing and/or fresh water) within the Project footprint including a 250 m buffer. Baffinland requests the coordinates and interviewer-assigned description of each value, so that the nature of these subsistence values can be understood. Baffinland is willing to consider modifications to its Tote Road Monitoring Program to monitor water quality at Inuit water use areas, if the appropriate IQ information can be made available.	
QIA 5.1	Fish Passage Risk Assessment Update (KP Ref VA19-00838)	5.1 - When will the monitoring and adaptive management plan related to flow diversion be shared for review and comment?	Monitoring and adaptive management at stream diversions are outlined in Attachment 05 (<i>Proposed North Rail Monitoring Programs</i>).	Attachment 05 - Proposed North Railway Aquatic Monitoring Programs
QIA 6.1	08MN053_BAF-PH1-830-P16-0022_railway-ops-maint-DRAFT-PHASE-2	6.1 - This plan or another should be resubmitted with the monitoring and mitigation measures to be taken for the construction and operations of the North Railway. This should include adaptive management.	Section 5.2 of the Railway Operation and Maintenance Plan (under the heading Component Inspections) describes the inspections and maintenance work to be undertaken at bridges and culverts. Section 1.3 identifies the relevant management plans for issues related to water quality and fish habitat, notably the EPP and the SWAEMP. These plans will be relied upon for addressing water quality and fish habitat issues that are identified as part of the Component Inspections of bridges and culverts.	
QIA 7.1	Multiple, for example: 08MN053_BAF-PH1-830-P16-0022_railway-ops-maint-DRAFT-PHASE-2 190506 2AM-MRY1325 Amend2 Applic Att-22-SWAEMP-ILAE	7.1 - Baffinland should be required to update all DRAFT management plans so that all references are clear and easy to access. At a minimum, references should include the section headers or section numbers.	Baffinland proposes to update the Water Licence related management plans in advance of the NWB Technical Meetings. Attachment 07 presents a table that identifies where each management plan references another plan. The references to other plans will be checked and updated the next update to these management plans.	Attachment 07 - References to Other Management Plans
QIA 8.1	190506 2AM-MRY1325 Amend2 Applic Att-22-SWAEMP-ILAE	8.1 - Resubmit the SWAEMP and include the frequency of the assessment of monitoring activities listed in Section 10 and how this will inform and prioritize maintenance activities.	A detailed outline of rail monitoring is provided as Attachment 05 (<i>Proposed North Rail Monitoring Programs</i>).	Attachment 05 - Proposed North Railway Aquatic Monitoring Programs
QIA 9.1	Multiple, including: 190506 2AM-MRY1325 Amend2 Applic Att-22-SWAEMP-ILAE	9.1 - Resubmit DRAFT plans and use language for what Baffinland will do should the Project be approved rather than delaying detail or recommending actions be taken.	Baffinland proposes to update the Water Licence related management plans in advance of the NWB Technical Meetings. Attachment 08 presents a table that identifies where each management plan forward-references an action and provides more detail or clarification on each of these commitments. These forward-referenced commitments will be addressed according to the proposed actions in the next update to these management plans in advance of the NWB technical meetings.	Attachment 08 - Forward-Referencing in Management Plans
QIA 10.1	190506 2AM-MRY1325 Amend2 Applic Att-22-SWAEMP-ILAE 08MN053_BAF-PH1-830-P16-	10.1 - Present the how, where and to what frequency is calcium chloride monitored to remain in accordance with applicable guidelines to minimize runoff into local watercourses.	As noted in the Roads Management Plan, calcium chloride is mixed with water for application to roads for dust suppression in accordance with its Dust Management Protocol, which is Attachment 6 of the Air Quality and Noise Abatement Management Plan, presented as Attachment 09 of this response. The Dust Management Protocol is consistent with Section 2.3 of the Nunavut Environmental Guideline for Dust Suppression (Government of Nunavut, 2002). This includes using dust suppressants approved by the GN (CaCl is an approved dust suppressant); following manufacturer application instructions; applying the dust suppressant to the roadway; monitoring the application rate	Attachment 09 - Dust Management Protocol

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	0023_Roads_Management_Plan-DRAFT-PHASE-2		to ensure adequate coverage without pooling or runoff of product; not using more dust suppressant than needed to effectively suppress dust; and ensuring the material does not migrate or run off the traveled portion of the roadway. Monitoring to determine if calcium chloride can be detected in local watercourses is not identified in the GN dust suppression guideline. Baffinland notes that in 2018 an alternate dust suppressant called Dust Stop was used on a trial basis, and an expanded trial application is being implemented in 2019. Dust Stop is non-toxic to aquatic life, and is being considered to partially or fully replace the use of CaCl as a dust suppressant at site.	
QIA 10.2		10.2 - Provide the applicable guideline used to minimize runoff into local watercourses.	The Dust Management Protocol presented as Attachment 6 of the Air Quality and Noise Abatement Management Plan provides the guidance Baffinland staff use to minimize runoff into watercourses. The Dust Management Protocol has been provided as Attachment 09 to this response.	Attachment 09 - Dust Management Protocol
QIA 11.1	190502-2AM-MRY1325-Amend2-Applic-Att-8.5-Rail-Geotech-Recomm	11.1 - The Water Licence should require Baffinland to monitor the construction, operations and closure of the North Railway.	Part D, Item 18 of the existing Water Licence requires geotechnical inspections of earthworks. Schedule B, Item 1e.ii of the existing Water Licence requires reporting of results of thermal modelling and/or research carried out in relation to permafrost integrity along the railway alignment.	
QIA 11.2	190502-2AM-MRY1325-Amend2-Applic-Att-8.5-Rail-Geotech-Recomm	11.2 - The Water Licence should require Baffinland to provide the monitoring program prior to any construction approvals for the North Railway is provided.	Baffinland will provide details on the construction geotechnical monitoring program as part of the Water Licence review process in advance of the technical meeting. The outcome of the construction geotechnical monitoring program will inform the operations phase geotechnical monitoring, to be incorporated into the updated Railway Operation and Maintenance Plan.	
QIA 12.1	08MN053_BAF-PH1-830-P16-0022_railway-ops-maint-DRAFT-PHASE-2	12.1 - These records should be provided to reviewers as part of Baffinland's reporting requirements under the Water Licence.	Part D, Item 18 of the existing Water Licence requires geotechnical inspections of earthworks. Schedule B, Item 1e.ii of the existing Water Licence requires reporting of results of thermal modelling and/or research carried out in relation to permafrost integrity along the railway alignment.	
QIA 12.2	08MN053_BAF-PH1-830-P16-0022_railway-ops-maint-DRAFT-PHASE-2	12.2 - Baffinland should be required to disclose the triggers that result in corrective actions being taken.	Thresholds and triggers will be established as appropriate in the future operations geotechnical monitoring program that will form part of the Railway Operation and Maintenance Plan. Triggers that will result in corrective actions will be defined after the completion of the construction monitoring phase, as no detailed site-specific information is currently available to make an accurate assessment of the potential triggers. These triggers will be disclosed once they have been developed.	
QIA 12.3	08MN053_BAF-PH1-830-P16-0022_railway-ops-maint-DRAFT-PHASE-2	12.3 - Baffinland should be required to update the NWB and reviewers on the effectiveness of the corrective actions.	Comments on the effectiveness of corrective actions can be provided as part of Baffinland's QIA and NWB Annual Report for Operations.	
QIA 13.1	190506 2AM-MRY1325 Amend2 Applic Att-22-SWAEMP-ILAE	13.1 - Provide figures that detail the field monitoring proposed to be completed as part of the construction, operation and closure of the North Railway.	Sections 10.2.3.1 and 10.2.3.2 describe the proposed monitoring along the North Railway during the construction and post-construction phases, respectively. For example, Section 10.2.3.1 states, " <i>Monitoring will occur at active work areas along the North Railway during construction, as prescribed in a future Fisheries Authorization for crossings. This is expected to include turbidity monitoring downstream of active work areas, including crossing locations as well as downstream of quarries and soil spoils disposal areas (mainly former borrow pits and quarries).</i> "The location of the embankment and water crossings are presented on the detailed railway figures presented as Attachment 10 of the Water Licence amendment Application. A map of proposed monitoring locations for operations will be provided prior to the technical meeting. Monitoring locations associated with quarries will be identified within each quarry management plan.	
QIA 13.2	190506 2AM-MRY1325 Amend2 Applic Att-22-SWAEMP-ILAE	13.2 - Provide additional details based on Baffinland's current experience from developing a mine with a linear transportation corridor (over 5 years) that would inform the selection of effective sedimentation and erosion controls along the North Railway.	Section 6.4.3 of the SWAEMP presents generic sediment and erosion control measures, with Baffinland's evaluation of performance based on its experience implementing each control measure.	
QIA 14.1	08MN053_BAF-PH1-830-P16-0023_Roads_Management_Plan-DRAFT-PHASE-2	14.1 - Provide the severity of the concern that requires immediate action be taken by Baffinland.	The response action framework for post-construction monitoring is outlined in Appendix C of the Roads Management Plan.	

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QIA 14.2	08MN053_BAF-PH1-830-P16-0023_Roads_Management_Plan-DRAFT-PHASE-2	14.2 - Provide the frequency at which Baffinland would determine and prioritize any corrective actions to the Project road network.	Water quality monitoring is conducted per the schedule outlined in Appendix C of the Roads Management Plan, including a response action framework to address issues of sedimentation. Geotechnical inspections of the project are completed bi-annually as required by the Type A Water Licence, and recommendations are provided in the resulting report and are actioned on Site. Fish passage is assessed annually, and generally any identified issues are addressed in the calendar year. The exception is fisheries crossings where QIA has not granted approval for Baffinland to conduct adjustments to the Tote Road under the Commercial Lease.	
QIA 14.3	08MN053_BAF-PH1-830-P16-0023_Roads_Management_Plan-DRAFT-PHASE-2	14.3 - Provide what would trigger Baffinland to construct the approved Tote Road to the 2014 Hatch design.	Baffinland continues to upgrade the Tote Road through ongoing operation and maintenance, implementation of the Tote Road Earthworks Execution Program (TREETP) and implementing or restoring sections of the road to the Hatch design.	
QIA 15.1	08MN053_BAF-PH1-830-P16-0022_railway-ops-maint-DRAFT-PHASE-2	15.1 - Provide the target areas identified as higher risk and validation for this assessment.	The complete list of target areas have not been identified. A study is currently underway to develop a geotechnical monitoring plan for use during the construction phase. The outcome of the construction geotechnical monitoring program will inform the operations phase geotechnical monitoring, to be incorporated into the updated Railway Operation and Maintenance Plan. Examples of high risk areas may include the four rail bridges over rivers, plate arch culverts, high embankments and deep excavations in both ice-rich and ice-poor soil areas.	
QIA 15.2	08MN053_BAF-PH1-830-P16-0022_railway-ops-maint-DRAFT-PHASE-2	15.2 - Provide what additional information will be gathered prior to construction of the North Railway and how that information will be used to inform the construction of the North Railway.	Thermistors for sub-surface temperature profiling, as well as topographical survey markers and settlement plates will be installed at various locations to validate design assumptions and to monitor potential creep and thaw settlement.	
QIA 15.3	08MN053_BAF-PH1-830-P16-0022_railway-ops-maint-DRAFT-PHASE-2	15.3 - Provide how the information gathered during the construction of the North Railway will be used to finalize the operational condition monitoring plan.	Data collected during the construction phase will be used to validate the design assumptions used for design analysis and modelling of thermal behaviour and changes to the permafrost regime. This will assist in identifying operations phase monitoring at representative and high risk locations, for example at deep excavations, high embankments, or plate arch culverts. The operations phase monitoring program will evolve over time should results show a specific need for additional monitoring.	
QIA 15.4	08MN053_BAF-PH1-830-P16-0022_railway-ops-maint-DRAFT-PHASE-2	15.4 - Provide the inventory of rail condition monitoring equipment and locations.	The construction geotechnical monitoring program for the North Railway is currently being prepared and will be submitted for review in advance of the technical meeting. A draft list of monitoring equipment and locations are provided in a table presented as Attachment 10 of this response, however this list is subject to change as the monitoring program is finalized. The final monitoring plan for the operations phase of the railway will be finalized following completion of the construction monitoring phase, when data collected has been analyzed and final recommendations can be provided.	Attachment 10 - Draft Geotechnical Monitoring Components
QIA 16.1	190506 2AM-MRY1325 Amend2 Applic Att-22-SWAEMP-ILAE	16.1 - Present the triggers based on monitoring data listed in Attachment 1, that will be implemented to mitigate against an exceedance of a water quality criteria, relevant thresholds, and potential impacts to the receiving environment. As committed to by Baffinland in the NIRB process, QIA is willing to work with Baffinland through updating its adaptive management included in monitoring and management plans.	A detailed outline of construction monitoring is provided as Attachment 05 (<i>Proposed North Rail Monitoring Program</i>). This includes a description of proposed monitoring of watercourses downstream of active construction areas in accordance with the Environmental Guidelines for Project Water Crossing Repairs, Modifications and/or Installations presented in Appendix C of the Roads Management Plan, which will be adapted for implementation during rail construction. The final monitoring program will be presented in an updated SWAEMP, to be made available in advance of the NRB technical meetings.	Attachment 05 - Proposed North Railway Aquatic Monitoring Programs
QIA 16.2	190506 2AM-MRY1325 Amend2 Applic Att-22-SWAEMP-ILAE	16.2 - Update all applicable water quality monitoring plans to include triggers, based on monitoring data, and to implement the mitigation measures to avoid exceedance of water quality criteria, relevant thresholds, and potential impacts to the receiving environment.	The reference to Attachment 1 is not clear as there is no Attachment 1 in the referenced SWAEMP. Baffinland will update the applicable water quality monitoring plans to be consistent with the Adaptive Management Plan currently under development in consultation with the QIA. This includes incorporating the concepts of triggers, thresholds and actions presented in the Environmental Guidelines for Project Water Crossing Repairs, Modifications and/or Installations presented in Appendix C of the Roads Management Plan. This is articulated further in the detailed outline of construction monitoring presented in Attachment 05 (<i>Proposed North Rail Monitoring Programs</i>).	Attachment 05 - Proposed North Railway Aquatic Monitoring Programs
QIA 16.3	190506 2AM-MRY1325 Amend2 Applic Att-22-SWAEMP-ILAE	16.3 - Describe how the proposed measures will mitigate the occurrence of an exceedance to water quality criteria.	See the detailed outline of construction monitoring provided as Attachment 05 (<i>Proposed North Rail Monitoring Programs</i>).	Attachment 05 - Proposed North Railway Aquatic

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				Monitoring Programs
QIA 17.1	Fish Passage Risk Assessment Update (KP Ref VA19-00838)	17.1 Is Baffinland committed to completing these recommendations? If yes, when will the assessment and detailed design be shared for review and comment?	Yes, Baffinland is committed to completing these recommendations. An assessment of the single high risk diversion will be undertaken in late August 2019, and site-specific modifications to the culvert design will be undertaken if appropriate following this assessment (i.e., through the fall of 2019). The resultant information will be presented in the application for an authorization under the Fisheries Act, to be prepared in late 2019 through early 2020. Baffinland can provide the QIA with this information once it has been developed. This is articulated in more detail on the construction monitoring outline provided as Attachment 05 (<i>Proposed North Rail Monitoring Program</i>).	Attachment 05 - Proposed North Railway Aquatic Monitoring Programs
QIA 18.1	Fish Passage Risk Assessment Update (KP Ref VA19-00838) 190502 2AM-MRY1325 Amend2 Applic-Att-27-AEMP-ILAE	18.1 - Is Baffinland committed to completing these recommendations? If yes, when will the monitoring program be shared for review and comment?	Yes, Baffinland is committed to completing these recommendations. An outline of the proposed fish passage monitoring program is presented in Attachment 05 <i>Proposed North Rail Monitoring Programs</i>). The resultant information will be presented in the application for an authorization under the <i>Fisheries Act</i> , to be prepared in late 2019 through early 2020. Baffinland can provide the QIA with this information once it has been developed.	Attachment 05 - Proposed North Railway Aquatic Monitoring Programs
QIA 18.2	Fish Passage Risk Assessment Update (KP Ref VA19-00838) 190502 2AM-MRY1325 Amend2 Applic-Att-27-AEMP-ILAE	18.2 - Given this statement can Baffinland explain why the North Railway did not cause greater changes to the AEMP? Please also consider the North Railway involved almost 400 stream crossing and 30 new quarries.	The AEMP focuses on the assessment of long-term aquatic effects from multiple stressors within the Potential Development Area of the Mary River Mine. The Mary River Mine site is considered to be the worst case scenario for impacts to the aquatic environment, including fish passage and habitat quality, due to multiple sources including surface runoff, discharges and dust. Baffinland suggests the SWAEMP is more appropriate as the project effects in the Northern Transportation Corridor are associated with construction and the monitoring program will be short-term focusing on validating that fish passage has been maintained.	
QIA 19.1	190502-2AM-MRY1325-Amend2-Applic-Att-8.5-Rail-Geotech-Recomm	19.1 - These reports should be included in Baffinland's reporting to NWB.	Observations of erosion and sedimentation may be identified during General or Component Inspections described in Section 5.2 of the Railway Operation and Maintenance Plan. As noted in Section 1.3 of the same Plan, water quality issues will be dealt with in accordance with the relevant plans including the EPP and SWAEMP, as with any other erosion and sedimentation issue on the Project.	
QIA 19.2	190502-2AM-MRY1325-Amend2-Applic-Att-8.5-Rail-Geotech-Recomm	19.2 - Provide the measures and what are the specific triggers to action them.	Rail operations staff will report any erosional events that are or have the potential to cause the release of sediment into watercourses to the Environment Dept. This would be the triggering event. Any remedial measures will be implemented consistent with the SWAEMP. Aside from potentially elevated TSS above thresholds described in the Water Quality Monitoring outline for rail construction presented in Attachment 05 (<i>Proposed North Rail Monitoring Programs</i>). Monitoring and sampling of select water crossings in the Northern Transportation Corridor will also include a visual inspection of crossings to assess erosion and sedimentation events, consistent with the monitoring framework outlined in the Tote Road Monitoring Program in the Roads Management Plan.	Attachment 05 - Proposed North Railway Aquatic Monitoring Programs
QIA 20.1	190502-2AM-MRY1325-Amend2-Applic-Att-8.5-Rail-Geotech-Recomm 2AM-MRY1325 Baffinland Iron Mines Revised Run of Mine Stockpile and Sedimentation Pond Issued For Construction Drawings	20.1 - This work should be completed and provided by Baffinland prior to any construction approvals for the North Railway deviation is provided.	Further geotechnical investigations to confirm permafrost conditions along the North Railway deviation are planned in advance of construction, during winter 2019/2020. Any required updates to the Geotechnical Recommendations for Northern Railway report will be filed with the NWB.	
QIA 21.1	190502-2AM-MRY1325-Amend2-Applic-Att-8.5-Rail-Geotech-Recomm	21.1 - The Water Licence should require Baffinland to complete and report on embankment cut test sections. The reporting should describe how the results were included in final designs. This work should be completed and provided by Baffinland prior to any construction approvals for the North Railway is provided.	A report on embankment cut sections cannot be produced unless actual cuts have been constructed and condition monitoring has taken place during construction. Following the construction monitoring phase, long-term monitoring will be proposed based on the findings from the construction monitoring program. Embankment cut sections have been studied in the thermal analysis reports and these have been presented as part of the FEIS Addendum.	

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QIA 22.1	190502-2AM-MRY1325-Amend2-Applic-Att-8.5-Rail-Geotech-Recomm	22.1 - Additional details regarding the frequency, and extent of the aerial assessments is requested.	Aerial Photosat imagery is already collected on an annual basis as agreed to with QIA. Aerial images from previous years will be compared with new images to identify areas of standing water which may indicate localized settlement has occurred.	
QIA 22.2	190502-2AM-MRY1325-Amend2-Applic-Att-8.5-Rail-Geotech-Recomm	22.2 - A specific trigger for when additional insulation is required should be considered in the Water Licence.	Triggers for when additional insulation or soil cover may be required will be determined after the completion of the construction monitoring phase, as no detailed site-specific information is currently available to make an accurate assessment of the potential triggers. Some triggers may relate to the safe operation of the rail line, such as excessive settlement (beyond what can be accommodated in the rail design) or cut slope failure as a result of freeze/thaw action within the active zone and changes to the local permafrost regime.	
QIA 22.3	190502-2AM-MRY1325-Amend2-Applic-Att-8.5-Rail-Geotech-Recomm	22.3 - The Water Licence should require Baffinland complete the aerial assessments committed to and report upon them.	Aerial assessments will continue to be undertaken annually with a report provided to the QIA as part of the Commercial Lease.	
QIA 23.1	190506 2AM-MRY1325 Amend2 Applic Att-22-SWAEMP-ILAE	23.1 - Provide what monitoring would be conducted that could lead to mitigation measures.	Further to the QIA's comment on the hydrological modelling completed in 2017 as presented in the FEIS Addendum (Appendix C of TSD 13), the railway design was updated. Ten diversions will now occur, and these were assessed with updated hydrological modelling, presented as Attachment 04 to this response (<i>Fish Passage Risk Assessment of Water Crossings and Stream Diversions</i>). Nine of the 10 stream diversions were assessed as low risk and the tenth stream diversion was assessed as medium risk. An outline of a proposed monitoring program is provided in Attachment 05 (<i>Proposed North Rail Monitoring Programs</i>).	Attachment 04 - Fish Passage Risk Assessment of Water Crossings and Stream Diversions; Attachment 05 - Proposed North Railway Aquatic Monitoring Programs
QIA 23.2	190506 2AM-MRY1325 Amend2 Applic Att-22-SWAEMP-ILAE	23.2 - Provide the monitoring values that would trigger mitigation measures.	Monitoring will consist of visual inspection, survey transects and possibly TSS/turbidity monitoring if elevated TSS is observed as the result of erosion of the stream channel. The only numerical value that would trigger mitigation would be TSS above the thresholds identified in the Rail Monitoring memo provided in Attachment 05 (<i>Proposed North Rail Monitoring Programs</i>). Effects to stream morphology will be based on professional judgement with consideration of potential alteration of fish habitat.	Attachment 05 - Proposed North Railway Aquatic Monitoring Programs
QIA 23.3	190506 2AM-MRY1325 Amend2 Applic Att-22-SWAEMP-ILAE	23.3 - Provide reasoning when monitoring and adaptive management would not be needed during and post construction.	Monitoring will not be required following a full open water season (plus a preceding partial season, if applicable) indicates that the channel capacity is not being exceeded, subsidence or slope instability is not occurring, and if channel bed scour or sediment deposition is not occurring within what is judged to be normal limits. Proposed monitoring is described further in Attachment 05 (<i>Proposed North Rail Monitoring Programs</i>).	Attachment 05 - Proposed North Railway Aquatic Monitoring Programs
QIA 24.1	190502 2AM-MRY1325 Amend2 Applic-Main-Rpt-ILAE	24.1 The NWB should develop a new Part of the amended Water Licence devoted to stream crossings, the construction of the North Railway, and subsequent reporting requirements. At a minimum this should consider the following: 24.1.1 - Environmental monitoring for construction 24.1.2 - Construction QAQC programs for the North Railway 24.1.3 - Infield design change reporting 24.1.3 - North Railway As-Built reporting on time frequency basis 24.1.4 - A construction sequence	Baffinland suggests that this can be dealt with in Part D of the current licence, through the process of the NWB approving design drawings and reports, requiring the submission of as-builts with construction summary reports, and the implementation of mitigation measures and monitoring as described in the management plans approved under the Water Licence. Baffinland would be amenable to inclusion of water quality criteria for water crossings that consider the influence of background or upstream concentrations (i.e. natural conditions).	
QIA 24.2	190502 2AM-MRY1325 Amend2 Applic-Main-Rpt-ILAE	24.2 - This new Part should also provide requirements for construction reporting.	Construction reporting requirements are outlined in Part D, Item 17 of the current Water Licence.	

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QIA 24.3	190502 2AM-MRY1325 Amend2 Applic-Main-Rpt- ILAE	24.3 QIA is willing to work through the NWB process and review to support the development of draft terms and conditions.	Baffinland is also open to discussing this further with the parties.	
QIA 25.1	190502-2AM-MRY1325- Amend2-Applic-Att-8.5-Rail- Geotech-Recomm 190506 2AM-MRY1325 Amend2 Applic Att-22- SWAEMP-ILAE 08MN053_BAF-PH1-830- P16-0022_railway-ops- maint-DRAFT-PHASE-2	25.1 - Provide a timeline for the completion of modelling; additional testing; final design; and final approval of the North Railway.	Thermal modelling have been completed and is provided in Attachments 8.4, 8.5, 8.9, 8.10 and 8.11 of the updated Application. Hydrological modelling is provided in Attachment 04 of this submission. Additional geotechnical testing will occur along the North Railway deviation in winter 2019/2020, and testing will continue through the construction phase. The final design has been completed and is shown on the plan and profile drawings in Attachments 11.1 to 11.3 of the updated Application. While this design is final and approved for construction, it is recognized that there may be local changes due to site conditions.	Attachment 04 - Fish Passage Risk Assessment of Water Crossings and Stream Diversions
QIA 25.2	190502-2AM-MRY1325- Amend2-Applic-Att-8.5-Rail- Geotech-Recomm 190506 2AM-MRY1325 Amend2 Applic Att-22- SWAEMP-ILAE 08MN053_BAF-PH1-830- P16-0022_railway-ops- maint-DRAFT-PHASE-2	25.2 - Baffinland should be required to provide bi-weekly reports during the construction of the North Railway that outline any deviations from the approved construction drawings.	Information on as-built deviations from the approved construction drawings will be provided in Construction Summary Reports to be prepared as required under Baffinland's Type 'A' Water Licence.	
QIA 25.3	190502-2AM-MRY1325- Amend2-Applic-Att-8.5-Rail- Geotech-Recomm 190506 2AM-MRY1325 Amend2 Applic Att-22- SWAEMP-ILAE 08MN053_BAF-PH1-830- P16-0022_railway-ops- maint-DRAFT-PHASE-2	25.3 - Provide a timeline for delivering the North Railway long term monitoring and maintenance plan for review, comment, and approval.	The long-term monitoring and maintenance plan for the North Railway will be finalized during the first year of railway operations. The development of this plan will take into account information and observations from the construction geotechnical monitoring program.	

APPENDIX 1

ATTACHMENTS

ATTACHMENT 1: REVISED DRAFT RAILWAY EMERGENCY RESPONSE PLAN

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Style Definition: TOC 2

Baffinland Iron Mines Corporation

DRAFT RAILWAY EMERGENCY RESPONSE PLAN

Phase 2 Proposal Revisions – FOR REVIEW PURPOSES ONLY

This document provides revisions to:
Document # BAF-PH1-830-P16-0021
Rev # DRAFT 2
~~October 2, 2018~~August 14, 2019

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Baffinland Iron Mines Corporation

Railway Emergency Response Plan

BAF-PH1-830-P16-0021

DRAFT

Prepared By:
Department:
Title:
Date:
Signature:

Approved By:
Department:
Title:
Date:
Signature:

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DOCUMENT REVISION RECORD

Issue Date MM/DD/YYYY	Revision	Prepared By	Approved By	Issue Purpose
09/25/2018	DRAFT	AV	SP	Document issued for use.
08/14/2019	DRAFT 2	SB	LK	Document issued for review.

Index of Major Changes/Modifications

Item No.	Description of Change	Relevant Section

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[Appendix A - Draft Railway Incident Report Forms \(Not for Use\)](#)

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1 INTRODUCTION

Baffinland's existing Emergency Response Plan (BAF-PH1-840-P16-0002) establishes the framework and procedures to safely and effectively respond to potential environmental, health and safety emergencies. Prior to the implementation of rail operations, this plan will be updated to incorporate the information contained within the Railway Emergency Response Plan.

1.2 PROCEDURE – RAIL INCIDENT OR DERAILMENT

When a rail incident or derailment occurs, the immediate priority is to ensure the safety and protection of people and the environment. The secondary priority is to protect and minimize property damage and then to ensure the continuance and restoration of rail operations.

All derailments, crossing accidents and releases of Dangerous Goods must be reported to the Transportation Safety Board of Canada.

1.2.1 INITIAL RESPONSE PROCEDURE

Any incident involving trains or equipment, fires, spills, derailments, crossing accidents or any emergency situation involving the rail operation must be reported immediately to the immediate supervisor or Rail Traffic Controller if the incident has occurred on the main track or other controlled location. The supervisor or Rail Traffic Controller shall notify emergency response personnel of the severity of the accident and the respective Mine and Railway emergency response teams will take the appropriate decisions and ensure the efficient course of action.

The following steps must be taken, as applicable:

- Protect the movement of rail cars, locomotive or track equipment;
- Keep clear of the incident scene and take immediate action to warn others;
- If the locomotive is not directly involved in the incident, cut the movement as close as safely possible and remove the remaining cars to a safe distance;
- Advise of the nature and extent of any injuries;
- Record the exact location of the incident and the time the incident occurred;
- Record the number and types of cars involved in the incident and status and condition of cars;
- If a spill has occurred, record the approximate volume and rate of release and actions taken;
- Record the weather conditions;
- Identify the resources required to respond to the incident; and
- Identify the location to meet emergency response personnel.

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[Draft railway incident report forms are provided in Appendix A. These forms are not for use and will be finalized prior to the commencement of rail operations.](#)

1.22.2 PRELIMINARY ASSESSMENT & RESPONSE

As soon as possible after the discovery of an incident, an initial assessment is performed to determine the magnitude of the incident and the actions required to minimize the impact. The remediation of many incidents can be successfully handled with minimal resources in a short period of time. The situation will be assessed by first responders including identify the incident type, hazards involved and any affected parties. More serious incidents may require the establishment of a command post and additional technical resources including response equipment and personnel.

2.3 HEALTH AND SAFETY EMERGENCIES

[Health and safety emergency scenarios that may occur along the rail line include Serious Injury, Fatality, Missing Employee, or Missing Member of the Public. Response actions for these emergency scenarios are provided in Section 4.2 of the Emergency Response Plan.](#)

1.32.4 DERAILMENT RECOVERY PROCEDURE

An expedited site visit will be required to assess the extent of work required to re-establish the service and perform preliminary steps to investigate the derailment possible cause (broken rail, axle, etc.). The representatives of track maintenance, railway operations and mechanical maintenance should be present.

Before working on the site, a security briefing will be held. The following topics shall be addressed:

- Establishment of incident command post;
- Role and responsibility of personnel;
- Radio frequencies used;
- Procedures to be followed during manoeuvres.

Derailment response equipment will be located at Milne Port. Equipment will be dispatched to the derailment site as required including mine operations equipment if deemed required for response and restoration purposes. Track material will be located at the Port or other designated stockpile locations along the rail alignment.

The Maintenance of Way Supervisor will be responsible for the coordination of track repairs. The Railway Operations Manager will ensure that someone is available on each shift to plan all train movements with the Rail Traffic Controller, to inform on the progress of the work and coordinate personnel changes to meet the maximum working hours on the site.

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All accidents must be investigated to determine the root cause and contributing factors. Representatives of track maintenance, railway operations and mechanical maintenance are jointly responsible to conduct the investigation.

1.42.5 SPILL OF HAZARDOUS MATERIAL

~~The Superintendent Transportation is responsible to establish and implement the Emergency Intervention Team. The team will comprise site employees who receive special training to assist in an emergency.~~

Baffinland's existing Spill Contingency Plan (BAF-PH1-830-P16-0036) identifies the potential for accidental release of hazardous material to the environment and provides spill scenarios and identifies protocols for prevention, response and recovery. Prior to the implementation of rail operations, this plan will be updated to incorporate additional potential risks of release related to rail operations. Site specific response plans in the case of a spill or derailment at the four proposed bridge locations will also be incorporated into Baffinland's Spill Contingency Plan.

In case of a spill of hazardous material caused by a derailment or another accident, the following procedure should be followed:-

To minimize the impact of a spill, it is very important to intervene as soon as possible. During an accident or the discovery of a hazardous material spill on the main track or other controlled location, the Rail Traffic Controller is informed by the team or employee who noticed the event. The Rail Traffic Controller shall ensure that someone on the scene maintains or establishes communications with the site on a continuous basis and obtains and transmits the following information as soon as possible:

- The exact location;
- Type of spill;
- Approximate quantity spilled;
- Extent of the spill;
- Distance between the track and the spill;
- Approximate distance between the track and the closest water body.

The employee(s) must not leave the site until the person designated for the first response arrives. This is important in order to measure, collect and submit the required information.

If the spill was caused in a derailment, the Rail Traffic Controller must also activate the derailment procedure simultaneously.

The Rail Traffic Controller will give priority on the track to the hi-rail vehicle used for the preliminary intervention and later to the work train assigned to the secondary intervention. To minimize damages, appropriate working time will be given to the concerned teams.

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2.3 PROCEDURE IN CASE OF EARTHQUAKE

2.2.3.1 MAGNITUDE AND EPICENTRE UNKNOWN

As soon as a Rail Traffic Controller becomes aware that an earthquake has or may have occurred, they must check with the Operations Manager or Maintenance of Way Supervisor to confirm whether the shake has been detected. Traffic must be stopped within 160 kilometres of where the earthquake was felt.

Traffic will be resumed under certain conditions, when the magnitude and the epicentre is determined. This information can be found on the following website:

<http://earthquakescanada.nrcan.gc.ca/index-eng.php>

Note that this information takes approximately one hour to register on the internet.

2.2.3.2 MAGNITUDE AND EPICENTRE KNOWN

Trains may re-start operations based on the following criteria:

2.2.3.2.1 EARTHQUAKE MAGNITUDE LOWER THAN 5.0 (RICHTER SCALE)

Restore normal operating speeds. Notify the Supervisor of Track and Signals who will assess the need to make an inspection.

2.2.3.2.2 EARTHQUAKE MAGNITUDE BETWEEN 5.0 AND 5.9 (RICHTER SCALE)

Within 100 miles (160 km) from the epicentre, the following risk areas will be checked in order to allow the circulation of trains:

- Bridges
- Rock cuts
- Retaining walls

In areas within 80 km (50 miles) from the epicentre, all locomotives and all trains shall move at restricted speed, until the inspections are made and appropriate speeds are established by the Superintendent of Track and Signals. Beyond 80 km from the epicentre, the normal speed can be restored.

2.2.3.2.3 EARTHQUAKE MAGNITUDE OF 6.0 (RICHTER SCALE) AND MORE

The operation of all locomotives and trains within 100 miles (160 km) from the epicentre should be discontinued. It should not be reinstated before the inspection of the area involved and the establishment of appropriate speed limits by those responsible for track maintenance.

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All locomotives and trains located beyond a radius of 100 miles (160 km) from the epicentre can move at restricted speed, after verification of the risk areas listed in 3.2.2. Following the inspections, speed limits throughout the territory will be determined by the Maintenance of Way Supervisor.

4 EMERGENCY RESPONSE EQUIPMENT

4.1 MEDICAL RESPONSE

Baffinland has equipped the Mine and Port sites with medical clinics capable of providing advanced life support (ALS) support in the event of a medical emergency.– The clinics are resourced by physician assistants working under the direction the Medical Director (physician) of our contracted medical services contractor. The physician assistants are able to provide advanced cardiac life support, basic trauma life support, administration of pain medication and narcotics, prescribe antibiotics, cardiac defibrillation and monitoring, intubation, cast application, and audiometry testing.

4.2 FIRE RESPONSE EQUIPMENT

Located at the Port is an Oshkosh T13000 Aircraft Rescue Fire Fighting (ARFF) truck with 3000 Gallon water tank, 420 Gallon foam tank, 450 lb dry chemical tank and ARFF snozzle. At the Mine are the Pierce Internation Fire Engine with 1000-gallon water tank and Oshkosh T1500 ARFF with 1500-gallon water tank, 750 litre foam capacity, 450 lb dry chemical tank with an ARFF snozzle.

The ERT is equipped with Scott AP 75 4.5 SCBA and associated turn-out gear for responding to emergencies and fires. Equipment is also available to support vehicle accidents such as hydraulic cutters, spreaders and rams, reciprocating saws, high pressure air lifting bags.

Locomotives and hi-rail vehicles are equipped with fire extinguishers.

4.3 AMBULATORY EQUIPMENT

In the event of a medical emergency along the railway alignment, ambulances are stationed at both the Port and Mine Site. Each of these ambulances are 4x4 Wheeled Coach models fitted with equipment to facilitate emergency medical care while in transit. For medical emergencies at locations along the alignment that are not accessible to wheeled ambulances, emergency medical equipment may be available in a hi-rail vehicle that can travel along the rail line. Injured personnel would be transported to the Mine or Port site at the discretion of medical response personnel, either in a hi-rail vehicle and/or wheeled ambulance. If available, the use of a helicopter to transport injured personnel will also be considered by the Emergency Response Team.

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4.4 SPILL RESPONSE EQUIPMENT

The Emergency Response Team is equipped and trained to respond to spills using the following equipment:

- Rescue and spill response truck at both the Mine Site and Milne Port;
- Pumps and containment structures;
- Floating booms, spill pads and containers;
- Diking and damming supplies;
- Spill kits; and,
- Safety equipment for working on or near water and/or specific hazardous materials.

Further detail on Spill Response is provided in the Spill Contingency Plan.

5 REPORTING

5.1 MINES HEALTH AND SAFETY REPORTABLE INCIDENTS

Under Section 16.02(1) in the event of a fatality or serious injury (reportable incident) the corporate emergency management team will be initiated who shall without delay notify a Workers' Safety and Compensation Commission (WSCC) inspector and OHSC Committee co-chairs. Reporting to WSCC shall be directly to the mines inspector (867-979-8527), chief mines inspector (867-669-4412), or to the 24-hour reporting phone line (800) 661-0792. A written report must be provided to the inspector within 72-hours of the occurrence.

5.2 SPILL REPORTING

Quantities of hazardous substances spilled that require reporting are listed in Schedule B of the Nunavut Spill Contingency and Reporting Regulation. After the initial field emergency response to the spill event, a spill report is filled out and reported to the 24-hour Spill Report Line:

24-Hour Spill Report Line

spills@gov.nt.ca

Tel. (867) 920-8130 or

Fax (867) 873-6924

Failure to report a spill can lead to fines. The Qikiqtani Inuit Association (QIA) Lands Administrator will also be promptly notified at (867) 975-8422 or via e-mail. Similarly, the CIRNAC Water Resources Officer will be promptly notified of the spill event at (867) 975-4295 or via e-mail. In the event of a spill on the ocean, the incident will be reported to the Canadian Coast Guard (Arctic region) 1-800-265-0237 (24 hour).

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It is the responsibility of the Environmental Superintendent on behalf of the Operations Manager to prepare the proper reports and transmit them to regulatory authorities. The Environmental Superintendent will determine on a spill by spill basis whom in addition to those above, should be contacted.

QIA requests that Baffinland produce a site map(s) listing the location in UTM coordinates, date, amount, and nature of the substance spilled. The map(s) should be updated annually and will be provided along with annual report requirements. The map(s) will also detail major project components and relevant water-bodies.

5.3 RAILWAY OCCURRENCE REPORTING

Reporting railway occurrences to the Transportation Safety Board is required as per Section 5(1) of the Transportation Safety Board Regulations, 2014.

Anyone that has direct knowledge of a railway occurrence must report the following railway occurrences to the Board:

- a person is killed or sustains a serious injury as a result of getting on or off or being on board the train, or coming into direct contact with any part of the train or its contents;
- the train or its contents are involved in a collision or derailment, sustain damage that affects the safe operation of the train, cause or sustain a fire or explosion, or cause damage to the railway that poses a threat to the safe passage of train or to the safety of any person, property or the environment;
- a risk of collision occurs between train;
- an unprotected main track switch or subdivision track switch is left in an abnormal position;
- a railway signal displays a less restrictive indication than that required for the intended movement of train;
- train occupies a main track or subdivision track, or track work takes place, in contravention of the Rules or any regulations made under the *Railway Safety Act*;
- train passes a signal indicating stop in contravention of the Rules or any regulations made under the *Railway Safety Act*;
- there is an unplanned and uncontrolled movement of train;
- a crew member whose duties are directly related to the safe operation of the train is unable to perform their duties as a result of a physical incapacitation which poses a threat to the safety of persons, property or the environment; or
- here is an accidental release on board or from a train which results in any of the events listed in subsection 8.4(2) of the *Transportation of Dangerous Goods Regulations*.

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The person making the report must send to the Transportation Safety Board as soon as possible and by the quickest means available, all the information required that is available at the time of the occurrence. The remainder of the required information must be submitted by the end of the calendar month following the month of the occurrence.

The report must contain the following information:

- the train's number, direction, tonnage, length and authorized speed;
- the number of loaded cars and empty cars on each train and cut of cars;
- the names of the operator of the train and the operator of the track;
- the date and time of the occurrence;
- the number of crew members, passengers and other persons involved in the occurrence and the number of those who were killed or sustained serious injuries as a result of the occurrence;
- the number of train or intermodal platforms that are damaged or have derailed and their reporting marks;
- for each train that is damaged or has derailed, whether the train is loaded, empty or contains residue;
- for each damaged or derailed train a list of all the dangerous goods on board the train, including the shipping name or UN number of the dangerous goods;
- if dangerous goods are released,
 - the shipping name or UN number of each dangerous good,
 - the reporting marks of each train from which the dangerous goods were released,
 - a brief description of each of the means of containment from which the dangerous goods were released, including the specification of the means of containment,
 - a brief description of the condition of each of the means of containment from which the dangerous goods were released,
 - the quantity of the dangerous goods on board each train or in each means of containment prior to the occurrence, and
 - the quantity of each dangerous good that is known or suspected to have been released;
 - the local weather conditions at the time of the occurrence and any climatic conditions such as snow, ice, wind, fog, dust and severe heat;
- the location of the occurrence, including the mile, the subdivision and the track designation;
- a description of the occurrence and the extent of any resulting damage to the environment and to the train, the railway and other property;

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- [a description of any action taken or planned to protect persons, property and the environment, including any evacuation as a result of the occurrence;](#)
- [the name and title of the person making the report and the phone number and address at which they can be reached; and](#)
- [any information specific to the occurrence that the Board requires.](#)

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Appendix A - Draft Railway Incident Report Forms (Not for Use)

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BAFFINLAND NORTH RAILWAY

Preliminary Accident Report **(DRAFT FOR INFORMATION ONLY)**

NOT FOR USE

Date:		Time:	
Type of accident:			
Subdivision:		Location:	
Mileage:			
Cndr:		Engr:	
Assignment:		Locomotives:	
Authority #:		Direction:	
Loads:		Empties:	
		Tonnage:	
Length:			
Speed:		Activity:	
Weather conditions:			
Engine number derailed:			
Cars number derailed:			
Numbering cars derailed:			
Verify if crossing obstructed:			
Track ID:			
Reported by:			
If involved in a crossing accident:			
Vehicle type:			
Number of occupants:			
State of the occupants:			
Direction of travel (To Port/Mine):			
RTC on duty:			
Incident Description:			

CALL LIST

NAME	OFFICE	CELL	HOME	TIME
DISPATCHING OFFICE				
Director Rail traffic Control				
OPERATIONS				
General Manager				
Operation Supervisor				
TRACK DEPARTMENT				
Roadmaster				
Assistant Roadmaster				
SIGNAL DEPARTMENT				
ALL ACCIDENTS WITH CROSSING				
Signal Maintainer				
CAR DEPARTMENT FOR INSPECTION OF CARS AND ENGINE				
Mechanical Supervisor				
SECURITY DEPARTMENT				
Director Safety				
POLICE AND GOVERNMENTAL AGENCIES				
RCMP				
Transportation Safety Board				
Environment Canada				
GN Spill Report Line				

UNUSUAL OCCURRENCE REPORT
DRAFT FOR INFORMATION ONLY – NOT FOR USE

This form is to be used for all rail accidents, including near misses.
Do not use for Personal Injury, Property or Motor Vehicle – see separate report.

Check Type of occurrence

- ☐ Derailment on our property / ☐ Derailment on other property / ☐ Others derailing on our property
☐ Grade crossing accident / ☐ Hazard material release / ☐ Side Swipe / ☐ Collision /
☐ Other accident/incidents / ☐ Trespasser / ☐ Near misses

Prepared By: _____ Preparer Title: _____
Preparer Date: _____ Signature: _____

I certify that the information in this report is accurate and complete: _____

(Supervisor's signature)

Supervisor's phone # _____ Name of supervisor (in block letters): _____

Claim Information			
Claim Name:		Nearest station:	
Date of Accident/Incident:		Time of Accident/Incident (military time):	
Narrative Description:			
FRA Primary Cause Code:		FRA Contributing Cause Code:	
General Information			
Reporting Railroad:	Other Railroad:	Reporting Accident #	
Maintenance Railroad:	Name of railroad where the accident occurred:		
G&W Responsible to Inspect? ☐ Y ☐ N (for Derailment on other property)			
Type of Accident/Incident (check one):	☐ Derailment	☐ Broken train collision	☐ Fire-violent rupture
	☐ Head on collision	☐ Hwy-rail crossing	☐ Other impacts
	☐ Rear end collision	☐ RR grade crossing	☐ Other (describe in narrative)
	☐ Side collision	☐ Obstruction	
	☐ Raking collision	☐ Explosion-detonation	
# Cars Carrying Hazmat:	Hazmat Cars Damaged/Derailed:	Cars Releasing Hazmat:	People Evacuated:
Location Description:			
Subdivision:	Accident State:	Nearest City:	
Accident County:	Milepost:	Specific Site:	
Was Police report made? ☐ Y ☐ N	Agency:	File number:	
Temperature: ☐ F ☐ C	Visibility: ☐ Dawn ☐ Day ☐ Dusk ☐ Dark	Weather: ☐ Clear ☐ Cloudy ☐ Rain ☐ Fog ☐ Sleet ☐ Snow	

Type of Equipment Consist (check one):	☐ Freight Train ☐ Passenger Train – Pulling ☐ Commuter Train – Pulling	☐ Work Train ☐ Single Car ☐ Cut of cars ☐ Yard/switching	☐ Light loco(s) ☐ Maint./inspect. Car ☐ Spec. MoW Equip ☐ EMU	☐ DMU ☐ Passenger Train – Pushing ☐ Commuter Train – Pushing	Was Equip attended: ☐ Y ☐ N						
Train #/Symbol:			Speed (recorded speed, if available) ☐ R – Recorded ☐ MPH ☐ E - Estimated ☐ KPH								
Trailing Tons:		Type of Territory (check all that apply) Signalization (Mandatory) ☐ Signaled ☐ Not Signaled Method of Operation/Authority for Movement (Mandatory) ☐ Signal Indication ☐ Direct Train Control ☐ Yard/Restricted Limits ☐ Block Register Territory ☐ Other Than Main Track Supplemental/Adjunct Codes _____			Remotely Controlled Locomotive? ☐ Not a remotely controlled operation ☐ Remote control portable transmitter ☐ Remote control tower operation ☐ Remote control portable transmitter – more than one remote control transmitter						
Type of Track (check one): ☐ Main ☐ Siding ☐ Yard ☐ Industry		Track Name/#:	Track Class:	Time Table: ☐ North ☐ South ☐ East ☐ West							
Casualties to:	Railroad Employees on Duty	Railroad Employees Not on Duty	Train Passengers	Others							
				Trespassers	Non-Trespassers on RR property	Non-Trespassers off RR property	Contractor – Worker on duty	Contractor – Other	Volunteer – Worker on duty	Volunteer - Other	
Nonfatal											
Fatal											
Principal Car/Unit:			Initial and Number		Position in Train		Loaded (Yes/No)				
First Involved (derailed, struck, etc.)							☐ Y ☐ N				
Causing (if mechanical, cause reported)							☐ Y ☐ N				
Locomotive Units:	Head End	Mid Train		Rear End		Cars:	Loaded		Empty		Caboose
		Manual	Remote	Manual	Remote		Freight	Passenger	Freight	Passenger	
Total in Train:						Total in Equipment Consist:					
Total Derailed:						Total Derailed:					
Engines Damaged (Unit #):						Cars Damaged (Car #):					
Engines Derailed (Unit #):						Cars Derailed (Car #):					
Crew Members											
# of Eng/Operators:			# of Firemen:			# of Conductors:			# of Brakemen:		
Engineer's Name:				Hours Worked:		Minutes Worked:		D&A Tested: ☐ Y ☐ N			
Conductor's Name:				Hours Worked:		Minutes Worked:		D&A Tested: ☐ Y ☐ N			
Other crew Name:				Hours Worked:		Minutes Worked:		D&A Tested: ☐ Y ☐ N			
# of Positive Drug Tests:			# of Positive Alcohol Tests:			Transporting Passengers: ☐ Y ☐ N					
Additional Information											
Latitude:						Longitude:					
First Finance Estimates (IF derailment, please sent the Derailment Costs Checklist)											
Equipment Cost \$:			Rerailing Cost \$:			Commodity Cost \$:			Track Cost \$:		
Misc. Cost \$:			Environmental Cost \$:			Property Cost \$:					
Department Supervisor:						Transportation Supervisor:					
Mechanical Supervisor:						Track Supervisor:					
Was this accident/incident reported to the FRA? ☐ Y ☐ N						Is this event re-billable to a third party ? ☐ Y ☐ N					

*ATTACHMENT 2: EMAIL AND PAPER ON ORE
DUSTING FROM RAIL CARS*

Richard Cook

From: Richard Cook
Sent: February 14, 2019 5:28 PM
To: 'Pirie, Bradley'; 'Emma Malcolm'; Michael Settingington; 'Megan Lord-Hoyle'; 'Joseph Tigullaraq'; 'S W. Bathory'; 'Jeff Higdon'; 'Fai Ndofo'; 'D Qamaniq'; 'SJoseph@QIA.ca'; 'Amanda Main'; 'Brandon Laforest'; Ringrose, John; Robinson, Amy; 'pond@baffinhto.ca'; 'Jean-Francois Dufour'; 'Paul Allen Smith'; Kelly, Alexander; 'Lyndsay Doetzel | EDI'; 'Philippe Rouget'; 'Abgrall, Patrick'; 'Solomon Amuno'; 'Cory Barker'; 'rick.hoos@tetrattech.com'; 'Wallace, Sara'; 'Krista Johnson'; 'Christopher Murray'; 'Nadolny, Rob'; 'Jason Ash'; 'Lou Kamermans'
Cc: 'Stephen Atkinson <stephen.atkinson@xplornet.com>' (stephen.atkinson@xplornet.com)
Subject: RE: Dust Study Design for Rail Cars
Attachments: Davies 1974 Transportation of Iron Ore - A Practical Exercise in Enviro....pdf

Hi Brad et al.,

Thanks for sending the coal dust generation paper. I've attached the paper referenced in Volume 5 of the 2012 FEIS, which supported the conclusion that ore dust-off from the rail cars at Mary River will be negligible. A couple of important notes in regard to the paper's applicability to the Mary River Project, and the basis of our conclusion that dust-off from the rail cars will be negligible:

1. The amount of blow-off of ore that may occur from the rail cars is a function of product density, particle size and speed (or wind velocity).
2. **Density** - The Davies 1974 study evaluated several different iron ore products; a couple of the products generated meaningful blow-off, but not the Cerro Bolivar ore. The iron content of the Cerro Bolivar ore closely matches that of Mary River ore (mostly 64-69%) https://mrdata.usgs.gov/mrds/show-mrds.php?dep_id=10111256). As such, the specific gravity (a measure of relative density compared to water) of the Mary River iron ore can be expected to be very similar to the Cerro Bolivar ore. Relative to coal (which has a specific gravity in the range of 1.2 to 1.5), the Mary River iron ore is about 3x as dense, with a specific gravity of 4.36.
3. **Particle Size** - The Davies 1974 study evaluated fine ore products. With the Phase 2 Proposal, only primary crushing (crushing of oversized material) will occur at the mine site, and so the product transported by the railway will be 100 cm minus (i.e., virtually no fines).
4. **Speed** - The Cerro Bolivar ore had negligible blow-off at 100 km/h, and the maximum speed the Mary River trains will operate at is comparatively lower at 60 km/h.

Essentially, the Mary River iron ore is dense relative to even some other iron ore products, there will be minimal fines with the 100 cm minus product transported on the railway, and the railway will be operating at a speed where even the fines of lower specific gravity ores won't have meaningful blow-off.

Best regards,
Richard

Richard Cook, P.Geo. (Ltd.)
Specialist Environmental Scientist | Associate
Knight Piésold Ltd.



This communication is confidential and subject to the legal disclaimer located at this link: [Disclaimer](#).

From: Pirie, Bradley [mailto:BPirie@GOV.NU.CA]

Sent: February 11, 2019 11:52 AM

To: 'Emma Malcolm' <Emma.Malcolm@baffinland.com>; Michael Settingington <msettingington@edynamics.com>; 'Megan Lord-Hoyle' <megan.lord-hoyle@baffinland.com>; 'Joseph Tigullaraq' <Joseph.tigullaraq@baffinland.com>; 'S W. Bathory' <SWBathory@qia.ca>; 'Jeff Higdon' <jeff.higdon@gmail.com>; 'Fai Ndofor' <FNdofor@qia.ca>; 'D Qamaniq' <dqamaniq@qia.ca>; 'SJoseph@QIA.ca' <SJoseph@QIA.ca>; 'Amanda Main' <amanda.main@hmc-services.ca>; 'Brandon Laforest' <blaforest@wwfcanada.org>; Pirie, Bradley <BPirie@GOV.NU.CA>; Ringrose, John <JRingrose@GOV.NU.CA>; Robinson, Amy <ARobinson@GOV.NU.CA>; 'pond@baffinhto.ca' <pond@baffinhto.ca>; 'Jean-Francois Dufour' <Jean-Francois.Dufour2@canada.ca>; 'Paul Allen Smith' <paulallen.smith@canada.ca>; Kelly, Alexander <AKelly@GOV.NU.CA>; 'Lyndsay Doetzel | EDI' <lidoetzel@edynamics.com>; 'Philippe Rouget' <Philippe_Rouget@golder.com>; 'Abgrall, Patrick' <Patrick_Abgrall@golder.com>; 'Solomon Amuno' <samuno@nirb.ca>; 'Cory Barker' <cbarker@nirb.ca>; 'rick.hoos@tetrattech.com' <rick.hoos@tetrattech.com>; Richard Cook <rcook@knightpiesold.com>; 'Wallace, Sara' <Sara.Wallace@stantec.com>; 'Krista Johnson' <krista.johnson@baffinland.com>; 'Christopher Murray' <christopher.murray@baffinland.com>; 'Nadolny, Rob' <Rob.Nadolny@stantec.com>; 'Jason Ash' <ash@arktissolutions.com>; 'Lou Kamermans' <lou.kamermans@baffinland.com>

Cc: 'Stephen Atkinson' <stephen.atkinson@xplor.net> (stephen.atkinson@xplor.net)'
<stephen.atkinson@xplor.net>

Subject: Dust Study Design for Rail Cars

Hello Everyone

During the TEWG we discussed the possibility of dust generation from uncovered ore cars. What I was trying to convey was that there are far too many unknowns due to a lack of literature on specifically iron ore transport by rail to simply state that the cars will not produce dust. The attached paper contains a study design that was used to assess the rate of dust production from coal cars. This study could be adapted to use on the proposed iron ore cars and based on the results we could say definitively if the ore cars need to be covered or not.

Brad



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TRANSPORTATION OF IRON ORE

A PRACTICAL EXERCISE IN ENVIRONMENTAL CONTROL

G. M. DAVIES

British Steel Corporation, Strip Mills Division, Port Talbot, Glamorgan

Abstract—At a very early stage in the planning of high speed iron-ore trains, British Rail and the British Steel Corporation concerned themselves with the possible environmental effects from iron ore "blow-off". Two trials were run, the first, using a wind jet at the Royal Aircraft Establishment, Farnborough, indicated that problems could arise from certain ores. The second trial was run on the main line between Llanwern, near Newport, and Swindon, a distance of 50 miles, at full operating speed and this confirmed the earlier findings. Control measures were tried and successfully contained the "blow-off".

Facilities for dust control designed with the experience gained from the trials have been incorporated at the appropriate loading sites.

WITH ore terminal developments at Port Talbot and Immingham, British Rail (B.R.) and the British Steel Corporation (B.S.C.) have been planning fast rail runs using continuously coupled trains designed to achieve minimum loading and discharge times. Calculations have shown that it will be most economical to use trains of twenty wagons, each 100 ton gross weight, operating at 60 m.p.h. with minimum delays. Any extra handling such as would occur by introducing covers on the wagons would appreciably affect the economics of the operation. It is expected to transport large quantities of iron ore (approximately 15 million ton*/annum) and it was realised that under the new operating conditions special precautions might be necessary to prevent the possible spread of dust along the route, which could create a nuisance to the general public and even a material loss of economic significance.

During discussions between B.R. and B.S.C. it was suggested that it might be possible to simulate the flow conditions in a wind tunnel using an ore loaded model. Although it soon became clear that an accurate simulation would not be possible, it was decided that comparative tests would prove useful.

Blowing facilities were made available at the Royal Aircraft Establishment, Farnborough and consisted of a 6 ft dia. jet blower tunnel capable of producing wind speeds up to a maximum of 120 m.p.h.

FARNBOROUGH TRIALS

Model test rig

For the trials eighth-scale models of a locomotive and three trucks were made. The containers of the model trucks were 55 in. long, 12½ in. wide and 10 in. deep. An aluminium tray 3 in. deep was fitted into each truck for most of the tests, so that

*Conversion factors: 1 ton = 1016 kg; 1 cwt = 50.8 kg; 1 lb = 454 g; 1 ft = 30.48 cm; 1 in. = 25.4 mm; 1 yd² = 0.836 m²; 1 gal = 4.54 l.; 1 m.p.h. = 0.447 m/s.

the amount of ore used for each test could be reduced to a manageable quantity and the loss of weight easily determined. The complete model was mounted on a British Road Services trailer (see Fig. 1) on the centre line of the tunnel with the front end of the train positioned at a distance of 12 ft from the jet tunnel outlet.

TABLE 1. R.A.E. FARNBOROUGH WIND TUNNEL TRIALS (FIRST DAY)
Two-minute runs at 60 m.p.h.: Weather—bright sunshine, cross wind, 3–4 m.p.h.

Ore	Weight of ore lost (lb/wagon)		
	Wagon 1	Wagon 2	Wagon 3
Olegorsky	13.5	9	8
Kovdorsky	50.5	34.25	19
Cerro Bolivar	5	8	1.5
Granada smalls	27	25	2
Tazadit A	7	31*	2
Labrador	0	1.75	0
Itabira	4	3	3

*Suspect weighing reading error.

Model trials

The ores and mixes tested and listed in Table 1 are typical of the types of ores which will be used. The procedure for the earlier tests was to load each tray so that it presented a flat surface flush with the upper edge. Although it was appreciated that this was an unrealistic contour, it was felt that it would give useful indications for comparing the performances of different ores subjected to a high velocity air jet stream. Having determined the ores most likely to give trouble, further tests were carried out on them. These included heaping to simulate actual loading, and treatment with a latex spray to contain dust.

The results obtained during the two days of test, are given in Tables 1 and 2. Each trial on the first day was limited to two minutes. On the second day the runs were increased to four minutes.

TABLE 2. R.A.E. FARNBOROUGH WIND TUNNEL TRIALS (SECOND DAY)
Four-minute runs at 60 m.p.h.: Weather—bright sunshine, cross wind 3–4 m.p.h.

Ore	Weight of ore lost (lb/wagon)		Comments
	Wagon 1	Wagon 2	
Kovdorsky	85	not used	Ore poured into truck in 3 heaps topping truck sides by approx. 1 in. Very dusty
Kovdorsky	64	not used	Ore poured into truck in 3 heaps below level of truck sides by approx. 1 in.
Kovdorsky	0	73	Truck 1 filled flat to top of sides and treated with Latex. Truck 2 filled flat to top of sides
Kovdorsky	0	70.5	As in previous experiment but a petrol engine run mounted on platform to vibrate trucks
Kovdorsky	No measurement	48	Truck 1 heaped in 3 piles and treated with Latex. Truck 2 flat and 1½ in. below top of truck sides

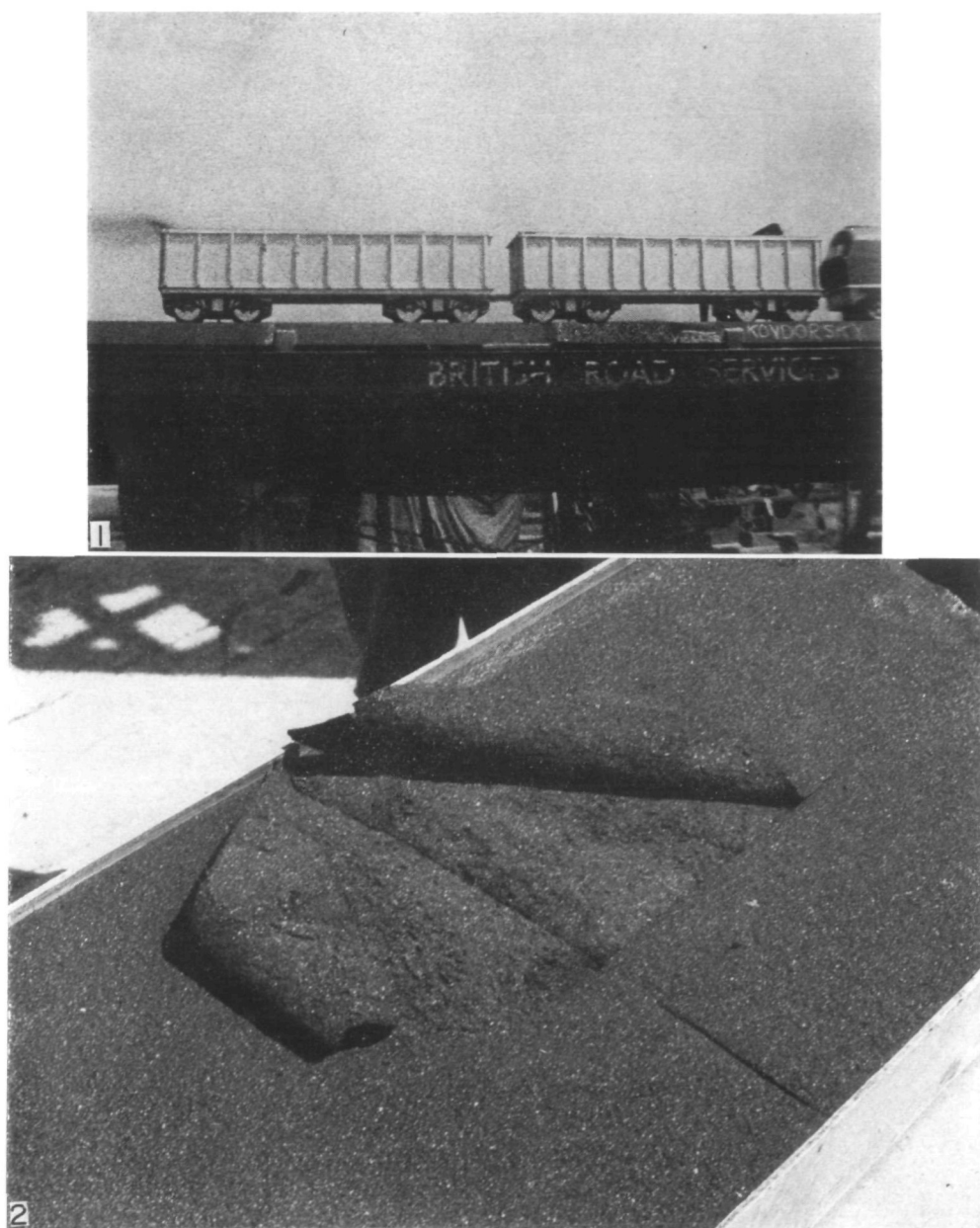


FIG. 1. Ore blow-off from model during Farnborough trials.

FIG. 2. Latex treatment of surface.

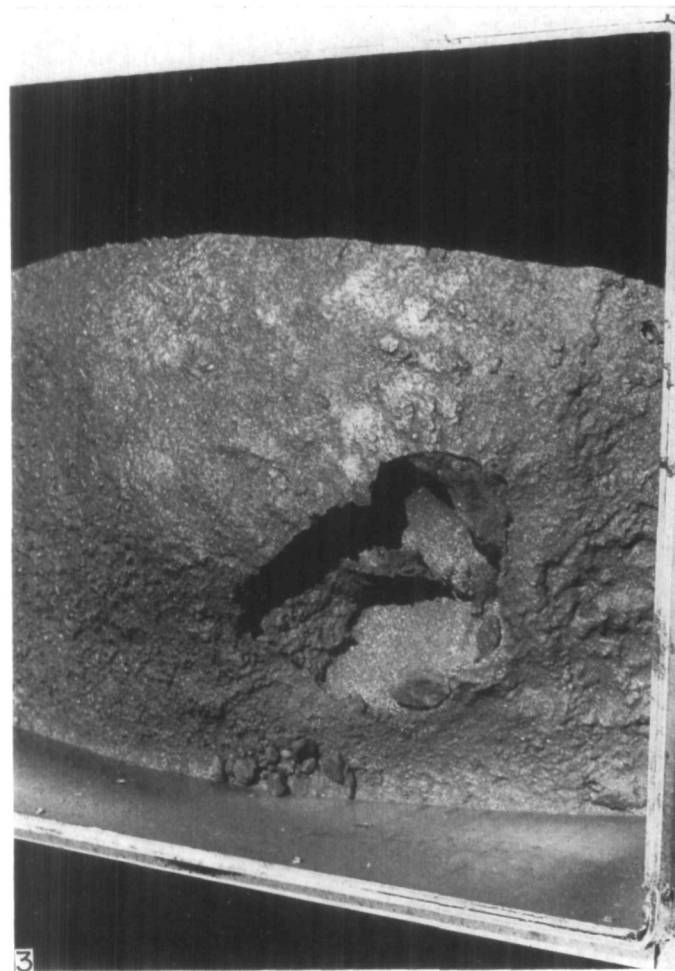


FIG. 3. Effects of latex skin rupturing.

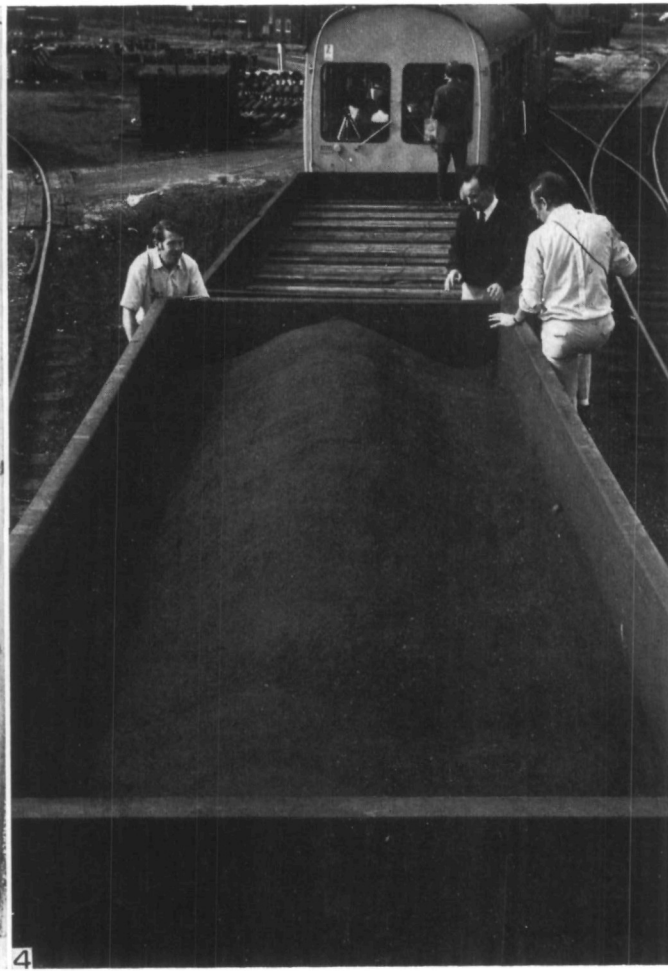


FIG. 4. Single ridge profile.

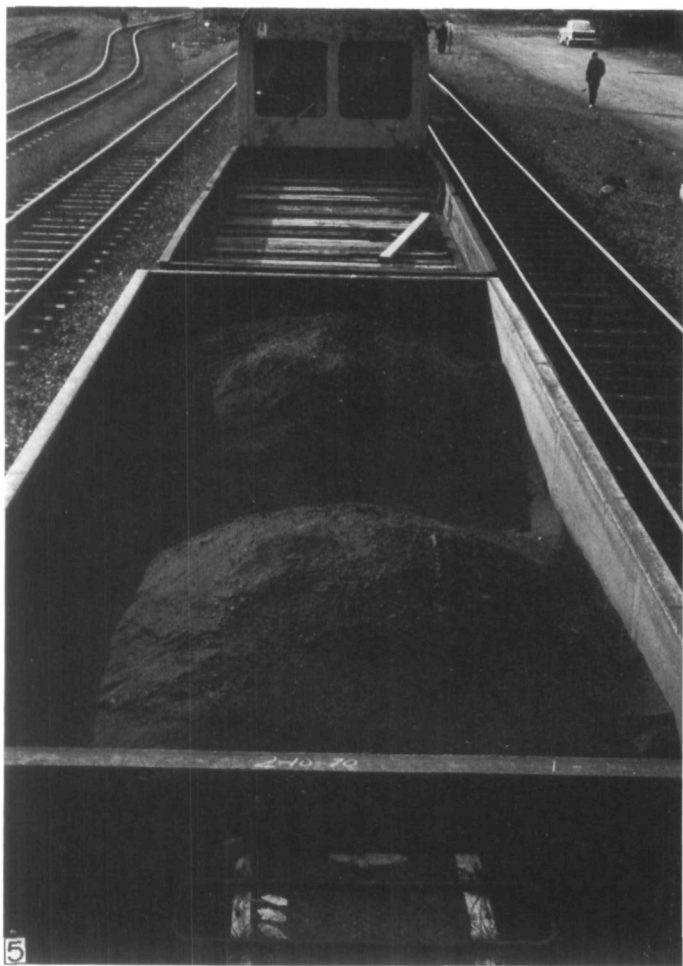


FIG. 5. Double hump profile.

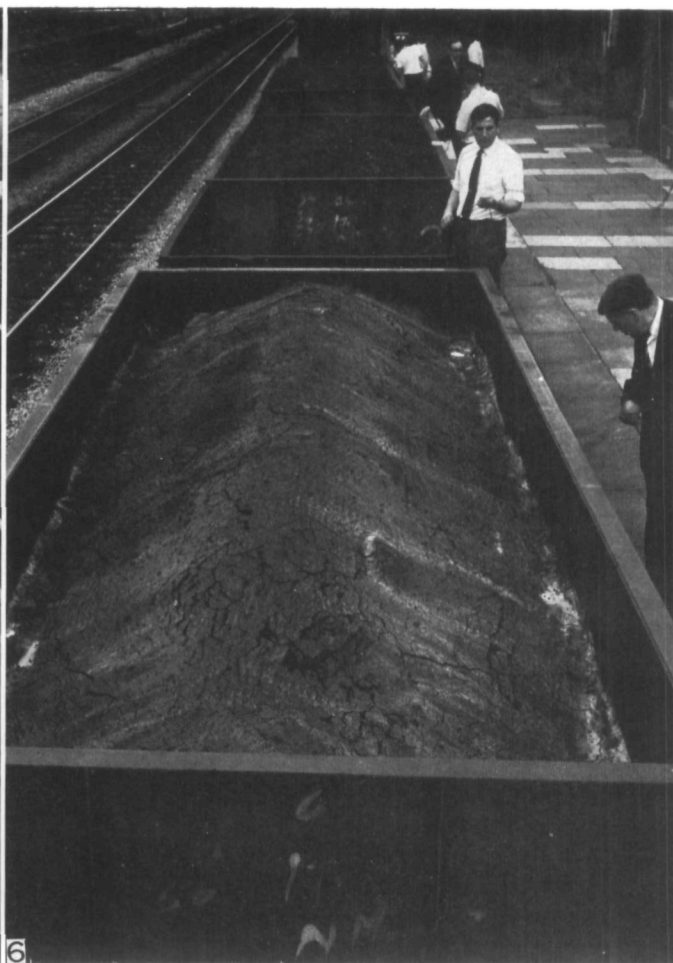


FIG. 6. Treated surface after a journey.

Apart from one result there was good agreement between the visual observations of dustiness and the measured losses in weight. During the trials on the first day with "flat tray" loadings, Labrador Blend ore showed the lowest weight loss. It was apparent that the dusty ores behaved in quite different ways. With Olengorski the dust given off diminished after the first minute, whilst Kovdorsky showed no apparent lessening after a period of two minutes. With some of the less dusty ores such as Cerro Bolivar, it was observed that larger particles of approximately $\frac{1}{4}$ in. dia., bounced across the top of the ore, and over the tail ends of the wagon to form mounds between them. It is very doubtful whether this would happen in practice as these particles would hardly clear the considerably higher "freeboard" of the full scale wagons.

Loading profile also had a considerable effect on ore loss as was shown by the results of the trials on the second day when it was decided to simulate the loading of ore in heaps as will occur in practice rather than on the flat. For this, Kovdorsky was tipped into the wagons in three similar conical heaps. Trials were made, firstly with the heaps protruding above the sides of the wagon, and secondly with the heaps below this level. As may be seen from the results in Tables 1 and 2 the differences were not conclusive.

Table 3 contains sieve analyses of the ores used in the survey and if these are examined together with the data from Table 1 it will be seen that there is some sort of relationship between sieve sizes and blow-off characteristics. For example, Kovdorsky suffered the highest blow-off weight and also had the largest amount of material in the smallest sieve range—28%. Labrador had the lowest loss from blow-off and also the lowest quantity in the smallest size range—0.5%. However, this relationship is far from linear and sieve analyses could not be used on their own to predict blow-off characteristics of ores.

During the tests no attempt was made to measure the effect of moisture on the dustiness of the ore. Throughout the trials the weather conditions were unusually hot and dry so that ore samples which appeared to be damp were soon dried in the shallow trays when exposed to the sun and the jet stream. This might well represent the actual situation in dry weather, but the influence of rain on the settling of dust was not established.

The effect of vibration which would occur in practice also was not determined. It is not known whether it would have a stabilising effect on the ore by acting as a packing mechanism, or conversely agitating it to such an extent that removal by air flow would be facilitated. Having shown that certain ores, notably Kovdorsky and Olengorsky might create an unacceptable nuisance, it was decided to test the effect of a proprietary latex spray previously used successfully for controlling dust emission induced by wind around iron ore stock piles. The experiments were carried out using two wagons (Fig. 1) the one downstream was left untreated. After a five minute drying period the air jet stream was turned on. From visual observation, it was obvious that the sprayed wagon gave off virtually no dust, whilst the second wagon gave off large quantities. This was confirmed by subsequent weighings, and the results were not altered on a repeat run when some attempt was made to simulate the vibration of the full scale wagon with a small petrol engine mounted on the trailer. After these experiments the latex covering was examined by cutting and rolling back (Fig. 2).

The experiment was repeated with the ore poured into the trays in three approximately conical piles, instead of flat as in the previous test. In the early stages of the blow there was no noticeable loss from the treated wagon; but then it appeared that the latex cover fractured and pulled away and a considerable amount of dust escaped (Fig. 3). This suggested that the spray treatment required greater care with the heaped ore, so the spraying was repeated. Subsequently the wind speed was increased to 120 m.p.h. as a final test. The ore treated with the latex spray remained intact.

The trials indicated that certain ores could be expected to give trouble from dust pollution when carried in open wagons. It was therefore recommended that a full scale main-line trial should be carried out with the dustiest ores in order that the effect of treatment and loading properties could be investigated.

MAIN LINE TRIALS

Composition of train

It was agreed that for most of the trial the train should comprise one diesel loco, one engineer's observation car, an empty platefit (B.R. term for a sideless wagon), two or three loaded modified platefits, a further empty platefit and a brake van. However this formation was altered on the first day. The platefits were 30 ft 6½ in. long with the floor 4 ft 4 in. from the rail. The modifications consisted in fitting a rectangular steel box to carry the ore, 18 ft long × 6 ft 9 in. wide × 2 ft 8 in. high. It was fixed centrally on the platefit floor, the top of the box thus being about 7 ft above rail level. It was considered that the airflow over the top of the box would be sufficiently near the airflow over the top of a train of proposed wagons to give valid results, provided an empty platefit preceeded and followed the loaded test wagons.

Materials

It was decided that the Kovdorsky ore, which had produced the worst pollution at the Farnborough trials, should be used on the initial runs; however, other ores such as Olenegorsky and Cerro Bolivar were available from the Llanwern Works ore stocks.

Variables monitored

- (i) Weights and loss of weights of ore
- (ii) Moisture content of ore
- (iii) Meteorological conditions of humidity, sunshine, rain and wind characteristics
- (iv) Train speed and air speed above trains if possible
- (v) Loading profile of ore
- (vi) Control techniques, if found necessary.

Both B.R. and B.S.C. photographic units were available to cover these events.

Procedures

The test runs carried out during the 5-day period in September 1970, were timed at 30 m.p.h. from Llanwern near Newport to Pilning and then 60 m.p.h. maximum to Swindon, with a stop at Chipping Sodbury. No operational difficulties were experienced.

No travelling or shunting shocks occurred, and over the majority of the runs, 60 m.p.h. was maintained steadily. For all tests the profile of the ore in the wagon box was arranged to be representative of that expected in practice from a discharge hopper having a long slot, except for one wagon on one day which was filled with a

double hump profile representative of discharge from a two-door hopper. The profiles can be seen in Figs. 4 and 5.

The necessary loading, unloading, treatment and weighing of the wagons was carried out before the tests and between trips on the weighbridge at Llanwern. Intermediate weighing was carried out on the Locomotive Works weighbridge at Swindon. Facilities in both cases were kindly provided by the Works Managements.

DISCUSSION

The weather conditions on all five days helped in no small way in making the trials a success. The low relative humidities on the Monday, Tuesday and Thursday produced drying conditions whilst on Wednesday slight drizzle occurred and Friday was showery.

The runs are described on a daily basis:

On the first day the train comprised the locomotive, saloon, empty platefit, modified platefit loaded with Kovdorsky, empty platefit, another modified platefit loaded with Kovdorsky, empty platefit and brake van. The humidity decreased during the day from 89 per cent at 10.00 hr to 58 per cent at 16.15 hr, it was sunny most of the day and the S.E. wind speed was 12–14 m.p.h. One wagon was allowed to run without reloading all week to act as a control. The overall losses of ore from two loaded wagons, Llanwern to Llanwern were 7 cwt (5 cwt on the outward and 2 cwt on the return journey) and 7 cwt (about 4 cwt on the outwards and just over 3 cwt on the return), respectively. The wind was generally against the train on the outward journey, and with it on the return.

The process of “blow-off” appeared to be one of surface-drying by wind action, followed by saltation. A cloud of dust then appeared to come from most of the top surface. It was noticeable that the more sheltered parts of the loaded wagons (corners and to a less extent the sides) were covered, after a run, with a layer of fine dry ore, but the rest of the surface was as before, with a slight caking appearance (Fig. 4). A number of fine cracks appeared due to the load settling under vibration, but they did not get progressively worse.

During the second day the humidity decreased from 71 per cent at 09.00 hr in the morning to 54 per cent at 16.15 hr in the afternoon, it was dry all day with sunny periods; the wind was westerly with speed varying from 7–18 m.p.h. The train comprised the loco, the engineers’ saloon coach, an empty platefit, the control platefit with untreated Kovdorsky, a platefit containing Kovdorsky sprayed first with water at 1 gal/5 yd² and then with a latex solution at 1 gal/10 yd², a platefit containing Kovdorsky sprayed with a bituminous emulsion material at 1 gal/2 yd², a further empty platefit and finally the brake van. As will be seen from Table 4 the two treated ores suffered little alteration in weight, whilst the untreated ore in the control platefit once again experienced a loss of 7 cwt (just over 2 cwt on the outward journey with the following wind and nearly 5 cwt. on the return with a head wind). It is interesting to note that unlike the previous day’s trip the greater loss of weight occurred on the return trip; this might possibly have been due to the change of wind direction.

The surface on both the treated wagons developed cracks due to vibration, the latex being rather the worse of the two (Fig. 6). There was however no loss of weight, presumably because the moisture in the ore preserved a slight caking of the crack sides, and the stagnant air inside the crack caused little or no drying-out and consequent blow-off.

TABLE 3. SIEVE PARTICLE SIZE ANALYSIS

	Cumulative oversize analysis (As delivered)												
	+125 mm	+63 mm	+31.5 mm	+16 mm	+8 mm	+4 mm	+2 mm	+1 mm	+500 µm	+250 µm	+125 µm	+63 µm	+31.5 µm
Ologosky	0	0	0	0	0	0	0	0.1	2.1	26	64.2	85.6	100
Kovdorsky	0	0	0	0	0	0	0	0	4	16	44	72	100
Cerro Bolivar	0	0	0	0	0	5	22.5	41.2	58.7	75	87.4	96	100
Granada smalls	0	0	0	0	5	23	38	52	63	72.5	81.5	90.5	100
Tazadit A	0	0	0	0	4	28	43	52	59	65	75	89	100
Labrador	0	1	12.5	23.5	34	44	54	62	71	79	87	95.5	100
Itabira	0	0	0	0	1	15	26	35	39	54	70	85	100

TABLE 4. MAIN LINE TRIALS

Day	Journey	Weight loss (cwt)		Wagon 3	Weather
		Wagon 1 (Control)	Wagon 2		
1		Kov'sky untreated	Kov'sky untreated		Dry
	Llanwern-Swindon	5	3½		Sunny
	Swindon-Llanwern	2	3½		SE 1-2
	Llanwern-Llanwern	7	7		
2		Kov'sky untreated	Kov'sky sprayed	Kov'sky sprayed	Dry
	Llanwern-Swindon	2½	½		Sun/cloud
	Swindon-Llanwern	4½	+½		W 3-4
	Llanwern-Llanwern	7	+½	+½	
3		Kov'sky untreated	Ol'sky untreated	Kov'sky untreated	Cloudy, drizzle a.m.
	Llanwern-Swindon	1	3½	2½	Sunny p.m.
	Swindon-Llanwern	5	4½	4	SW 6
	Llanwern-Llanwern	6	8	6½	
4		Kov'sky untreated	Ol'sky untreated	Kov'sky watered	Dry
	Llanwern-Swindon	2	+½	+1½	Cloudy/Sunshine
	Swindon-Llanwern	6½	6½	½	WNW 4
	Llanwern-Llanwern	8½	5½	+1	
5		Kov'sky untreated	Cerro Boliver untreated	Kov'sky untreated since yesterday	Dry a.m.
	Llanwern-Swindon	1	½	0	Drizzle p.m.
	Swindon-Llanwern	3½	+½	+½	Cloudy
	Llanwern-Llanwern	4½	+½	+½	WNW 5-6

Reading to ¼ cwt (28 lb) on total weight of 26-28 tons.

The third day was cloudy with little sunshine and occasional drizzle, the humidity ranged from 94 per cent at 11.15 hr down to 61 per cent at 15.45 hr while the south westerly wind speed varied from 12 to 23 m.p.h. Two platefits (one the control) containing untreated Kovdorsky and a third containing untreated Olenegorsky were studied. The control platefit lost 6 cwt on the round trip from Llanwern to Llanwern, 1 cwt on the outward and 5 cwt on the return journey and other wagons containing untreated Kovdorsky also lost an overall weight of about 6 cwt—just over 2 cwt on the outward and 4 cwt on the return journey. The wagon containing Olenegorsky lost an overall weight of 8 cwt, just over 3 cwt on the outward and nearly 5 cwt on the return journey.

The weather on the fourth day was dry with sunny periods, the wind was from the west north west, speed varying between 12–20 m.p.h. and the humidity ranged from 75 per cent at 09.50 hr in the morning to 58 per cent at 16.10 hr. The control platefit suffered an overall loss of $8\frac{1}{2}$ cwt (2 cwt on the outward journey and $6\frac{1}{2}$ cwt on the return journey). The untreated Olenegorsky ore lost $5\frac{1}{2}$ cwt on the overall trip, apparently all of this on the return journey. Once again with both the untreated Kovdorsky and Olenegorsky ores the major losses appeared to take place on the return journey when the train was running into the prevailing wind.

The wagon containing Kovdorsky, sprayed with untreated water at about 1 gal/1.5 yd² before the start of the trip, suffered no significant loss of weight.

During the final (fifth) day of the trials, the weather deteriorated from dry in the morning to showery in the afternoon. Humidity varied from 68 per cent at 09.15 hr down to 43 per cent at 12.00 hr up to 55 per cent at 17.00 hr and the westerly wind speed was from 12 to 21 m.p.h. The control platefit containing untreated Kovdorsky lost $4\frac{1}{2}$ cwt (1 cwt on the outward trip and $3\frac{1}{2}$ cwt on the return). For this final journey the profile of the ore in this platefit was altered from the ridge formation used previously to two heaps (Fig. 5). Another platefit carried untreated Cerro Bolivar, one of the ores which gave off very little pollution at the Farnborough trials. This behaviour was confirmed in these trials where the change in weight for the round trip was insignificant. Finally the wagon of Kovdorsky ore which had been sprayed with water on the previous morning was re-run with its surface undisturbed. Once again the change of weight was not significant.

CONCLUSIONS

- (a) There could be substantial losses of some ores such as Kovdorsky and Olenegorsky in certain weather conditions whilst other ores such as Cerro Bolivar should not present a problem.

The loss of 6 to 7 cwt of Kovdorsky ore per 100 miles round trip could present a potentially serious problem for two reasons:

- (i) *Economics.* The wagons which will be used in the trains operated on the rapid turn-round principle will have approximately $2\frac{1}{2}$ times the surface area of the ones used in the main-line trials. It is reasonable to assume that the rate of ore loss could be proportional to surface area and this could mean a loss of approximately 15 cwt per wagon. A train of 20 wagons would therefore lose something in the region of 15 tons per 100 mile journey if climatic conditions resembled those experienced during the trials. It is anticipated that 9 such trains will be run per day in the South

Wales area, and on these assumptions a daily loss of approximately 135 tons per 100 miles would be expected. At approximately £4 per ton for Kovdorsky and Olengorsky the losses would be somewhere in the region of £200 to £300 per day per 50 miles (approximate distance of the Port Talbot-Llanwern Works journey). It is worth noting that in the South Wales area there were 186 dry days in 1968 and 177 in 1969, of which 120 days in 1968 and 84 days in 1969 had easterly winds.

- (ii) *Nuisance.* It was felt that the losses from Kovdorsky and Olengorsky ores could be sufficient to cause complaint both on an immediate and a longer-term basis.

On an immediate basis the ore clouds rising from the wagons would be strongly criticised as offensive to the general public. On a longer term basis the clogging of the track ballast, grit deposit on signal and permanent-way equipment, possible effects on track circuits, and damage to paintwork would be unacceptably high and the lineside residents would complain of nuisance.

- (b) It was visually apparent that there was a critical wind speed (train speed and effect of natural wind) which had a pronounced effect on blow-off, this was subsequently assessed to be in the region of 40 m.p.h.
- (c) Effects due to passing trains or entering or leaving tunnels, were not significant. The greatest blow-off in general occurred in open country or on embankments, with marked reduction in cuttings.
- (d) All three forms of spray treatment experimented with in the trials, latex solution, a bituminous emulsion and water proved successful.
- (e) Ore moisture contents as measured by a nucleonic gauge did not appear to be significantly related to losses.
- (f) Both rainfall and high humidity seemed to reduce blow-off.

RECOMMENDATIONS

- (a) The various ores which it is intended to transport from the main ore-ports should be tested to assess their potential as dust-producers. This could be done with a laboratory rig test.
- (b) The ores which prove to be problems as indicated by (a) should be treated to contain the dust "blow-off".
- (c) Water should first be used as a form of treatment but its effectiveness should initially be continuously reviewed in various climatic conditions to ensure that it remains effective. In the event of water treatment proving inadequate the use of a latex solution or bituminous suspension or other forms of treatment should be further investigated.

Acknowledgements—I would like to express appreciation for the help received from staff of the several British Rail and British Steel Corporation departments who combined to make these investigations a success. Particular mention must also be made of Mr A. J. Harby and Mr D. W. Peacock, consultants to B.S.C. and B.R. respectively, who played a major part in the designing, organising and reporting on the trials.

Finally I would like to thank the Technical Director, Strip Mills Division, B.S.C., and the Executive Director, Freight, British Railways Board for permission to publish this paper.

ATTACHMENT 3: ADDITIONAL INFORMATION ON FISH HABITAT INTERACTIONS

MEMORANDUM

Date:	July 2, 2019	File No.:	NB102-00181/53-A.01
		Cont. No.:	NB19-00516
To:	Mr. Lou Kamermans		
Copy To:	Genevieve Morinville		
From:	Oscar Gustafson, R.P.Bio.		
Re:	Additional Information on Fish Habitat Interactions - Mary River Project - Phase 2 Proposal		

1.0 INTRODUCTION

At the recent technical meetings in Iqaluit, Fisheries and Oceans Canada (DFO) identified several pieces of information required to support their review of Baffinland Iron Mines Corporation's (Baffinland's) assessment of the Phase 2 Proposal. This included:

- **Watershed Catchment Information (DFO Technical Review Comment 3.10.3)** - DFO requested zoomed out maps that show the entire catchments of North Railway crossings, as figures previously provided by Knight Piésold (KP, 2019) or North/South Consultants Inc. (NSC, 2019) did not present the all catchments in their entirety.
- **Fish Habitat Interactions Maps (DFO Technical Review Comment 3.11.3)** - Maps for the entire length of the Tote Road and North Railway that show existing and proposed crossings on each, to aid with the review of potential cumulative effects (additive project effects) on fish habitat, such as proposed rail culverts located close to existing Tote Road crossings that may together act as a barrier to fish passage.
- **Crossing Selection Basis (DFO Technical Review Comment 3.11.3)** - DFO had previously requested that Baffinland provide a short-list of crossings that are better suited to alternatives to corrugated steel pipe (CSP) culverts, and this information was provided by NSC (2019) on May 31, 2019. DFO had also requested that 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).*" The basis for selecting crossing methods is presented below.

2.0 BACKGROUND

The North Railway connecting the Mine Site and Milne Port is the most substantial infrastructure component associated with the Phase 2 Proposal. The railway will be 110 km in length, and most of the length of the railway embankment will be constructed adjacent to the Tote Road. However, a 20 km section of the railway will deviate from the Tote Road alignment due to steep topography. The construction of the railway is estimated to take two years, with the rail being operational in 2021. The construction of the rail will require multiple laydown sites, temporary construction camps, and quarries for aggregate. A detailed description of the facilities and activities listed above is provided in Section 3.2 of TSD (technical supporting document) 2 Project Description (Baffinland, 2018).

In general, the Tote Road alignment will remain unchanged, however some upgrades and minor realignments will be required to facilitate railway crossings. These updates are identified in Section 3.2 of TSD 2 Project Description (Baffinland, 2018).

3.0 WATERSHED CATCHMENT INFORMATION

Figure 1 presents the existing Tote Road crossings and their catchments, and Figure 2 presents the same for the North Railway. The catchments shown are for confirmed and potential fish-bearing watercourses. Not fish-bearing catchments are provided in the updated Water Licence application (KP, 2019).

4.0 FISH HABITAT INTERACTION MAPS

Figure 3 is a key plan showing detailed figures of the North Railway, which are presented as Figures 4 through 36. These figures were presented in the updated application to amend the Type A Water Licence (KP, 2019), and have been updated to show the location of culverts along the Tote Road as well as fish presence information at these crossings.

North/South Consultants Inc. (2019) conservatively identified rail crossings that are located <20 m from an existing Tote Road culvert as locations where two culverts in proximity could be a potential barrier to fish passage. These locations are listed in Table 1 and include corresponding attached figure numbers.

TABLE 1 RAILWAY CROSSINGS WITH AN EXISTING TOTE ROAD CROSSING <20 m AWAY

Site ID	Interaction Type	UTM		Corresponding Figure(s) ^[1]
		Easting	Northing	
BG-13-1	Culvert	551001	7917116	Figure 32 (Sheet 29)
CV-103-1	Culvert	557449	7915244	Figure 34 (Sheet 31)
CV-13-4	Culvert	512419	7966799	Figure 8 (Sheet 5)
CV-29-2	Culvert	521389	7954522	Figure 12,13 (Sheets 9,10)
CV-31-1	Culvert	521755	7952784	Figure 13 (Sheet 10)
CV-31-2	Culvert	521755	7952773	Figure 13 (Sheet 10)
CV-33-6	Culvert	521950	7950550	Figure 14 (Sheet 11)
CV-57-1	Culvert	528308	7928844	Figure 21 (Sheet 18)
CV-84-3	Culvert	541202	7922083	Figure 29 (Sheet 26)
CV-85-2	Culvert	541774	7922382	Figure 29 (Sheet 26)
CV-86-2	Plate Arch Culvert	542768	7921695	Figure 29,30 (Sheets 26,27)
M-Culv-3A (CV-107-4)	Plate Arch Culvert	560706	7913504	Figure 35,36 (Sheets 32,33)

NOTES:

1. FIGURES/SHEETS PROVIDED IN ATTACHMENTS.

5.0 CROSSING SELECTION BASIS

5.1 INTRODUCTION

DFO requested a description of the rationale for selecting particular watercourse crossing types during their review of the Phase 2 Proposal (DFO TRC 3.11.3). The rationale provided is also relevant to the selection of watercourse crossings for the Tote Road, Mine Site, and secondary access roads.

The Mary River Project is located in northern Canada in a remote area of Baffin Island, Nunavut. The region is characterized by short summers and long cold winters. The transportation of construction materials is limited to the three-month open water season that occurs from mid July to mid October. This is a unique and complicated logistical and economic challenge for the Project.

The North Railway will be constructed mostly adjacent to the Tote Road and will cross an estimated 395 streams and drainages along the North Railway. Most crossings (approximately 90%) are confirmed as not fish bearing. The streams identified as not fish-bearing will receive one or more non-embedded CSP to meet the peak design flow and freeboard requirements. The remaining streams are fish-bearing. These will meet the peak design flow and freeboard requirements for each crossing.

The selection of watercourse crossings is influenced by the remote location and weather conditions. Three types of crossings will be used to cross streams and drainages along the North Railway:

- Corrugated steel pipe (CSP) culverts
- Plated arch culverts
- Bridges.

Corrugated steel pipes (CSP) are the preferred option for the majority of watercourse crossings. CSP have several advantages relative to other crossing types:

- Cost-effective
- Minimal foundation requirements compared to arch culverts and bridges
- Efficient to transport to site both on ships and transport trucks
- Easy to install with no major foundation preparation required
- Relatively low profile which is an advantage where the height of the rail embankment cannot easily accommodate larger structures such as arch culverts and bridges
- Can be installed in clusters to meet a given design flow and freeboard
- Relatively fish friendly when embedded

CSP culverts can create issues for fish passage if installed without the appropriate mitigation. CSP are unfeasible at some locations due to fish passage issues.

Arch culverts are more expensive than CSP and are accompanied by increased installation costs and time due to the need to prepare foundations. Arch culverts are considered more fish friendly than embedded culverts as they provide increased natural substrate areas. They are an installation option at high value fish streams where CSP are unfeasible. Disadvantages of arch culverts include requirements for good founding conditions (they are a poor choice at locations with ice-rich soils) and a comparatively high profile means that they are not suitable where the rail embankment is low. Arch culverts are proposed for a small number of watercourses to address high value fish streams.

Bridges are proposed for the largest watercourse crossings. They are the most expensive option due to the transportation and installation costs. Bridges clear span the affected streams and come with the lowest potential impacts to river processes and fish habitat.

Hatch Ltd. (2017, 2018) provided design criteria for watercourse crossings on the North Railway and Tote Road. These criteria are summarized in the following sections.

5.2 CORRUGATED STEEL PIPES

The peak design flows at watercourse crossings were calculated based on the hydrological analysis conducted by Knight Piésold (KP, 2018). The 1:200-year flood event was used as the basis for all crossings. Freeboard of 0.30 m above the 1:200-year flood elevation will be maintained for non-navigable streams. Navigable streams will have a freeboard of 1.5 m above the average annual high-water elevation. The peak design flow and fish-bearing status will determine the size and numbers of CSP required. Fish-bearing CSP will be a minimum of 1,000 mm diameter. The CSP or first CSP where multiple CSP are used in fish-bearing streams will be embedded by 20%. Typical CSP sizing includes 600 mm, 900 mm, 1,200 mm, 1,500 mm, and 1,800 mm diameter structures. The analysis and design for CSP will consider design flow, culvert size and material, entrance structure layout, outlet structure layout, and erosion protection. Baffles will be installed in CSP where fish passage is considered an issue.

5.3 PLATED ARCH CULVERTS

Plated arch culverts are proposed for a small number of watercourses to address high value fish streams. The rationale for sizing plated arch culverts and determining freeboard is the same as CSP. The 1:200-year flood event was used as the basis for all crossings. The analysis and design for plated arch culverts will consider design flow, culvert size and material, entrance structure layout, outlet structure layout, and erosion protection.

5.4 BRIDGES

Bridges are proposed for the largest watercourse crossings. The watercourses at these locations are too large to support multiple culverts. The rationale for sizing bridges is the same as CSP and arch culverts with some additional criteria. Bridges will be sized to accommodate one rail track. The 1:200-year flood event was used as the basis for all crossings. Hydraulic modelling was conducted by Hatch for each bridge crossing. The freeboard selected above the 1:200-year flood event was 1.5 m. The freeboard selected for winter conditions was 1.8 m above the winter 5-year flood event. The preference was for multi-span bridges with 15 m spans and pier widths of 0.6 m. The bridge abutments will be protected by riprap on either side of the crossing.

6.0 TOTE ROAD FIGURES

A total of 37 culvert crossings will occur along the Tote Road, due to modifications including new crossings and existing culverts that will need to be relocated. Their locations are included on the attached North Railway figures.

7.0 REFERENCES

Baffinland Iron Mines Corporation (Baffinland), 2018. *Addendum to the Final Environmental Impact Statement - Mary River Project - Phase 2 Proposal - NIRB File No. 08MN053*. August 2018, Revised September 2018.

Hatch Ltd., 2017. *Baffinland Iron Mines Corporation - Mary River Expansion Project - Design Criteria - Railway Design Criteria and Design Rational*. November 28. Ref. No. H353004-39000-224-210-0001, Rev. 0.

Hatch Ltd., 2018. *Baffinland Iron Mines Corporation - Mary River Expansion Project - Design Criteria - Civil Design Philosophy*. March 12. Ref. No. H353004-00000-200-210-0001, Rev. 2.

Knight Piésold Ltd. (KP), 2018. *Technical Supporting Document No. 13 Surface Water Assessment*. Prepared for Baffinland Iron Mines Corporation for the Mary River Project - Phase 2 Proposal. October 3. North Bay, Ontario. Ref. No. NB102-181/39-8, Rev. 4.

Knight Piésold Ltd. (KP), 2019. *Updated Application for Amendment No. 2 of Type A Water Licence 2AM MRY1325*. Prepared for Baffinland Iron Mines Corporation for the Mary River Project - Phase 2 Proposal. May 2.

North/South Consultants Inc. (NSC), 2019. Technical Memorandum to: Lou Kamermans of Baffinland Iron Mines Corporation. Re: *Mary River Phase 2 Proposal: Updated Estimates of Areas of Fish Habitat Loss and Alteration*. May 31.

Yours truly,
Knight Piésold Ltd.

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Approval that this document adheres to the Knight Piésold Quality System:



Attachments:

Figure 1, Rev 0	Milne Inlet Tote Road - Water Crossings and Catchments
Figure 2, Rev 0	Proposed North Railway - Water Crossings and Catchments
Figure 3, Rev 0	North Railway Key Plan
Figure 4, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 1 of 33)
Figure 5, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 2 of 33)
Figure 6, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 3 of 33)
Figure 7, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 4 of 33)
Figure 8, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 5 of 33)
Figure 9, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 6 of 33)
Figure 10, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 7 of 33)
Figure 11, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 8 of 33)
Figure 12, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 9 of 33)
Figure 13, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 10 of 33)

Figure 14, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 11 of 33)
Figure 15, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 12 of 33)
Figure 16, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 13 of 33)
Figure 17, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 14 of 33)
Figure 18, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 15 of 33)
Figure 19, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 16 of 33)
Figure 20, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 17 of 33)
Figure 21, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 18 of 33)
Figure 22, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 19 of 33)
Figure 23, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 20 of 33)
Figure 24, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 21 of 33)
Figure 25, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 22 of 33)
Figure 26, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 23 of 33)
Figure 27, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 24 of 33)
Figure 28, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 25 of 33)
Figure 29, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 26 of 33)
Figure 30, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 27 of 33)
Figure 31, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 28 of 33)
Figure 32, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 29 of 33)
Figure 33, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 30 of 33)
Figure 34, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 31 of 33)
Figure 35, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 32 of 33)
Figure 36, Rev 0	North Railway - Detailed Construction Phase Layout (Sheet 33 of 33)

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