Completion Report:

Environment and Climate Change Canada Fisheries Act Direction (File: 4408-2016-05-10-001) and INAC Letter of Non-Compliance (NWB Licence 2AM-MRY1325)

September 2016

DATE	REV	STATUS	PREPARED BY	APPROVED BY
29 Sept 2016	0	Issued For Use	Wayne McPhee	Brian Penney

This Completion Report has been prepared by Baffinland Iron Mines Corporation (Baffinland) to respond to the *Fisheries Act* Direction (FAD) received from Environment and Climate Change Canada (ECCC) and the Letter of Non-Compliance (LNC) received from Indigenous and Northern Affairs Canada (INAC) on June 7, 2017 and June 16, 2017, respectively. The FAD and LNC were based on inspections made of the Mary River Project Site by ECCC and INAC Enforcement and Water Resource Officers during the period May 18 to 20, 2016. Specifically, this report complies with a requirement in those documents for a submission of a Completion Report by September 30, 2016.

Unauthorized Sediment Releases

Freshet in 2016 was characterized by high flows in the tributaries and streams due to a thick snow pack, large snow drifts from blowing snow and an early start to Freshet. During the early stages of freshet, there were a number of instances where water samples exceeded the Discharge Criteria for Total Suspended Solids (TSS) but as the incident response measures were implemented, the majority of the discharge samples met the discharge criteria. In addition, all samples collected for Acute Toxicity analysis have shown non-lethal results from the discharge.

Unauthorized releases of sediment were reported by Baffinland to ECCC, INAC, and the NT-NU Spill Line during the months of May and June 2016. These included the Spill Report numbers 16-158, 16-176, 16-181, 16-198, 116-202, and 116-202 Update No. 1.

ECCC Fisheries Act Direction (FAD) and INAC Letter of Non-Compliance (LNC)

The FAD and LNC documents specified measures to be taken by Baffinland to reduce the risk of ongoing and future sedimentation and to also take action to improve current conditions (e.g., completion of some construction ditching projects).

ECCC FAD Measures to be taken

"Immediately take all reasonable measures consistent with public safety and with the conservation and protection of fish and fish habitat to prevent the above mentioned occurrence or to counteract, mitigate, or remedy, any adverse effects that result from the above mentioned occurrence or might reasonably be expected to result from it, including:

a. *Provide by June 24, 2016, a report on the actions taken to address sedimentation issues at the BIM, Mary River Project following the ECCC on-site inspection of May 18-20, 2016 and provide Bi-weekly updates (once every two weeks) of ongoing actions being taken at the site including actions to address issues mentioned in measures to be taken 2 & 3.*
b. *Provide by September 30, 2016 a dust mitigation action plan with an implementation schedule addressing crushing operations, wind coming in contact with the crushed rock/iron stock piles, and vehicle traffic on the Tote Road.*
c. *Provide by September 30, 2016 a Tote Road and Mine Hall Road mitigation action plan with an implementation schedule addressing sediment water runoff from the road into culverts, ditches, and creeks/streams which leads to David Lake, Mural Lake, Kabikok Lake, KM 32 Lake and KM27 Lake, Camp Lake, Sheardown Lake, Mary River, and Phillips Creek.*

d. *Finish constructing by July 17, 2016 the drainage ditching to the Milne Port Stockpile East Sedimentation Pond (MP05) to allow contact water with the iron ore stockpiles to divert into the Milne Port Stockpile East Sedimentation Pond (MP05) to prevent the contact water from entering Milne Inlet, Arctic Ocean.*

e. *Finish constructing by July 17, 2016 the drainage ditching to the Mary Rive Mine Site Iron Ore Stockpile crusher sediment pond (MS06) to allow contact water with the iron ore stockpiles and crusher area to divert into this Sedimentation Pond (MS06) to prevent the contact water from entering Sheardown Lake.*

A report on the completion of these measures signed by Mr. Brian Penney must be submitted in writing to the undersigned Inspector on or before September 30, 2016."

INAC LNC Measures to be taken

a. Implement a plan to address "*the Ore Stockpile Diversion Ditches at Milne Inlet with a completion date by July 17, 2016*". (Based on May 23, 2016, Plan submitted to INAC)

b. Produce an "*Action Plan to address the sedimentation of watercourses along the Tote Road. This plan shall be submitted to the INAC Inspector by June 24, 2016 and will include a schedule of work to be done in 2016 on the Tote Road to specifically deal with the sedimentation of watercourses.*"

c. Requirement for Baffinland to take reasonable diligence towards meeting the requirement of their licence, Part D Item 4, namely "*The Licensee shall implement sediment and erosion control measures, as required, prior to ensuring all phases of the Mary River Project to prevent and/or minimize sediment loading into water.*"

Preventative and Corrective Actions

Baffinland had undertaken significant measures prior to the May 2016 inspections to prepare for the onset of freshet including but not limited to:

- A major program of culvert replacement and riprap installation was completed on the Mine Haul Road between April 15 and May 15, 2016. The work involved the installation of 525 m of new culverts and the installation of 4,400 m3 of rip rap in 3.5 km of ditches and on surface slopes located upstream and downstream of seven culvert crossings. The as built report for this work is presented in Appendix A.1.
- Clearing of snow from the road surface, embankment, and from areas adjacent to the road to minimize the impact of runoff from road contact water to downstream water bodies.
- Early excavation and clearing of snow from the inlets and outlets of the stream crossings and clearing of culverts with steamers to ensure water flow.
- The installation of silt fences and check dams at selected locations.

Immediate response to the early onset of freshet to address sediment releases to water bodies included:

- Additional silt fence and silt curtain installation.
- Check dam construction and operation to allow settling of solids from the water column.
- Construction of temporary settling ponds near the Camp Lake Jetty.
- Redirection of sediment / turbid waters away from fish habitat using ditches, swales, and pumping.
- Removal of sediment accumulated at culvert crossings at various locations.
- Removal of dirty snow and ice from under Tote Road bridges and from the north end of the Ore Stockpile Area along the beach at Milne Port.

Over the summer months other preventative actions were undertaken including:

- Additional check dam construction (a total of eight).
- Placement of geotextile and riprapping of ditches along the Tote Road and along the upper sections of the Mine Haul Road.
- Targeted road resurfacing with granular material the Tote Road and Mine Haul Road.
- Berm construction along the Tote Road and Mine Haul Road to limit migration of material mobilized due to permafrost degradation.
- Excavation of ditches around the Crusher Stockpile and Ore Stockpile pads to help direct drainage to the established settling ponds.

A comprehensive record of immediate and near term actions undertaken to address sediment releases was provided in update reports to ECCC and INAC including the June 24, 2016 Report on Actions Taken and the six additional Biweekly Progress Reports.

The Ore Milne Ore Stockpile ditching was completed by Baffinland as soon as ground temperatures permitted excavation. A construction plan was submitted to INAC and ECCC inspectors in late May with ditch construction commencing within one week of the May 18 to 20 Regulatory Inspection. The ditching system was substantially completed by mid-June. The as-built drawings for the facility are presented in Attachment A.2.

The ditching system for the Crusher Stockpile area was partially completed in 2015 to allow for drainage from much of the stockpile area to the settling pond. During late June and early July, additional ditching was constructed to fully address drainage from the stockpile area. The as-built drawing for the ditching system constructed this past summer is presented in Attachment A.3.

Dust and Sedimentation Mitigation Action Plans

In response to ECCC direction, comprehensive Dust Mitigation and Sedimentation Action Plans were developed as separate deliverables consistent with the FAD and LNC requirements. These plans are closely related to each other and are synergistic when they are implemented together. Plan development included review of existing information, a site visit by technical specialists in mid-August, interviews with key managers and superintendents on site, and a series of several follow-up meetings and discussions with key representatives of Site Operations.

Dust Mitigation Action Plan

The Dust Mitigation Action Plan (Attachment B) outlines detailed recommended actions including responsible party and schedule for completion for the affected areas of the Project Site. Baffinland commits to completing the recommended actions to address dust management at the Mary River site.

Sedimentation Mitigation Action Plan

The Sedimentation Action Plan (Attachment C) outlines actions including responsible party and schedule for completion for the affected areas of the Project Site. Baffinland commits to completing the recommended actions to address sediment mitigation at the Mary River site.

Lessons Learned

Baffinland has conducted a review and analyses of lessons-learned with regard to sedimentation issues along the roads and at the camps. Key conclusions and recommendations have been provided as part of the Dust and Sediment Mitigation Action Plan reports.

Closure

With the submission of this Completion Report, the report on actions taken to address sedimentation issues (June 24, 2016), Bi-weekly reports, Dust Mitigation Action Plan (Sept 30, 2016), Sedimentation Mitigation Action Plan (Sept 30, 2016), and the completion of construction of drainage structures at Milne Stock pile (Sept 27, 2016), and Mary River Site Iron Ore Stockpile (Sept 30, 2016), Baffinland has complied with the requirements of the ECCC *Fisheries Act* Direction and INAC Letter of Non-Compliance.

Attachments:

Attachment A: As Built Drawings

- A.1: Mine Haul Road Drainage Improvement Project Phase 1 Construction As-Built Report (abbreviated)
- A.2: Milne Ore Stockpile Ditches
- A.3: Crusher Stockpile Ditches

Attachment B: Dust Mitigation Action Plan

Attachment C: Sedimentation Mitigation Action Plan

Attachment A

As Built Drawings

Attachment B

Dust Mitigation Action Plan

September 29, 2016

MARY RIVER PROJECT

Dust Mitigation Action Plan Rev. 1

Submitted to:
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REPORT

Project Number: 1661774 (5000)

Distribution:

1 e-copy – Baffinland Iron Mines Corporation
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Golder Associates

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1.0 INTRODUCTION

On May 10, 2016, Mr. James Millard, Baffinland Iron Mines (Baffinland) Environmental Manager provided an email report to Mr. Curtis Didham, an Inspector designated by the Minister of Fisheries and Oceans (EO Didham), that on May 7, 2010, a snowmelt event occurred at the Baffinland site that led to sediment-laden runoff flowing into Sheardown Lake. Further, on May 17, 2016, Mr. Allan Knight, Baffinland Environmental Superintendent reported to Northern District Spills Duty Officer, EO MacDonald that a snowmelt event resulted in runoff containing sediments was observed to be flowing into Camp Lake Tributary #1 and into Camp Lake. EO MacDonald forwarded the report to EO Didham. These events, singularly and collectively set in motion a process of sample collection, laboratory analysis, reporting and ultimately resulted in a Baffinland site visit and inspection by EO Didham, Indigenous and Northern Affairs Canada (INAC) Water Resource Officers Justin Hack and Jonathan Mesher and INAC Environmental Assessment Officer Jason Patchell on May 18th and 19th, 2016.

A number or outcomes resulted from the site visit and inspection of the Baffinland site including a *Fisheries Act Direction* (FAD) to remedy a number of the immediate issues and further to develop and implement two action plans including, and by September 30, 2016:

1) A Dust Mitigation Action Plan with an implementation schedule addressing crushing operations, wind coming in contact with the crushed rock/iron stockpiles and vehicle traffic on the Tote Road; and

2) A Tote Road and Mine Haul Road Mitigation Action Plan with an implementation schedule addressing sediment water runoff from the road in to culverts, ditches and creeks/streams which lead to David, Mural, Kabikok, KM 32, KM 27, Camp and Sheardown lakes and into the Mary River and Phillips Creek.

The action plans were developed to address the specific areas noted in the FAD and to also address other areas on the site where dust and sediment could become an issue in the future. The action plans have been developed as separate deliverables consistent with the direction, but it is important to recognize that they are closely related to each other and will be synergistic when they are implemented together. This document specifically addresses the *Dust Mitigation Action Plan*.

Baffinland retained Golder Associates Ltd. (Golder) to prepare both the Dust Mitigation Action Plan and the Sedimentation Action Plan. The preparation of these plans included a site visit by Messrs. Chris Madland, Senior Air Quality Scientist, and Paul Bedell, PEng, Senior Geotechnical Engineer, of Golder from August 12 to August 16, 2016, inclusive. Extensive discussions between Baffinland personnel and Golder were carried out to develop the plans.

The Reader is referred to the Study Limitations (Section 8.0), which follows the text and forms an integral part of this document.

2.0 TOTE ROAD

Dust generated from use of the Tote Road is one of the items identified in the FAD that requires attention. The Tote Road is currently being used in this early phase of the Baffinland project to transport crushed ore from the crusher site at the main mine complex to the Milne Port Site. The Tote Road is a 100 kilometre (km)-long gravel road that supports approximately 100 return haul truck trips per day.

2.1 What are the mechanisms for dust generation on the Tote Road?

There are three mechanisms involved in generating dust along the Tote Road. Each of these mechanisms could result in dust being transported from the road to the immediately adjacent land and potentially into nearby water bodies. The three different ways that dust generation has been observed include:

- Wheel Entrainment;
- Wind-blown Dust; and
- Losses from the Ore Haul Truck Boxes.

2.1.1 Wheel Entrainment

Wheel-entrained dust is the dust that is re-suspended into the air after the passage of a vehicle on the road surface. It is suspended due to direct mechanical contact with vehicle tires and the following turbulent air at the surface and in the wake of the vehicle further lofts the particles where they are subject to any ambient wind present. This type of dust is typically composed of relatively large particles (most particles >30 microns (µm)) that fall out of suspension within a short distance of the road, e.g., within approximately 100 metres of the road, most of the dust will be settled out of the air column. The calculated amount of dust that is suspended due to wheel entrainment on an unmitigated gravel road that is typically generated by vehicle passage is described in the United States Compendium of emission factors (AP-42) is affected considerably by two factors. The two factors include the silt content (particles nominally smaller than 75 µm) of the travel surface and the weight of the vehicle using the road. In general terms, the higher the silt content and the heavier the vehicle, the more dust generation should be expected.

During a Golder Associates (Golder) site reconnaissance and inspection visit completed in mid-August, a step in the development of this Action Plan, we observed that among the various sources of dust present at the Mine, the crusher, the Port and along the Tote and Mine Haul roads, wheel-entrained dust was the single most significant and important source. The relatively short time to complete the action plan has not permitted the development of an objective measurement program to definitively quantify dust from each of the sources, nor is such a program actually necessary. Many years of experience in addressing dust management issues in the Arctic, Sub-Arctic and many other locations around the world provide an appropriate lens through which the dust issues at Baffinland can be viewed and addressed.

Though wheel-entrained dust is considered the most important source of dust on the site in general, Golder notes that between dust generation and erosion issues related to moving water on and near the road, airborne dust deposition is the least likely to lead to inappropriate levels of total suspended solids in the areas' water bodies.

2.1.2 Wind-blown Dust

Wind-blown dust on the Tote Road is also recognized as a source of dust. The following (in italics) is an excerpt from the United States Environmental Protection Agency (U.S. EPA). It is part of the introductory section of the Fugitive Dust Sources Chapter (13.2):

> *Significant atmospheric dust arises from the mechanical disturbance of granular material exposed to the air. Dust generated from these open sources is termed "fugitive" because it is not discharged to the atmosphere in a confined flow stream. Common sources of fugitive dust include unpaved roads, agricultural tilling operations, aggregate storage piles, and heavy construction operations.*

In general terms, wind-blown dust could be expected when dry conditions, fine materials (particles <75 µm) on the road surface and relatively strong winds (over 19 km/hr) prevail. If any of these three factors are not present, wind-blown dust should be considered a negligible source.

While on site for the reconnaissance visit in mid-August, which was largely characterized by dry, windy conditions, we did observe the presence of wind-blown dust along the Tote Road. While these conditions were occasionally present during our visit, our observations during the multi-day visit and complete travel of the Tote Road suggest that wind-blown dust is a small source, especially when compared to the dust generated through wheel entrainment. Given our assertion that even wheel-entrained dust should be considered a minor contributor to sediment loading in local water bodies, the importance of wind-blown dust in the overall management of in-stream sedimentation is low.

2.1.3 Losses from the Ore Haul Truck Boxes

Ore is loaded into open-topped side-dump style haul trucks for transport along the Tote road from the crusher area at the mine site to the Milne port. There is some potential that iron ore dust, when exposed to the wind could be caught by the wind and be blown out of the truck box. During a site visit in mid-August, it was apparent, even through visual observation, that this potential source is not an important contributor to dust. The iron ore has a high density and is not easily moved by wind. No dust was observed to be leaving the trucks as they moved along the Tote Road.

2.2 What actions have been undertaken to date to address each of the identified sources?

Baffinland has undertaken a number of actions over the course of the summer season to control dust emissions related to travel along the haul road. They include the following:

- Road Resurfacing;
- Application of Chemical Suppressant; and
- Application of Water.

2.2.1 Wheel Entrainment

The single most substantial reduction in the amount of dust produced that has been achieved to date related to wheel entrainment has been the application of chemical dust suppressant (CaCl), followed by grading and water application to the Tote Road running surface. Our observations suggest that when an appropriate running surface is adequately treated and maintained, that dust generation was considerably reduced. Though a specific

measurement program was not conducted to support this claim, it is widely known in the dust management industry that reductions of 80% are readily achievable using this treatment regime. In the areas of the Tote Road where chemical suppressants and watering were employed, they were effective and we suggest that an 80% reduction in dust generation was achieved.

Progress was made in the spring and summer of 2016 on resurfacing portions of the Tote Road. Note that the limited re-topping of the Tote Road running surface that has been completed to date has not, nor would it be expected to be effective in controlling dust emissions on its own. For re-topping alone to be effective, the material would need to be unduly coarse, and would lead to haul-truck maintenance issues.

2.2.2 Wind-blown Dust

The same activities that led to meaningful reductions in dust generation on areas of the Tote Road related to wheel entrainment were also effective in controlling wind-blown dust from the surface of the road. The combination of a structurally sound road embankment and running surface coupled with the integration of chemical suppressants and watering have been effective in the areas where the application has been substantially completed. The road maintenance team was observed to be actively engaged in dust suppression activities at various locations along the Tote Road.

2.2.3 Losses from the Ore Haul Truck Boxes

As described in Section 2.1.3, losses from the ore haul truck boxes play a very minor, even negligible role in dust management at Baffinland and an even less significant role in the contribution of sediment to waterbodies in the vicinity of the Tote Road. No specific action has been taken to limit dust transport from the boxes of the ore haul trucks.

2.3 What additional actions will be undertaken to address each of the identified dust sources?

2.3.1 Wheel Entrainment

Section 2.2.1 of this action plan discussed in some detail the actions that have been undertaken to date to limit the amount of dust released from the Tote Road surface as a function of wheel entrainment. The continuation of the three identified activities is recommended including road resurfacing with durable, coarse, granular fills, the application and integration of chemical dust suppressants (CaCl) and road watering. The coordination of these activities should be directed through the Tote Road management plan which will be updated over the winter of 2016/17 and will be in place prior to the 2017 “dust season.” The dust season refers to the period nominally between June and October where it is reasonable to expect that the Tote Road surface would be bare. A compacted snow veneer on the Tote Road is expected to reduce dust emissions by approximately 95% between November and May.

Progress was made in the spring and summer of 2016 on resurfacing portions of the Tote Road. Because the season for road improvements has largely passed for 2016, the resurfacing activities will need to resume after the break-up season in 2017, after the frost has left the active layer and the road embankment has dried to the point where it can be improved with blading and supplemental materials without doing damage in the process. The length of the Tote Road should be brought up to a specification that includes a minimum of 150 mm depth of coarse granular fill over several years and will require regular maintenance over time to maintain the running surface and manage dust.

The application of a durable and workable running surface will not appreciably reduce dust generation without the integration of chemical suppressants and regular maintenance through road watering. The August 2016 sea-lift brought an additional 20 sea containers of CaCl to the site for use on the Tote Road and other high priority areas. CaCl should be applied using the existing tandem-axel spreader truck in the dust season as needed until the compacted snow veneer is established on the road.

CaCl suppressant works primarily by retaining existing soil moisture at the surface and promoting the "cementing" and retention of fine materials in the road surface. From time to time however, the road embankment and surface will dry to the point where the presence of CaCl alone will not materially affect dust generation. Supplemental watering of the Tote Road is recommended through the use of the existing "740 water truck", and the existing, smaller, tandem water truck in the dust season. The existing tandem water truck should be retrofitted to improve the efficiency of distribution of water through an appropriate spreader-bar and pump. The tandem water truck should also be fitted with a filling fixture so that it can be filled with a six-inch pump to reduce filling times. Additional water truck capacity should be added to the Tote Road water truck fleet. The retrofits and increased watering capacity are expected to considerably increase the efficiency of watering on the Tote Road.

2.3.2 Wind-blown Dust

The actions proposed to manage wind-blown dust are the same as those prescribed to manage wheel-entrained dust. No additional actions are required or proposed beyond those being taken to limit wheel-entrained dust. Wind-blown dust is considered a minor source relative to the wheel-entrained dust.

2.3.3 Losses from the Ore Haul Truck Boxes

Observations made during a site visit in mid-August suggest that the amount material being deposited on and adjacent to the Tote Road related to ore dust being blown out of the truck boxes is negligible. No additional actions are proposed to limit the very small potential for deposition to water bodies adjacent to the Tote Road from this dust source.

Table 2-1 summarizes the dust mitigations actions planned for the Tote Road.

Table 2-1 Tote Road Dust Mitigation Actions and Implementation Schedule

Action	Accountable Department	Completion Date
Chemical suppressant (CaCl) application	Ore Handling	Summer months every year
Road watering equipment retrofit and supplement	Ore Handling	Retrofit completed by May 31, 2017, supplemental equipment to arrive on 2017 sea-lift
Road watering	Ore Handling	Summer months every year

3.0 CRUSHER PAD

Dust generated from use of the crusher pad is one of the items identified in the FAD that requires attention. The crusher pad is located at the mine site at the bottom end of the mine haul road. The equipment on it is used to process raw ore that has been transported from the mine into pieces nominally 30 mm in diameter (lump ore) and 19 mm in diameter (fines), to stock pile it temporarily and then to load it into the haul trucks for transport on the Tote Road to the Milne Port. The crushing facilities on the pad are also used to crush granitic materials to produce aggregate for various purposes at the mine including road building.

3.1 What are the mechanisms for dust generation on the crusher pad?

There are several important sources of dust generation on the crusher pad. Some are similar to those already discussed in Section 2 of the Action Plan relating to the Tote Road and others are related specifically to the processing of iron ore and aggregate. The important sources include the following:

- Wheel Entrainment;
  - Haul truck
  - Front-end loader
- Wind-blown Dust;
- Conveyor Transfer Points;
- Ore Discharge to Surge Pile;

3.1.1 Wheel Entrainment

The mechanism whereby wheel-entrained dust is generated is discussed in detail in Section 2.1.1. It is considered the most important source of dust on the site in general and in the case of the crusher pad, wheel-entrained dust sources include the movement of front-end loaders used for managing the stockpiles and for loading haul trucks, and the movement of the haul trucks on the crusher pad. We note that between dust generation and erosion issues related to moving water on and near the pad, airborne dust deposition is the least likely to lead to inappropriate levels of total suspended solids in the areas' water bodies.

3.1.2 Wind-blown Dust

Wind-blown dust on the crusher pad is also recognized as a source of dust. The mechanism that drives wind-blown dust is discussed in detail in Section 2.1.2. While on site for the reconnaissance visit in mid-August, which was largely characterized by dry, windy conditions, we did observe the presence of a small amount of wind-blown dust at the crusher pad. While these conditions were occasionally present during our visit, our observations during the multi-day visit and ongoing observations suggest that wind-blown dust is a small source, especially when compared to the dust generated through wheel entrainment. Given our assertion that even wheel-entrained dust should be considered a minor contributor to sediment loading in local water bodies, the importance of wind-blown dust in the overall management of in-stream sedimentation is low.

3.1.3 Conveyor Transfer Points

Each of the conveyor transfer points in the crushing circuit and the crushing and screening activities themselves are categorized here generally as conveyor transfer points. The mechanism for dust generation at these locations is similar in each case and regardless of the specific activity, the control effort will take a similar form. As the materials being crushed make their way through the crushing circuits, fines are generated through friction due to abrasion with other aggregate materials being processed and through direct interaction with the hard surfaces of the equipment. In some cases, the fines are retained in the flow of materials and do not become airborne. In other cases, for example where one conveyor discharges to another, materials are dropped a short distance and can become exposed to the prevailing ambient wind of the day. In another example, where materials are separated by size on a screen deck, they can become temporarily suspended in the air. In both these examples, dust can be lost to the wind and transported a short distance from the crusher pad or simply onto the crusher pad itself without leaving the immediate area.

3.1.4 Ore Discharge to Surge Pile

The dust generation associated with the discharge of fine ore to its dedicated surge pile is of particular note. Of the sources not related directly to wheel entrainment on the crusher pad, this source was the most important. During some periods, fine ore and its higher percentage of fines drops a few metres to the surge pile. Under windy conditions, a visible plume of dust was observed being entrained by the wind as the materials cascaded to the surge pile. This is a more important source than much of the rest of the activity in the crushing circuit because the length of time of exposure to ambient wind is considerably greater at this location than at other points in the circuit. It is important to note that wheel entrainment is a more important source by a wide margin.

3.2 What actions have been undertaken to date to address each of the identified dust sources?

In some cases, it was possible to mitigate dust sources on the crusher pad immediately after they were noted during the reconnaissance and inspection visit.

3.2.1 Wheel Entrainment

Upon becoming aware that wheel-entrained dust on the crusher pad was a potentially significant dust source, immediate mitigation action was taken to provide road watering trucks to wet the surface of the crusher pad. Chemical suppressants were not used, nor are they planned for the crusher pad location as they can impact iron ore product quality. The mitigating effects observed due to watering were significant.

3.2.2 Wind-blown Dust

Because there is a substantial amount of traffic on the crusher pad, mechanical pulverizing of the pad materials can make very fine material available for entrainment by the ambient wind. This was observed in small measure at the crusher pad. The actions taken as described in Section 3.2.1 to control wheel-entrained dust were equally effective, timely and appropriate for controlling wind-blown dust where it was observed, primarily on the road portion of the crusher pad.

3.2.3 Conveyor Transfer Points

No specific actions have yet been taken to limit the dust generated at the conveyor transfer points and from various crushing activities. Preliminary discussion about the actions that could be taken have occurred but in each case, some level of engineering and preparation is required to implement the appropriate mitigation.

3.2.4 Ore Discharge to Surge Pile

No specific actions have yet been taken to limit the dust generated where ore and crushed aggregates are discharged to the various surge piles. Preliminary discussion about the actions that could be taken have occurred but in each case, some level of engineering and preparation is required to implement the appropriate mitigation.

3.3 What additional actions will be undertaken to address each of the identified sources?

As discussed in Section 3.2, actions have already been taken to address dust emissions from the crusher pad location. Additional actions are warranted and planned. This section addresses the recommended actions to address the additional dust mitigation needs at the crusher pad.

3.3.1 Wheel Entrainment

The most appropriate dust mitigation action that can be undertaken at the crusher pad regarding wheel entrainment-related dust at the crusher pad is to maintain a moist surface. When the surface is wet, dust generation is typically controlled by approximately 80%. Dust literature suggests that when theoretical calculations of dust are required for assessment purposes, days where there is measureable precipitation (rain or snow) can be considered non-generating days. Systematic watering of the crusher pad surface can be used during the dust season (typically June-September) until the establishment of a compacted snow veneer.

3.3.2 Wind-blown Dust

As described in Section 3.3.1, watering of the pad surface in the dust season is the most effective way to control dust from the crusher pad related to wheel entrainment. When wheel-entrained dust is controlled, wind generated dust will also necessarily be controlled. No additional actions outside of those used to control wheel-entrained dust are proposed for controlling wind-blown dust.

3.3.3 Conveyor Transfer Points

Section 3.2.3 indicated that some level of planning, engineering and procurement may be required to develop an appropriate dust mitigation approach for the crusher conveyor transfer points and other areas in the crusher circuit where materials are temporarily suspended in the air where they could be subject to ambient wind. The primary method of controlling dust at these locations is to enclose the transfer point to the extent possible to reduce the exposure of suspended materials to the wind. The design of equipment shrouding, where there is potential for suspended fines to be exposed to and entrained by the wind, is underway and the shrouding of the transfer points and other exposed locations in the crusher circuit should be completed by June 1, 2017.

3.3.4 Ore Discharge to Surge Pile

Though considered a relatively minor source compared to wheel entrainment at the crusher pad, the discharge point from the crusher circuit to the surge various surge piles is still a source of dust. The potential use of loading bellows fitted to the point of discharge from the conveyors to the surge piles should be evaluated for possible installation prior to the 2017 dust season.

3.3.5 Aggregate-specific Crushing Operations

Observations by mine personnel suggest that crushing aggregate, not iron ore can lead to higher levels of airborne dust. To specifically control dust associated with crushing aggregate, Baffinland should install a water spray-bar on the aggregate crusher spread or feed pile. Watering in the summer months is expected to considerably mitigate dust generation from this source.

Table 3-1 summarizes the dust mitigations actions planned for the Crusher Pad

Table 3-1 Crusher Pad Dust Mitigation Actions and Implementation Schedule

Action	Accountable Department	Completion Date
Pad watering	Ore Handling	Summer months every year
Installation of shrouding at crusher circuit transfer points	Crushing	December 31, 2017
Install bellows at stockpile conveyor head(s) – fines head first	Crushing	Winter 2016/2017
Install downwind snow fence to limit dustfall transport - trial basis	Crushing	October 31, 2016
Install spray-bar on aggregate crusher spread or feed pile	Crushing	May 1, 2017

4.0 MILNE PORT ORE STOCKPILES

The Milne Port facility serves as a receiving and temporary storage facility for iron ore being transported from the mine and crushers along the Tote Road, prior to being loaded onto bulk transport ships in the ice-free season. Dust is generated from a number of activities at the Milne Port site including from the following:

- Wheel Entrainment from arriving and departing haul trucks, front-end loaders and other smaller equipment necessary for operating the facility;
- Wind-blown Dust from the storage piles and the traveled areas of the pad; and
- To a lesser extent, losses from ore haul truck boxes.

4.1 What are the mechanisms for dust generation at the Milne Port?

4.1.1 Wheel Entrainment

The mechanism whereby wheel-entrained dust is generated is discussed in detail in Section 2.1.1. It is considered the most important source of dust on the site in general and in the case of the Milne Port Ore Stockpiles, wheel-entrained dust sources include the movement of front-end loaders used for managing the stockpiles and the movement of the haul trucks on the pad.

4.1.2 Wind-blown Dust

Wind-blown dust at the Milne Port is also recognized as a source of dust. The mechanism that drives wind-blown dust is discussed in detail in Section 2.1.2. While on site for the reconnaissance visit in mid-August, which was largely characterized by dry, windy conditions, we did observe the presence of a small amount of wind-blown dust

at the Milne Port pad. While these conditions were occasionally present during our visit, our observations during the multi-day visit and ongoing observations suggest that wind-blown dust is a small source, especially when compared to the dust generated through wheel entrainment. Given our assertion that even wheel-entrained dust should be considered a minor contributor to sediment loading in local water bodies, the importance of wind-blown dust in the overall management of in-stream sedimentation is low.

4.1.3 Losses from the Ore Haul Truck Boxes

Losses from the boxes of ore-haul trucks has been described as a potential source of dust deposition in Section 2.1.3. We assert that at the Milne Port site, the potential for iron ore dust to be liberated from the haul truck boxes in any meaningful quantities is exceptionally low. It is described in this section to account for the concern that has been raised on the matter but our opinion is that the contributions to dust deposition from this source are negligible.

4.2 What actions have been undertaken to date to address each of the identified dust sources?

4.2.1 Wheel Entrainment

The most appropriate dust mitigation action that can be undertaken at the Milne Port regarding wheel entrainment-related dust is to maintain a moist surface whenever possible. When the surface is wet, dust generation is typically controlled by approximately 80%. Systematic watering of the Milne Port haul truck route across the pad surface during the dust season is being completed. Chemical suppressants are not used for the crusher pad area because of the potential for contamination of the ore.

4.2.2 Wind-blown Dust

Because of the considerable traffic present at the Milne Port, mechanical pulverizing of the pad materials can make very fine material available for entrainment by the ambient wind. This however, was not observed during a visit to the facility. No specific actions have been undertaken to limit wind-blown dust at the facility that are not part of the inherent design of the facility. Inherent design characteristics include the use of stackers instead of front-end loaders where possible, the use of covered conveyors that are in good repair for transferring iron ore from the stockpiles to the ships and the use of loading bellows by the ship-loaders. Each of these components of the design serve to control the transmission of fine particles from their point of origin to the surrounding environment.

4.2.3 Losses from the Ore Haul Truck Boxes

Iron ore dust being blown out of the ore-haul truck boxes is not a significant source of dust; therefore, no specific action has been taken to limit this source.

4.3 What additional actions will be undertaken to address each of the identified mechanisms?

4.3.1 Wheel Entrainment

The most appropriate dust mitigation action that can be undertaken at the crusher pad regarding wheel entrainment-related dust at the crusher pad is to maintain a moist surface. The systematic watering of the crusher pad surface during the dust season should be continued to maintain dust mitigation.

4.3.2 Wind-blown Dust

As described in Section 4.3.1, watering of the Milne Port pad surface in the dust season is the most effective way to control dust from wheel entrainment. When wheel-entrained dust is controlled, wind generated dust will also necessarily be controlled. No additional actions outside of those used to control wheel-entrained dust are proposed for controlling wind-blown dust.

On occasion, it is expected that despite best efforts, some dust may be moved by the wind off the pad. A snow fence system is proposed to limit the spatial extent of the deposition of dust so that it can be more efficiently managed and removed prior to snow melt. The use of snow fence to minimize dust movement will tested in the immediate vicinity of the crusher pad.

4.3.3 Losses from the Ore Haul Truck Boxes

No additional actions are proposed to control dust losses from the ore haul truck boxes.

Table 4-1 summarizes the dust mitigations actions planned for the Milne Port Ore Stockpiles

Table 4-1 Milne Port Ore Stockpiles Dust Mitigation Actions and Implementation Schedule

Action	Accountable Department	Completion Date
Pad watering	Ore Handling	Summer months every year
Install downwind snow fence to limit dust fall transport - trial basis	Ore Handling	October 31, 2016

5.0 MINE HAUL ROAD

The mine haul road is a 6 km-long gravel road used to transport raw ore from the mine down the mountain to the crushing facilities where it is processed and loaded for transport along the Tote Road to the Milne Port.

5.1 What are the mechanisms for dust generation on the Mine Haul Road?

There are two important mechanisms involved in generating dust along the mine haul road. Each of these mechanisms could result in dust being transported from the road to the immediately adjacent land and potentially into nearby water bodies. The two ways that dust generation has been observed include:

- Wheel Entrainment; and
- Wind-blown Dust.

5.1.1 Wheel Entrainment

The mechanism whereby wheel-entrained dust is generated is discussed in detail in Section 2.1.1. It is considered the most important source of dust on the site in general and in the case of the mine haul road, primarily includes the movement of haul trucks up and down the mountain and light vehicle traffic. We note that between dust generation and erosion issues related to moving water on and near the mine haul road, airborne dust deposition is the least likely to lead to inappropriate levels of total suspended solids in the areas' water bodies.

5.1.2 Wind-blown Dust

Wind-blown dust on the Tote Road is also recognized as a source of dust. The mechanism that drives wind-blown dust is discussed in detail in Section 2.1.2.

While on site for the reconnaissance visit in mid-August, which was largely characterized by dry, windy conditions, we did observe the presence of wind-blown dust along the mine haul road. While these conditions were occasionally present during our visit, our observations during the multi-day visit and travel of the mine haul road suggest that wind-blown dust is a small source, especially when compared to the dust generated through wheel entrainment.

5.2 What actions have been undertaken to date to address each of the identified sources?

5.2.1 Wheel Entrainment

The single most substantial reduction in the amount of dust produced that has been achieved to date related to wheel entrainment on the mine haul road has been the application of water using a dedicated 740 water truck. Our observations suggest that when an appropriate running surface is adequately treated and maintained, that dust generation was considerably reduced.

5.2.2 Wind-blown Dust

The same activities that led to meaningful reductions in dust generation on areas of the mine haul road related to wheel entrainment were also effective in controlling wind-blown dust from the surface of the road. The application of water has been effective in controlling wheel-entrained dust and in controlling wind-blown dust. The mine road maintenance team was observed to be actively engaged in dust suppression activities on the mine haul road.

5.3 What additional actions will be undertaken to address each of the identified dust sources?

5.3.1 Wheel Entrainment

The activities currently being undertaken at the mine haul road to control dust have been quite effective. Additional gains could be made, however, by spending less time filling the water truck and more time applying water. It was noted during the site visit that the water truck was being filled using a four-inch pump and a fill time of approximately 35 minutes was common. Retrofitting the water truck to accept filling using a six-inch pump will significantly reduce the amount of time the water truck takes to fill and additional operator time can be spent watering the roads instead of waiting for the truck to fill. Retrofitting the water truck to improve efficiency should be implemented prior to the 2017 dust season.

A pilot program to test the effectiveness of the application of chemical suppressants in this setting is proposed for the summer of 2017 as well. Chemical suppressants anticipated for testing include CaCl and EK-35. Other suppressants may be included in the testing program as appropriate.

5.3.2 Wind-blown Dust

The actions proposed to manage wind-blown dust are the same as those prescribed to manage wheel-entrained dust. No additional actions are required or proposed beyond those being taken to limit wheel-entrained dust. Wind-blown dust is considered a minor source relative to the wheel-entrained dust.

Table 5-1 summarizes the dust mitigations actions planned for the Mine Haul Road.

Table 5-1 Mine Haul Road Dust Mitigation Actions and Implementation Schedule

Action	Accountable Department	Completion Date
Chemical suppressant (CaCl) or EK-35 application (subject to performance of pilot program)	Mine Operations	August 31, 2017
Road watering equipment retrofit and supplement	Mine Operations	Retrofit completed by May 31, 2017
Road watering	Mine Operations	Summer months every year

6.0 MINE AND MILNE PORT SITE

Though the specific areas of the mine are not discussed directly in the FAD, Baffinland considers it important to include them in the general discussion around dust management at the site. Dust generation arising from vehicle use at the various pads, laydowns and parking areas was apparent during a site visit in mid-August and the desired holistic approach to management would not be possible without consideration of these areas.

6.1 What are the mechanisms for dust generation at the Mine and Milne Port Site pads, laydowns and parking areas?

As discussed in detail in each of the sections above, wheel entrainment and wind-blown dust each play an important role in the generation of dust at the Baffinland operation and the mine site pads, laydowns and parking areas are also prone to dust generation from these sources.

6.1.1 Wheel Entrainment

The mechanism whereby wheel-entrained dust is generated is discussed in detail in Section 2.1.1. Wheel-entrained dust is considered the most important source of dust on the site in general and in the case of the mine site pads, laydowns and parking areas, wheel-entrained dust sources primarily include the movement of light traffic and heavy equipment. We note that between dust generation and erosion issues related to moving water on and near the pads, laydowns and parking areas , airborne dust deposition is the least likely to lead to inappropriate levels of total suspended solids in the areas' water bodies.

6.1.2 Wind-blown Dust

Wind-blown dust at the mine site pads, laydowns and parking areas are a recognized as a source of dust. While on site for the reconnaissance visit in mid-August, which was largely characterized by dry, windy conditions, we did observe the presence of wind-blown dust at many of these locations. While these conditions were occasionally present during our visit, our observations during the multi-day visit suggest that wind-blown dust is a small source, especially when compared to the dust generated through wheel entrainment.

6.2 What actions have been undertaken to date to address each of the identified sources?

6.2.1 Wheel Entrainment

Upon becoming aware of the dust issue at the mine site, a plan was developed to have the mine road water truck extend its route to include some of the pads, laydowns and parking areas. When water was applied, considerable reductions in dust generation were noted.

6.2.2 Wind-blown Dust

The same actions taken to reduce dust generation arising from wheel entrainment are applicable to mitigate wind-blown dust.

6.2.3 Airstrip Dust Mitigation

A dedicated dust suppression program using a specialized dust suppressant (EK-35) is being evaluated for the mine site airstrip.

6.3 What additional actions will be undertaken to address each of the identified dust sources?

6.3.1 Wheel Entrainment

The mine haul water truck and the Tote Road water truck will be coordinated and deployed to water the pads, laydowns and parking areas. The evaluation of the EK-35 suppressant program will continue at the airstrip.

6.3.2 Wind-blown Dust

The mine haul water truck and the Tote Road water truck will be coordinated and deployed to water the pads, laydowns and parking areas.

Table 6-1 summarizes the dust mitigations actions planned for the Mine and Milne Port Site.

Table 6-1 Mine and Milne Port Site Dust Mitigation Actions and Implementation Schedule

Action	Accountable Department	Completion Date
Apply chemical dust suppressant on pads, laydowns, and parking areas (calcium chloride)	Site Services	Summer months every year
Evaluate the use of EK-35 at the airstrip	Site Services	Continue
Apply water as a dust suppressant	Site Services	Summer months every year

7.0 SUMMARY AND CONCLUSIONS

Wheel-entrained road dust is the single most important source of dust to be controlled at the Baffinland site; however, it should be noted, that as it relates to sedimentation in local streams and water bodies, even wheel-entrained dust should be considered a relatively small source in comparison to the erosion potential of water transporting sediments to water bodies.

There is a considerable amount of effort and expense that has gone into the reduction of dust generation at the Baffinland facility over the course of the summer of 2016. In many cases, the efforts have been rewarded with substantial reductions in dust generation. Road resurfacing, the application of chemical suppressants and watering have all played a role in the effort and results to date. More remains to be done, however, to appropriately mitigate dust generation. Depending on the area of the operation in question, this could mean:

- retrofitting equipment to be more efficient (water truck filling or dispensing),
- acquiring additional equipment (additional water truck) or supplies (CaCl, EK-35 or other), or
- adding dust control devices like shrouds and loading bellows at various points in the crushing circuits.

With a coordinated approach to dust management as described in this action plan, significant additional gains can be realized that will contribute to the overall reduction of sediment in local water bodies.

8.0 STUDY LIMITATIONS

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Report Signature Page

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Original signed

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Golder Associates

Attachment C

Sedimentation Mitigation Action Plan

September 29, 2016

MARY RIVER PROJECT

Sedimentation Mitigation Action Plan, Rev.1

Submitted to:
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2275 Upper Middle Road East, Suite 300
Oakville ON L6H 0C3

REPORT

Project Number: 1661774 (5000)

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Golder Associates

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1.0 INTRODUCTION

On May 10, 2016, Mr. James Millard, Baffinland Iron Mines Corporation (Baffinland) Environmental Manager, provided an email report to Mr. Curtis Didham, an Inspector designated by the Minister of Fisheries and Oceans (EO Didham), that on May 7, 2010, a snowmelt event occurred at the Mary River Project site that led to sediment-laden runoff flowing into Sheardown Lake. Further, on May 17, 2016, Mr. Allan Knight, Baffinland Environmental Superintendent, reported to Northern District Spills Duty Officer, EO MacDonald that a snowmelt event resulted in runoff containing sediments was observed to be flowing into Camp Lake Tributary #1 and into Camp Lake. EO MacDonald forwarded the report to EO Didham. These events, singularly and collectively, set in motion a process of sample collection, laboratory analysis, reporting, and ultimately resulted in a Baffinland site visit and inspection by EO Didham, Indigenous and Northern Affairs Canada (INAC) Water Resource Officers Justin Hack and Jonathan Mesher and INAC Environmental Assessment Officer Jason Patchell on May 18 and 19, 2016.

A number of outcomes resulted from the site visit and inspection of the Mary River Project site including a *Fisheries Act Direction* (FAD), dated June 7, 2016, to remedy a number of the immediate issues and to develop and implement two action plans by September 30, 2016:

1) A Dust Mitigation Action Plan with an implementation schedule addressing crushing operations, wind coming in contact with the crushed rock/iron stockpiles and vehicle traffic on the Tote Road; and

2) A Tote Road and Mine Haul Road Mitigation Action Plan with an implementation schedule addressing sediment water runoff from the road in to culverts, ditches and creeks/streams which lead to David, Mural, Kabikok, KM 32, KM 27, Camp and Sheardown Lakes, and into the Mary River and Phillips Creek.

The mitigation action plans were developed to address the specific areas noted in the FAD and to also address other areas on the site where dust and sediment could become an issue in the future. The mitigation action plans have been developed as separate deliverables consistent with the direction, but it is important to recognize that they are closely related to each other and will be synergistic when they are implemented together. This document deals specifically with Item 2, above. As this document includes the various sources of sediment at the Tote Road, the Mine Haul Road, the crusher pad, the Milne Port ore stockpile, and the Mine and Milne Port Sites, it is titled the *Sedimentation Mitigation Action Plan*.

Baffinland retained Golder Associates Ltd. (Golder) to prepare both the Dust Mitigation Action Plan and the Sedimentation Action Plan. The preparation of these plans included a site visit by Messrs. Chris Madland, Senior Air Quality Scientist, and Paul Bedell, PEng, Senior Geotechnical Engineer, of Golder from August 12 to August 16, 2016, inclusive. Extensive discussions between Baffinland personnel and Golder were carried out to develop the plans.

The Reader is referred to the Study Limitations (Section 9.0), which follows the text and forms an integral part of this document.

2.0 TOTE ROAD

The Tote Road extends from the Milne Port to the Mine Site and is approximately 104 km in length. The crushed ore is hauled to the Milne Port Ore Stockpile (Section 5.0) from the Crusher Pad (Section 4.0) by B-train haul trucks that traffic the Tote Road.

2.1 Sediment Sources

The following are identified as the primary sources of sediment water runoff from the Tote Road into culverts, ditches, creeks, and streams:

- Sediment-contaminated snow melt. Snow management practices have resulted in sediment-laden meltwater, from snow cleared from the road, reporting to the receiving environment.
- Road embankment erosion at some culvert locations. Steep road embankments, due to short culverts, are prone to erosion and challenge proper armouring with rip rap. Short culvert lengths also result in narrow road widths which result in traffic safety issues. The lack of sufficient rip rap placement at culverts inlets and outlets, even those with flatter slopes, also results in erosion of the road embankment.
- Insufficient drainage of the running surface resulting in runoff and erosion of running surface. Runoff along steeper sections of the road increases erosion of the road and sediment loading to the ditches and/or the receiving environment. Low-lying sections of the road are prone to the ponding of water, seasonally or as a result of rainfall events; these sections are prone to road deterioration and generate sediment-laden runoff to the ditches and/or receiving environment. Finer-grained road surfacing fills are especially prone to generating sediment, especially during intensive maintenance activities.
- Insufficient sizing and armouring of roadside ditches. Erosion of the ditches in steeper sections results in sediment-laden flows that report to the receiving environment.
- Cut-slope instability resulting from permafrost degradation. Ice-rich permafrost and fine-grained soils, upon thawing, result in sediment-laden flows to ditches, culverts, the road surface, and directly to the receiving environment. Cut-slopes into ice-rich permafrost and fine-grained and fine-grained soils exist at several locations along the Tote Road.

2.2 Mitigation Actions Undertaken to Date

Baffinland had undertaken a number of mitigation actions to reduce the adverse impacts of sedimentation on the receiving environment prior to the issuance of the FAD on June 7, 2016. These actions, in addition to those undertaken to the date of this document, include:

- Road resurfacing using high quality and durable granular fills. The placement of these fills has been carried out in select locations along the Tote Road as part of ongoing maintenance and upgrading activities. These fills satisfy the requirements for the Tote Road improvement design (prepared by Hatch Ltd.). Their placement will: reduce sediment generation due to their grain size; improve road drainage performance due to road embankment raising and crowning; and will reduce the generation of sediment-contaminated snow due to their grain size.

- Rip rap placement and check dam construction in roadside ditches. In excess of 4 km of ditch length was armoured with rip rap prior to the 2016 freshet between KM 83+000 and KM 89+000; steeper gradient sections of the road ditch were selectively targeted for rip rap placement. Several check dams were installed at select locations along the ditch to aid in flow control and to enable the use of flocculent. The installation of geotextile, underlying the rip rap, was carried out, in the majority of these areas.
- Rip rap placement at culvert inlets and outlets. The inlets and outlets of several culverts were armoured with rip rap prior to the 2016 freshet to reduce further erosion and generation of sediment.
- Installation of silt fencing, installation of geojute, and use of flocculation. These measures were used at select locations along the roadside ditch, upstream of culverts, and downstream of culverts to reduce the adverse impact of sediment-laded flows on the receiving environment.
- Removal of eroded materials from roadside ditch, creeks, and streams. Eroded materials, for example at KM 97+200 (bridge crossing), were removed from the steams in early 2016.
- Berm construction along the road from about KM 90+100 to KM 90+800 to limit movement of material mobilized from permafrost degradation in cut-slope. This berm was constructed using rip rap and served to retain materials.

2.3 Additional Mitigation Measures to be Undertaken

It is recognized that several mitigation measures need to be undertaken for the proper control of sediment impacts from the Tote Road. These measures need to be scheduled in consideration of seasonality, material availability, and resource requirements. The following general mitigation measures are recommended to be carried out by Baffinland:

- Procurement and bringing into use of a 6-way blade for the snow plows and evaluation of commercial-sized snow blowers for improved snow management based on ability to mobilize the equipment to the site.
- Development of a snow management plan for the Tote Road, including identification of snow dumps and snow clearing requirements, to manage the quantity and spatial extent of sediment-contaminated snow.
- Signage on all fisheries culverts at inlets and outlets.
- Replacement or extension of culverts to improve performance. Priority will be given to fish culverts and those identified having safety concerns. Armouring of culvert inlets and outlets with rip rap will be part of this work.
- Armouring and protection of cut-slopes exhibiting permafrost degradation to limit further erosion and sediment transport.
- Improve water management and drainage on the road surface and ditches. Placement of high quality and durable granular fills in select areas during road maintenance will be carried out. Armouring of ditches with rip rap will be carried out at identified locations to improve ditch performance; construction of check dams will be included in this work. The installation of silt fencing will be used, as required, to reduce the impact of sediment on the receiving environment.

- Removal of sediment laden snow from the ice surfaces of stream crossings.
- The Tote Road monitoring program will be revised. This will require regular visual inspections, including the documentation of areas of concern and required repairs.
- Develop and implement an earthworks execution plan for the Tote Road including; road re-surfacing, culvert replacement and other road improvements in consideration of the design prepared by Hatch Ltd. This requires that the carriageway be three times the width of the largest vehicle and with safety berms, in areas having a 3 m drop-off or greater, the berm having a height of three-quarters the diameter of the largest vehicle's tire; these are requirements of the *Mine Health and Safety Act* of Nunavut.

The summary of the specific mitigation actions recommended is shown in Table 1. The accountable department and completion date are shown for each mitigation action.

Table 1: Tote Road Sedimentation Mitigation Actions and Implementation Schedule

Action	Accountable Department	Completion Date
Revise and implement snow management plan	Ore Handling (support from Environment)	October 30, 2016
Signage posted on all fisheries culverts (inlets and outlets)	Environment	December 31, 2016
Procure and bring into use 6-way snow plow blade	Ore Handling	November 30, 2016
Replace CV104 culvert	Ore Handling	October 31, 2016
Increase road protection berms, rip rap culvert inlets/outlets, and replace non-functioning small diameter culverts (as required) between KM 90+100 and KM 90+800	Ore Handling	May 1, 2017
Construct water diversion ramps on running surface and check dams in ditch on slopes section near KM 97+200	Ore Handling	May 1, 2017
Remove sediment/dust-impacted snow from river ice surface (beneath bridges)	Ore Handling	As required (April 2017)
Prepare road improvement earthworks execution plan for 2017-and-beyond construction seasons	Ore Handling	February 15, 2017
Evaluate the potential to procure, transport and bring into use commercial-sized snow blower	Ore Handling	September 30, 2017
Replace priority culverts	Ore Handling	May 31, 2017
Execute earthworks execution plan for 2017 construction season - resurfacing	Ore Handling	December 31, 2017
Execute earthworks execution plan for 2017 construction season - balance of priority culverts	Ore Handling	December 31, 2017

3.0 MINE HAUL ROAD

The Mine Haul Road extends from the Crusher Pad (Section 4.0) about 6 km to the open pit. Blasted ore is loaded into CAT777 haul trucks and hauled to the Crusher Pad.

3.1 Sediment Sources

The following are identified as the primary sources of sediment water runoff from the Tote Road into culverts, ditches, creeks, and streams:

- Sediment-contaminated snow melt. Snow management practices have resulted in sediment-laden meltwater, from snow cleared from the road, reporting to receiving environment.
- Sediment from the low quality fills used in previous road embankment construction. These materials are prone to breaking down and are the sediment source to flows along the road surface.
- Cut-slope instability resulting from permafrost degradation. Ice-rich permafrost and fine-grained soils, upon thawing, result in sediment-laden flows to ditches, culverts, the road surface, and directly to the receiving environment. Cut-slopes into ice-rich permafrost and fine-grained and fine-grained soils exist at several locations along the Mine Haul Road.

3.2 Mitigation Actions Undertaken to Date

Baffinland had undertaken a number of mitigation actions to reduce the adverse impacts of sedimentation on the receiving environment prior to the issuance of the FAD on June 7, 2016. These actions, in addition to those undertaken to the date of this document, include:

- Six twin culverts and one single culvert were installed and the existing ditch was protected with rip rap along the mine haul road. The culvert trench was excavated by drilling and blasting due to the frozen ground conditions. The existing ditches were cleared of snow and inspected. Due to the time constraints and weather conditions the existing ditches were not modified. The existing ditches were observed to have little to no erosion protection. Rip rap was added along the length of the ditch, and in steep sections geotextile was placed prior to rip rap. This work was carried out and completed prior to the 2016 freshet.
- Road resurfacing using high quality and durable granular fills. The placement of these fills has been carried out since May 2016 in select locations along the Mine Haul Road as part of ongoing maintenance and upgrading activities. Their placement will: reduce sediment generation due to their grain size; improve road drainage performance due to road embankment raising and crowning; and will reduce the generation of sediment-contaminated snow due to their grain size.

3.3 Additional Mitigation Measures to be Undertaken

It is recognized that several mitigation measures need to be undertaken for the proper control of sediment impacts from the Mine Haul Road. These measures need to be scheduled in consideration of seasonality and material and resource requirements. The following general mitigation measures are recommended:

- Improve water management and drainage on the road surface through the placement of high quality and durable granular along the entire Mine Haul Road. The placement of these durable fills will encapsulate the lower quality fills within the original road embankment to limit further degradation and reduce the ability for sediment generation.
- Revision of the snow management plan for the Mine Haul Road, including identification of snow dumps and snow clearing requirements, to manage the quantity and spatial extent of sediment-contaminated snow.
- Enact a program of sediment removal from the culvert inlet basins on an “as required” basis.
- Armouring and protection of cut-slopes exhibiting permafrost degradation to limit further erosion and sediment transport.
- A Mine Haul Road monitoring program will be developed. This will require regular visual inspections by including the documentation of areas of concern and required repairs.

The summary of the specific mitigation actions recommended is shown in Table 2. The accountable department and completion date are shown for each mitigation action.

Table 2: Mine Haul Road Sedimentation Mitigation Actions and Implementation Schedule

Action	Accountable Department	Completion Date
Revise and implement snow management plan	Mine Operations (support from Environment)	October 15, 2016
Develop strategy to manage flows on running surface	Mine Operations	March 31, 2017
Remove sediment from culvert inlet basins	Mine Operations	As required
Running surface resurfacing	Mine Operations	September 30, 2017
Develop requirements for area downstream of Mine Haul Road and culverts (permafrost degradation area)	Mine Operations	March 31, 2017
Implement strategy to manage flows on running surface	Mine Operations	September 30, 2017
Implement short term mitigation for area downstream of Mine Haul Road and culverts	Mine Operations (support from Environment)	March 31, 2017

4.0 CRUSHER PAD

The Crusher Pad is the location where ore, hauled from the open pit, is crushed, stockpiled, and loaded into B-train trucks for haulage to the Milne Port Stockpile (Section 5.0). Two ore crushing setups and a single aggregate crushing setup are located on the Crusher Pad. The aggregates produced at the Crusher Pad are used across the site, as required, for granular fills.

4.1 Sediment Sources

The following are identified as the primary sources of sediment water runoff from the Tote Road into culverts, ditches, creeks, and streams:

- Sediment-contaminated snow melt. Snow management practices have resulted in sediment-laden meltwater, from snow cleared from the Crusher Pad, reporting to receiving environment.
- Sediment-contaminated snow from wind-blown dust generated during ore and aggregate crushing and loading activities.

4.2 Mitigation Actions Undertaken to Date

Baffinland had undertaken a number of mitigation actions to reduce the adverse impacts of sedimentation on the receiving environment prior to the issuance of the FAD on June 7, 2016. These actions, in addition to those undertaken to the date of this document, include:

- Maintenance to the Crusher Pad surface to improve runoff management. This work included the placement of granular fills and the re-grading of the pad surface resulting in better runoff management. Runoff is directed to the collection sump adjacent to the Crusher Pad.
- Reconfiguration and armouring of the south bank of the Crusher Pad. Material was removed and rip rap was placed to reduce the erosion of finer-grained fills.

4.3 Additional Mitigation Measures to be Undertaken

It is recognized that several mitigation measures need to be undertaken for the proper control of sediment impacts from the Crusher Pad. The following general mitigation measures are recommended:

- Revision of the snow management plan for the Crusher Pad, including identification of snow dumps and snow clearing requirements, to reduce the quantity and limits of sediment-contaminated snow.
- Installation of a downwind snow fence system (nominally on the south and southeast margins of the Crusher Pad) to test the ability of snow fence to manage the spatial extent of wind-blown sediments and sediment-laden snow and to permit the efficient removal of sediment laden snow, should it become apparent over the winter season.
- Develop the design of a potential sedimentation pond system in the drainage adjacent to the Crusher Pad. This design would be constructed should the dust mitigation actions to reduce dust fall from the Crusher Pad be insufficient. This design will be prepared such that it can be constructed in the summer of 2017, if required.

The summary of the specific mitigation actions recommended is shown in Table 3. The accountable department and completion date are shown for each mitigation action.

Table 3: Crusher Pad Sedimentation Mitigation Actions and Implementation Schedule

Action	Accountable Department	Completion Date
Revise and implement snow management plan	Crushing (support from Environment)	October 31, 2016
Design potential downstream sedimentation pond system as a contingency measure	Crushing (support from Environment)	February 28, 2017

5.0 MILNE PORT ORE STOCKPILE

The Milne Port Ore Stockpile is the location for ore storage prior to loading and shipping. Ore hauled from the Crusher Pad (Section 4.0) along the Tote Road (Section 2.0) is stockpiled at the Milne Port Ore Stockpile facility using loaders and conveyors for stacking. Ships are loaded using the ship loader; this is fed by loaders and conveyors.

5.1 Sediment Sources

The following is identified as the primary sources of sediment water runoff from the Milne Port Ore Stockpile facility:

- Sediment-contaminated snow melt from the stockpile area and on the beach area.

5.2 Mitigation Actions Undertaken to Date

Baffinland had undertaken a number of mitigation actions to reduce the adverse impacts of sedimentation on the receiving environment prior to the issuance of the FAD on June 7, 2016. These actions, in addition to those undertaken to the date of this document, include:

- Construction of ditching around the perimeter of the stockpile facility to intercept and route runoff to the sedimentation ponds.
- Removal of contaminated snow from the beach. This activity is carried out prior to the onset of melting conditions.

5.3 Additional Mitigation Measures to be Undertaken

It is recognized that several mitigation measures need to be undertaken for the proper control of sediment impacts from the Milne Port Ore Stockpile facility. The following general mitigation measures are recommended:

- Revision of the snow management plan for the facility, including identification of snow dumps and snow clearing requirements, to reduce the quantity and limits of sediment-contaminated snow.
- Installation of a downwind snow fence system (nominally on the northwest margins of the Milne Port Ore Stockpile facility) to test the ability of snow fence to manage the spatial extent of wind-blown sediments and sediment-laden snow and reduce the amount of sediment laden snow that requires management..
- Removal of contaminated snow from the beach. This activity will be carried out prior to the onset of melting conditions.

The summary of the specific mitigation actions recommended is shown in Table 4. The accountable department and completion date are shown for each mitigation action.

Table 4: Milne Port Ore Stockpile Sedimentation Mitigation Actions and Implementation Schedule

Action	Accountable Department	Completion Date
Revise and implement snow management plan	Ore Handling (support from Environment)	October 31, 2016
Remove dust-impacted snow from beach area	Ore Handling	As required

6.0 MINE AND MILNE PORT SITES

There are a number of locations at the Mine and Milne Port Sites from which sedimentation may be generated. These include pads, laydowns, and parking areas and their associated drainage infrastructure.

6.1 Sediment Sources

The following are identified as the primary sources of sediment water runoff from the Mine and Milne Port Sites:

- Camp Lake jetty ditching handling runoff from the apron and pad area.
- Sediment-contaminated snow melt from various pads, laydowns, and parking areas.

6.2 Mitigation Actions Undertaken to Date

Baffinland had undertaken a number of mitigation actions to reduce the adverse impacts of sedimentation on the receiving environment prior to the issuance of the FAD on June 7, 2016. These actions, in addition to those undertaken to the date of this document, include:

- Remediation of slope at north end of airstrip. This area experienced erosion of material due to concentrated water flow from the airstrip apron. Some of the material was removed from the toe of the slope. The slope was covered with rip rap and stabilized.
- Remediation of ditch and outflow area at Camp Lake Jetty. Sedimentation ponds were constructed and commissioned to flocculate flows prior to their release to Camp Lake.

6.3 Additional Mitigation Measures to be Undertaken

It is recognized that several mitigation measures need to be undertaken for the proper control of sediment impacts from the Mine and Milne Sites. The following general mitigation measures are recommended:

- Revision of the snow management plan, including identification of snow dumps and snow-clearing requirements, to reduce the quantity and limits of sediment-contaminated snow.
- Construction of a series of check dams along the Camp Lake jetty ramp ditch.

The summary of the specific mitigation actions recommended is shown in Table 5. The accountable department and completion date are shown for each mitigation action.

Table 5: Mine and Milne Sites Sedimentation Mitigation Actions and Implementation Schedule

Action	Accountable Department	Completion Date
Revise and implement snow management plan	Site Services (support from Environment)	September 30, 2016
Construct and improve check dams in ditch along ramp to Camp Lake jetty	Site Services	October 30, 2016

7.0 SUMMARY AND RECOMMENDATIONS

This document presents the Sedimentation Mitigation Action Plan for the Mary River Project prepared in response to the FAD issued to Baffinland on June 7, 2016. The implementation schedule for each mitigation action is also presented herein. A requirement of the FAD was that Baffinland also prepare and submit a Dust Mitigation Action Plan; the action plans have been developed as separate deliverables consistent with the direction, but it is important to recognize that they are closely related to each other and will be synergistic when they are implemented together.

It is recommended that Baffinland complete all of the listed mitigation actions to reduce the impacts of sediment on the receiving environment. Specific attention is drawn to the following through the following recommendations:

- Procure and bring into use proper snow removal equipment, including 6-way blades and evaluate the use of commercial-sized snow blowers, when it is possible to transport the equipment to the site.
- Revise and implement snow management plans for each of the areas on the site prior to the onset of winter conditions in 2016. A stand-alone plan for each facility or an overall project site plan, with a section for each area, may be prepared.
- Develop and implement a road improvement earthworks plan for 2017 for the Tote Road. A significant amount of work, including culvert lengthening and replacement, road widening, rip rap placement, ditch upgrading, and road surfacing, is required to reduce sediment generation from the road. Proper scheduling to complete this work must be developed in consideration of seasonality constraints and to determine material and resource requirements. The implementation the upgrade design to satisfy the requirements of the *Mine Health and Safety Act* of Nunavut is required to be part of this work.
- Performance of regular inspections of the Tote Road and Mine Haul Road to identify conditions of concern and required maintenance work.

8.0 CLOSING

We trust this draft document provides the information you presently require. Should you have any comments or questions, please contact the undersigned.

9.0 STUDY LIMITATIONS

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Report Signature Page

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