ATTACHMENT 26

Borrow Pit and Quarry Management Plan

(61 Pages)

Baffinland Iron Mines Corporation

BORROW PIT AND QUARRY MANAGEMENT PLAN

BAF-PH1-830-P16-0004

PHASE 2 PROPOSAL REVISIONS
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1.0 INTRODUCTION

1.1 PURPOSE AND APPROACH

The purpose of this overarching Borrow Pit and Quarry Management Plan is to set out the objectives and measures to maintain and enhance environmental performance of quarries and borrow pits while avoiding to the extent practical, remedying, and mitigating any potential adverse environmental effects associated with quarries and borrow pits.

This is an overarching plan for borrow pits and quarries, as the various authorizations issued to Baffinland (Section 1.4) requires its own individual quarry or borrow pit management plan. These individual plans will present the most up to date information on the quarry yields. The individual borrow pit and quarry specific plans are to be used in conjunction with the Borrow Pit and Quarry Management Plan, and other plans referred to in this document.

Aggregate requirements for the Mary River Project will be supplied by quarry and borrow sites located at Milne Port, along the northern transportation corridor, at the Mine Site, at the Steensby Port, and along the South Railway.

Results of geochemical testing conducted to date for acid rock drainage (ARD) and metal leaching (ML) indicate that quarry materials that have been targeted generally have low potential for acid generation and metals leaching (See FEIS Volume 6, Appendix 6 B 2 regarding the South Railway; see Knight Piésold (2019) and Hatch (2019) regarding the North Railway). Based on the results of studies to date, the individual quarry sites will be assessed for potential ARD/ML on a case by case basis.

This overarching Borrow Pit and Quarry Management Plan will be updated to reflect situations related to incident investigations, regulatory changes, or other Project-related changes. Specifics related to individual quarries or borrow pits are found in the site-specific quarry or borrow pit management plans.

1.2 RELATIONSHIP TO OTHER MANAGEMENT PLANS

Development of quarries and borrow pits has the potential to affect site water quality and other environmental components. Therefore, this Plan (and each quarry-specific management plan) must be viewed in conjunction with the other management plans described in Table 1.1.

TABLE 1.1 RELATIONSHIP TO OTHER MANAGEMENT PLANS

Plan/Guideline	Document No.	Information Provided by Referenced Plan
Environmental Protection Plan (EPP)	BAF-PH1-830-P16-0008	Provides relevant environmental protection measures.
Surface Water and Aquatic Ecosystem Management Plan	BAF-PH1-830-P16-0026	Identifies the management strategies and general mitigation measures related to controlling sedimentation and erosion effects on aquatic ecosystems.
Fresh Water Supply, Sewage and Wastewater Management Plan	BAF-PH1-830-P16-0010	Management of sewage effluent and sludge and other effluents.
Aquatic Effects Monitoring Plan	BAF-PH1-830-P16-0039	Monitors changes in the local aquatic environment from multiple Project stressors (effluent discharges, sedimentation, dust deposition).
Roads Management Plan	BAF-PH1-830-P16-0023	Describes environmental protection measures related to road operation and maintenance.
Waste Management Plan	BAF-PH1-830-P16-0028	Describes the wastes generated, waste minimization strategies and disposal methods. Includes an overview of the management and disposal of hazardous wastes provided in more detail within this plan.
Hazardous Materials and Hazardous Waste Management Plan	BAF-PH1-830-P16-0011	Management of hazardous wastes, including used oils, contaminated fuel, used chemical products, biomedical waste, and spill clean-up materials.
Interim Closure and Reclamation Plan	BAF-PH1-830-P16-0012	Closure measures including the waste disposal during active closure.
Spill Contingency Plan	BAF-PH1-830-P16-0036	Response measures associated with spills, including releases of wastes.
Emergency Response Plan	BAF-PH1-840-P16-0002	Process for responding to emergencies.

1.3 CORPORATE POLICIES

Baffinland has four corporate policies that apply to this management plan:

- **Sustainable Development (SD) Policy -** identifies Baffinland's commitment internally and to the public to operate in a manner that is environmentally responsible, safe, fiscally responsible and respectful of the cultural values and legal rights of Inuit.
- **Health, Safety and Environment (HSE) Policy -** describes the company's commitment to achieve a safe, healthy, and environmentally responsible workplace.
- **Anti-Bribery and Anti-Corruption Policy -** describes Baffinland's commitment to ensuring its directors, officers, employees, contractors, and representatives conduct due diligence on third parties when promoting Baffinland's business.
- **Code of Business Conduct Policy -** describes Baffinland's minimum requirements for directors, officers, employees, contractors, and representatives to follow a Code of Business Conduct.

All employees and contractors must comply with the contents of the above mentioned policies. The first two policies are included in Appendix A.

1.4 REGULATORY REQUIREMENTS

This Borrow Pit and Quarry Management Plan is required by the following Project authorizations:

- Type A Water Licence No. 2AM-MRY1325 issued by the Nunavut Water Board (NWB, or the Board)
- Quarry Concession Agreement that forms Schedule B of Commercial Lease No. Q13C301 with the Qikiqtani Inuit Association (QIA)
- Quarry Concession Agreement with the QIA
- Class A Land Use Permit No. N2019Q0011 issued by Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC)
- Project Certificate No. 005 issued by the Nunavut Impact Review Board (NIRB)

Tables of concordance with the applicable regulatory approvals are provided in Appendix B.

The Quarry Concession Agreement requires the development of individual Quarry Operations Plans, to be approved by the QIA when on Inuit Owned Land (IOL). Similarly, for quarries and borrow pits on Crown Land greater than 1,000 m^3 in volume or operated by multiple users, the Indian and Northern Affairs Canada (INAC; now CIRNAC) Northern Land Use Guidelines for Pits and Quarries (INAC, 2015) state that a Quarry Operations Plan is required and must be approved by a Land Use Inspector prior to the approval and the issuance of quarry permits. Most of the existing and proposed quarries for the Mary River Project are likely to exceed the volume threshold of 1,000 m^3.

The following legislation place specific requirements on the Project with respect to the exploitation of aggregate sources:

- *Territorial Lands Act* and Territorial Land Use Regulations
- Nunavut Waters and Nunavut Surface Rights Tribunal Act
- Canadian Environmental Protection Act
- *Safety Act* and Occupational Health and Safety Regulations
- Fisheries Act

In the event the Project ceases operation permanently, the quarries will be subject to reclamation, as per relevant regulatory and permit obligations and the Interim Closure and Reclamation Plan (ICRP).

2.0 PLANNING

2.1 OBJECTIVES

The objectives and performance indicators of this Borrow Pit and Quarry Management Plan are identified in Table 2.1.

TABLE 2.1 OBJECTIVES AND PERFORMANCE INDICATORS

Objective	Performance Indicator
Minimize direct habitat loss (footprint area) and indirect habitat loss (disturbance to wildlife)	• Direct habitat loss relative to EIS predictions • Adherence to established setbacks from sensitive receptors (watercourses, bird nests, archaeological sites)
Prevent or minimize ongoing permafrost degradation following quarry/borrow pit development	• No ponding water and stable ground and slope
Protect downstream water quality	• ARD/ML potential
	• Runoff water quality
Protect local aquatic life from potential blasting effects	• Compliance with blasting overpressure threshold
(Insert Inuit Objectives)	• (Insert Inuit performance indicators)

Monitoring plans and applicable thresholds are described in Section 5. Baffinland and the QIA are jointly implementing an adaptive management process into management plans developed for the Project (Section 2.3), and this includes the development of Inuit objectives and indicators, as noted in Table 2.1.

2.2 CONSIDERATION OF INUIT QAUJIMAJATUQANGIT

An Inuit Stewardship Plan (ISP) will be developed by the QIA pursuant to the Inuit Certainty Agreement referenced above. The ISP will describe how Inuit monitoring activities tie into the adaptive management system and other management, mitigation, and monitoring plans, and, how Inuit monitoring will relate to the protection and promotion of Inuit rights defined under the *Nunavut Agreement* and described under legal agreements with Baffinland related to management and stewardship of Inuit owned lands and resources. The ISP will be the framework for Inuit-led monitoring of impacts and changes within communities and on the land, waters and ice as a result of the Project. The ISP will embed a “boots on the ground” approach to monitoring whereby Inuit will be hired and trained as professional monitors for monitoring under the ISP. Through the ISP, Inuit will govern the use of Inuit knowledge and observations regarding the Project.

Further updates to this plan are expected as an outcome of the development of the ISP that articulate Inuit monitoring objectives, indicators, thresholds and responses (OITRs) related to the protection of surface waters and aquatic ecosystems.

In the interim, Table 2.2 identifies the opportunities that Baffinland has explored to incorporate IQ into this Plan.

TABLE 2.2 INCORPORATION OF IQ INTO THIS MANAGEMENT PLAN

Element	Description
Environmental sensitivities and receptors	Subsistence Fishing and Fresh Water values identified in Pond Inlet's Tusaqtavut Study can be integrated into a future revision of the monitoring component of this Plan
Indicators and thresholds	Confirmation required with Inuit through QIA-Baffinland AMP Working Group; interim Inuit objectives, indicators, thresholds and responses to be identified in this Management Plan and subject to later revision through the ISP and AMP reviews on a scheduled basis
Mitigation measures	Confirmation required with Inuit through QIA-Baffinland AMP Working Group
Monitoring	Confirmation required with Inuit through QIA-Baffinland AMP Working Group
Adaptive management	Confirmation required with Inuit through QIA-Baffinland AMP Working Group
Validation of IQ Integration	To be verified by Inuit Committee
Management review	To be verified by Inuit Committee

An important aspect of integrating IQ is validating such integration with Inuit. For this reason, only potential opportunities for IQ integration have been identified. A more fulsome effort to incorporate IQ into this draft plan will be undertaken in the future, based on feedback from the Inuit Committee and a standing Baffinland-QIA Adaptive Management Working Group, and consistent with the Adaptive Management Plan (Baffinland, 2020).

2.3 ADAPTIVE MANAGEMENT

2.3.1 DEFINING THE ADAPTIVE MANAGEMENT PROCESS

Adaptive management is a planned and systematic process for continuously improving environmental management practices by learning about their outcomes (Canadian Environmental Assessment Agency, 2016). Adaptive management provides flexibility to identify and implement new mitigation measures or to modify existing ones during the life of a project.

Baffinland has developed a draft Adaptive Management Plan (AMP) that provides the framework by which adaptive management is to be incorporated into Project operations (Baffinland, 2020). The Project-wide adaptive management process begins with a planning phase, followed by iterative phases of implementing and monitoring the actions included in the plan(s), evaluating the effectiveness of actions included in the plans based on results of monitoring and other feedback mechanisms, and adjusting management strategies and actions and responses based on monitoring. The cycle begins anew with implementation and monitoring of a revised plan, which integrates the outcomes of the previous cycle. This cycle can occur, in real-time or over an extended period according to the nature of the situation or area of focus. In this way, a properly designed and well-implemented adaptive management process progressively diminishes uncertainty, as management strategies and processes are refined throughout a project's operational lifecycle.

Monitoring and responding to effects in the short-term is addressed in a Trigger Action Response Plan (TARP) described in Section 5.0. The TARP identifies the pre-defined actions to be taken should threshold levels be exceeded. A series of escalated actions to be implemented are detailed in Section 5.0. Longer term review of and response to monitoring data is addressed in an annual review of plan effectiveness in Section 6. The latter includes

an annual comparison of project effects against impact predictions made in the Final Environmental Impact Statement (FEIS; Baffinland, 2012) and the addendums (Baffinland 2013, 2018), which are presented in Appendix B.

Implementation of the AMP will be overseen by a Baffinland-QIA Adaptive Management Working Group. Ongoing inputs from the Inuit Stewardship Plan as well as Baffinland's ongoing project monitoring will also form the basis of amendments and refinements to the objectives, indicators, thresholds, and response requirements over time.

Section 2.4 of the AMP states that with the QIA's approval of Baffinland's AMP and management plans, that implementation of pre-determined responses to effects as described in the management plan does not require additional approval by the QIA. Baffinland will communicate response actions to QIA prior to implementation unless this is not possible due to the expediency required by the circumstance. However, if a new response not previously considered is proposed, QIA approval will be sought.

2.3.2 ADAPTIVE MANAGEMENT CHECKLIST FOR ENVIRONMENTAL MANAGEMENT

As described above, the adaptive management process begins with a planning phase. As part of the planning phase, Baffinland developed a checklist to determine the status of adaptive management within its environmental management plans. Table 2.3 presents an adaptive management checklist developed for the Borrow Pit and Quarry Management Plan, identifying how adaptive management has been incorporated into the current revision of the Plan.

TABLE 2.3 ADAPTIVE MANAGEMENT IN THE BORROW PIT AND QUARRY MANAGEMENT PLAN

Adaptive Management Phases	Components	Proposed Adaptive Management Mechanisms	Status of Management Plan
Plan	Objectives	Are objectives clear and key desired outcomes defined?	In Progress Objectives are presented in Section 2.1. These will be augmented through the work of the AMP Working Group and later inputs by the Inuit Committee.
	Indicators	Are performance indicators adequately identified?	In Progress Performance indicators are presented in Sections 2.1 and 5.1. Resourcing in accordance with Inuit Agreements will need to be discussed through the AMP Working Group, with annual work plans and budgets developed.
	Identification of Thresholds	Are thresholds for specific responses identified (e.g., early warning triggers, action levels, quantitative metrics or qualitative descriptions)?	In Progress Thresholds are identified in Section 3 and 5.1. Additional thresholds tied to Inuit objectives and indicators will be established through QIA-Baffinland engagement.
	IQ Integration / Influence	Are mechanisms for IQ integration/influence identified?	In Progress Integration of IQ will be clarified in a future draft of the Borrow Pits and Quarry management Plan through the AMP Working Group, and later firmed up through inputs by the Inuit Committee.

Adaptive Management Phases	Components	Proposed Adaptive Management Mechanisms	Status of Management Plan
Implement and Monitor	Management Strategies and Responses	Are management strategies and response options clearly identified?	In Progress Management strategies are described in Section 3. Trigger Action Response Plans are presented in Section 5.0 (Table 5.1). These will be augmented through the work of the AMP Working Group and later inputs by the Inuit Committee.
	Resourcing	Are all phases of the adaptive management cycle properly resourced (in accordance with Inuit Agreements) to be fully implemented?	In Progress Resourcing in accordance with Inuit Agreements will need to be discussed through the AMP Working Group, with annual work plans and budgets developed.
Implement and Monitor	Monitoring	Does the monitoring program provide the information needed to determine the effectiveness of management strategies and responses?	In Progress Section 5 presents Baffinland-led monitoring activities related to borrow pits and quarries and monitoring covered by other plans. The role of Inuit monitors as per the Inuit Stewardship Plan, needs to be established and integrated into this Plan.
	Timeline for implementation	Is the possibility that rapid response may be necessary, considered in the implementation plan/process?	In Progress TARPs are developed for key project activities (Table 5.1). This includes the identification of low, moderate, and high action responses that correspond to low, moderate, and high-risk conditions.
Evaluate and Learn	Review Data and Feedback	Is the process for reviewing and evaluating management effectiveness (based on monitoring data and feedback) articulated?	Partially, further detail including adaptive management-related roles and responsibilities, reporting structures, and applicable response action forms need to be developed.
	Additional Mitigation	Are mechanisms for determining the need for additional mitigation described?	In Progress Table 5.1 identifies actions to be undertaken according to various triggers. Need for additional mitigation is determined based on results of monitoring programs described in Section 5.
	Input of IQ Holders	Are opportunities identified for IQ holders to review results and provide input into adaptive management responses/mitigations?	In Progress To be discussed at the AMP Working Group and later with the Inuit Committee. Mechanisms for this to occur to be defined in a future draft of the Borrow Pit and Quarry Management Plan.
Adjust	Unanticipated Effects or Issues	Is it apparent how unanticipated effects or issues will be actioned and resolved?	Pending Approval Section 6 (Figure 6.1 in particular) describes the process for incorporating repeat non-compliance and unanticipated effects into future updates.
	Reporting	Are reporting mechanisms for new / revised strategies and response actions established?	Pending Approval Section 6 describes the process for reporting mechanisms for new/revised strategies. A review schedule of the plan is provided in Table 6.1.
	Scheduled Updates	Is the frequency of scheduled updates to the management plan identified?	In Progress Section 6 describes the basis for conducting plan reviews. A review of the Plan is provided in Table 6.1.

2.4 PROJECT DESIGN CONSIDERATIONS

2.4.1 PLANNING AND DESIGN OF BORROW PITS AND QUARRIES

The exploitation of aggregate sources inevitably causes habitat loss and may result in soil erosion and sedimentation. Excavation in permafrost can result in permafrost degradation if ice-rich and thaw-sensitive soils are disrupted and/or if quarries and borrow pits are not made to be free draining. Blasting near fish-bearing watercourses has the potential to result in fish mortalities. Quarrying activities have the potential to disturb nearby wildlife such as cliff-nesting birds. Fuel spills and blasting residues have the potential to affect water quality in local watercourses.

Early planning and proper design are important to minimize environmental and social effects of aggregate operations. The following considerations will be incorporated into planning and design of borrow pits and quarries:

- Representative rock samples will be tested for ARD and ML potential prior to quarry development (i.e., during geotechnical investigations), in accordance with this plan (Section 2.4.2)
- Footprints will be minimized, and footprints approved in the FEIS and addendums will be identified on the site plan(s)
- Environmentally sensitive areas (archaeological sites, bird nests including cliff-nesting raptor nests, important land use areas) will be identified and avoided to the greatest extent possible during the siting process
- Appropriate setbacks will be established and maintained:
    - 31 m setback from local watercourses, retaining vegetated buffer zones to maintain slope stability and protect waterbodies (100 m setback for any quarries with ARD/ML potential, as per Condition #41 of Project Certificate 005
    - 100 m setback from known bird-nesting locations
    - 35 m from archaeological sites
- Selected sites will be in well drained areas
- Ditches and/or berms will be placed to direct runoff away from the site
- Quarries and borrow pits will be designed to be free draining to avoid ponding of water and the degradation of permafrost
- Quarry and borrow pit side slopes will be constructed to achieve long-term stability
- Management plans will be developed and submitted to the NWB for approval for each individual quarry or borrow pit, in accordance with the Type A Water Licence and Commercial Lease

The quarry management strategy will remain relatively consistent across the Project although the terrain differs over the Project study area. Quarries will be blast/crush type of operations, with an attempt to minimize the creation of depressions that would permanently alter drainage. Quarries and borrow pits will avoid, as much as is practical, sensitive areas and features. Quarries will be relatively free of soil piles, due to the limited soil overburden present throughout the area. Borrow pits will be operated through mechanical removal of material or, when the ground is frozen, by controlled blasting to loosen the unconsolidated material.

2.4.2 GEOCHEMICAL TESTING OF AGGREGATE SOURCES TO DATE

2.4.2.1 BEDROCK GEOLOGY

The bedrock geology along the current Milne Inlet Tote Road and the proposed North Railway can be summarized as follows (Scott and de Kemp, 1998):

- **Km 0 to Km 20 -** Precambrian terrane, consisting of metamorphic magmatitic gneisses.
- **Km 20 to Km 93 -** Paleozoic rocks of the Gallery and Turner Cliffs Formations, Ship Point Formation, and the Baillarge Formation. These formations comprise primarily sedimentary rocks that are carbonate dominant (i.e., dolomitic sandstone, dolomite, and limestone).
- **KP 93 to Km 107 -** Precambrian terrane, consisting of metamorphic magmatitic gneisses.

2.4.2.2 GEOCHEMICAL TESTING OF ROCK FROM QUARRIES AND OVERBURDEN FROM BORROW PITS

A total of 76 rock and overburden samples have been tested as part of four separate geochemical evaluations (KP, 2007; AMEC, 2010; Hatch Ltd., 2017 and 2019). Geochemical testing results from the various programs are summarized in Appendix C. A breakdown of the testing by rock type is presented in Table 2.4.

TABLE 2.4 SUMMARY OF GEOCHEMICAL TESTING BY ROCK TYPE

Geological Unit	KP 2007	AMEC 2010	Hatch 2017/2019	Total
Overburden	6	14		20
Granitic Gneiss	6	21	7	34
Schist		3		3
Carbonate		9	6	15
Sandy Carbonate		3		3
Diabase			1	1
Total	**12**	**50**	**14**	**76**

NOTES:

1. Geology taken from the individual reports.
2. The schist sample is a part of the Archean metamorphic bedrock and is considered to be a minor lithology.
3. The diabase is a dyke that intruded the host bedrock and is considered to be a minor lithology.

2.4.2.3 TESTING OF ARD POTENTIAL

Of the 76 samples tested for ARD/ML potential:

- The average total sulphur concentration was 0.02% (by weight), with a maximum concentration of 0.07% (by weight). Eleven samples had a sulphide sulphur concentration above the minimum detection limit (MDL), with an average concentration of 0.02% (by weight).
- The minimum neutralizing potential (NP) / acid potential (AP) value was 6.94, which is well above the conservative cut-off for potentially acid generating (PAG) of 2.0. It should be noted that most of the AP values were 0.62 t-$CaCO_3$/1000 t, which is calculated from a sulphur content below minimum detection limit (MDL). This suggests that the NP/AP ratios with sulphur content <MDL are higher than calculated.
- The average Net NP value was 269.2 t-$CaCO_3$/1000 t, which indicates good buffering capacity (NP).

Based on these testing results, ARD is not likely, given that all the samples have little to no AP with low to moderate NP (KP, 2019). Considerable ARD/ML testing has also been conducted at the two large operating quarries at the Mine Site (QMR2) and Milne Port (Q1). Nearly all the rock in these quarries has tested not PAG, but pockets of PAG rock have been encountered in both quarries based on anomalous sulphur sulphide results greater than 0.2% (Baffinland, 2020). For this reason, Baffinland conducts ongoing geochemical testing of its operating quarries as an important mitigation measure to reduce the potential for impacts to local water quality from ARD.

2.4.2.4 TESTING OF ML POTENTIAL

pH is an important indicator of the degree to which a material will leach metals; metals tend to leach at low (pH <6) and high (pH >9.5) values, and hence both the Type A Water Licence (NWB, 2015) and the Metal and Diamond Mining Effluent Regulations (MDMER) specify that mine effluent discharges should have a pH of 6 to 9.5. Of the 76 sample tests described above, nine had a pH >9.5, and none had a pH <6.0.

Both the shake flask extraction (SFE) and the synthetic precipitation leaching procedure (SPLP 1312) are aggressive tests as they are completed on a crushed sample (increased surface area, compared to field conditions) exposed to either lower pH water or aggressive shaking. As such, the final pH derived from these short-term leach tests may overstate what is measured in the field. Many of the samples returned a high pH, and these same samples measured an aluminum concentration greater than the Canadian Environmental Quality Guidelines - Protection of Aquatic Life (CEQG-PAL) limit (Canadian Council of Ministers of the Environment, 2007). This is not unexpected, as the solubility of aluminum is lowest between pH 6 and 7 and increases at high pH (Langmuir, 1997).

With respect to metal leaching potential, one sample from the 2007 dataset exceeded the MDMER Schedule 4 discharge limit for copper. Several metals (aluminum, chromium, copper, iron, phosphorus, nickel, and zinc) exceeded the CEQG-PAL limits under short-term leaching conditions. Most of the metal exceedances were from the SPLP 1312 dataset, which indicates that they are prone to leaching under acidic conditions. However, based on the Modified acid-base accounting (ABA) data, acid conditions are not expected, as most of the samples were net neutralizing. As such, metal leaching is not likely a concern, given the low ARD potential of the samples.

Most of the samples have low to no potential for ML, given the neutral to alkaline nature of the tested material. Though some 76 samples did demonstrate some elevated concentrations of metals above CEQG-PAL, this was primarily under acidic laboratory conditions and is not indicative of field conditions.

3.0 IMPLEMENTATION

This section of the plan describes the measures to be undertaken regarding borrow source and quarry development to protect the environment and minimize health and safety risks. This section describes:

- Environmental concerns and mitigation measures
- Contents of individual development plans
- Water management measure to be taken
- High-level overview of resource extraction methods
- Blasting thresholds
- Closure and site reclamation of borrow pits and quarries

Additionally, Appendix D (Borrow Source Approach) provides further detail regarding borrow source best management practices that will be applied.

3.1 THRESHOLDS

Thresholds are an important element of adaptive management (Section 2.3) and the establishment of TARPs (Section 5). The construction, operation, and closure of borrow pits and quarries has the potential to affect various elements of the environment, including air quality, land use, water quality and wildlife. As noted in Section 1.2, this is an area/activity management plan that overlaps with other discipline-specific management plans for those components of the environment.

Adaptive management includes short-term and longer-term review and response cycles. The thresholds for the short-term review and response cycle are presented in Section 3.1.1.

The effects predictions from the FEIS and addendums are thresholds that are appropriate for a longer-term review and response cycle, such as the annual review of regulatory compliance and unexpected effects. The effects predictions from the FEIS and addendums can be used for comparison to the Project's performance as described in Section 6.1 Annual Review of Compliance and Unanticipated Effects. The Company may also identify the need for further adaptive management when unanticipated effects or effects that exceed FEIS predictions occur

3.1.1 THRESHOLDS TRIGGERING SHORT-TERM RESPONSES

Thresholds that apply to borrow pit and quarry operations in most instances have been established under those other discipline-specific management plans (Table 3.1). Specific wording of these thresholds is presented in the TARP (Table 5.1).

TABLE 3.1 THRESHOLDS TRIGGERING SHORT-TERM RESPONSES

Performance Indicator	Threshold	Source
Direct habitat loss	Disturbed footprint relative to the assessed footprint	FEIS Addendum for the Phase 2 Proposal (Baffinland, 2018)
Indirect habitat loss	Setbacks from sensitive receptors: • Watercourses - 31 m; retaining vegetated buffer zones to maintain slope stability and protect waterbodies, or 100 m setback for any quarries with ARD/ML potential, as per Condition #41 of Project Certificate 005 • Bird nests - 100 m • Archaeological sites - 35 m	EPP
Geotechnical stability	Ponding of water or visual indications of ground instabilities (Professional Engineer's judgement during biannual geotechnical inspections)	Water Licence
Runoff water quality	Applicable thresholds established in another plan	SWAEMP
ARD/ML potential	Initial testing (based on total sulphur threshold): • <0.20% total sulphur • Neutralization potential ratio (NPR) >2 Advanced testing (based on sulphide-sulphur threshold and uncertain PAG category)[1]: • Non-PAG: sulphide-sulphur <0.2% and NPR >2 • Uncertain PAG: sulphide-sulphur between 0.01% and 0.2% and NPR between 1 and 2 • PAG: sulphide-sulphur >0.2% or NPR <1 PAG rock is separated if there is at least 2,000 bank cubic metres (BCM) of PAG rock within each 10,000 BCM blast	This plan
Blasting impacts to fish	Overpressure measured at >50 kPa (threshold adopted by the Project as requested by DFO)	Adopted by the Project as requested by DFO[2]

NOTES:

1. If the sulphide-sulphur concentration is below the laboratory minimum detection limit (MDL), the AP value is calculated from the MDL, which results in an AP value that is erroneously high. Similarly, if the carbonate concentration is below the MDL, the calculated NP value is inaccurate and erroneously high as well.
2. Baffinland made a commitment to adhere to a 50 kPa blasting overpressure threshold, rather than the 100 kPa threshold published by DFO (Wright and Hopky, 1998) based on the Nunavut Impact Review Board's reconsideration of Baffinland's Project Certificate for the Phase 2 Proposal, Baffinland

3.1.2 INUIT OBSERVATIONAL GUIDELINES

Inuit may identify thresholds that are applicable to borrow pit and quarry operations. In no instance will Inuit thresholds lead to non-compliance with regulatory objectives or requirements; Inuit requirements may be more sensitive - but not less sensitive - to environmental change than regulatory requirements.

3.2 GENERAL MITIGATION MEASURES

Table 3.2 presents a summary of environmental concerns and mitigation techniques associated with development of borrow pits and quarries.

TABLE 3.2 PIT AND QUARRY ENVIRONMENTAL CONCERNS AND MITIGATION TECHNIQUES

Development Phase	Activities	Environmental Concerns	Possible Mitigation Techniques	Relevant Plan/Procedure
Site design and development	• Vegetation clearing • Overburden removal	• Habitat loss • Soil erosion • Sediment deposition	• Described in Section 2.3	• Quarry-specific management plans • ARD/ML Monitoring (Section 5.2) • Section 3.3 Water Management
Operations and monitoring	• Blasting • Excavating • Crushing • Stockpiling • Access road maintenance	• Soil erosion • Sediment deposition	• Limit sediment movement using erosion controls (e.g., silt fence) • Use riprap to reinforce drainage channel corners and water discharge points • Use settling ponds before discharging water • Revegetate where required to stabilize slopes	• Quarry-specific management plans • Chance Finds Procedure (EPP s.2.1) • S.3.3 Water Management • EPP s.4.3 Fuel Storage and Handling; s.4.6 Drilling, Blasting and Crushing
		• Fuel spills • Blasting residue	• Use industry accepted fuel containment and explosives handling techniques	• Operations Blasting Procedure • Blasting Management Framework (Appendix E) • Blasting Operations Management Plan • Section 5.2 Water Monitoring
		• Permafrost degradation	• Limit pit or quarry depth to within the active layer • Minimize in-pit water by directing surface water in a controlled manner away from the site • Thaw ice-rich material at a location where meltwater will re-enter the pit	• Quarry-specific management plans • Section 5.1 Routine inspections and biannual geotechnical inspections
		• Dust generation	• Use water and dust skirts on conveyors to minimize dust • Apply dust suppressants	• Dustfall Monitoring Program (Terrestrial Environment Mitigation and Monitoring Plan)

NOTE:

1. Source: Northern Land Use Guidelines, Pits and Quarries, INAC 2010.

3.3 DEVELOPMENT PLANS

A site-specific plan will be prepared before commencing extraction of material from each borrow pit or quarry. These development plans will include:

- Site layout and boundaries with the following provisions:
  - Minimum setbacks (Table 3.1)
  - Adequate room for all activities
  - Estimates of the resources to be extracted
  - Refuelling station with appropriate containment (if required)
  - Dust and noise consideration
  - Waste management
  - Water management structures
  - Sequence of operation
  - Site operating procedures
  - Spill response procedures
- ARD/ML potential:
  - Results of testing to confirm the rock does not have ARD/ML potential
  - Mitigation measures to be implemented if rock with ARD/ML potential may be encountered
- Blasting issues and mitigation:
  - Whether fish-bearing waters are nearby that could potentially be affected by blasting, and measures to protect fish by meeting the blasting overpressure threshold
- Inspections and monitoring:
  - Wall stability for quarries and borrow pits
  - Extent of permafrost or ground-ice
  - Wildlife interactions or sightings
  - Water monitoring
  - Blast monitoring if blasting may occur near fish-bearing waters
  - Contingencies if changes to the original development scenario are required
- Reclamation:
  - Overburden replacement for site grading and re-contouring
  - Reclamation of natural drainage
  - Slope reconstruction
  - Removal of garbage and debris
  - Removal of temporary storages/structures/equipment
  - Reclamation of access road and block access (if required)
  - Replacement of salvaged topsoil (if required)

3.4 ARD/ML MANAGEMENT

Material from borrow pits and quarries characterized as PAG or uncertain PAG will be managed as follows:

- Uncertain or confirmed PAG material that is present in small quantities (i.e., less than 2,000 BCM of a 10,000 BCM blast) will be tracked as to the location of its final placement
- Uncertain or confirmed PAG material that is present in separable quantities (i.e., generally more than 2,000 BCM of a 10,000 BCM blast) will be transported to the Waste Rock Facility for final disposal

For other potential management alternatives, Baffinland will consult a geochemist and a site-specific plan will be developed with input from the QIA.

3.5 WATER MANAGEMENT

Site development must ensure positive drainage to prevent water pooling or flooding of the pit. The following measures will be implemented to enhance re-establishment of thermal equilibrium and minimization of erosion, water ponding and permafrost degradation:

- Where possible, excavations will be minimized to hills and swales, which will minimize water collection and drainage disruption
- There will be no excavations and/or removal of material from any quarry or borrow source beyond a depth of 1 m above the ordinary HWM or above the groundwater table, to prevent the potential contamination of groundwater, unless otherwise approved by the NWB in writing
- Cut and fill areas will be stabilized by constructing gentle slopes less prone to erosion
- The side slopes of the borrow pits will be 1H:1V to 2H:1V, slightly gentler than natural slopes to reduce erosion
- The length of borrow pit side slopes will be minimized where possible to reduce erosion
- In low-lying areas where roadbed fill is in the order of 1 m thick and permafrost can be expected to rise to a meaningful degree, swales or culverts will be installed as part of road maintenance to prevent water ponding
- At closure, swales will be left in place, or alternatively, the roadbed will be breached to allow drainage
- Borrow areas will be designed to minimize the area of disturbance
- Thawed layers will be removed sequentially
- Areas of unexpected settlement will be filled with backfill from historic ground disturbances to re-establish natural contours and eliminate water ponding
- Borrow locations will be regularly inspected and unstable slopes regraded to eliminate depressions and re establish natural drainage patterns

3.6 RESOURCE EXTRACTION

Extraction methods will depend on the nature of the material, equipment used, and extent and nature of the permafrost.

In general efforts will be made to minimize excavation of pits and quarries below the water table. If excavated material contains ground-ice, the material will be stored at a location in the pit where it can thaw and drain. Sediment control for melt water from such stockpiles must be carried out (see Surface Water and Aquatic Ecosystems Management Plan).

Machinery and equipment used on the site will be serviced following a routine maintenance schedule to ensure proper operation and thus minimize emissions and noise.

If fuel storage is required, fuel tanks will be double-walled and placed within a containment berm. A well-stocked spill response kit will be placed in the refuelling area. Vehicles will be equipped with spill response kits and drip trays. Used oil and fuel will not be stored at the pit/quarry sites; it will be transported to an appropriate disposal site located at either the Mine Site or Milne Port.

The Spill Contingency Plan outlines the logical order of how operators should respond to spills, resources available onsite for spill response, and notification procedures.

3.7 BLASTING THRESHOLDS

Blasting near water has the potential to result in the injury or death of fish. DFO (1998) provide guidelines for blasting near fish habitat including a 100 kPa threshold based on the instantaneous pressure change in the swim bladder of a fish. However, Baffinland will adhere to a lower threshold of 50 kPa based on a DFO recommendation agreed to by Baffinland during the NIRB review of the Phase 2 Proposal.

3.8 CLOSURE

The abandonment of the Project works and site reclamation for the quarries and borrow pits will be undertaken at or before the close of the Project. The works will be integrated into the Project Interim Closure and Reclamation Plan, although separate closure plans for each quarry and borrow pit will be required prior to closing each facility. Closure of the Project will involve removing construction materials, equipment and infrastructure and reclaiming the site to a self-sustaining productive ecosystem near its original condition.

In addition to the measures described in Section 3.1 to Section 3.5 above, the general closure and reclamation plans include the following:

- Dismantle and transport all fuel/chemical storage and handling infrastructure to an approved facility or for reuse where applicable
- Remove hazardous waste and explosives
- Regrade as necessary to establish safe slopes and restore the natural drainage to the area
- Test soils and granular materials for hydrocarbon content; contaminated soils will be remediated

4.0 ROLES AND RESPONSIBILITIES

The personnel responsible for implementing this plan and their respective roles are described in Table 4.1.

TABLE 4.1 ROLES AND RESPONSIBILITIES FOR THIS PLAN

Position	Responsibilities and Accountabilities
Chief Operations Manager (COO)/ General Manager	• Reports to the Chief Executive Officer • Responsible for providing oversight for all Project operations and allocating the necessary resources for the operation, maintenance and management of Project infrastructure • Responsible for the implementation of Baffinland's commitments and objectives related to health, safety and environment during operations • Accountable for on-site environmental, health and safety performance during operation
Chief Procurement Officer	• Reports to the Chief Executive Officer • Accountable for procurement and purchasing • Ensures that environmental commitments, policies and objectives are included in all contract documents
Head of Health, Safety, Environment and Security	• Reports to Baffinland's President & CEO • Establish corporate environmental policies and objectives • Monitors and reports on Baffinland's performance related to environmental policies and objectives • Liaise with regulatory authorities • Obtains necessary permits and authorizations • Monitors compliance with terms and conditions of permits and licences
Health, Safety, Environment and Security Manager	• Reports to Head of Health, Safety, Environment and Security • Monitors environmental performance of contractors on site • Monitors compliance with permits, licences and authorizations • Regulatory environmental monitoring and reporting (monthly, annual) • Routine audit of contractor's environmental performance on-site • Initiate/supervise environmental studies • Investigate and reports on accidents and incidents when they occur • Liaises with regulatory inspectors • Review and update environmental management plans
Environmental Superintendent	• Reports to Director of Sustainable Development and indirect reporting and coordination with Chief of Operations • Overall accountability for environmental staff and performance at site • Coordinates implementation and monitors the performance of the Environmental Management System at site • Serves as a liaison for regulators during onsite inspections and visits • Provides ongoing environmental education and environmental awareness training to all employees and contract workers • Oversees investigations and reporting of environmental incidents to regulatory bodies, stakeholders and senior management

Position	Responsibilities and Accountabilities
Environmental Coordinators and Technicians	• Reports to the Environmental Superintendent • Specific accountabilities for environmental monitoring and reporting • Provides day to day direction to Environmental staff onsite • Serves as a liaison for regulators during onsite inspections and visits • Provides ongoing environmental education and environmental awareness training to all employees and contract workers • Assists with environmental database management • Prepares updates for management plans • Assists with monitoring and sampling activities as per the Project's management plans
QIA Regulatory Manager (IIBA)	• Directs QIA's onsite environmental resources • Liaise with Baffinland's Permitting and Compliance Manager and/or Environmental Superintendents • Reviews regulatory submissions on behalf of the QIA • Member of the QIA-Baffinland Adaptive Management Working Group
QIA Environmental Monitor (IIBA)	• Monitors implementation of commitments, environmental compliance, and QIA interests • Participate in routine compliance inspections and monitoring alongside Baffinland staff • Participate follow-up corrective action undertaken regarding non-compliance events including spills • Weekly reporting to the QIA Regulatory Manager • Presents annual monitoring data to communities • The core responsibilities of this position are described completely in the IIBA
QIA Construction Inspector (ICA 8.3.1)	• To be defined by QIA
QIA Construction Monitor (ICA 8.2.2 (j))	• To be defined by QIA
Environmental Support Groups (consultants, etc.)	• Assists with sampling, monitoring and reporting activities as required by permits, licences and environmental management plans • Provides technical expertise to various environmental studies

5.0 MONITORING

Table 5.1 identifies the monitoring associated with borrow pits and quarries in relation to the objectives and targets identified in Section 2.1. Each of these monitoring programs are described below.

5.1 INSPECTIONS

Operation of the borrow pits and quarries will be inspected regularly to ensure they are proceeding according to the Borrow Pit and Quarry Management Plan and remain in compliance with regulations and land use permits.

Regular inspections focus on:

- Site-preparation measures:
  - Compliance with setbacks from environmental features identified in the borrow pit / quarry-specific management plans
  - Site safety and security
  - Site maintenance and general housekeeping conditions
- Drainage and water management structures and assessment of their effectiveness
- Positive drainage and slope stability
- Proper fuel storage and handling practices
- Determining if the granular resource material is still suitable for end-use
- Establishing how much ground-ice is present in the material and behaviour and volume loss of the material as thawing occurs
- Inspecting records of wildlife interactions and sightings
- Reporting quantities of material extracted

In addition, quarries are subject to biannual geotechnical inspections between July and September each year, as required by Part D Item 18 of the Type A Water Licence. Reports on geotechnical Inspections must be submitted to the Board within sixty (60) days of the inspection and must include a cover letter from the Licensee outlining an implementation plan to respond to the Engineer's recommendations. The geotechnical inspection reports are also included in annual reports to the QIA and the NWB.

Active borrow pits and quarries may be subject to external inspections or audits by the Lands and Waters Inspectors.

Site monitoring is required for several years after closure of the borrow pit or quarry to assess whether reclamation objectives have been met. Post-closure monitoring requirements will be specified in the land-use permits.

5.2 OPERATIONAL GEOCHEMICAL TESTING

Once quarries are under development, confirmation geochemical and visual testing will be undertaken by means of collection of a set frequency of samples, based on quantity to be quarried and available site-specific characterization information. Methods of sampling to be used could include systematic sampling of muck after blasts or sampling of blast hole cuttings.

Once development of the quarry has begun, an operational testing program will be implemented to continue during the quarry extraction process. Approximately one (1) composite sample of quarry material representative of a blast (muck sample or blast hole cuttings) will be collected per roughly 10,000 m^3 of material quarried.

TABLE 5.1 TRIGGER ACTION RESPONSE PLANS FOR BORROW PITS AND QUARRIES

Project Activity	Objective	Performance Indicator / Threshold	Monitoring Program / Plan	Condition Status			Pre-defined Response(s)		
				Low Risk	Moderate Risk	High Risk	Low Risk	Moderate Risk	High Risk
Establishment of quarry extents	Minimize direct habitat loss (footprint area)	Direct habitat loss relative to EIS predictions	Pre-development land disturbance form (planning phase); inspections	Disturbed footprint is approaching area identified in EIS or quarry-specific management plans.	Disturbed footprint extends outside of area identified in EIS or quarry-specific management plans.	Sustained non-compliance (i.e., repeated occurrences).	Projects Dept: Notify Env't Dept that additional land is required. Env't Dept: Initiate permitting process applying to extend approved boundary of borrow pit or quarry.	Env't Dept: Stop work outside lease boundary immediately; determine if land disturbance form completed; determine if any documented environmental sensitivities (bird nests, archaeology, water setbacks) have been breached. Conduct root cause analysis and submit report of findings for submission to landowner. Include in NIRB annual report. Determine if the additional footprint lies outside buffer zone of Commercial Lease boundary or quarry specific Quarry Management Plan; notify the landowner (QIA and/or CIRNAC) if this occurs; apply to amend lease boundary if appropriate.	In addition to low and moderate risk response: Env't Dept: Review and amend land disturbance form process and/or management plan; conduct additional training of workers involved in land disturbance activities.
	Minimize indirect habitat loss (disturbance to wildlife)	Setbacks from sensitive receptors (Indirect habitat loss)	Inspections	Sensitive receptor has been identified within the active work area after work has been initiated.	Sensitive receptor has been identified within the active work area after work has been initiated, and the setback has not (or cannot be) adhered to.	Effect occurs to a sensitive receptor (e.g. bird nest destruction, damage to an archaeological site).	Projects Dept: Notify Env't Dept immediately upon discovery of sensitive receptor. Env't Dept: Investigate sensitive receptor, demarcate appropriate setback. Consult appropriate regulatory bodies if appropriate (e.g., Territorial Archaeologist if new archaeological site). Notify the QIA. Continue to monitor.	Projects Dept: Notify Env't Dept immediately upon discovery of sensitive receptor. Env't Dept: Stop work; investigate sensitive receptor, consult appropriate regulatory bodies if appropriate, consider if work can be restarted by implementing additional mitigation (e.g., install snow fencing around archaeological site). Notify the QIA. Continue to monitor.	Projects Dept: Stop work; notify Env't Dept immediately. Env't Dept: Investigate effect; notify appropriate regulatory bodies. Develop remedial actions if applicable.
				Setbacks: 31 m vegetated buffer from watercourses; 100 m vegetated buffer from watercourses if ARD/ML issues exist; 100 m from bird nests; 35 m from archaeological sites.					

Project Activity	Objective	Performance Indicator / Threshold	Monitoring Program / Plan	Condition Status			Pre-defined Response(s)		
				Low Risk	Moderate Risk	High Risk	Low Risk	Moderate Risk	High Risk
Borrow Pit development and operation	Prevent or minimize ongoing permafrost degradation following borrow pit development	Drainage and slope stability	Inspections Biannual geotechnical inspection	Localized ponding of water. Evidence of potential slope erosion or slumping.	Ponding of water observed throughout quarry. Localized erosion of slope impacting stability.	Drainage not controlled on site. Slope failure.	Projects Dept: Identify drainage and/or stability issue; undertake remedial measures if appropriate. Actions to address ponded water may include: removing ponded water; backfilling local depression; or installing drainage improvements. Potential slope erosion may be repaired, contingency erosion and sediment control measures put in place. Continue to monitor. Env't Dept: Identify drainage and/or stability issue during routine inspections or biannual geotechnical inspections; notify Projects Dept.	Projects Dept: Identify drainage and/or stability issue; immediately undertake remedial measures such as those identified in low action response. Stop quarry operations to implement remedial measures, if necessary. Monitor effectiveness of remedial measures. Env't Dept: Identify drainage and/or stability issue during routine inspections or biannual geotechnical inspections; notify Projects Dept that action must be taken immediately to address issue(s).	In addition to moderate risk response: Projects Dept: Stop work; notify Env't Dept immediately. Implement remedial measures immediately before resuming work. Env't Dept: Investigate effect; notify appropriate regulatory bodies. Assist Projects Dept in developing remedial actions. Investigate reasons why issues were not addressed under moderate risk condition and report this to the QIA.
Quarry/Borrow pit development and operation	Protect downstream water quality	Runoff water quality	Surveillance Network Program (SNP); monitoring program in quarry-specific management plan	Downstream TSS is between 75% and 100% of the applicable discharge limits in WL Table 1 (TSS 50 mg/L (max avg) and 100 mg/L (max grab); no visible sheen and pH 6-9.5; not acutely toxic.	Exceed discharge limits in WL Table 1 (TSS 50 mg/L (max avg) and 100 mg/L (max grab); no visible sheen and pH (6-9.5); acutely toxic.	Sustained non-compliance, even after applying standard mitigation under moderate risk response.	Env't Dept: Report potential erosion and sedimentation issues to Projects Dept. Projects Dept: Implement precautionary mitigation to avoid potential exceedance of discharge limits.	Env't Dept: Report exceedance of discharge limits to Projects Dept. immediately[1] after receiving results. Notify QIA if response deviates from this plan. Projects Dept: Assess cause and take immediate action to implement enhanced mitigation measures, including stop work if this will address the non-compliance.	Env't Dept: Communicate issue to the QIA; conduct investigation of cause as to why the non-compliance has not been adequately addressed. Implement mitigation measures to reverse trend.

Project Activity	Objective	Performance Indicator / Threshold	Monitoring Program / Plan	Condition Status			Pre-defined Response(s)		
				Low Risk	Moderate Risk	High Risk	Low Risk	Moderate Risk	High Risk
Quarry development and operation (continued)	Protect downstream water quality	ARD/ML Potential	Section 5.2	Acid-generating potential: One or more samples with uncertain acid generating potential: ≥0.2% total sulphur by weight or Neutralizing Potential/Acid Potential (NPR) ratio between 1 and 2. Metal leaching potential: pH between 6.0 and 9.5; no exceedances of WL discharge limits at neutral pH. Visual evidence: iron staining, red water, field pH measurements indicating potential generation of ARD.	Acid-generating potential: Small proportion of samples are potentially acid-generating (PAG): ≥0.2% total sulphur by weight or NPR <2. Metal leaching potential: Small proportion of samples contain exceedances of WL discharge limits under neutral pH.	Acid-generating potential: Majority of samples are PAG: ≥0.2% total sulphur by weight and NPR <2. Metal leaching potential: Majority of samples contain metal concentrations above the water quality objectives.	Geology Dept: Notify Env't Dept and Projects Dept of tests indicating uncertain PAG; increase sampling density near test. Env't Dept: Record uncertain PAG result for future reference when interpreting runoff water quality results.	Geology Dept: Notify Env't Dept and Projects Dept of tests indicating PAG; Increase sampling density near test, determine if quantity of PAG is separable from non-PAG. Env't Dept: Record uncertain PAG result for future reference; increase monitoring locations/frequency of runoff water quality. Based on additional geochemical and runoff water quality testing, determine with Geology and Projects if PAG materials can be separated for disposal in the WRF, or if other mitigation (i.e., downstream limestone apron) can be implemented. Projects Dept: Determine extent of PAG with Geology and Env't Dept and appropriate management of PAG material.	Geology Dept: Notify Env't Dept and Projects Dept of tests indicating large proportion of PAG and/or ML within quarry. Conduct additional testing to determine extent. Projects Dept: Stop quarry operations until extent of PAG is established. With Geology and Env't Dept, determine if quarry operations can continue by avoiding PAG rock, or if the quarry should be abandoned, and if any remedial measures are required to address PAG rock in place. Env't Dept: Support Geology and Projects in determining next steps; conduct follow-up monitoring to determine if runoff water quality is being adversely affected.
Blasting in or near water	Protect local aquatic life from potential blasting effects	Compliance with blasting overpressure threshold	Quarry Specific Management Plan	Overpressure measured at >50 kPa (threshold adopted by the Project as requested by DFO).	Overpressure measured at >100 kPa (DFO's published guideline).	Fish mortalities are evident.	Env't Dept: Immediately notify Projects Dept that the threshold has been exceeded and that changes to blasting practices required before blasting can continue. Inspect waterbody to confirm that fish mortalities have not occurred. Notify DFO and QIA immediately and include incident in annual reporting. Projects Dept: Immediately implement additional mitigation to lower blasting overpressure.	Env't Dept: Implement low risk response; conduct investigation and cease blasting operations until investigation is completed.	In addition to low and moderate risk response: Env't Dept: Implement low risk response; conduct investigation and cease blasting operations until investigation is completed. Report occurrence to DFO and QIA and seek guidance on appropriate remedial measures.

Representative test sample(s) of the quarries will be retrieved by means of surface grabs, test pits, or exploratory core drilling and analyzed for the potential to produce ARD/ML. Samples will initially be tested for total sulphur, acid potential (AP) and neutralizing potential (NP), applying the initial screening thresholds identified in Table 3.1. The quarried material can also be visually inspected for the presence of sulphides.

Additional testing may be conducted in developing plans for managing uncertain PAG, including testing for sulphide-sulphur and applying the advanced testing thresholds in Table 3.1. This includes applying the 0.2% sulphur threshold to sulphide-sulphur as recommended by Price (2009), instead of the more conservative total sulphur value.

The TARP presented as Table 5.1 describes the responses to be taken based on different test results.

5.3 WATER MONITORING

When a quarry is in operation and until reclamation objectives for water quality have been met, the following monitoring is required (as per the Type A Water Licence):

- Where water flow may directly or indirectly enter into a water body, from quarry activities for the Project, the water shall be sampled weekly and not exceed the effluent quality limits as per Table 5.2 below.
- Monitor runoff and/or discharge from borrow pits and quarry sites, on a monthly basis, for the following parameters:
  - Total Suspended Solids (TSS)
  - Oil and Grease
  - Ammonia (total NH_3-N)
  - Nitrate (total NO_3-N)
  - pH
  - Conductivity
  - Demonstrate to be non-acutely toxic

TABLE 5.2 DISCHARGE LIMITS FOR SURFACE RUNOFF DURING CONSTRUCTION

Parameter	Maximum Average Concentration	Maximum Concentration of any Grab Sample
Total Suspended Solids	50 mg/L	100 mg/L
Oil and Grease	No Visible Sheen	No Visible Sheen
pH	Between 6.0 and 9.5	Between 6.0 and 9.5

NOTE:

1. Source: Table 1 of the Type A Water Licence.

The monitoring protocols are further explained in the Surface Water and Aquatic Ecosystems Management Plan.

5.4 BLAST MONITORING AT FISH-BEARING WATERS

Borrow pit and quarry-specific management plans will identify whether blasting will be required, and if that blasting will occur near fish-bearing waters. None of the currently proposed quarries or borrow pits are located near lakes. As such, the primary mitigation for blasting effects to fish will be to schedule blasting during periods when fish are not present (the fish are overwintering in nearby lakes or ponds).

Blast monitoring will form part of borrow pit and quarry-specific management plans in instances where this may occur.

6.0 REVIEW OF PLAN EFFECTIVENESS

An important element of Baffinland's management system is reviewing the continued suitability, adequacy and effectiveness of each management plan. This will occur through an annual review process as well as scheduled updates.

6.1 ANNUAL REVIEW OF COMPLIANCE AND UNANTICIPATED EFFECTS

Baffinland conducts internal inspections and audits throughout the year, as described in Section 5. In addition, the Project is subject to regular inspections and external audits as noted in Section 5.1. Throughout the year, immediate corrective actions are taken as appropriate to address instances of non-compliance, as well as unanticipated effects observed. Follow-up corrective actions may also be required. These immediate and follow-up corrective actions are documented in the annual report.

One follow-up corrective action may be to revise mitigation measures or monitoring programs described in the applicable management plans. During the annual reporting cycle, Baffinland staff will review instances of non-compliance as well as unanticipated effects and determine if a review of plan effectiveness is appropriate. This process is articulated on Figure 6.1.

Part of this annual review cycle is the incorporation of IQ, which may include feedback from the Inuit Committee and/or community observations. This process may occur annually whether repeat non-compliance and/or unanticipated effects are identified (Figure 6.1).

6.2 SCHEDULED UPDATES

In addition to the annual review cycle described above, scheduled Plan reviews will occur according to the schedule presented in Table 6.1.

TABLE 6.1 PLAN REVIEW SCHEDULE

Review Event	Description
Post-construction	Mandatory management review
Every 3 years during operation	Mandatory management review

NOTE:

1. This is a generic term that applies to Project expansions or other major sustaining capital works.

Plan updates will be recorded in the Document Revision Record located at the front of the Plan. Each plan update will be provided to the QIA for review and approval before being finalized for implementation.

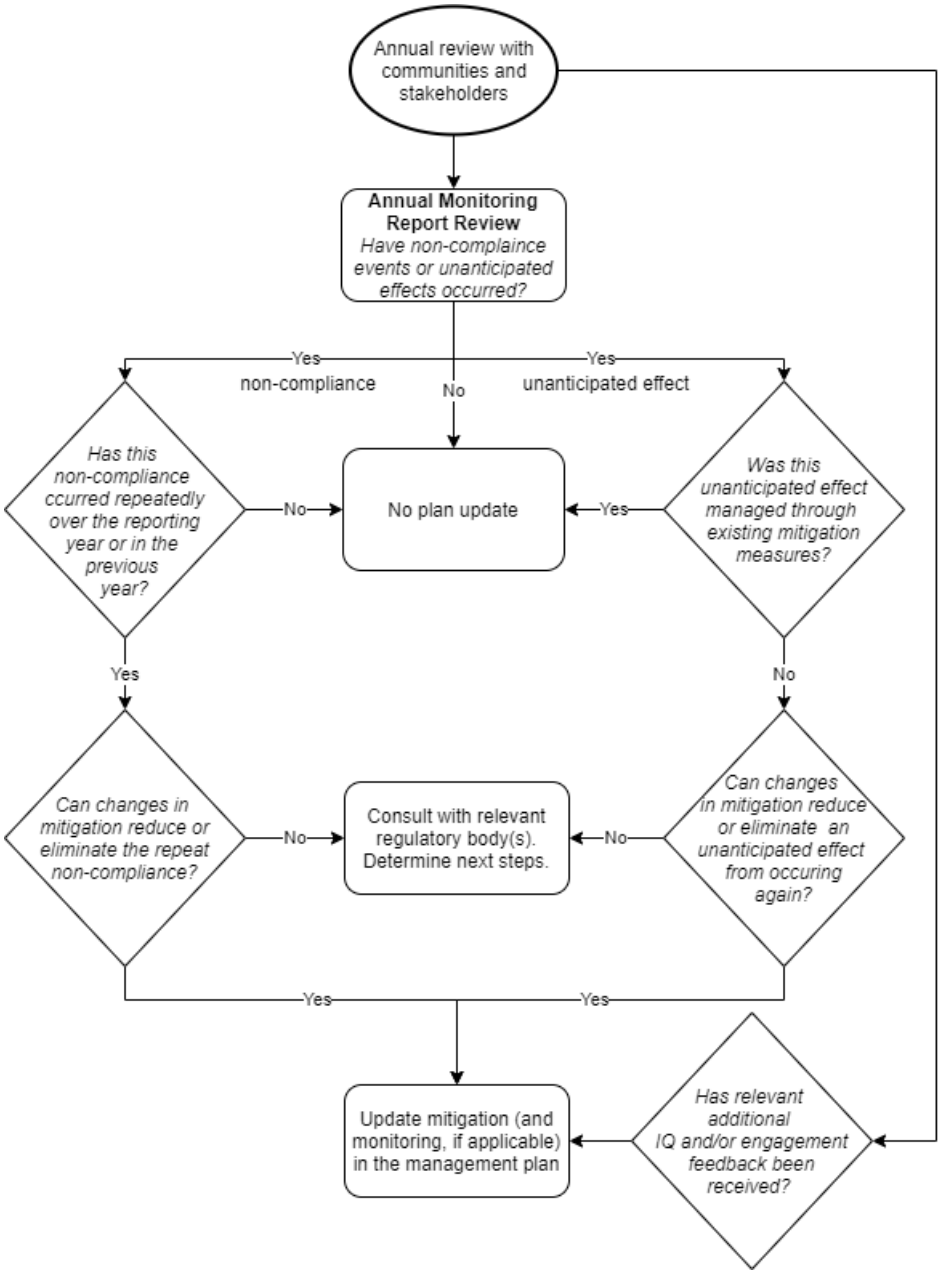

FIGURE 6.1 ANNUAL REVIEW OF PLAN EFFECTIVENESS

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Appendix A
Corporate Policies

Baffinland Iron Mines Corporation

Health, Safety and Environment Policy

BAF-PH1-800-POL-0001

Rev 2

Approved By: **Brian Penney**

Title: **Chief Executive Officer**

Date: **April 20th, 2018**

Signature: 

DOCUMENT REVISION RECORD

Issue Date MM/DD/YY	Revision	Prepared By	Approved By	Issue Purpose
05/07/15	0	EM	TP	For Use
03/07/16	1	JS	BP	Minor edits
04/20/18	2	TS	SA/BP	Minor edits

This Baffinland Iron Mines Corporation Policy on Health, Safety and Environment is a statement of our commitment to achieving a safe, healthy and environmentally responsible workplace. We will not compromise this policy for the achievement of any other organizational goals.

We implement this Policy through the following commitments:

- Continual improvement of safety, occupational health and environmental performance
- Meeting or exceeding the requirements of regulations and company policies
- Integrating sustainable development principles into our decision-making processes
- Maintaining an effective Health, Safety and Environmental Management System
- Sharing and adopting improved technologies and best practices to prevent injuries, occupational illnesses and environmental impacts
- Engaging stakeholders through open and transparent communication.
- Efficiently using resources, and practicing responsible minimization, reuse, recycling and disposal of waste.
- Reclamation of lands to a condition acceptable to stakeholders.

Our commitment to provide the leadership and action necessary to accomplish this policy is exemplified by the following principles:

- As evidenced by our motto “Safety First, Always” and our actions Health and Safety of personnel and protection of the environment are values not priorities.
- All injuries, occupational illnesses and environmental impacts can be prevented.
- Employee involvement and active contribution through courageous leadership is essential for preventing injuries, occupational illnesses and environmental impacts.
- Working in a manner that is healthy, safe and environmentally sound is a condition of employment.
- All operating exposures can be safeguarded.
- Training employees to work in a manner that is healthy, safe and environmentally sound is essential.
- Prevention of personal injuries, occupational illnesses and environmental impacts is good business.
- Respect for the communities in which we operate is the basis for productive relationships.

We have a responsibility to provide a safe workplace and utilize systems of work to meet this goal. All employees must be clear in understanding the personal responsibilities and accountabilities in relation to the tasks we undertake.

The health and safety of all people working at our operation and responsible management of the environment are core values to Baffinland. In ensuring our overall profitability and business success every Baffinland and business partner employee working at our work sites is required to adhere to this Policy.

Brian Penney
Chief Executive Officer
April 2018

Sustainable Development Policy

At Baffinland Iron Mines Corporation (Baffinland), we are committed to conducting all aspects of our business in accordance with the principles of sustainable development & corporate responsibility and always with the needs of future generations in mind. Baffinland conducts its business in accordance with the Universal Declaration of Human Rights.

Everything we do is underpinned by our responsibility to protect the environment, to operate safely and fiscally responsibly and with utmost respect for the cultural values and legal rights of Inuit. We expect each and every employee, contractor, and visitor to demonstrate courageous leadership in personally committing to this policy through their actions. The four pillars of our corporate responsibility strategy are:

1. Health and Safety
2. Environment
3. Upholding Human Rights of Stakeholders
4. Transparent Governance

Health and Safety

- We strive to achieve the safest workplace for our employees and contractors; free from occupational injury and illness, where everyone goes home safe everyday of their working life. Why? Because our people are our greatest asset. Nothing is as important as their health and safety. Our motto is “Safety First, Always”
- We report, manage and learn from injuries, illnesses and high potential incidents to foster a workplace culture focused on safety and the prevention of incidents
- We foster and maintain a positive culture of shared responsibility based on participation, behaviour, awareness and promoting active courageous leadership. We allow our employees and contractors the right to stop any work if and when they see something that is not safe

Environment

- Baffinland employs a balance of the best scientific and traditional Inuit knowledge to safeguard the environment
- We apply the principles of pollution prevention, waste reduction and continuous improvement to minimize ecosystem impacts, and facilitate biodiversity conservation
- We continuously seek to use energy, raw materials and natural resources more efficiently and effectively. We strive to develop more sustainable practices. We strive to develop more sustainable practices
- Baffinland ensures that an effective closure strategy is in place at all stages of project development to ensure reclamation objectives are met

Upholding Human Rights of Stakeholders

- We respect human rights, the dignity of others and the diversity in our workforce. Baffinland honours and respects the unique cultural values and traditions of Inuit
- Baffinland does not tolerate discrimination against individuals on the basis of race, colour, gender, religion, political opinion, nationality or social origin, or harassment of individuals freely employed
- Baffinland contributes to the social, cultural and economic development of sustainable communities in the North Baffin Region

Sustainable Development Policy

- We honour our commitments by being sensitive to local needs and priorities through engagement with local communities, governments, employees and the public. We work in active partnership to create a shared understanding of relevant social, economic and environmental issues, and take their views into consideration when making decisions
- We expect our employees and contractors, as well as community members, to bring human rights concerns to our attention through our external grievance mechanism and internal human resources channels. Baffinland is committed to engaging with our communities of interest on our human rights impacts and to reporting on our performance

Transparent Governance

- Baffinland will take steps to understand, evaluate and manage risks on a continuing basis, including those that may impact the environment, employees, contractors, local communities, customers and shareholders.
- Baffinland endeavours to ensure that adequate resources are available and that systems are in place to implement risk-based management systems, including defined standards and objectives for continuous improvement.
- We measure and review performance with respect to our safety, health, environmental, socio-economic commitments and set annual targets and objectives.
- Baffinland conducts all activities in compliance with the highest applicable legal & regulatory requirements and internal standards.
- We strive to employ our shareholder's capital effectively and efficiently and demonstrate honesty and integrity by applying the highest standards of ethical conduct.

Brian Penney
Chief Executive Officer
March 2016

Appendix B
Tables of Concordance with Applicable Permits and Licences

TABLE B.1 CONCORDANCE WITH NWB TYPE A WATER LICENCE, 2AM-MRY1325

<table>
<tr><th>Part</th><th>Number</th><th>Term and Condition</th><th>Section</th></tr>
<tr><td>D</td><td>4</td><td>Quarrying activities shall be conducted in accordance with all applicable legislation, guidelines and industry standards including the Northern Land Use Guidelines, Pits and Quarries (INAC, 2009).</td><td>Refer to Section 3. Updates have been done in accordance with 2010 edition.</td></tr>
<tr><td>D</td><td>7</td><td>The License shall submit to the Board for review, an addendum to the Plan referred to in Part D, Item 6a for any quarry site selected for future development that the plan does not adequately address. If the content of the existing quarry plan referred to under Part D, Item 6a, does not adequately address the proposed activities for the management requirements of the selected Quarry site, the Licensee shall submit to the Board for approval, a site-specific Quarry management plan.</td><td>Refer to Section 1.4. This management plan provides the overarching plan for Quarry and Borrow Source development. Respective Quarry and Borrow Source Management Plans have site specifics (e.g. drainage plans).</td></tr>
<tr><td>D</td><td>14</td><td>The Licensee shall maintain a minimum of thirty-one (31) metre undisturbed buffer zone between the periphery of Quarry sites and the ordinary High Water Mark of any water body unless otherwise approved by the Board in writing. The Licensee shall not excavate and/or remove material from any Quarry beyond a depth of one (1) meter above the ordinary High Water Mark or above the groundwater table, to prevent the potential contamination of groundwater unless otherwise approved by the Board in writing. The Licensee shall construct and operate the Mine Site and associated infrastructure and facilities in accordance with all applicable legislation and industry standards.</td><td>Refer to Sections 3.2, 3.3 and 3.4.</td></tr>
<tr><td>D</td><td>15</td><td>All surface runoff from Quarry activities for the Project, where flow may directly or indirectly enter a Water body, shall be sampled Weekly and not exceed the Effluent quality limits under Part D, Item 16.</td><td>Refer to Section 5.2.</td></tr>
<tr><td>D</td><td>16</td><td>All surface runoff during the Construction Phase of the Project, where flow may directly or indirectly enter a Water body, shall be sampled Weekly and not exceed the following Effluent quality limits:
Table 1 Effluent quality limits for surface runoff during construction
<table>
<tr><th>Parameter</th><th>Maximum Average Concentration (mg/L)</th><th>Maximum Concentration of Any Grab Sample (mg/L)</th></tr>
<tr><td>Total Suspended Solids</td><td>50</td><td>100</td></tr>
<tr><td>Oil and Grease</td><td>No Visible Sheen</td><td>No Visible Sheen</td></tr>
<tr><td>pH</td><td>Between 6.0 and 9.5</td><td>Between 6.0 and 9.5</td></tr>
</table></td><td>Refer to Section 5.2.</td></tr>
<tr><td>F</td><td>28</td><td>The Licensee shall incorporate best management practices including ditches, diversions, sumps and berms where necessary to minimize or prevent surface runoff from entering nearby water bodies from Quarry and borrow pit sites.</td><td>Refer to Section 3.4 and Appendix E.</td></tr>
</table>

Part	Number	Term and Condition	Section
I	23	The Licensee shall monitor runoff and/or discharge from borrow pits and rock Quarry sites, on a monthly basis, for the following parameters: • Total Suspend Solid (TSS) • Oil and Grease • Ammonia (total NH_3-N) • Nitrate (total NO_3-N) • pH • Conductivity • Demonstrate to be non-acutely toxic	Refer to Section 5.2.

TABLE B.2 CONCORDANCE WITH NIRB PROJECT CERTIFICATE NO. 005

No.	Term and Condition		Comments
30	**Category:**	Landforms, Geology and Geomorphology - Quarries	Refer to Section 1.4 and respective Quarry and Borrow Source Management Plans.
	Responsible Parties:	The Proponent	
	Project Phase:	Construction, Operations, Temporary Closure/Care and Maintenance, Closure and Post--Closure Monitoring	
	Objective:	To provide oversight on quarry design and management	
	Term or Condition:	The Proponent shall develop site-specific quarry operation and management plans in advance of the development of any potential quarry site or borrow pit	
	Reporting Requirements:	Plans to be provided to the NIRB for review and comment at least 30 days prior to commencement of construction activities	

Appendix C
Acid Rock Drainage/Metal Leaching Testing Summary

Knight Piésold CONSULTING

MEMORANDUM

Date:	March 22, 2019	**File No.:**	NB102-00181/53-A.01
		Cont. No.:	NB19-00237
To:	Mr. Lou Kamermans		
Copy To:	Sara Wallace, Stantec		
From:	Amber Blackwell		
Re:	**Mary River Project - Phase 2 Proposal - Summary of Geochemistry Testing of Rock and Overburden Samples Representative of Quarries, Borrow Pits and Rock Cuts Along the North Railway**		

1.0 INTRODUCTION

Knight Piésold Ltd. (KP) is pleased to provide a summary of the geochemical testing that was completed to date along the proposed North Railway for the Mary River Project. This summary was prepared to support Baffinland Iron Mines Corporation's (Baffinland's) response to technical comments on the Addendum to the Final Environmental Impact Statement (FEIS) prepared for the Phase 2 Proposal (Baffinland, 2018).

2.0 APPLICABLE STUDIES

Regional bedrock geology is presented on Figure 1. Starting from Milne Port and moving south, the bedrock geology along the current Milne Inlet Tote Road and the proposed North Railway can be summarized as follows (Scott and de Kemp, 1998):

- **Km 0 to Km 20 -** Precambrian terrane, consisting of metamorphic magmatitic gneisses.
- **Km 20 to Km 93 -** Paleozoic rocks of the Gallery and Turner Cliffs Formations, Ship Point Formation, and the Baillarge Formation. These formations comprise primarily sedimentary rocks that are carbonate dominant (i.e. dolomitic sandstone, dolomite, and limestone).
- **KP 93 to Km 107 -** Precambrian terrane, consisting of metamorphic magmatitic gneisses.

A total of 76 samples have been tested as part of four separate geochemical evaluations (KP, 2007; AMEC, 2010; Hatch Ltd., 2017 and Hatch Ltd., in-progress). Table 1 identifies the number of samples collected in each rock type encountered within the transportation corridor.

Authors have used different descriptions of rock type, and so the rock type specified in the report was included in the table without interpretation. For example, Hatch's 2018 sampling (report in-progress) did not describe the geologic unit but included mineralogy testing that identified the presence or absence of calcite or dolomite. The carbonate-rich samples are likely the dolomitic limestone and sandstone of the Gallery and Turner Cliffs Formations and the non-carbonate-rich rocks are likely the Archean granitic gneiss.

Table 1 Summary of Geochemical Testing by Rock Type

Geological Unit	KP 2007	AMEC 2010	Hatch 2017/2018	Total
Overburden	6	14		20
Granitic Gneiss	6	21	7	34
Schist		3		3
Carbonate		9	6	15
Sandy Carbonate		3		3
Diabase			1	1
Total	**12**	**50**	**14**	**76**

NOTES:
1. GEOLOGY TAKEN FROM THE INDIVIDUAL REPORTS.
2. THE SCHIST SAMPLE IS A PART OF THE ARCHEAN METAMORPHIC BEDROCK AND IS CONSIDERED TO BE A MINOR LITHOLOGY.
3. THE DIABASE IS A DYKE THAT INTRUDED THE HOST BEDROCK AND IS CONSIDERED TO BE A MINOR LITHOLOGY.

3.0 ASSESSMENT OF ACID ROCK DRAINAGE POTENTIAL

Table 2 presents a summary of the results for key parameters used to establish acid rock drainage (ARD) generating potential. These results have been interpreted using the guidelines by Price (1997 and 2009), as follows:

- **Criterion 1:** If the sulphide concentration is greater than 0.3% by weight, the suggested classification is potentially acid generating (PAG).
- **Criterion 2:** If the neutralizing potential / acid potential (NP/AP) ratio is less than 1, the suggested classification is PAG. The NP and AP values are reported as equivalents of t $CaCO_3$/1,000 t.
- **Criterion 3:** If the NP/AP ratio is greater than 2, the suggested classification is Non-PAG. If the NP/AP ratio is between 1 and 2, the suggested classification is Uncertain.
- **Criterion 4:** If the sulphide concentration is less than 0.3% by weight, the suggested classification is Non-PAG. However, samples with a sulphide concentration between 0.01 and 0.3% by weight and an NP/AP ratio between 1 and 2 are characterized as Uncertain (due to the material being primarily composed of minerals that have poor NP values; Price, 2009).

With respect to Criterion 2 to 4, it should be noted that AP is calculated using the sulphide sulphur concentration. Therefore, if the sulphide concentration is below the laboratory minimum detection limit (MDL), the AP value is calculated from the MDL, which results in an AP value that is erroneously high. Similarly, if the carbonate concentration is below the MDL, the calculated NP value is inaccurate and erroneously high as well.

Of the 76 tested samples that were tested for ARD/ML potential:

- The average Total Sulphur concentration was 0.02% (by weight), with a maximum concentration of 0.07% (by weight).
- 11 samples had a Sulphide Sulphur concentration above the minimum detection limit (MDL), with an average concentration of 0.02% (by weight).
- The average Total Carbon concentration is 3.05% (by weight), with a minimum concentration of 0.02% (by weight).
- The minimum NP/AP value was 6.94, which is well above the conservative PAG cut-off of 2.0. It should be noted that most of the AP values were 0.62 t-$CaCO_3$/1000 t, which is calculated from a sulphur content below minimum detection limit (MDL). This suggests that the NP/AP ratios with sulphur content < MDL are higher than calculated and shown on Table 2.
- The average Net NP value was 269.2 t-$CaCO_3$/1000 t, which indicates good buffering capacity (NP).
- X-Ray Diffraction (XRD) on the 11 samples collected by Hatch (in-progress) was conducted and the results do not indicate the presence of sulphide species.
- ARD is not likely, given that all the samples have little to no AP with low to moderate NP.

4.0 ASSESSMENT OF METAL LEACHING POTENTIAL

The potential for the rock and overburden samples to leach metals was reviewed by screening short-term leach test results against the Metal and Diamond Mining Effluent Regulations (MDMER, 2019 and the Canadian Water Quality Guidelines for the Protection of Aquatic Life (Canadian Council of Ministers of the Environment, 2019). The water quality limits are outlined in Table 3 below.

Table 3 Water Quality Objectives

Parameter	MDMER[1,2]	CEGQ-PAL[3]
pH	6-9.5	6-9
Aluminum		0.1
Arsenic	1.0	0.005
Boron		29
Cadmium		0.001
Chromium		0.001
Copper	0.6	0.004
Lead	0.4	0.007
Nickel	1.0	0.15

Parameter	MDMER[1,2]	CEGQ-PAL[3]
Molybdenum		0.073
Phosphorus		0.1
Selenium		0.001
Silver		0.0003
Thallium		0.0008
Uranium		0.033
Zinc	1.0	0.037

NOTES:

1. METAL AND DIAMOND MINING EFFLUENT REGULATIONS (MDMER), 2019. *METAL AND DIAMOND MINE EFFLUENT REGULATIONS*. SOR/2002-222.
2. MDMER LIMITS ARE BASED ON SCHEDULE 4, MAXIMUM GRAB SAMPLE LIMITS.
3. CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT, 2019. *CANADIAN WATER QUALITY GUIDELINES FOR THE PROTECTION OF AQUATIC LIFE*.

AMEC (2010) and Hatch (2017 and in-progress) used shake flask extraction (SFE) tests. The SFE test analysis is used to determine the mass of soluble constituents within the sample at higher water to solid ratios. A 3:1 deionized water to solid ratio is used to represent the higher volume of water present. The water added to the sample is considered neutral, with a pH of approximately 7.0. Samples are gently shaken in a flask for 24 hours and supernatant fluids are analytically measured for dissolved constituents to help determine which elements are susceptible to leach at high water volumes. The use of a neutral pH water is more applicable if the rock is not acid-generating, which is the case with all the samples presented in Table 2. It should be noted that the SFE test is conservative (i.e. aggressive) in terms of evaluating acid-generating potential, despite the use of neutral pH water.

KP (2007) used the synthetic precipitation leaching procedure (SPLP 1312) test. The SPLP test was designed by the US Environmental Protection Agency (USEPA) to mimic metal leaching under acid rain conditions. The leaching reagent is a mixture of nitric and sulphuric acids adjusted to pH 4.2, with a 20:1 liquid to solid ratio (by wt.). The sample is crushed (if required) to less than 9.5 mm and both the sample and leaching reagent are placed in a flask, which is rotated end over end over a 24hr period. The leachate is then drained, filtered and analysed. An SPLP 1312 test is conservative and more aggressive than an SFE test due to the lower pH of the reagent.

Of the 76 samples, 9 exceeded the MDMER upper limit of 9.5 pH, and none were below the MDMER lower limit of 6.0 pH. One single sample from the 2007 dataset exceeded MDMER for copper. Several metals exceeded the CEQG-PAL limits under short-term leaching conditions. These include: aluminum, chromium, copper, iron, phosphorus, nickel, and zinc. Most of the metal exceedances were from the SPLP 1312 dataset, which indicates that they are prone to leaching under acidic conditions. However, based on the Modified ABA data, acid conditions are not expected, as most of the samples were net neutralizing. As such, metal leaching is not likely a concern, given the low ARD potential of the samples.

Both the SFE and the SPLP 1312 tests as they are completed on a crushed sample (increased surface area, compared to field conditions) exposed to either lower pH water or aggressive shaking. As such, the final pH derived from these short-term leach tests may overstate what is measured in the field. Many of the samples returned a high pH, and these same samples measured an aluminum concentration greater than the CEQG-PAL limit. This is not unexpected, as the solubility of aluminum is lowest at between pH 6 and 7 and increases at high pH (Langmuir, 1997).

5.0 SUMMARY OF ARD/ML POTENTIAL

None of the 76 tested samples are PAG. Additionally, most of the samples have low to no potential for ML, given the neutral to alkaline nature of the tested material. Though some samples did demonstrate some elevated concentrations of metals above CEQG-PAL (Canadian Council of Ministers of the Environment, 2007), this was primarily under acidic laboratory conditions and is not indicative of field conditions.

6.0 REFERENCES

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Yours truly,
Knight Piésold Ltd.

Prepared:
Amber Blackwell, P.Geo.
Project Geoscientist

REGISTERED PROFESSIONAL ENGINEER
S.R. AIKEN
LICENSEE
March 22/19
NWT/NU

PERMIT TO PRACTICE
KNIGHT PIESOLD LTD.
Signature
Date March 22 2019
PERMIT NUMBER: P 547
The Association of Professional Engineers, Geologists and Geophysicists of NWT/NU

Reviewed:
Steven R. Aiken, P.Eng.
Manager, Environmental Services

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

Attachments:

Table 2 Rev 0	Geochemical Testing Summary - North Railway
Figure 1 Rev 0	Regional Bedrock Geology and Geochemical Sample Locations Along North Railway

/ab

Knight Piésold CONSULTING

TABLE 2

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

SUMMARY OF GEOCHEMISTRY TESTING OF ROCK AND OVERBURDEN SAMPLES REPRESENTATIVE OF QUARRIES, BORROW PITS AND ROCK CUTS ALONG THE NORTH RAILWAY
GEOMECHANICAL TESTING SUMMARY- NORTH RAILWAY

Print Mar-22-19 16:04:50

Sample No.	Geology	Sample Location			Report	Modified Acid Base Accounting (ABA) Results								Static Metal Leaching Tests		ARD/ML Evaluation	
						NP	AP	Net NP	NP/AP	Total Sulphur	Sulphide	C	Carbonate	Metals Exceeding MDMER Schedule 4 Limits	Metals Exceeding CEQG - PAL	Acid Generating Potential	Metal Leaching Potential[5]
		Easting	Northing	Tote Road Chainage		t $CaCO_3$ / 1000t	t $CaCO_3$ / 1000t	t $CaCO_3$ / 1000t	ratio	%	%	%	%				
SC50	Overburden	505,806	7,971,897		KP, 2007	222	< 0.31	222	716	< 0.005	< 0.01	2.62	11.8	pH >9.5	Al	Non-PAG	Low[6]
SC51	Overburden	506,120	7,971,575		KP, 2007	172	< 0.31	172	555	< 0.005	< 0.01	2.11	9.25	pH >9.5	Al	Non-PAG	Low[6]
SC28	Overburden	529,366	7,926,975		KP, 2007	363	< 0.31	363	1170	< 0.005	< 0.01	4.55	19	pH >9.5	Al	Non-PAG	Low[6]
SC27	Overburden	529,371	7,926,671		KP, 2007	316	< 0.31	316	1020	< 0.005	< 0.01	3.82	16.2		Al	Non-PAG	Low[6]
SC02	Overburden	556,044	7,915,009		KP, 2007	3.7	< 0.31	3.4	11.9	< 0.005	< 0.01	0.035	0.055		Al, Cr, Fe, P	Non-PAG	Moderate[6]
SA1	Overburden	586,880	7,826,413		KP, 2007	5.1	< 0.31	4.8	16.4	< 0.005	< 0.01	0.019	0.02		Al, Fe	Non-PAG	Low[6]
BC12	Granitic Gneiss	595,511	7,802,321		KP, 2007	8.3	< 0.31	8	26.8	0.028	< 0.01	0.08	0.05		Al, Cr, Cu, Fe	Non-PAG	Moderate[6]
BC11	Granitic Gneiss	581,795	7,849,686		KP, 2007	7.9	< 0.31	7.6	25.5	< 0.005	< 0.01	0.087	0.05		Al, Cr, Cu, Fe	Non-PAG	Moderate[6]
BC10	Granitic Gneiss	605,673	7,848,344		KP, 2007	8.2	< 0.31	7.9	26.5	0.007	< 0.01	0.058	0.08		Al, Cr, Cu, Fe, Zn	Non-PAG	Moderate[6]
BC8	Granitic Gneiss	563,246	7,913,150		KP, 2007	8.7	< 0.31	8.4	28.1	0.015	< 0.01	0.11	0.015		Al, Cr, Cu, Fe, P, Zn	Non-PAG	Moderate[6]
BC9	Granitic Gneiss	541,089	7,926,876		KP, 2007	14	< 0.31	13.7	45.2	0.026	< 0.01	0.18	0.1		Al, Cr, Cu, Fe, Ni, Zn	Non-PAG	Moderate[6]
BC1	Granitic Gneiss	504,415	7,975,004		KP, 2007	9.5	< 0.31	9.2	30.6	0.014	0.01	0.11	0.14	Cu	Al, Cr, Cu, Fe, P, Zn	Non-PAG	Moderate[6]
10-TR-034 BH10-21	Schist			85+000	AMEC, 2010	12.5	0.31	12.2	40.3	0.015	< 0.01	0.096	0.282			Non-PAG	
10-TR-035 BH10-12	Schist			22+000	AMEC, 2010	10.2	0.77	9.43	13.3	0.06	0.02	0.052	0.054	pH >9.5	pH >9.0, Al	Non-PAG	None
10-TR-036 BH10-12	Schist			22+000	AMEC, 2010	10.4	0.41	9.99	25.6	0.023	0.01	0.049	0.023			Non-PAG	
10-TR-001 BH10-04	Granitic Gneiss			2+100	AMEC, 2010	7.9	0.31	7.59	25.5	0.014	< 0.01	0.059	0.103		Al	Non-PAG	None
10-TR-002 BH10-04	Granitic Gneiss			2+100	AMEC, 2010	8.1	0.31	7.79	26.1	<0.005	< 0.01	0.05	0.101			Non-PAG	
10-TR-003 BH10-04	Granitic Gneiss			2+100	AMEC, 2010	8.8	0.31	8.49	28.4	<0.005	< 0.01	0.064	0.137			Non-PAG	
10-TR-007 BH10-06	Granitic Gneiss			4+100	AMEC, 2010	7.5	0.31	7.19	24.2	<0.005	<0.01	0.036	0.048			Non-PAG	
10-TR-008 BH10-06	Granitic Gneiss			4+100	AMEC, 2010	7.3	0.31	6.99	23.5	0.008	<0.01	0.028	0.025			Non-PAG	
10-TR-009BH10-06	Granitic Gneiss			4+100	AMEC, 2010	7.7	0.31	7.39	24.8	0.006	<0.01	0.035	0.075	pH >9.5	pH >9.0, Al	Non-PAG	None
10-TR-010 BH10-07	Granitic Gneiss			5+000	AMEC, 2010	9.5	0.36	9.14	26.2	0.035	0.01	0.027	0.014			Non-PAG	
10-TR-011 BH10-07	Granitic Gneiss			5+000	AMEC, 2010	11.7	0.31	11.4	37.7	0.036	<0.01	0.038	0.027			Non-PAG	
10-TR-012 BH10-07	Granitic Gneiss			5+000	AMEC, 2010	11.5	0.31	11.2	37.1	0.019	<0.01	0.036	0.052			Non-PAG	
10-TR-013 BH10-08	Granitic Gneiss			6+000	AMEC, 2010	6.3	0.31	5.99	20.3	<0.005	<0.01	0.028	0.035			Non-PAG	
10-TR-014 BH10-08	Granitic Gneiss			6+000	AMEC, 2010	9.6	0.31	9.29	31	0.02	<0.01	0.044	0.38	pH >9.5	pH >9.0, Al	Non-PAG	None
10-TR-015 BH10-08	Granitic Gneiss			6+000	AMEC, 2010	10.4	0.31	10.1	33.5	0.028	<0.01	0.043	0.062			Non-PAG	
10-TR-016 BH10-09	Granitic Gneiss			7+000	AMEC, 2010	6.2	0.31	5.89	20	0.012	<0.01	0.02	0.034			Non-PAG	
10-TR-017 BH10-09	Granitic Gneiss			7+000	AMEC, 2010	7.1	0.31	6.79	22.9	0.012	<0.01	0.07	0.048	pH >9.5	pH >9.0, Al, Cr	Non-PAG	Low
10-TR-018 BH10-09	Granitic Gneiss			7+000	AMEC, 2010	6.6	0.31	6.29	21.3	0.038	<0.01	0.023	<0.005			Non-PAG	
10-TR-019 BH10-12	Granitic Gneiss			22+000	AMEC, 2010	8	0.31	7.69	25.8	0.029	<0.01	0.035	0.018	pH >9.5	pH >9.0, Al, Cr	Non-PAG	Low
10-TR-020 BH10-12	Granitic Gneiss			22+000	AMEC, 2010	10.4	0.4	10	26	0.028	0.01	0.051	0.071			Non-PAG	
10-TR-021 BH10-12	Granitic Gneiss			22+000	AMEC, 2010	8.8	0.31	8.49	28.4	0.006	<0.01	0.046	0.065			Non-PAG	
10-TR-022 BH10-13	Carbonate Bound Quartz Sandstone With Silty Interlayers			39+100	AMEC, 2010	229	0.31	229	739	<0.005	<0.01	2.77	12			Non-PAG	
10-TR-023 BH10-13	Carbonate Bound Quartz Sandstone With Silty Interlayers			39+100	AMEC, 2010	252	0.31	252	813	<0.005	<0.01	2.98	12.5			Non-PAG	
10-TR-024 BH10-13	Carbonate Bound Quartz Sandstone With Silty Interlayers			39+100	AMEC, 2010	273	0.31	273	881	<0.005	<0.01	3.25	14		pH >9.0, Cr	Non-PAG	Low
10-TR-025 BH10-14	Sandy Carbonate			45+200	AMEC, 2010	959	0.31	959	3095	<0.005	<0.01	11.1	54.3		pH >9.0, Al	Non-PAG	None
10-TR-026 BH10-14	Sandy Carbonate			45+200	AMEC, 2010	930	0.31	929	2998	<0.005	<0.01	10.8	52.3			Non-PAG	
10-TR-027 BH10-14	Sandy Carbonate			45+200	AMEC, 2010	956	1.29	955	742	0.071	0.04	11.2	54			Non-PAG	
10-TR-028 BH10-15	Carbonate With Minor Shale And Mudstone			50+000	AMEC, 2010	978	0.31	978	3155	0.014	<0.01	10.9	53.2			Non-PAG	
10-TR-029 BH10-15	Carbonate With Minor Shale And Mudstone			50+000	AMEC, 2010	953	0.77	952	1245	0.041	0.02	10.7	51.3		Al	Non-PAG	None
10-TR-030 BH10-15	Carbonate With Minor Shale And Mudstone			50+000	AMEC, 2010	945	0.34	945	2749	0.02	0.01	10.7	51.5			Non-PAG	

Knight Piésold CONSULTING

TABLE 2

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

SUMMARY OF GEOCHEMISTRY TESTING OF ROCK AND OVERBURDEN SAMPLES REPRESENTATIVE OF QUARRIES, BORROW PITS AND ROCK CUTS ALONG THE NORTH RAILWAY
GEOMECHANICAL TESTING SUMMARY- NORTH RAILWAY

Print Mar-22-19 16:04:50

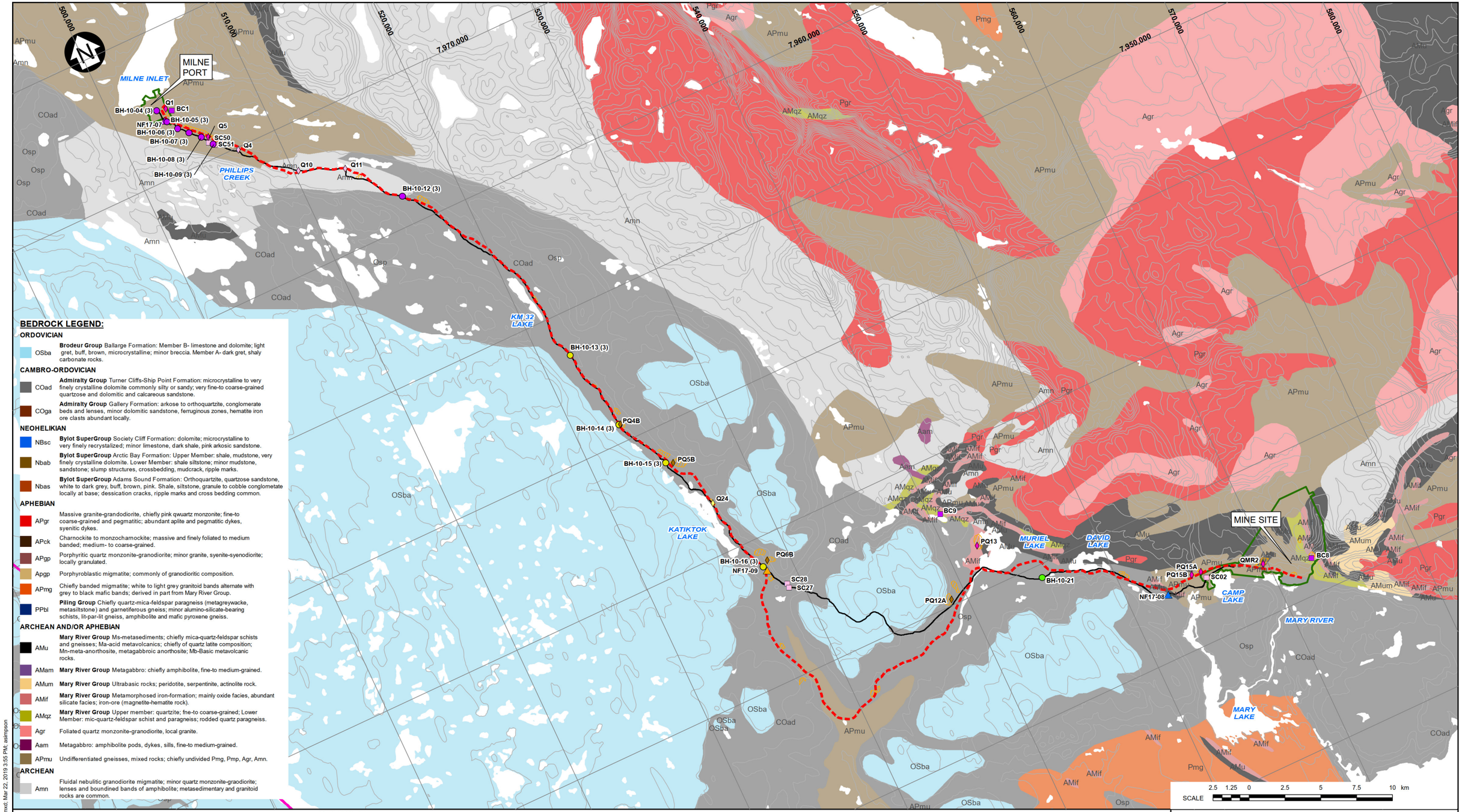
Sample No.	Geology	Sample Location			Report	Modified Acid Base Accounting (ABA) Results								Static Metal Leaching Tests		ARD/ML Evaluation	
						NP	AP	Net NP	NP/AP	Total Sulphur	Sulphide	C	Carbonate	Metals Exceeding MDMER Schedule 4 Limits	Metals Exceeding CEQG - PAL	Acid Generating Potential	Metal Leaching Potential[5]
		Easting	Northing	Tote Road Chainage		t $CaCO_3$ / 1000t	t $CaCO_3$ / 1000t	t $CaCO_3$ / 1000t	ratio	%	%	%	%				
10-TR-031 BH10-16	Carbonate			61+500	AMEC, 2010	965	0.31	965	3114	<0.005	<0.01	10.8	53.5			Non-PAG	
10-TR-032 BH10-16	Carbonate			61+500	AMEC, 2010	961	0.31	960	3099	<0.005	<0.01	10.7	52.9			Non-PAG	
10-TR-033 BH10-16	Carbonate			61+500	AMEC, 2010	954	0.31	953	3076	<0.005	<0.01	10.7	52.1		pH >9.0	Non-PAG	None
10-TR-004 BH10-05	Granitic Gneiss			3+100	AMEC, 2010	7.4	0.31	7.09	23.9	0.02	<0.01	0.041	0.059			Non-PAG	
10-TR-005 BH10-05	Granitic Gneiss			3+100	AMEC, 2010	6.6	0.31	6.29	21.3	0.015	<0.01	0.032	0.033	pH >9.5	pH >9.0, Al	Non-PAG	None
10-TR-006 BH10-05	Granitic Gneiss			3+100	AMEC, 2010	6.2	0.44	5.76	14.2	0.038	0.01	0.029	0.028			Non-PAG	
S449-10	Sand/Gravel				AMEC, 2010	678	0.31	677	2185	0.011	<0.01	7.86	33.9		Cr	Non-PAG	Low
S450-10	Sand/Gravel				AMEC, 2010	699	0.31	699	2256	<0.005	<0.01	8.02	36			Non-PAG	
S451-10	Sand/Gravel				AMEC, 2010	237	0.31	237	765	<0.005	<0.01	2.92	11.7			Non-PAG	
S452-10	Sand/Gravel				AMEC, 2010	250	0.31	249	805	0.014	<0.01	2.89	12.4			Non-PAG	
S453-10	Sand/Gravel				AMEC, 2010	267	0.31	266	861	<0.005	<0.01	3.22	13.9			Non-PAG	
S454-10	Sand/Gravel				AMEC, 2010	5.3	0.31	4.99	17.1	<0.005	<0.01	0.061	0.016		Al, Cr	Non-PAG	Low
S455-10	Sand/Gravel				AMEC, 2010	37.5	0.31	37.2	121	<0.005	<0.01	0.41	0.255			Non-PAG	
S456-10	Sand/Gravel				AMEC, 2010	150	0.31	149	482	0.007	<0.01	1.82	6.2			Non-PAG	
S457-10	Sand/Gravel				AMEC, 2010	172	0.31	171	554	<0.005	<0.01	1.44	5.37			Non-PAG	
S458-10	Sand/Gravel				AMEC, 2010	86.7	0.31	86.4	280	0.007	<0.01	1.12	4.17		pH >9.0, Al	Non-PAG	None
S459-10	Sand/Gravel				AMEC, 2010	309	0.31	309	998	<0.005	<0.01	3.87	16.2			Non-PAG	
S460-10	Sand/Gravel				AMEC, 2010	137	0.31	136	441	<0.005	<0.01	1.71	7.29			Non-PAG	
S461-10	Sand/Gravel				AMEC, 2010	192	0.31	192	621	0.005	<0.01	2.33	10.2		pH >9.0, Al, Cr	Non-PAG	Low
S462-10	Sand/Gravel				AMEC, 2010	310	0.31	310	1001	0.007	<0.01	3.75	16.7			Non-PAG	
NF17-07	Granitic Gneiss			~ km 3	Hatch, 2017	6.1	0.67	5.43	9.1	0.035	< 0.02	0.044	0.11			Non-PAG	
NF17-08	Diabase			~ km 95	Hatch, 2017	11	0.67	10.6	16.9	0.042	< 0.02	0.061	< 0.025			Non-PAG	
NF17-09	Limestone			~ km 62	Hatch, 2017	1077	0.67	1077	1608	0.029	< 0.02	11.1	54.1			Non-PAG	
Q1	Granitic Gneiss	504,087	7,975,305		Hatch, 2019	12	0.62	10.9	18.5	< 0.005	< 0.02	0.106	0.145		pH >9.0, Al	Non-PAG	None
Q5	Granitic Gneiss	505,934	7,972,277		Hatch, 2019	12	0.62	11.1	18.9	0.006	< 0.02	0.048	< 0.025		Al, Cu	Non-PAG	None
PQ4B	Calcite-Rich Rock	523,505	7,941,976		Hatch, 2019	958	0.62	958	1546	< 0.005	< 0.02	11.4	50.9		Al	Non-PAG	None
PQ5B	Calcite-Rich Rock	525,723	7,937,982		Hatch, 2019	1185	0.62	1184	1911	0.006	< 0.02	11.3	54		Al	Non-PAG	None
Q24	Dolomite-Rich Rock	527,045	7,934,268		Hatch, 2019	975	0.62	975	1561	0.02	0.02	11	52.9		Al, Cu	Non-PAG	Low
PQ6B	Calcite-Rich Rock	528,798	7,929,044		Hatch, 2019	1135	0.62	1134	1831	< 0.005	< 0.02	11.1	52		Al, Cr	Non-PAG	Low
PQ12A	Calcite-Rich Rock	539,277	7,921,138		Hatch, 2019	870	1.25	868	696	0.032	0.04	11.2	42.1		pH >9.0	Non-PAG	None
PQ13	Granitic Gneiss	542,481	7,923,782		Hatch, 2019	5.4	0.62	4.78	8.71	< 0.005	< 0.02	0.07	0.105		Al	Non-PAG	None
PQ15B	Granitic Gneiss	555,185	7,915,620		Hatch, 2019	4.8	0.62	4.18	7.74	< 0.005	< 0.02	0.05	0.1		Al, Fe	Non-PAG	Low
PQ15A	Granitic Gneiss	555,849	7,915,556		Hatch, 2019	5.6	0.62	4.98	9.03	< 0.005	< 0.02	0.032	0.035			Non-PAG	None
QMR2	Granitic Gneiss	560,022	7,914,204		Hatch, 2019	4.3	0.62	3.68	6.94	0.005	< 0.02	0.033	0.07		pH >9.0, Al	Non-PAG	None

I:\1\02\00181\53\A\Correspondence\NB19-00237 - Memo - North Rail Geochem Summary\[Geochemistry Summary 2019-03-22 SRA edits.xlsm] Table 2

NOTES:

1. KNIGHT PIESOLD LTD. (KP), 2007. *RE: PRELIMINARY RESULTS OF PHASE I GEOCHEMICAL CHARACTERIZATION PROGRAM.* MARCH 16. NORTH BAY, ONTARIO. REF NO. NB07-00232 (NB102-181/4).
2. AMEC EARTH & ENVIRONMENTAL (AMEC), 2010. *BAFFINLAND MARY RIVER PROJECT - TRUCKING FEASIBILITY STUDY INTERIM ML/ARD ASSESSMENT OF TOTE ROAD QUARRY AND BORROW PIT SAMPLES.* DECEMBER 10. MISSISSAUGA. PROJECT NO. TC10510, FILE NO. 017.
3. HATCH, 2017. MEMORANDUM TO: M. WEAVER. RE: *INVESTIGATIONS - ACID ROCK DRAINAGE ASSESSMENT.* SEPTEMBER 11. REF NO. H353004.
4. HATCH, IN PROGRESS. *BORROW SOURCE INVESTIGATION FACTUAL DATA REPORT.* REF NO. H353004-30000-229-230-0002, REV A.
5. METAL LEACHING RESULTS WERE SCREENED AGAINST THE MMER CRITERIA UTILIZED IN AMEC, 2010.
6. LEACH TESTING WAS COMPLETED AT AN ACIDIC pH OF 4.2, AS SUCH METALS WERE LEACHED UNDER ACIDIC CONDITIONS, WHICH IS NOT INDICATIVE OF THE MODIFIED ABA TEST RESULTS.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	22MAR'19	ISSUED WITH MEMO NB19-00237	MJJ	AMB



BEDROCK LEGEND:

ORDOVICIAN

OSba — **Brodeur Group** Ballarge Formation: Member B- limestone and dolomite; light gret, buff, brown, microcrystalline; minor breccia. Member A- dark gret, shaly carbonate rocks.

CAMBRO-ORDOVICIAN

COad — **Admiralty Group** Turner Cliffs-Ship Point Formation: microcrystalline to very finely crystalline dolomite commonly silty or sandy; very fine-to coarse-grained quartzose and dolomitic and calcareous sandstone.

COga — **Admiralty Group** Gallery Formation: arkose to orthoquartzite, conglomerate beds and lenses, minor dolomitic sandstone, ferruginous zones, hematite iron ore clasts abundant locally.

NEOHELIKIAN

NBsc — **Bylot SuperGroup** Society Cliff Formation: dolomite; microcrystalline to very finely recrystalized; minor limestone, dark shale, pink arkosic sandstone.

Nbab — **Bylot SuperGroup** Arctic Bay Formation: Upper Member: shale, mudstone, very finely crystalline dolomite. Lower Member: shale siltstone; minor mudstone, sandstone; slump structures, crossbedding, mudcrack, ripple marks.

Nbas — **Bylot SuperGroup** Adams Sound Formation: Orthoquartzite, quartzose sandstone, white to dark grey, buff, brown, pink. Shale, siltstone, granule to cobble conglometate locally at base; dessication cracks, ripple marks and cross bedding common.

APHEBIAN

APgr — Massive granite-grandodiorite, chiefly pink qwuartz monzonite; fine-to coarse-grained and pegmatitic; abundant aplite and pegmatitic dykes, syenitic dykes.

APck — Charnockite to monzochamockite; massive and finely foliated to medium banded; medium- to coarse-grained.

APgp — Porphyritic quartz monzonite-granodiorite; minor granite, syenite-syenodiorite; locally granulated.

Apgp — Porphyroblastic migmatite; commonly of granodioritic composition.

APmg — Chiefly banded migmatite; white to light grey granitoid bands alternate with grey to black mafic bands; derived in part from Mary River Group.

PPbl — **Piling Group** Chiefly quartz-mica-feldspar paragneiss (metagreywacke, metasiltstone) and garnetiferous gneiss; minor alumino-silicate-bearing schists, lit-par-lit gneiss, amphibolite and mafic pyroxene gneiss.

ARCHEAN AND/OR APHEBIAN

AMu — **Mary River Group** Ms-metasediments; chiefly mica-quartz-feldspar schists and gneisses; Ma-acid metavolcanics; chiefly of quartz latite composition; Mn-meta-anorthosite, metagabbroic anorthosite; Mb-Basic metavolcanic rocks.

AMam — **Mary River Group** Metagabbro: chiefly amphibolite, fine-to medium-grained.

AMum — **Mary River Group** Ultrabasic rocks; peridotite, serpentinite, actinolite rock.

AMif — **Mary River Group** Metamorphosed iron-formation; mainly oxide facies, abundant silicate facies; iron-ore (magnetite-hematite rock).

AMqz — **Mary River Group** Upper member: quartzite; fne-to coarse-grained; Lower Member: mic-quartz-feldspar schist and paragneiss; rodded quartz paragneiss.

Agr — Foliated quartz monzonite-granodiorite, local granite.

Aam — Metagabbro: amphibolite pods, dykes, sills, fine-to medium-grained.

APmu — Undifferentiated gneisses, mixed rocks; chiefly undivided Pmg, Pmp, Agr, Amn.

ARCHEAN

Amn — Fluidal nebulitic granodiorite migmatite; minor quartz monzonite-graodiorite; lenses and boundined bands of amphibolite; metasedimentary and granitoid rocks are common.

LEGEND:

- PROPOSED NORTH RAILWAY
- MILNE INLET TOTE ROAD
- POTENTIAL DEVELOPMENT AREA
- QUARRY AREA

GEOCHEMICAL TESTING BY:

- ○ AMEC (2010)
- □ KNIGHT PIESOLD LTD. (2007)
- △ HATCH (2017)
- ◊ HATCH (2019)

GEOLOGY TYPE

- CARBONATE
- NON-CARBONATE ROCK
- CALCITE-RICH ROCK
- DIABASE
- DOLOMITE-RICH ROCK
- GRANITIC GNEISS
- LIMESTONE
- OVERBURDEN
- SCHIST WITH PEGMATITE VEINING

NOTES:

1. COORDINATE GRID IS IN KILOMETRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N.
2. REGIONAL BEDROCK GEOLOGY FROM SCOTT AND KEMP, 1998.
3. HATCH AND AMEC SAMPLE LOCATIONS BASED ON TOTE ROAD CHAINAGES.
4. BODIES OF WATER ARE SHOWN IN WHITE.
5. FIGURE CREATED BY KNIGHT PIESOLD LTD.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	22MAR19	ISSUED WITH MEMO	RAC	AS	SRA

SAVED: I:\1102\00181\53\A\GIS\Figs\B08 R0.mxd: Mar 22, 2019 3:55 PM: asimpson

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

REGIONAL BEDROCK GEOLOGY AND GEOCHEMICAL SAMPLE LOCATIONS ALONG NORTH RAILWAY

Knight Piésold CONSULTING

P/A NO. NB102-181/53

REF NO. NB19-00237

FIGURE 1

REV 0

Appendix D
Borrow Source Approach

D BORROW SOURCE APPROACH

D.1 INTRODUCTION

This Appendix is a supplement to the Borrow Pit and Quarry Management Plan. The purpose of this addendum is to provide further detail regarding borrow source best management practices that will be applied on the Mary River Project.

Borrow material is an essential element for numerous construction activities including: grading, laydown areas, backfill, foundations for fuel storage, camp expansion, local roads and administration and maintenance facilities, and heavy equipment storage. The purpose of this addendum is to briefly outline Baffinland's borrow management strategy as well as key borrow source locations and quantities. As part of the NIRB Project Certificate #005 and the QIA Commercial Lease (Q13C301), each borrow source requires its own Management Plan, these management plans will include drawings, site specific information and closure management, however the general guidelines set out below will be followed for each borrow source.

D.2 OPERATIONS AT BORROW SITES

D.2.1 MECHANICAL REMOVAL OF BORROW

D.2.1.1 PROCEDURES

In the summer months (July - October) borrow material will be removed via mechanical methods. This will consist of utilizing dozers with rippers, or excavators to remove loose borrow material including sand and gravel. Borrow material will then be pushed into a pile within the permitted boundaries of the borrow site and removed via haul truck to its designated location. Benching will be minimized where practical and the activities will work to "pushback" existing hills for borrow material. As a result, there will be no "pits" created as a result of borrow development. Upon closure of the borrow source only a cliff face or the side of a hill will remain. This step is being taken to ensure that no "ponding" of water will occur and all borrow sources will have natural drainage upon closure. During borrow extraction care will be taken to ensure that all activity remains within the permitted borrow site boundaries.

D.2.1.2 ENVIRONMENTAL CHALLENGES

Mechanical removal of borrow material will pose few environmental challenges. Where necessary borrow areas will be drilled prior to extracting material in order to acquire geochemical and geotechnical test samples. The samples will be tested to ensure that material is not considered acid generating and that the area is considered stable and secure. Baffinland will not utilize any borrow sources that contain acid generating material. As no chemicals or explosives are required for mechanical removal both spills and runoff contamination are expected to pose little risk. Noise and dust will exist but are not expected to pose any problems given the method of extraction and the remote location of the site.

D.2.1.3 BEST PRACTICES AND MITIGATION MEASURES

Borrow source best management practices will be implemented and followed by all personnel on site. Site personnel will undergo extensive training in operating a borrow source safely and efficiently. To ensure limited environmental impact the following best practice guidelines will be followed at all times:

- All activities will be confined to the agreed upon site layout and boundaries.
- All borrow sources will have a minimum setback of 31 m from fish bearing streams.
- Adequate space will be provided for all borrowing activities.
- Dust and noise will be minimized to the extent that is reasonably practicable.
- Waste on site will be managed adequately and disposed of in an appropriate manner (see: Waste Management Plan for Construction, Operation, and Closure and Hazardous Material and Hazardous Waste Management Plan).
- Operations will be sequenced in such a way as to minimize unnecessary disturbances to the local environment.
- Proper spill response procedures will be followed with adequate spill response equipment available on site at all times (Please see: Emergency Response and Spill Contingency Plan).
- No fuel storage will occur at borrow or quarry sites.
- Activities will be undertaken in such a way as to minimize any effects on or damage to permafrost or ground-ice. Thawed layers will be removed sequentially.
- Interaction with local wildlife will be handled in an appropriate manner (Please see: Terrestrial Environmental Management and Monitoring Plan).
- The borrow face will be “pushed back” in a calculated and designed matter to ensure geological stability. Excavations will be minimized by utilizing above grade sources for material (hills and swales), which will minimize water collection and drainage disruption.
- Borrow locations will be regularly inspected and unstable slopes re-graded to eliminate depressions and re-establish natural drainage patterns.
- Proper site drainage plan will be implemented. The drainage plan will ensure positive drainage to prevent water pooling or flooding.
- Areas of unexpected settlement will be filled to re-establish natural contours and eliminate water ponding.

D.2.2 BLASTING AT BORROW LOCATIONS

D.2.2.1 PROCEDURES

As a result of the extreme temperatures encountered on Baffin Island and the existence of extensive permafrost the removal of material from borrow sources will at times require the use of blasting. This requirement will be particularly critical during winter months when the ground will be fully frozen. These frozen conditions will create borrowed material that is too hard for mechanical removal.

Proper blasting procedures, as laid out in site specific borrow source management plans, will be followed to ensure that all blasting activities are conducted in a safe and efficient manner avoiding an unnecessary impact to the surrounding environment. The nature of the material will be taken into account and best blasting management practices will be employed. This will include: appropriate grid size and powder factor, the use of hydrophobic high quality emulsion explosives, and a highly trained competent staff.

Potential borrow source areas will be drilled and sampled prior to borrowing when necessary, geochemical and geotechnical tests will be conducted to ensure that no acid generating material is present in the area and that the area is geotechnically stable and secure. Baffinland will not utilize borrow sources containing acid generating material.

D.2.2.2 ENVIRONMENTAL CHALLENGES

The primary challenge related to the removal of material from borrow sources via blasting is the management of explosives, specifically ammonia nitrate (AN). The primary ecological concerns with ammonia are acute end-of-pipe toxicity and chronic toxicity in downstream lakes. Secondary issues relate to ammonia as a nutrient and the fact that ammonia nitrifies to nitrate in the environment. Some forms of nitrogen such as anionic ammonia or free ammonia and nitrite can be detrimental to fish at elevated concentrations.

The risk of ammonia entering the environment is low given the fact that all blasting will be completed using hydrophobic emulsion explosives that has an extremely low solubility in water. In addition to this all blasting of borrow material will be completed in frozen ground. This will ensure that potential "pathways" for AN will be frozen substantially limiting the ability of AN to enter the surrounding environment.

D.2.2.3 BEST PRACTICES AND MITIGATION MEASURES

Borrow Source and blasting best management practices will be implemented and followed by all personnel on site. The blasting activities at burrow sites will be completed by trained and qualified personnel. Baffinland is committed to implementing best management practices in its use of explosives. To ensure limited environmental impact the following best practice guidelines will be followed at all times:

- All activities will be confined to the permitted site layout and boundaries.
- All borrow sources will have a minimum setback of 31m from fish bearing streams.
- Adequate space will be provided for all borrowing activities.
- Dust and noise will be minimized to the extent that is reasonably practicable.
- Waste on site will be managed adequately and disposed of in an appropriate manner (see: Waste Management Plan for Construction, Operation, and Closure and Hazardous Material and Hazardous Waste Management Plan).
- Operations will be sequenced in such a way as to minimizing unnecessary disturbances to the local environment.
- Proper spill response procedures will be followed with adequate spill response equipment available on site at all times (Please see: Emergency Response and Spill Contingency Plans).
- No fuel will be stored at borrow or quarry sites.
- Activities will be undertaken in such a way as to minimize any effects on or damage to permafrost or ground-ice. Thawed layers will be removed sequentially.
- Interaction with local wildlife will be handled in an appropriate manner (Please see: Terrestrial Environmental Management and Monitoring Plan).
- Whenever possible "benching" will be avoided. Instead hills will be "pushed back" in a calculated and designed matter to ensure geological stability. Where possible, excavations will be minimized by utilizing above grade sources for material (hills and swales), which will minimize water collection and drainage disruption.
- Borrow locations will be regularly inspected and unstable slopes re-graded to eliminate depressions and re-establish natural drainage patterns.
- When possible, blasting will be conducted in frozen conditions when contamination of water will not be a problem.

- Blasting will be conducted utilizing emulsion explosives.
- Best blasting practices will be utilized to ensure that all explosives are fully detonated.
- Areas of unexpected settlement will be filled to re-establish natural contours and eliminate water ponding.
- Borrow locations will be regularly inspected and unstable slopes re-graded to eliminate depressions and re-establish natural drainage patterns.
- A performance monitoring program will be implemented to ensure that AN release to receiving waters from explosives is minimized to an acceptable level. Site specific performance targets will be developed and finalized in concert with the site contractors.
- Blast performance monitoring to optimize blasting efficiency.
- Monitoring and auditing of field operations to ensure acceptable field implementation of procedures and delivery of associated training.
- Based on drainage plan and site conditions, there may be surface flow or runoff from the borrow source to the downstream receiving environment. Discharge and runoff to the aquatic receiving environment (fish habitat), will meet water licence requirements for total suspended solids, and ammonia/nitrate will be at concentrations that are non-acutely toxic.

D.2.3 BORROW SITE DEVELOPMENT

Development of each of the Borrow Sites are expected to progress as detailed in the following steps.

D.2.3.1 CRUSHER PAD

Construct a crusher pad at a suitable distance from blasting areas using locally available fill material. The crusher pad will be sized for crushing and screening operations, stockpiles of finished product, and loading operations to deliver produced borrow materials. If required, storm water drainage will be managed with perimeter ditching and/or berms to divert rainfall or snow melt to natural drainage channels. Rip-Rap rock will be placed at strategic locations along the drainage channel to minimize erosion and to enhance settlement of sediments.

D.2.3.2 ACCESS ROAD

This borrow site is adjacent to the Tote Road; therefore, access to the area where material is extracted will be via a simple graded surface at existing ground elevation. A dedicated embankment is not necessary since the existing soils will support the expected truck and equipment loads. There are no streams at this site, therefore culverts or water crossings are not expected. This access road is used to transport the borrow materials from the material source to the crusher pad for processing and loading the finished product.

D.2.3.3 SUMMER EXTRACTION OPERATIONS AT BORROW SITE

Summer extraction of borrow can be achieved by simple excavation of thawed gravels at the surface, dozing the thawed materials into a stockpile, loading, and hauling to the crusher or to the construction site for placement.

D.2.3.4 WINTER EXTRACTION OPERATIONS AT BORROW SITE

With the use of a track drill, a bench is drilled and blasted at some designated elevation to begin bench development. Bench development can proceed from a higher elevation to a lower elevation or vice versa, depending on the topography of the site. Blasted borrow material is ready for loading into haul trucks and hauled to the crusher pad as crusher feed material to produce finished products or hauled to construction sites if crushing is not required.

D.2.3.5 BENCH DRILLING

As each drill round is blasted out, the drill either stays at this elevation to expand the bench in a longitudinal direction along the face, or the drill climbs to a higher or lower elevation to drill and blast subsequent benches. These benches are expanded in length as required for subsequent blasting of borrow at that elevation. Benches are created for safety and for efficient drill/blast operations.

D.2.3.6 SUBSEQUENT BENCH DEVELOPMENT

Each bench proceeds toward the main body of borrow rock at that elevation. Lower benches follow behind upper benches and drilled and blasted to move toward the main body of rock. Ramps may be constructed to the upper benches for truck loading near the blasted rock. Whenever practical benching will be minimized during borrow operations, instead utilizing the pushback of hills. When benches are deemed necessary to operate the borrow source safely and effectively, they will be properly regarded upon closure of the borrow source to ensure natural drainage and avoid the pooling of water.

D.2.3.7 DRILLING FROZEN GRAVELS

Drilling frozen gravels is completed with the use of one or two drill rigs using small diameter boreholes less than 165 mm. The boreholes are laid out by a surveyor to the engineered spacing and burden for each particular rock type and geologic conditions. The drill is removed from the area for loading explosives and blasting. The drill can proceed along the bench to continue drilling or proceed to a new bench.

D.2.3.8 BLASTING OPERATIONS

Blasting frozen gravels is completed by installing high explosive detonating boosters at the bottom of each hole with initiation wires extending to the surface for connection to the blasting circuit, followed by dropping in pre-packaged sticks of explosives and pouring from pre-packaged emulsion bags. Detonation and initiation is carried out with the use of delays to time the detonators in a fast millisecond sequence of smaller blasts for efficient rock breakage. Blasting lags behind the drill as more drilling is completed. As each new drill round is completed, the drill moves on and the drilled round is loaded with explosives and blasted.

D.2.3.9 HAULING BORROW GRAVELS

The blasted material is loaded onto trucks for delivery to the crusher, temporary stockpiles or to construction sites.

D.2.3.10 CRUSHING OPERATIONS

Borrow material is fed to the crusher and/or screening equipment to size and produce the desired rock product, stored in stockpiles and loaded into trucks for delivery to construction sites.

D.2.4 BORROW SOURCE CLOSURE

The abandonment of the Project works and site reclamation for the borrow sources will be undertaken at or before the close of the Project. Separate closure plans for each borrow source will be required prior to closing each facility, for more information on site closure please refer to the Project Interim Closure and Reclamation Plan. Closure of the Project will involve removing construction materials, equipment and infrastructure and reclaiming the site to self-sustaining productive ecosystem near its original condition.

The general closure and reclamation plans include the following:

- Dismantle and transport all fuel/chemical storage and handling infrastructure to an approved facility or for reuse where applicable.
- Dismantle and remove all buildings and related infrastructure.
- Remove all hazardous waste and explosives.
- Re-grade as necessary to establish safe slopes and restore the natural drainage to the area.
- If overburden topsoil has been removed and stockpiled, it will be used to re-grade the land.
- Test soils and granular materials for hydrocarbon content; contaminated soils will be remediated.

Appendix E
Blasting Management Framework

E BLASTING MANAGEMENT FRAMEWORK

E.1 BACKGROUND

Soluble inorganic nitrogen compounds such as ammonium nitrate (AN) are commonly used in explosives to support mining operations throughout the world. Large quantities of AN will be shipped and stored at the Mary River site and used in the manufacture and use of explosives used in blasting operations. The framework focuses on the control and mitigation of key potential risks arising from the management and use of AN explosives associated with quarrying and mining operations during the construction and operations phase of the Project. The potential risks arise from the aqueous dissolution of soluble nitrogen compounds and the potential pathways/impacts to surface water bodies which may support aquatic life.

E.1.1 AMMONIUM NITRATE EXPLOSIVES - POTENTIAL RISKS

The primary ecological concerns with ammonia are acute end-of-pipe toxicity and chronic toxicity in downstream lakes. Secondary issues relate to ammonia as a nutrient and the fact that ammonia nitrifies to nitrate in the environment. Some forms of nitrogen such as anionic ammonia or free ammonia and nitrite can be detrimental to fish at elevated concentrations. Nitrate, in the presence of phosphorus, can contribute to the process of freshwater eutrophication. The natural concentration of phosphorus in lakes in the North Baffin region is low and measures will be implemented to limit phosphorous loading to the aquatic receiving environment. This involves control of sediment loading to surface waters during construction and the minimization of phosphate in effluent discharge.

E.1.2 POTENTIAL PATHWAYS

Ammonium nitrate is highly soluble and can readily leach into surface water by one or more of the following pathways:

- Spillage, which is the most common source of ammonium nitrate loss and the easiest to control.
- Improper selection of explosives medium, leading to losses of explosives through incomplete detonation.
- Site peculiarities such as geology and groundwater affecting the migration of explosives into permeable fractures or fault systems and causing incomplete detonation.

Due to potential environmental concerns related to the introduction of nitrogen compounds at the Mary River Project, operating procedures will be implemented to limit, control and mitigate the release of undetonated explosives originating from blasting operations.

E.2 BLASTING MANAGEMENT FRAMEWORK

Baffinland is committed to implementing best management practices in its use of explosives. To this end a Blasting Management Framework has been developed based on a review of similar plans implemented at other northern mines.

Baffinland in concert with its Company Representative contractor will develop site specific operating procedures to limit, control and mitigate the release of undetonated explosives from blasting operations. A Blasting and Operations Plan will be developed for each quarry based on the site specific geologic and biophysical conditions encountered at each quarry location.

The specific objectives for the framework Plan are as follows:

1. To identify and implement explosives management practices that will result in the lowest practical losses of undetonated explosives to the receiving environment.
2. To ensure that explosives are used and site runoff water is managed in such a way that explosives losses do not result in a change in the trophic status of receiving water bodies.

E.2.1 SOURCE CONTROLS

Proactively controlling the source of AN explosives has a positive net environmental effect versus managing ammonia after dissolution in water which is much more difficult. The AN-based explosives handling procedures require that personnel who handle explosives take the necessary precautions to prevent spillage during blasting operations. When AN-based explosives come in contact with water, some dissolution of ammonium nitrate occurs. To limit explosives-water contact, areas that are subject to shallow groundwater flows are identified and dewatered prior to blasting. Proper selection of explosives types can prevent dissolution and release to the receiving environment. For example, emulsion based ammonium nitrate-fuel oil (ANFO) mixture contains emulsifiers that can minimize AN dissolution in water and improve blast performance. The types of procedures to be developed and actions to be taken will include the following:

- Loading explosives in wet blast holes and limiting stand time for explosives in wet holes.
- Rigorous employee orientation and training procedures for managing, transporting and loading explosives into blast holes.
- Selecting, adopting, and manufacturing the optimum explosive mix types and loading procedures for site specific applications.
- Quarry and pit plans will incorporate a site specific drainage control plan.

E.2.2 PERFORMANCE MONITORING

A performance monitoring program will be implemented to ensure that AN release to receiving waters from AN explosives is minimized. Site specific performance targets will be developed and finalized in concert with the site contractors. The performance monitoring targets may include the following key elements:

- Blast performance monitoring to optimize blasting efficiency.
- Monitoring and auditing of field operations related to explosive selection, manufacturing, handling, blasting, and pit/quarry development to ensure acceptable field implementation of procedures and delivery of associated training.
- Based on the drainage plan and site conditions, there may be surface flow or runoff from the quarry to the downstream receiving environment. Discharge and runoff to the aquatic receiving environment (fish habitat), will meet water licence requirements for total suspended solids, and ammonia/nitrate will be at concentrations that are non-acutely toxic.

In the event that performance monitoring indicates that targets are not being met, corrective actions will be taken to improve performance and contingency measures will be taken to prevent acutely toxic discharges to the aquatic receiving environment.