APPENDIX L10

Interim Closure and Reclamation Plan

(Pages L10-1 to L10-388)

Baffinland Iron Mines Corporation

INTERIM CLOSURE AND RECLAMATION PLAN

BAF-PH1-830-P16-0012

Revised Draft - Rev 5

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FOREWORD

The Interim Closure and Reclamation Plan (ICRP) builds on the Preliminary Closure and Reclamation Plan (PCRP) which was reviewed and approved by the Nunavut Impact Review Board (NIRB) under Project Certificate 005 and its amendment, and, by the Nunavut Water Board (NWB) with the issuance of Type 'A' Water Licence 2AM-MRY1325 and Amendment No. 1. The ICRP reflects the requirements of Qikiqtani Inuit Association (QIA) Commercial Lease No. Q13C301 and requirements of Part J, Item 2 of the Type 'A' Water Licence, 2AM-MRY1325 - Amendment No. 1 which requires the March 2015 ICRP to be updated 60 days after the issuance of the amended Type A Licence, taking into consideration the items listed in Part J, Item 2. The revised plan is to address the relevant comments and recommendations provided by intervening parties during the review period for the Type A Licence amendment application.

The development of the PCRP and subsequent development of the ICRP is based on Crown Indigenous Relations and Northern Affairs Canada (CIRNAC, formerly AANDC) guidelines[1] which envisage three primary stages in the development of a Mine Closure and Reclamation Plan (or A&R Plan):

- A Preliminary Closure and Reclamation Plan
- An Interim Closure and Reclamation Plan
- A Final Closure and Reclamation Plan

The ICRP considers the complete development of the Project and describes expected closure activities at the end of the Project Life (21 year mine life). The ICRP is thus a conceptual benchmark for the intended reclamation and closure activities associated with all components of the Mary River project approved under Project Certificate No. 005 and its Amendment No 1. The ICRP will be updated as required throughout the life of the Project.

As per Type "A" Water License 2AM-MRY1325 - Amendment No. 1 and QIA Commercial Lease No. Q13C301, the Final CRP will be developed and submitted no later than one (1) year, or earlier if possible, before scheduled permanent closure or immediately after notification of an unplanned closure (within 120 days) to provide greater detailed descriptions of the proposed reclamation activities in such a manner that they can be subsequently implemented. If future revisions of referenced Project authorizations were to require this to change, this timeframe will be adjusted accordingly.

[1] MVLWB/AANDC, Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories, November 2013

1 PLAIN LANGUAGE SUMMARY

BACKGROUND AND INTRODUCTION

The Mary River Project (the Project) is located on north Baffin Island, in the Qikiqtani Region of Nunavut. The Project is wholly owned by Canadian mining company Baffinland Iron Mines Corporation (Baffinland). The scope of the Project is defined by Project Certificate No 005 (and its Amendment No 1) and Type A Water Licence 2AM-MRY1325 - Amendment No. 1. The Project's Interim Mine Closure and Reclamation Plan (ICRP) is considered to be a "living" document, which is refined regularly throughout the life of mine until a Final Closure and Reclamation Plan is achieved. Ongoing iterations to the ICRP will address issues such as notable changes to the Project and refinements to the closure design based on findings from operational data collection (e.g. community engagement, environmental monitoring, research studies, etc.). This version of the ICRP builds on the initial Preliminary Mine Closure and Reclamation Plan (PMCRP) (H337697-0000-07-126-0014) presented in Volume 3, Appendix 3B, Attachment 10 of the Mary River Project Final Environmental Impact Statement (FEIS) and approved by Nunavut Impact Review Board (NIRB).

This ICRP document has been developed in accordance with applicable requirements from numerous regulatory instruments and guidelines, including the following primary sources:

- Conditions applying to security and abandonment, closure and reclamation or temporary closure in Type "B" Water Licence 8BC-MRY1416, Type "A" Water Licence 2AM-MRY1325 - Amendment No. 1.
- Conditions applying to closure and reclamation set forth in Commercial Lease No. Q13C301.
- The Project Certificate No. 005 (December 28, 2012) and its associated Amendment (May 28, 2014) terms and conditions.
- The Qikiqtani Inuit Association (QIA) Abandonment and Reclamation Policy for Inuit Owned Lands (Version 3.0, 2013).
- Mackenzie Valley Land and Water Board (MVLWB)/Aboriginal Affairs and Northern Development Canada (AANDC) Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the NWT (2013).

Document Organization

Following development of the PMCRP in 2011, Baffinland agreed to reorganize the ICRP document at QIA's request to follow the recommended template provided in the MVLWB/AANDC Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories. These Guidelines were released in 2013. This ICRP follows the suggested template with some minor exceptions, and includes the following major topics of discussion:

Section 2 Provides the purpose, scope, and goal of the ICRP, outlines the closure and reclamation planning team, details the approach for engagement, and summarizes regulatory instruments (permits, authorizations, and agreements) for closure and reclamation;

Section 3 Provides a description of pre-disturbance (baseline) conditions for the atmospheric, physical (terrestrial), biological and socio-economic environment;

Section 4 Provides a detailed description of the Mine, including the location and access, project history, site geology, and high-level project summary;

Section 5 Provides a detailed description for the permanent closure of the Mine for each of the mine components, including the expected final conditions. This Section contains the bulk of available detail for how the Mine will be closed, the reclamation targets Baffinland seeks to achieve (closure objectives and criteria) and the other key components of the closure design (e.g. performance monitoring, uncertainties, contingency planning).;

Section 6 Provides a description of planned and completed progressive reclamation at the Mine site;

Section 7 Discusses planning for short-term temporary mine closure and long-term mine closure and suspension of activities.

Section 8 Provides a schedule for the planned closure activities;

Section 9 Provides a post-closure site assessment that summarizes how the residual environmental impacts of the Mine as a whole will be assessed once the selected closure activities have been completed;

Section 10 Discusses the estimated costs associated with closure and reclamation activities

Section 11 Provides a tabulated summary of the ICRP's concordance with the primary regulatory instruments

Section 12 Glossary of terms, acronyms, and abbreviations

Section 13 References

Appendix A Provides the closure drawings

Appendix B Provides a tabulated summary of mine closure and reclamation planning guidelines, regulations, and lease requirements

Appendix C Presents recent photos of major work areas

Appendix D Discusses the Reclamation Research Plans developed to address such as pit water quality, waste rock seepage quality and natural revegetation efforts

Appendix E Provides a record of engagement on closure issues

Appendix F Discusses lessons learned from other sites applicable to the closure and reclamation of this Project

Appendix G Summarizes residual effects predictions from the FEIS and Addendum

Appendix H Summarizes FEIS Freshwater Quality Predictions (Based on FEIS and its Addendum, Volume 7, Section 3.4)

UPDATES TO THE CLOSURE PLAN

This interim closure and reclamation plan will be updated as the project progresses taking into account lessons learned, the results of research and monitoring data, input from stakeholders, and changes to how the site is operated.

To account for interim closure and reclamation security adjustments to reflect project development phases until such a time planned closure commences, an updated determination of Project closure and reclamation security is currently captured on an annual basis in Annual Security Review (ASR) process to account for any planned constriction activities. This is done incrementally and reflects closure requirements if Baffinland is not able to reach its planned closure phase. The ASR process is conducted in accordance with Part C and Schedule C of Type "A" Water License 2AM-MRY1325 - Amendment No. 1 and Section 9.2 of the Commercial Lease, No. Q13C301, agreed to between Baffinland and the QIA and includes consultation with Land-owners and other key stakeholders. The results of this ASR process should be considered on the interim basis to assess Project closure and reclamation liability for the end of the upcoming year until such time planned closure commences. In all cases, closure and reclamation liability estimates adhere to required closure and reclamation guidelines including, but not limited to, the QIA Abandonment and Reclamation policy guiding principles and stated assumptions.

As per Type "A" Water License 2AM-MRY1325 and QIA Commercial Lease No. Q13C301, the Final Mine Closure and Reclamation Plan will be developed and submitted at least one year before a scheduled permanent closure or within 120 days of the notification of an unplanned closure. The Final Mine Closure and Reclamation Plan will provide more detailed descriptions of the proposed reclamation activities in such a manner that they can be subsequently implemented. If future revisions of referenced Project authorizations were to change, this timeframe will be adjusted accordingly.

The Final Mine Closure and Reclamation Plan will be issued to relevant stakeholders including the Land Use Engineer of CIRNAC (Territorial Land Use Regulations, Sections 33 and 35), to the Lands Director at QIA, and to the Nunavut Water Board.

Prior to closing out the Project, Baffinland will consult with the Landlord and surrounding communities regarding transfer of ownership of structures that may be utilized by the surrounding communities during harvests, camping, and other recreational uses or relocated to local hamlets.

PROJECT AND CLOSURE SUMMARY

Project related facilities were designed and constructed to minimize the footprint. These design and construction considerations have facilitated reclamation plans and minimized the engineering required to support the complete decommissioning and reclamation of the site.

Three closure scenarios and their associated closure and reclamation activities are described in this ICRP: Short-Term Temporary Care and Maintenance, Long-Term Temporary Mine Closure and Final Mine Closure. In addition to these scenarios, progressive reclamation measures have been proposed to facilitate temporary and final mine closures measures.

Temporary closure, Short-Term Temporary Care and Maintenance or Long-Term Temporary Mine Closure, occurs when the Project ceases Operation with the intent of resuming activities in the future. During temporary closure, Baffinland will maintain all operating facilities and programs necessary to protect humans, wildlife, and the environment, including necessary environmental monitoring. Short-Term Temporary Care and Maintenance activities will occur if the Project ceases operation for a period of less than one (1) year with the intent of resuming activities in the future. Long-Term Temporary Mine Closure will occur if the Project ceases operation for a period of greater than (1) year with the intent of resuming activities in the future.

In Short-Term Temporary Care and Maintenance, all facilities and equipment would be secured and de-energized. An inventory of all hydrocarbon products, chemicals, hazardous wastes and explosives would be carried out and all effluents would be monitored. Personnel necessary, including environmental personnel, to maintain site security and project monitoring requirements would remain on site.

During Long-term Temporary Mine Closure the Project sites will be maintained in a secure condition, all facilities and equipment would de-energized and winterized. Hazardous waste and explosives would be removed from the site. Personnel necessary, including environmental personnel, to maintain site security and project monitoring requirements would remain on site.

Final Mine Closure and Reclamation will occur when there is no foreseeable intent by Baffinland to return to active mining. Final Mine Closure and Reclamation will include removing all infrastructure, equipment and materials into an on-site landfill, the Mine Pit, quarries and/or other approved disposal location(s) for disposal of inert, non-hazardous, non-combustible materials. All other infrastructure, equipment and materials will be sent off-site to an approved disposal location. Arrangements will be made with a sealift contractor to collect materials and equipment at Milne Port to ship material destined for off-site transport. The airstrips will be closed and reclaimed unless otherwise directed by regulatory agencies or the Land Owner in order to provide emergency/rescue landing spots for regional aircraft and access for post closure monitoring. Permanent dock structures will be left in place at Milne Port and Steensby Port but all surface equipment and materials will be removed. Disturbed areas would undergo contouring of ground or granular surfaces as required to maintain stability and natural drainage patterns will be re-established, if required, as reasonably possible. At Final Mine Closure and Reclamation, project components will be inspected to ensure specific closure objectives of project components are achieved and closure principles of long-term safety of the site, no long term active care requirements, physical stability and chemical stability have been met.

Following the closure activities, there will be several long-term landform changes, including: the creation of waste rock pile, the creation of a mine pit lake where previously there had been a hilltop, and several small quarries will be visible landforms.

The final closure and reclamation activities are expected to last a period of three (3) years based on estimated duration and level of effort required for identified closure activities[2]. Post closure monitoring will continue until closure principles of long-term safety of the site, no long term active care requirements, physical stability and chemical stability have been shown to be met by monitoring results. These activities may be periodic. It is currently estimated post closure monitoring and follow-up inspections will be conducted for a period of fifteen (15) years based on impacts assessment determinations described in the Mary River Project Final Environmental Impact Statement.

An outline of major reclamation activities for each mine area, and the envisioned post-closure landscape is presented on the following page.

[2] Estimated duration and level of effort required for identified closure activities is described in 'Annual Security Review (ASR)' documentation required under Section 9.2 of the Commercial Lease, No. Q13C301, and under Part C and Schedule C of the NWB Type "A" Water Licence No. 2AMMRY1325.

Table 1.1: Outline Of Major Reclamation Activities at Each Mine Area

Area	Project Operations	Major Reclamation Activities	Post Closure Landscape
Milne Port	Deep water port operation, with ore dock, ship loading facilities, ore stockpiles and stormwater ponds. Other primary infrastructure includes an accommodation complex with sewage treatment plant, power plant, warehouse/garages, fuel storage, landfarm and hazardous waste storage area, polishing ponds, and quarry/borrow areas.	Decommissioning of all infrastructure, removal of building materials and hazardous waste from site. Ore stockpiles removed. All equipment and supplies will be removed. Assessment and potential removal of contaminated soils. Grading of earthen structures and disturbed areas to re-establish natural drainage pathways where acceptable.	No visible foreign building materials will remain. Deep water dock will remain in place. Disturbed areas will be graded to establish stable drainage pathways that do not require maintenance. Natural recovery of vegetation will occur over many years. Surface materials will be scarified to accelerate recovery in priority areas. Ship traffic associated with the mine will stop. Travel to site for post-closure monitoring will be via aircraft only.
Tote Road	Ore hauling road from the Mine site to Milne Port. Approximately 100 km long, all-season gravel road. The road includes over a hundred water crossings consisting of culverts and four bridges. Ore is hauled by truck and trailer assembly, with payload of roughly 150 tonnes. Water intake infrastructure from permitted sources for dust suppression. Quarries and borrow areas exist along the road.	Removal of all water crossing structures, water intakes, and equipment associated with quarries and borrow areas. Assessment of bridge abutments for long-term physical stability, and potential removal of fill. Streambed and banks will be assessed for physical stability and alterations will be made as necessary. Grading at quarries and borrow areas to re-establish natural drainage pathways where possible.	Remaining sections of the road adjacent to former water crossings will be shaped to maintain long-term stability. Tote road traffic associated with mining will stop. No further maintenance of the road will be completed by BIM. Remaining sections of the road may be used by land users. At former water crossings, banks will be graded to provide access for ATVs. Natural recovery of vegetation will occur over many years. Surface materials will be scarified to accelerate recovery in priority areas.

Table 1.1: Outline Of Major Reclamation Activities at Each Mine Area

Area	Project Operations	Major Reclamation Activities	Post Closure Landscape
Mine Site	Mining operations commencing on a hill crest outcrop, progressing to open pit mining following 10-12 years of mining at full production rates. A haul road exists from the orebody to the Ore crushing/loading facilities and Waste Rock Stockpile. Supporting infrastructure includes the airstrip and helipad, utilities (power, water, sewage), warehouses/garages, offices, accommodations camp, landfill, explosives storage and emulsion plant, sedimentation and polishing ponds, quarries and borrow areas.	The final Open Pit will be flooded by natural inflows and active pumping. An engineered spillway will be constructed to discharge overflowing water to a tributary of the Mary River. The Waste Rock Stockpile will be progressively reclaimed during mining by placement of a 25 m thick cover of non-PAG rock over PAG rock. Decommissioning of all infrastructure, removal of building materials and hazardous waste from site. Ore at crushing/loading facilities removed. All mobile equipment and supplies will be removed. Assessment and potential removal of contaminated soils. Grading of earthen structures and disturbed areas to re-establish natural drainage pathways where acceptable.	Current estimates for the final Open Pit include a footprint of approximately 1 km by 1.75 km wide with roughly 200 m average depth. The Waste Rock Pile will be approximately 250 m high at its highest point. Actual dimensions of these areas are irregular and may change based on the orebody and market conditions. Water treatment is not expected to be required at the Open Pit and Waste Rock Stockpile. No visible foreign building materials will remain. Disturbed areas will be graded to establish stable drainage pathways that do not require maintenance. Natural recovery of vegetation will occur over many years. Surface materials will be scarified to accelerate recovery in priority areas.

Predictions for Post-closure Conditions

Following reclamation, all Project areas are expected to be physically and chemically stable. Excluding the Open Pit and Waste Rock Stockpile areas, water quality is predicted to return to pre-disturbance levels, and the wildlife may begin to safely access the area again. Changes to water quality and fish and fish habitat in Mary River and Camp Lake (including tributaries) downgradient from the Open Pit and Waste Rock Stockpile have been identified as a research priority of Baffinland. Baseline studies indicated natural fluctuations in concentrations of several metals (reflecting the nature of the regional geology) exceeded water quality (CCME) and safe fish consumption (Health Canada) guidelines. This is unlikely to improve following mining.

Disturbed areas will be graded to re-establish natural drainage pathways where practical, and natural revegetation will be promoted in priority areas by scarifying the surface materials to assist recovery. The revegetation process is expected to take many years, and may never return to baseline conditions in certain locations. Communities have indicated a preference to leave select infrastructure in place (e.g. Ore Dock, Tote Road, Airstrip), but the majority of non-native materials will be removed or no longer visible.

Baffinland has committed to a rigorous monitoring program which is laid out in Project permits (i.e. NIRB Project Certificate, NWB Type A Water Licence), and will adaptively manage operations and mitigation strategies to effectively minimize post-closure residual effects where practical. Monitoring results will be reported to government agencies and the QIA for review and comment on an ongoing basis, and working groups have been established specifically to monitor Terrestrial and Marine effects during mining, to avoid unforeseen impacts post-closure. Ongoing mine closure planning will also be informed by community engagement feedback, and focus studies which may address priority areas.

Focus of this Revision

The main objectives of an ICRP are to set out the objectives and criteria for the successful closure and reclamation of the site, develop options for the reclamation of various areas on site, and to plan research efforts to address uncertainties with respect to closure. The aim of this revision is to update and streamline the presented information, to simplify Table 5.1 to support its discussion and further refinement in collaboration with QIA, and to provide a more accessible document for upcoming QIA engagement efforts for future development of the ICRP.

2 INTRODUCTION

2.1 PURPOSE AND SCOPE OF ICRP

This Interim Mine Closure and Reclamation Plan (ICRP) outlines the closure goal, principles, objectives, criteria and activities associated with the final closure and reclamation of the Project as approved under Project Certificate No 005 and its Amendment No.1 issued by the Nunavut Impact Review Board (NIRB) on May 28, 2014.

Mine closure and reclamation for the Project will be regulated under Baffinland's Commercial Lease No. Q13C301, Type 'A' Water Licence 2AM-MRY1325 - Amendment No. 1 (Type 'A' Water Licence), Type 'B' Water Licence 8BC-MRY1314 and CIRNAC (formerly INAC) Land Lease 47H/16-1-2. In cases, if any, where there was conflict between Type 'B' Water Licence 8BC-MRY1314 and the amended Type 'A' Water Licence, Baffinland will adhere with the terms and conditions of the Type 'A' Water Licence. In cases where the term 'Abandonment and Reclamation (A&R)' is used in authorizations, regulations and other forms of communication, Mine Closure and Reclamation (MCR) is synonymous for the purpose of the Mary River Project.

The ICRP considers the complete development of the Mary River Project (the Project) and describes expected closure activities at the end of the Project Life. Based on current planning, temporal boundaries of the projected Project lifecycle are as follows:

- Construction (Early Revenue Phase (ERP); 2014 to 2015)
- Operation (2016 to 2039)
- Closure and Post-Closure (2040 to 2047)

As planned final closure is decades away, the ICRP is thus a conceptual benchmark for the intended reclamation and closure activities associated with all components of the Mary River project approved under Project Certificate No. 005. The ICRP will be updated as required throughout the life of the Project.

As per Type "A" Water License 2AM-MRY1325 and QIA Commercial Lease No. Q13C301, the Final Closure and Reclamation Plan (Final CRP) will be developed and submitted no later than one (1) year, or earlier if possible, before scheduled permanent closure or immediately after notification of an unplanned closure (within 120 days) to provide greater detailed descriptions of the proposed reclamation activities such a manner that they can be subsequently implemented. If future revisions of referenced Project authorizations were to change, this timeframe will be adjusted accordingly.

2.2 ICRP Goal and Principles

Over the life of the Project it is expected that closure and reclamation techniques and methodologies for site reclamation will continue to evolve with changes to the understanding of the Project site, stakeholder's views, and technologies for cost effective and practical reclamation in northern conditions. Planning for mine site reclamation will be based on the protection of human health and the environment, and remain dynamic to take into account the results of ongoing and future studies and identified best practices.

2.2.1 Policies and Guidelines for Final Closure

The Project is being designed with closure and reclamation considerations in mind in compliance with the Baffinland Sustainable Development Policy (Baffinland, 2015). General closure and reclamation objectives of this ICRP correspond with the QIA A&R Policy (QIA, 2013). The main goals of this Policy and the above guidelines and regulations are to:

- Apply the principles of pollution prevention and continuous improvement to minimize ecosystem impacts and facilitate biodiversity conservation.
- Use energy resources, raw materials and natural resources efficiently and effectively.
- Engage with governments, employees, local communities and the public to create a shared understanding of closure and reclamation issues and take their views into consideration in making decisions.
- Return the Project affected and viable sites (Milne Port, Mine Site, and Quarries) to "wherever practicable, self-sustaining ecosystems that are compatible with a healthy environment and human activities" (NRCan, 1994).
- Where practicable, undertake reclamation of affected areas in an ongoing and progressive manner to reduce the environmental risk once the mine ceases operation (INAC, 2002. INAC, 2002a. Northwest Territories Water Board, 1990 and QIA, 2013).
- Provide for the reclamation of affected sites and areas to a stable and safe condition and restore altered water courses to near their original alignment and cross-section. Where practical, affected areas will be returned to a state compatible with the original undisturbed area (Territorial Land Use Regulations).
- Restore altered water courses to their original alignment and cross-section (Territorial Land Use Regulations).
- Reduce the need for Long-term monitoring and maintenance by designing for closure and instituting progressive reclamation, when possible.
- Provide for mine closure using the current available proven technologies in a manner consistent with sustainable development.

- Provide sufficient detail such that adequate scopes of work can be developed for the execution of reclamation work. Where insufficient details exist, monetary allowances should be included in the reclamation security cost estimate to account for additional engineering and planning. Identification of the specific aspects of closure planning requiring refinement to reach a Final CRP and the corresponding reclamation security amounts are determined as part of the ASR process.

2.2.2 Site Abandonment Goal

In accordance with the above Policy, regulations, and guidelines, the site abandonment goal of the final closure activities is to return project sites and affected areas to viable and, wherever practicable, self-sustaining ecosystems that are compatible with a healthy environment and with human activities[3].

2.2.3 Closure Principles to Achieve Site Abandonment Goal

In order to achieve the Site Abandonment Goal, closure objectives and criteria have been selected for Project components (Section 4.4.2) based on the following Closure Principles:

- Ensure the safety of the abandoned sites for wildlife and human users.
- Ensure physical stability of abandoned Project sites and remaining physical features (open pit, waste rock stockpile, quarries, road and railway embankments, stream crossings).
- Ensure chemical stability of the mine open pit, waste rock stockpile, quarries, and, other Project disturbed areas.
- Incorporate considerations for future land use of Project sites in final closure planning (to be informed over time by the Mine Closure Working Group).
- Achieve the "Recognized Closed Mine" status in as minimal duration as reasonably practical, as defined by Part (4) of the Metal and Diamond Mining Effluent Regulations (MDMER, formerly the Metal Mining Effluent Regulations) SOR/2002-222 dated 1 June 2018 and ensure no requirements for long-term active care.
- Implement reclamation in a progressive, ongoing manner during the life of the Project and restore sites as soon as an area is no longer required for operations to limit the need for long term maintenance and monitoring.
- Reclaim disturbed Project areas such that no long-term active care is required.
- The objectives and criteria proposed for implementing Final Closure and achieving the stated goal and principles are discussed in Section 5.1.1 of this ICRP.

[3] Based on alignment with Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories (MVWLB/AANDC, 2013)

2.3 Closure and Reclamation Planning Team

The Mary River Project ICRP contains and describes the plans related to closure and reclamation of the Project. The ICRP addresses the activities expected to be required to ensure the Project closure goal, principles, objectives, and criteria are met. Participation of local communities and other stakeholders in the consideration of alternative reclamation activities to safeguard community values is encouraged as the Project proceeds. Currently, closure planning related to the Project is the responsibility of the Sustainable Development Department at Baffinland with support consultants. Stantec Consulting ltd. has provided input on this latest revision of the ICRP.

2.3.1 Closure Plan Progression

2.3.1.1 Preliminary Mine Closure and Reclamation Plan

A Preliminary Mine Closure and Reclamation Plan (PCRP) (H337697-0000-07-126-0014) was prepared for Baffinland in support of the regulatory approval process, including the Final Environmental Impact Statement (FEIS) for the Project, and was based on available Project design information which was at a conceptual level. The PCRP assumes that the reader has access to and is familiar with the FEIS content.

The purpose of the PCRP was to provide an initial closure and reclamation plan for the Mary River Project, at a conceptual level, in accordance with the regulatory framework established by the Inuit, Federal and Territorial governments.

2.3.1.2 Interim Mine Closure and Reclamation Plan

The ICRP builds on the PCRP which was reviewed and approved by NIRB under Project Certificate 005 and its amendment, and, by the Nunavut Water Board (NWB) with the issuance of Type A Water Licence 2AM-MRY1325. The ICRP reflects the requirements of Commercial Lease No. Q13C301, AANDC Land Lease 47H/16-1-2, and Part J, Item 2 of the Type A Water Licence, 2AM-MRY1325 - Amendment No. 1 which required the PCRP to be updated to an ICRP 60 days prior to the commencement of the mining operations.

The Mary River ICRP was developed to increase the detail of the closure criteria and planning presented in the PCRP. It addresses progressive rehabilitation undertaken to date and addresses temporary care and maintenance and long-term closure as well as final cessation of operations. Public health and safety is considered throughout all stages of progressive rehabilitation, closure, and post-closure.

The ICRP does not constitute a Final Mine Closure and Reclamation Plan. The ICRP reflects the level of advancement of development on site and what is expect in future development.

2.3.1.3 Updates to the Interim Mine Closure and Reclamation Plan

It is anticipated the ICRP will be reviewed annually and updated regularly throughout the life of the Project, as per the terms and conditions of the Commercial Lease No. Q13C301 and the Type “A” Water License 2AM-MRY1325 - Amendment No. 1, and AANDC Land Lease 47H/16-1-2. Once the Project reaches full planned operation, and site activities and infrastructure have stabilized, less frequent updates may be discussed with QIA. Parties reserve the right to request an update, if warranted, and any changes to the existing ICRP update schedule would require QIA approval. Updates to the ICRP are primarily expected to focus on the refinement and elaboration of the specific performance indicators and commitments and incorporating any reclamation strategy changes based on reclamation research.

Baffinland expects ICRP updates to mainly coincide with the development of the Annual Work Plans as ICRP updates will primarily be required when an Annual Work Plan calls for the construction and operation, or reclamation, of components of the Project that have not been adequately addressed previously or further information has become available or the Annual Work Plans notes material changes to project activities which would require consideration to closure and reclamation strategies. The update would also include any outcomes of the previous year's reclamation research, if successful or positive[4]. If a previously not considered activity or project component is proposed in an Annual Work Plan, the closure strategy will be detailed in the respective Work Plan and/or its supporting documentation.

- When updates to the ICRP are required, Baffinland proposes the following timetable[5]:
- By October 15 of a given year, Baffinland will provide a draft of the upcoming Annual Work Plan to the Landlord for discussion.
- By October 31 of a given year, Baffinland will submit the upcoming Annual Work Plan to all other relevant stakeholders.
- By November 30 of a given year, Baffinland expects review and comments on the upcoming Annual Work Plan from relevant stakeholders including the Landlord.
- By December 31 of a given year, Baffinland will provide an updated ICRP, if required, to the Landlord for review.
- By February 28 of the subsequent year, Baffinland expects discussions with the Landlord to be complete regarding the upcoming Annual Work Plan and ICRP revisions and Landlord approval of the ICRP, if required.
- By March 31 of the subsequent year, Baffinland will distribute the current version of the ICRP to all relevant stakeholders.

2.3.1.4 Final Closure and Reclamation Plan

As per Type "A" Water License 2AM-MRY1325 - Amendment No. 1 and QIA Commercial Lease No. Q13C301, the Final CRP will be developed and submitted no later than one (1) year, or earlier if possible, before scheduled permanent closure or immediately after notification of an unplanned closure (within

[4] The results of any reclamation research that occur during a given year will first be reported to relevant stakeholders in that year's NWB and QIA Annual Report.

[5] Proposed schedule of ICRP updates will be revisited if the frequency of the ASR process changes.

120 days) to provide greater detailed descriptions of the proposed reclamation activities such a manner that they can be subsequently implemented. If future revisions of referenced Project authorizations were to change, this timeframe will be adjusted accordingly. The Final CRP will include a schedule for the implementation of work; any additional appropriate closure criteria based on completed reclamation research and site monitoring; and fully describe the level of detail and certainty surrounding post-closure monitoring and contingency planning.

2.3.1.5 Final Monitoring Agreement

As per Section 12.3 and 12.4 of the QIA Commercial Lease No. Q13C301, Baffinland will submit a Final Monitoring Agreement within twelve (12) months prior to the completion of Operations. The Final Monitoring Agreement shall include, but not be limited to, provisions detailing the implementation of the contents of the Final CRP in respect of monitoring subsequent to the completion of the Operations and closure activities. The Final Monitoring Agreement will be entered into and determined with Baffinland and the Landlord before Baffinland submits the Final CRP or any other Monitoring Plans in respect thereof to other Governmental Authorities.

2.3.1.6 Exploration Abandonment and Reclamation Plan

The Exploration Abandonment and Reclamation Plan (BAF-PH1-830-P16-0038) is a distinct separate plan from the ICRP that describes the closure and reclamation activities and costs for the Mary River Exploration Project regulated under Baffinland's Type "B" Water Licence No. 2BE-MRY142. In the event Mary River Exploration Project activities occur on Inuit Owned Lands, Baffinland's IOL Commercial Lease (No. Q13C301) conditions will also then apply and the Exploration Abandonment and Reclamation Plan would be required to be reviewed and approved by the QIA. If exploration liability did occur on IOL, it is expected closure goal, principles, objectives, and criteria would apply for similar components.

2.4 Engagement

Baffinland's approach to stakeholder and Inuit community engagement emphasizes the importance of informing stakeholders, establishing effective communication strategies, and collecting feedback from them on potential issues and concerns.

Since 2014, the engagement program has included considerable consultation related to the Phase 2 Proposal, including the identification and discussion of topics of interest and concern regarding the proposal and potential effects. For detailed consultation information, refer to the Public Consultation Report (TSD-4), prepared in support of the Approved Project for the Phase 2 Proposal.

In support of achieving the engagement objectives defined for the Project, Baffinland implements a variety of engagement mechanisms that are intended to ensure that a broad and comprehensive approach to the identification of stakeholders and that the creation of enhanced opportunities for dialogue and input are executed. During engagement with the North Baffin communities, the QIA and other stakeholders related to the ERP and ongoing operations, a few questions were raised about Project closure and reclamation. These were mainly concerned with who would be cleaning potential Project-related spills as proponents of past projects created fuel spills, which may have affected marine mammals. Some community members wondered what would happen to Project infrastructure and equipment post-closure and others asked about the status of the ICRP.

Baffinland has proposed to establish a Mine Closure Working Group to best incorporate considerations for post-closure land use of the Project site. The role of this Mine Closure Working Group will be to facilitate the integration of community representation and technical expertise by drawing on Inuit knowledge, arctic experience for similar mining operations, and discussion of alternative uses for decommissioned facilities into the reclamation options for various Project components.

A mandate or terms of reference for the Mine Closure Working Group is currently being developed in consultation with the QIA prior to the initial first meeting of the Mine Closure Working Group. Baffinland is aiming to establish this group following the Phase 2 Project regulatory process in order to incorporate community engagement in the planning for the working group. As a prerequisite, Baffinland will review a summary of community feedback received on mine closure to date, as well as available QIA engagement records relevant to closure. This review will help align the terms of reference, group membership, and topic identification with stakeholder priorities. While the Mine Closure Working Group is anticipated to be developed following community engagement during the Phase 2 regulatory process, the approval of the Phase 2 expansion is not a prerequisite for the formation of the working group, and it is anticipated that this working group will be in place by the end of 2019.

Baffinland expects an early priority for the Mine Closure Working Group will be to determine additional or modified reclamation research activities (Appendix D) applicable to the Project to help address identified uncertainties and determine the appropriateness of existing action levels (Section 5.2).

As the Project advances, Baffinland is committed to engagement with stakeholders regarding closure and reclamation issues. These issues include, but are not limited to:

- Appropriate closure and reclamation objectives and criteria based on desired future land use (aesthetics and values) of Project areas.
- Additional or modified reclamation research activities (Appendix D).
- Requirements to address identified uncertainties and determine the appropriateness of existing action levels (Section 5.2).
- Whether there will be any interest in maintaining the bulk fuel storage facilities and/or sealift landing areas for use by the local community assuming responsibility for the operation and maintenance of the facilities would be transferred to the local interested party.
- Transfer of responsibility of the Tote Road water crossings to the local community and if the Tote Road will be left completely intact assuming road operation and maintenance responsibility would

then be transferred to another party. Implications for liability will need to be discussed with QIA in advance of this transfer.

- Transfer of responsibility of airstrip (including airstrip lighting) to the local community assuming the airstrip is left intact and operation and maintenance responsibility would then be transferred to another party. Implications for liability will need to be discussed with QIA in advance of this transfer.
- Whether there will be any interest in transfer of salvageable materials and buildings for local community use assuming responsibility would be transferred to another party.

Baffinland anticipates relying on the Mine Closure Working Group to best facilitate stakeholder engagement related to the Mary River Project and incorporate considerations for post-closure land use of the Project site. Stakeholder comments and Baffinland responses related to closure and reclamation are found in Appendix E.

2.5 Regulatory Instruments for Closure and Reclamation

Baffinland is committed to, and will be responsible for, carrying out the closure and rehabilitation measures in a phased, ongoing (progressive) manner as reviewed and agreed with the Landlord, regulatory agencies and impacted communities.

This current revision of the ICRP has been developed as per the Type "A" Water License 2AM-MRY1325 - Amendment No. 1 Part J, Item 2, in accordance with the *Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories (MVWLB/AANDC, 2013)*; and the *Abandonment and Reclamation Policy for Inuit Owned Lands* (the Qikiqtani Inuit Association-Version 3.0).

Relevant policies, guidelines, and associated regulations that Baffinland will adhere to in the development of this and future revisions to the ICRP are outlined in Table 2.1, below.

Table 2.1: Applicable Mine Closure Planning Policies, Guidelines, And Lease Requirements

Title/Year/Agency
Project Certificate No.005 (with associated amendment), 2014, NIRB
Type A Water Licence 2AM-MRY1325 (2013) and Amendment No. 1 (2015), NWB
Commercial Lease No.: Q13C301, 2013, QIA
AANDC Land Lease 47H/16-1-2, 2014, AANDC
Guidelines for the Preparation of an Environmental Impact Statement for Baffinland Iron Mines Corporation's Mary River Project (NIRB File No. 08MN053), 2009, NIRB
Abandonment and Reclamation Policy for Inuit Owned Lands, Qikiqtani Inuit Association, Version 3.0. 2013, 2013, QIA
Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories, 2013, MVWLB/AANDC
Mine Site Reclamation Policy for Nunavut, 2002, AANDC

Title/Year/Agency
Guidelines for Abandonment and Restoration Planning for Mines in the Northwest Territories, 1990, Northwest Territories Water Board
NWT/Nunavut Mines Health and Safety Act and Regulations, 2005, Government of Nunavut

A Glossary of Terms, Acronyms and Abbreviations used throughout this document and the applicable guidelines and regulations can be found in Section 12. Refer to Section 11 for a concordance review of applicable requirements.

2.5.1 Annual Security Review

On an annual basis, in order to account for interim closure and reclamation security adjustments to reflect project development phases until such a time planned closure commences, an updated determination of Project closure and reclamation security is captured through the Annual Security Review (ASR) process should Baffinland not be able to reach its planned closure phase. The ASR process is conducted in accordance with Schedule C of Type “A” Water License 2AM-MRY1325 and Section 9.2 of the Commercial Lease, No. Q13C301, agreed to between Baffinland and the Landlord and includes consultation with landowners and other key stakeholders.

2.5.2 Project Updates and Reporting

Since 2007, Baffinland has provided annual reports to the Nunavut Impact Review Board (NIRB) summarizing the site work completed, and the work planned for the following year for the activities previously screened and approved by NIRB. These reports also provide a synopsis of compliance performance with explorations licences, permits, approvals and commitments, and include the results of monitoring activities. An update on the existing environmental conditions and progressive reclamation activities are also contained in these reports. The reports are publicly available through NIRB (http://www.nirb.ca/) and results of the monitoring activities described in these annual reports which have an impact or influence on the goals, objectives, criteria, or strategy of the ICRP will be considered in future revisions of the ICRP.

Appendix C provides site photographs of current conditions onsite.

3 PROJECT ENVIRONMENT

A summary description of the atmospheric, bio-physical terrestrial and socio-economic environments at the Project site locations are outlined in the following sections. A comprehensive description of the baseline social, physical, biological and chemical conditions at the Project Location and impact area, with supporting documentation, are presented in Volumes 4 to 8 of the Mary River Project Final Environmental Impact statement (FEIS), and the ERP (Baffinland, 2013), available through the NIRB website (http://www.nirb.ca/), as follows:

- Volume 4: Human Environment
- Volume 5: Atmospheric Environment
- Volume 6: Terrestrial Environment
- Volume 7: Freshwater Environment
- Volume 8: Marine Environment

3.1 ATMOSPHERIC ENVIRONMENT

3.1.1 CLIMATE

The Project is situated in the Northern Arctic Ecozone. The climate is semi-arid and permafrost coverage is continuous to a depth of 500 metres, with an active layer of up to two (2) metres. Extremely cold temperatures, combined with the permafrost, result in a short period of runoff that typically occurs from June to September. All rivers and creeks, except for the very largest systems, freeze during winter. Due to the combination of low temperatures and low infiltration, vegetative cover is minimal and surface water is abundant. The region is dotted with thousands of small lakes and streams.

The region experiences near 24-hour darkness with less than two hours of twilight from November to January. During the winter months the treeless topography and fine powdery snow produce blowing snow conditions, resulting in restricted visibility. Frost-free conditions occur from late June to late August. There is continuous daylight from May to August. The months of July and August usually experience the greatest precipitation. From September to November, temperature and the number of daylight hours decrease, and by mid-October the mean daily temperature is generally well below 0°C. The highest snowfall typically occurs during this period.

For additional details on the Project climate conditions refer to Mary River Project FEIS, February 2012, Volume 5, Section 1.

A meteorological baseline report is included in the Mary River FEIS, Appendix 5A, Section 1.1 summarizes the collection of baseline meteorological data at each Project site and incorporates long-term meteorological data from regional Environment Canada (EC) stations. Figure 1 in Appendix 5A Meteorological Report and Meteorological Instrument Report, Volume 5 of the Mary River Project FEIS shows the regional and project specific meteorological station locations used to complete the climatic assessment to support the development of the Mary River Project.

At present meteorological data at the Project sites is continuously being collected internally. Baffinland are required under their Project Certificate to report on Climate change and provide weather information publicly on Baffinland website.

3.1.1.1 Air Temperature

The baseline meteorological report and meteorological instrument report provided in the Mary River FEIS, Volume 5, Appendix 5A, specifically Section 1.3 provides an overview of the mean monthly, annual, and expected project air temperature conditions. Figure 4 in Appendix 5A - Meteorological Report and Meteorological Instrument Report, Volume 5 of the Mary River Project FEIS shows the monthly mean average temperatures for the years 2005 to 2008 for both Environment Canada (EC) and Baffinland meteorological stations. EC climate stations range from approximately -34°C in February at Pond Port to about 7°C in July at Igloolik. The monthly average temperatures at Nanisivik are 0.7 -7.3°C colder than at other stations during summer and fall. Temperatures at Pond Port are 1-5.6°C colder than other stations during winter months.

Data from Pond Port are most representative of temperatures at all three Baffinland stations compared to the other long-term EC stations, although there is a tendency for warmer temperatures at the Baffinland stations during summer. The Pond Port data, corrected upward by 2.4°C during summer, are assumed to be reasonably representative of baseline conditions at Mary River Project site and to provide the best source of long-term temperature information for the Project sites

3.1.1.2 Precipitation

In the Canadian Arctic, precipitation comes in the form of rain, sleet, snow, and ice crystals. The climatic assessment found in Appendix 5A of the Mary River Project FEIS provides a mean monthly and long term annual precipitation data for meteorological stations. Data indicates that precipitation has increased slightly over the entire measurement period (about 0.24 mm/year). Mean monthly precipitation at long-term ECCC climate stations range from 4 mm in February at Pond Port, Hall Beach and Nanisivik, to about 64 mm in August at Dewar Lakes. Variability in precipitation at the long-term ECCC stations ranges from about 5 mm in January to about 30 mm in August.

Total rainfall was measured at the Project site meteorological stations for months where the mean temperature was typically above 0°C which includes May to October. These months were used to compare the Project-measured precipitation data with measurements from the EC meteorological stations. Mary River had more rainfall in summer than all other Project stations, whereas rainfall in Milne Port and Steensby was mid-low range except for autumn months, when they were higher than at all other stations. Based on a comparison of the monthly trends, it appears that the data from Hall Beach are most representative of rainfall in Mary River, and data from Pond Port and Igloolik are most representative of rainfall from Milne Port and Steensby, respectively.

Data from the EC Hall Beach meteorological station was assumed to be reasonably representative of baseline rainfall conditions at the Mary River Project site and to provide the best source of long-term precipitation information. Likewise, an average of precipitation data from Pond Port and Igloolik meteorological stations were assumed to be reasonably representative of baseline conditions at both Milne Port and Steensby Port. Additional details are provided in Section 1.4, Appendix 5A, Volume 5 of the Mary River Project FEIS.

3.1.2 Air Quality

The Project is in a remote location with no existing local sources of air pollutants other than the Project which introduces new, local sources of air contaminants such as particulate matter (TSP, PM_{10}, and $PM_{2.5}$), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), and carbon monoxide (CO) to the Project area.

In order to identify air quality baseline conditions, Baffinland did some ambient monitoring to assess the background air quality in the areas where project activities would occur. The monitoring results were supplemented with long term ambient air quality data that exists for other monitoring stations in the north. Parameters monitored for include:

- Total suspended particulate (TSP)
- Inhalable particulate matter (PM_{10})
- Total particulate deposition (dustfall)
- Sulphur dioxide (SO_2)
- Nitrogen dioxide (NO_2)
- Ozone (O_3)
- Dust deposition
- Metals deposition

Baffinland's 2007 baseline ambient air quality monitoring program had two components: an active and a passive monitoring program:

Active Monitoring Program: Measured ambient concentrations of TSP. Samples were collected simultaneously from two locations near the Mine Site over 72 hours using battery-powered Airmetrics "MiniVol" samplers. Sampling time was increased from 24 hours to ensure adequate capture of particulate and to increase the accuracy of the measurements, as low particulate levels were anticipated. A Dust Track monitored particulate matter with aerodynamic diameters less than 10 µm (i.e., PM_{10}).

Passive Sampling Program: Collection of SO_2, NO_2, and O_3 samples simultaneously at two different locations near the Mine Site. Passive monitors (duplicate monitors for each contaminant) were installed at each location for 49 days. This program also involved collection of particulate deposition (dustfall), including metals at the same locations also over the same period. Section 2, Volume 5 of the Mary River

Project FEIS, February 2012, identifies existing air quality conditions in the project area and describes potential effects of the Project on air quality.

Summary tables below were extracted from Tables 5-2.1, 5-2.2 and 5-3.3, Section 2.2, Volume 5 of the Mary River Project FEIS provide the baseline air quality conditions for the Project. Additional details on the air quality monitoring program and baseline conditions refer to the Baseline Air Quality Report Appendix 5C-1 of the Mary River Project FEIS.

Table 3.1: Measured Baseline Concentrations

Parameter	Baseline Concentration ($\mu g/m^3$)
24-hour TSP	7.0
24-hour PM_{10}	3.8
30-day SO_2	0.262
30-day NO_2	0.188
30-day O_3	52.8

Table 3.2: Baseline Dustfull Deposition Rates

Parameter	Baseline Deposition Rate ($mg/100cm^2/30$-day)
Total Dustfall	0.398

Table 3.3: Baseline Metal Deposition Rates for Select Metals

Parameter	Baseline Deposition Rate ($\mu g/100cm^2/30$-day)
Al	26.9
Co	0.5
Cr	0.3
Fe	30.6
Mg	23.9
Mn	1.7

Source: Tables 5-2.1, 5-2.2 and 5-2.3, Section 2.2, Mary River FEIS Volume 5

Air quality monitoring conducted since project operation in 2014 has included ambient air quality monitoring of gaseous emissions at the Mine Site and Milne Port, and dust fall monitoring along the Tote Road, at Mine Site and Milne Port. Ambient air quality results to date have indicated that NO_2 and SO_2 continue to meet ambient air quality standards. Dust fall at the Mine Site has generally been within predicted levels; however, at Milne Port dust fall has exceeded predictions near the ore stock piles and near the camp where dust is generated by both traffic and the nearby ore piles. Along the Tote Road, within 30 m and one kilometre on either side of the road, dust fall has shown an increase over predictions. However, outside the one kilometre range the dust fall deposition rates decreased to just at or below laboratory detection limits, which is within predicted levels.

3.1.3 Noise and Vibration

A detailed noise baseline assessment was conducted in 2007 and provided as Appendix 5D-1 of the Mary River Project FEIS, February 2012. The basic procedure to establish baseline noise levels consisted of:

- Conducting measurements and recording sound levels at Milne Port, the Mine Site, and Steensby Port.
- Validating the data based on the recordings and weather information.
- Calculating the resulting validated sound level data.

Background atmospheric noise levels in remote areas are typically low, ranging from about 25 to 40 dBA, similar to those measured for the Mine Site, Steensby Inlet and Milne Inlet. Table 3.4 below which is a replica of Table 5-3.1 from Volume 5 of the Mary River Project FEIS shows the measured ambient noise values for each site. At these levels, noise would be described as faint.

Table 3.4: Baseline Noise Monitoring Results

Site	L_{eq} (24 h) (dBA)	L_{eq} (Day, 15h) (dBA)	L_{eq} (Night, 9h) (dBA)	Minimum L_{eq} (1 h) (dBA)	Maximum L_{eq} (1 h) (dBA)
Mary River	25	25	26	20	34
Steensby Inlet	29	31	26	23	35
Milne Inlet	30	31	29	21	35

Source: Mary River FEIS, Appendix 5, Table 5-3.1

3.2 Physical (Terrestrial) Environment

Superficial landforms and deposits in the Mary River Project area are associated with widespread glaciation on Baffin Island. Surface geology consists of locally abundant sediment deposits from glaciers and rivers. Occasional outcrops of granitic and sedimentary rock formations occur. The North Baffin region containing the Mary River area lies within the Committee Belt, a granite-greenstone terrain mixed with sedimentary and volcanic rock. The mountains to the east are older than 540 million years old, and the lowland plateaus to the west are about 250 to 540 million years old.

3.2.1 Topography

Topography varies considerably across the Project area. The shoreline of Milne Inlet in the northern part of the Project area is situated on a relatively broad, deep and flat sand beach. Milne Inlet itself is enclosed by steep fiord walls measuring 60–600 m above sea level (asl). Moving inland, the Milne Inlet Tote Road follows the Phillip's Creek valley that starts near sea level at Milne Inlet and rises to 188 m asl at the Mine Site. The Phillip's Creek valley is confined by hills or mountains on both sides. West of the Phillip's Creek Valley is mountainous terrain with some occurrence of glaciers.

At the Mine Site, Nulujaak (Deposit No. 1) rises quickly to 679 m asl from the fairly flat and sandy outwash plain where the exploration camp is currently located. Nulujaak is a landmark for Inuit travelling on the land and is part of a ridge trending approximately north–south. The land to the west is equally mountainous with some minor coverage of glaciers. East of Deposit No. 1 the land is somewhat rolling with several elevated plateaus formed by horizontal sedimentary deposits. South of Mary River the undulating outwash plains end near the Ravn River. South of the Ravn River the land is quite flat and poorly drained and begins to drop steeply toward the Cockburn Lake valley, which is bounded by steep cliffs that range from 360–380 m asl. The land south of Cockburn Lake to Steensby Inlet becomes flatter with mainly undulating bedrock and boulder landforms. Figure 6-2.1 - Relief Map of the Northern Baffin Region, found in Section 2.1.1.1. Volume 6 of the Mary River Project FEIS shows the relief across North Baffin Island, and the topography as it relates to Project features starting in the north at Milne Inlet and extending towards Steensby Port in the south.

Additional details on topography can be found in Section 2.1.1.1, Volume 6 of the Mary River FEIS, February 2012.

3.2.2 Permafrost

The Project is located in a zone of continuous permafrost which can extend to depths of several hundred metres. Cryosolic soils (i.e., those affected by permafrost-related processes) predominate. The active layer through the Project area typically ranges from approximately 1 to 2 m but may be greater in areas where there is loose, sandy soil at the edges of lakes or ponds and less in areas with a substantial surface layer of wet organics. Unfrozen taliks can exist within areas of continuous permafrost below lakes, under large rivers or near the coast.

Permafrost thickness in and around the RSA is considered to be deep, typically in the 400–700 m depth range. In 2007, a 400 m thermistor installed into Deposit No. 1 showed that the depth to permafrost is predicted to extend to 610 m at this location which is well below the planned depth of mining.

Between 2006 and 2008 more than fifty ground temperature monitoring instruments (thermistor cables) were installed and sporadically monitored to determine typical ground temperatures in the overburden soils and bedrock across the RSA. Many were installed to depths sufficient to define the typical stable temperatures in the permafrost soils below the depth of zero annual amplitude. The depth of zero annual amplitude in temperature fluctuation appears to exist at depths of between 10 and 15 m in the valleys. At that depth, the "typical" permafrost temperature is roughly -10°C. Details on permafrost are described in Section 2.1.1.4, Volume 6, of the Mary River Project FEIS.

3.2.3 Surficial and Bedrock Geology

The surficial geology of the area generally consists of locally abundant Holocene glacio-lacustrine sediments, alluvial sediments (alluvial deposits), marine and glacio-marine deltaic sediments and end moraine till, with occasional outcrops of pre-Quaternary bedrock and sedimentary rock formations. Figure

6-2-2 - Surficial Geology in the Regional Study Area (RSA) in Volume 6 of the Mary River FEIS shows the surficial geology of the Project area.

The following sections provide some more specific observations associated with the surficial geology at some of the proposed and existing project infrastructure locations/sites.

Mine Site - The Project is located in a glaciofluvial outwash deposit in what appears to be a classic U-shaped valley. There are some direct glacial deposits consisting of kames, moraines and eskers in and around the southeastern portion of Sheardown Lake. The outwash valley is essentially a relatively flat plane with very little local relief, the primary exceptions being along water bodies, esker deposits and adjacent to valley edges. Valley walls are generally steep and abrupt, often with distinct terraces.

Northern Transportation Corridor - The Northern Transportation Corridor alignment (along the Tote Road) generally follows a glacial valley-oriented northwest-southeast to the Mine Site. The surficial deposits along this alignment include till veneer or blankets on the higher elevations with some drumlins and moraines. Glaciofluvial outwash sediments (gravel and sand) forming braided floodplains, terraces and fans or stratified glacial drift (gravel and sand) are typically found in the valley floors. Limited bedrock exposure is present along the Tote Road.

Milne Port - The dominant landforms in the Milne Inlet area are typically a result of glacial activity, marine and mechanical forms in various degrees. Glacial activity is not overly apparent on the immediate Port site but is more pronounced in the higher elevations south of the site. Marine and mechanical features are most predominant with terraces and strand (beach) lines formed by marine action which have been cut by mechanical features, some of which may be attributed to permafrost. Wind appears to have been responsible for some drifting on the finer grained soils on the lower part of the site. Recently deposited colluvium is present on many of the slopes and side hills in the area. The action of surface water has produced numerous sharp gullies along water-ways. Marine clays were also noted at some locations at the site.

Southern Transportation Corridor - The topography of the Southern Transportation Corridor from the mine site to the Steensby Port is generally quite hilly, with the exception of the Ravn River area which is relatively flat. Glaciated valleys are evident along a significant portion of the alignment. The surficial geology of the corridor is also characterized by the relatively recent glacial activity of Baffin Island. Surficial geology consists of several types of deposits including glacio-lacustrine sediments, alluvial sediments (alluvial deposits), end moraine till, and till veneers and blankets. Occasional outcrops of pre-Quaternary bedrock and sedimentary rock formations are also common along the southern section of the RSA.

Steensby Port - Near surface bedrock is dominant in the Steensby Port area. Limited overburden is in the form of marine sediments and localized deposits of till. The majority of the overburden is located in depressions bet

For additional details on site specific baseline conditions refer to Section 2.1.1.2 Surficial Geology, Volume 6 of the Mary River Project FEIS.

3.2.3.1 Surficial Soils Composition

A soils evaluation was carried out in 2007 and 2008 by an Arctic soils specialist (Veldhuis, 2010). Regionally, soil formation is controlled and limited by year-round low soil temperatures, low precipitation rates and near-surface permafrost. Soil formation occurs in the thin layer overlying the permafrost that is subject to seasonal thawing, known as the active layer. The thickness of the active layer varies substantially across the region with topography, depth to bedrock, and vegetative or water cover but is typically between 1 to 2 m thick in the Project area depending on the local soil cover. In locations where well drained, dry sand and gravels are present, thaw depth can extend to 2 to 4 m depth.

3.2.3.2 Bedrock Geology

The baseline information available on bedrock geology in the Project area is based on field geological exploration programs conducted by Baffinland geologists from 2004 to 2008 and summarized by Aker Kvaerner (2008).

The North Baffin Island region and Mary River area lie within the Committee Belt, a granite-greenstone terrane mixed with rift basin sediments and volcanic rocks. The belt lies within the Churchill Province, extending from Baker Lake to Greenland, and is divided into five main assemblages: the Archean, the Mary River Group, the Piling Group, the Bylot Supergroup, and the Turner Cliffs-Ship Formation.

The Mary River iron deposits are located within the Mary River Group, an assemblage of Late-Archean (2.76 to 2.72 Ga) metasedimentary to metavolcanic rocks that have been folded and preserved in greenstone belts. The Mary River Group greenstone belts are present as fragmented remnants stretching from Bylot Island south to Eqe Bay. Refer to Figure 6-2.5 – Bedrock Geology in the RSA shown in Volume 6 of the Mary River Project FEIS, Primary sequences within the Group consist of a lower series of metavolcanic rocks and an upper series of turbidite pelitic-greywacke; the stratigraphic position of iron formation, quartzite, conglomerate, minor marble, and volcanic breccia units within the belts, which varies across the region. The Mary River Group is part of the regional Committee Belt, an Archean-aged (2.9 to 2.5 Ga) assemblage of granite-greenstone terranes, granitic migmatites gneissic granitic intrusions, and clastic and carbonate sedimentary units reworked during the Paleo-Proterozoic (2.5 to 1.6 Ga). For additional details on site specific baseline conditions refer to Section 2.1.2, Volume 6 of the Mary River Project FEIS.

3.2.4 Hydrology and Drainage

Groundwater flow in the Local Study Area (LSA) consists of seepage through unconsolidated materials within the active layer, which typically ranges from 1 to 2 m (up to 3 m) below surface. This groundwater reports to local surface drainages and lakes. The long period of sub-zero temperatures results in a very short runoff season, typically occurring from June through September. Runoff may extend to late October in systems with large lake components. A Baseline Hydrology Report for the Project is found in Appendix 7A, Volume 7 of the Mary River FEIS.

The key findings within the Baseline Hydrology Report pertain to four main hydrometric parameters: timing of runoff, magnitude of runoff, spatial variability of timing and magnitude of runoff, and long-term runoff estimates. Runoff in the vicinity of the Mary River Project are characterised as follows:

- Streamflow typically commences in early to mid-June as temperatures climb above 0°C, and ends in late September to late October, depending upon watershed characteristics.
- The annual hydrograph is dominated by a nival (snowmelt) freshet, which occurs between late June and the end of July, followed by a period of low baseflows driven by permafrost melt and shallow subsurface flow. Baseflows are punctuated by precipitation events through July to early September.
- Precipitation runoff events are usually quite large and flows increase rapidly as interception, infiltration, and evapotranspiration are minimal due to shallow permafrost, cool temperatures and lack of vegetative cover.

The drainage pathways for the Mary River Project are defined by catchments as shown in the following figures in from Volume 7 of the Mary River Project FEIS. Additional details on drainage can be found in Section 2.0 of Volume 7 of the Mary River Project FEIS.

- Figure 7-1.1 – Freshwater Regional Study Area
- Figure 7-1.2 – Milne Port Local Study Area and Milne Tote Road Local Study Area
- Figure 7-1.3 – Mine Site Local Study Area
- Figure 7-1.4 – Railway Corridor Local Study Area and Steensby Port Local Study Area

3.3 Chemical Environment

3.3.1 Surficial Soil Chemistry

Project area soils were classified based on the Canadian System of Soil Classification (National Research Council, 1998), and included primarily Cryosols (permanently frozen soils or soils with permafrost within 100–200 cm of soil surface) and Brunisols (soils with weak B horizon development). In general, Project-area soils all showed weakly developed horizons, with a general lack of organic material accumulation. Fine to medium-textured soil materials were generally cryoturbated, and patterned ground phenomena related to permafrost and freeze-thaw cycling were also commonly observed throughout the RSA. Soils throughout the RSA were generally poor in nutrients (Table 3.5). This factor, in combination with the depressed level of pedogenic development in the area and thinness of soils where present, generally make local soils unsuitable for stockpiling for revegetation purposes (Veldhuis 2010). For further information regarding surficial soils composition, see Section 2.1.1.3, Volume 6, of the Mary River Project FEIS.

Table 3.5: Total Amounts of Organic Matter And Primary Nutrients In Soils in the Project Area

Parameter	Concentration Range per Horizon, %			
	B Horizon (sandy)	C Horizon (sandy)	B and C Horizons (loamy)	A Horizon
Organic Matter	0.83 (0.17 - 2.21)	0.34 (0.17 - 0.51)	2.81 (0.17 - 5.44)	13.72 (2.38 - 26.00)
Nitrogen	0.04 (0.02 - 0.08)	0.03 (0.02 - 0.04)	0.15 (0.012 - 0.36)	0.93 (0.09 - 1.14)
Phosphorous	0.03 (0.01 - 0.09)	0.07 (0.04 - 0.11)	0.04 (0.02 - 0.10)	0.06 (0.06 - 0.11)
Potassium	0.13 (0.05 - 0.36)	0.15 (0.09 - 0.25)	0.47 (0.16 - 0.69)	0.08 (0.06 - 0.11)
Sulphur	< 0.01	< 0.01	0.02 (0.01 - 0.05)	0.06 (0.01 - 0.10)

NOTE(S):
1. FROM VELDHUIS 2010.

3.3.2 Surface Water and Sediment Quality

Freshwater quality measurements in the Mary River area indicate naturally elevated concentrations of dissolved oxygen, turbidity, aluminium, and iron. Some average values for pH, as well as cadmium and mercury in fresh water are greater than levels recommended by the guidelines of Canadian Council of Ministers of the Environment.

A baseline water quality program was carried out over the period of 2005 through 2008 which included up to 74 surface water sampling sites distributed throughout the study area. Three lakes in the vicinity of the Mine Site with the potential to be affected by Project-related components and activities were sampled in 2006 through 2007: Camp Lake, Sheardown Lake and Mary Lake. In 2008, lake water sampling extended to the Steensby Inlet area, the Rail Camp area, and the current railway alignment. A follow-up water and sediment quality monitoring program was carried out in summer 2011 to update the dataset and to obtain water and sediment quality data from candidate long-term water monitoring locations. Sediment samples were collected from various lake, stream, and river locations. The complete water and sediment quality baseline data are provided in the Surface Water and Sediment Baseline Report found in Appendix 7B-1, Volume 7 of the Mary River FEIS.

Volume 7 of the Mary River FEIS, February 2012 discusses impacts to the Freshwater Environment, including impacts on water quantity, quality and fish habitat. Sections 1 and 2 of Volume 7 describe the baseline hydrologic conditions, potential impacts and mitigation measures and residual effects of activities on the hydrologic system in the Project area. Sections 3 and 4 of Volume 7 include similar content related to water quality and aquatic biota and habitat, respectively.

Water quality monitoring of the mine has demonstrated general compliance with required discharge limits and have not identified project-related effects on water quality in potentially affected waterbodies. Baffinland has generally been in compliance with the discharge limits specified in its Type A Water Licence, with two exceptions, where immediate corrective action was undertaken. Aquatic Effects Monitoring Program monitoring to date has not identified a significant mine-related effect to the nearby aquatic environment. To date, monitoring under the Environmental Effects Monitoring (EEM) Program under Metal and Mining Effluent Regulations (MDMER, formerly the Metal Mining Effluent Regulations) has demonstrated compliance with MDMER requirements (Baffinland, 2017c).

3.3.3 Geochemistry

Deposit No.1 occurs at the nose of a syncline plunging steeply to the north-east (Aker Kvaerner, 2008). The iron formation occupies the nose and two limbs of this feature with a -1,300 m long northern portion and a – 700 m long southern portion. For the LOM characterization, waste rock was subdivided based on broad geo-structural categories about the iron ore zone, mainly by hanging wall and footwall zones.

- The iron ore deposits at the Mary River project represent high-grade examples of Algoma-type iron formation and are composed of hematite, magnetite and mixed hematite-magnetite-specular hematite varieties of ore (Aker Kvaerner 2008). The iron deposits consist of a number of lensoidal bodies that vary in their proportions of the main iron oxide minerals and impurity content of sulphur and silica in the ore. The massive hematite ore is the highest grade ore and also has the fewest impurities, which may indicate it was derived from relatively pure magnetite orthat chert, quartzite and sulphides were leached and oxidized during alteration of the iron formation.
- The footwall to the iron formation mainly consists of gneiss with minor schist, psammitic gneiss (psammite) and amphibolite. The footwall mainly consists of quartz-feldspar-mica gneiss with lesser meta-sediment (greywacke) and quartz-mica schist. Microcline and albite are the predominant feldspars within the gneiss and biotite is generally more abundant than muscovite.
- The hanging wall is primarily composed of schist and volcanic tuft with lesser amphibolite and metasediment. The hanging wall primarily encompasses chlorite--actinolite schist and garnetiferous amphibolites. Metavolcanic tuftis also a significant lithology identified in the hanging wall.

Metal leaching and acid rock drainage (ML/ARD) characterization studies in support of the LOM pit waste rock are provided in the report entitled "Mine Rock ML/ARD Characterization Report Deposit 1, Mary River Project", March 2014 as appended to the LOM Waste Rock Management Plan. Additional investigations have been completed specifically for the 5-year open pit and in response to observed acidic conditions within the current waste rock pile (AMEC, 2014 and AMEC, 2017).

A total of 776 Acid-base Accounting (ABA) samples and 376 minerology samples were selected to provide representative samples of the waste rock categories and broad spatial coverage of non-ore mine rock in the vicinity of the LOM open pit development. All 776 ABA samples were analyzed for modified Sobek acid base accounting (ABA), NAG, pH, and elemental content. Subsets of drill core samples were also analyzed for downhole variability, NAG leachate, short-term metal leaching, whole rock elemental content, detailed mineralogical analysis, and long-term kinetic testing.

Results of ABA testing from the Life of Mine (LOM) characterization determined that waste rock is generally characterized as having low neutralization potentials (NP) and low acid potentials (AP). Data suggests that the waste rock is dominated by noncarbonate sources of NP (e.g. silicates) with lesser NP derived from carbonate sources. Sulphide was the primary form of sulphur; however, further review of the geochemical database notes that sulphates may also contribute to total sulphur contents.

- Approximately 85% of waste rock samples had neutralization potential ratios (NPR) greater than 2 and are classified as non-potentially acid generating (Non-PAG) and are unlikely to generate acidic drainage.
- Approximately 10% of the samples had NPR values of less than 1.
- Approximately 5% of the samples were classified as having uncertain acid generating potential (1 < NPR < 2).

Extrapolating these results to the project waste rock model, indicates that approximately 11% of the LOM in-pit waste rock is expected to have NPR <2 and is considered potentially acid generating (PAG). Proximity to ore appears to correlate to increased PAG quantities (defined as NPR <2) with the hanging wall schist (HWS) and footwall schist (FWS) zones identified with the greatest proportion of PAG of the major waste units. The proportion of LOM PAG waste rock was estimated to be 14% as part of the baseline studies and FEIS, representing a larger proportion than current projections.

Ten (10) waste rock samples were run in humidity cells for 53 weeks in 2008 and 2009. A further 17 waste rock samples were initiated in humidity cell tests in May 2011 for between 109 and 120 weeks of reported data. Nine (9) of these samples were standard humidity cells and eight (8) were NP depleted humidity cells designed to assess drainage quality in the absence of carbonate NP.

The pH of most cells was in the range of 5.5 to 7 throughout testing. Of the 17 cells in operation since 2011, three cells exhibited slowly declining pH throughout testing reaching a minimum measured weakly acidic pH of between 4.5 and 5 after approximately two (2) years of operation (under laboratory conditions). Selected humidity cell tests are planned to continue. Kinetic testing results and cold climate conditions at site suggest the lag time to acid on-set in PAG rock would be on the order of five (5) years or longer.

Total sulphide content of samples is weakly correlated with sulphate release rates; however, through the current periods of testing metal release rates and trends vary among the cells. Though metal release rates are generally low in most cells, release rates are the highest in the lower pH humidity cells with notable release rates for cadmium, cobalt, copper, nickel, lead and zinc in two (2) cells which also contain near worst case solid concentrations for these metals in Deposit 1 mine rock.

Water quality of the Waste Rock Stockpile runoff and discharge from the Waste Rock Stockpile pond(s) will be used as key environmental performance indicators. Conductivity, pH and sulphate will be used as early-warning indicators to identify potential acid generation in the pile. Ammonia and nitrate will be monitored to inform the effects of remaining explosive residue on the water quality of WRF runoff.

Water quality of effluent discharges from the waste rock surface water management pond(s) will be compared to the water quality criteria outlined in the Type A Water Licence and MDMER and used to inform and implement adaptive management actions as required.

3.4 Biological Environment

3.4.1 Vegetation

Existing knowledge of the North Baffin region with respect to vegetation describes the area as having a harsh climate, high winds and shallow soils result in sparse and dwarfed plant life. Herb- and lichen-dominated communities constitute the main vegetative cover. The latter is closely associated with the rock fields and hilly upland areas. Common herbs are purple saxifrage, mountain avens, and arctic poppy, often mixed with shrubs such as arctic willow. The size of shrubs decreases rapidly as one moves north. Vegetative cover tends to be greater on wetter sites confined to coastal lowlands, sheltered valleys and moist nutrient-rich corridors along streams and rivers. Baseline studies of the Mary River Project area were conducted during each of the summers of 2005 through 2008. A total of 833 plots were surveyed across the terrestrial RSA, focusing mainly on the Potential Development Areas (PDA). A total of 155 vascular plant species were recorded, a vegetation classification system was developed, and a species list was compiled. In addition to vegetation surveys, there was particular emphasis on establishing baseline levels of different metals and elements of the area prior to project development. Results for of the Vegetation Baseline Report for the project, including selected metals in plant species foliage are summarized and detailed in the Vegetation Baseline Report, Appendix 6C, Volume 6 of the Mary River Project FEIS, February 2012. Figure 2 –Terrestrial Regional Study Area showing Vegetation plot locations found in Appendix 6C of the Mary River FEIS shows the vegetation plot locations in the regional study area.

The vegetation abundance monitoring program to date has indicated no evidence of changes in vegetation abundance in the Project area from 2014 to 2017 as a result of the Project. There is annual variation in the cover of some plant groups in the Project area; however, these differences were found across all plots; therefore, the variation is attributed to natural variation in plant group cover and there is no evidence to support a Project-related effect in the first three (3) years of monitoring. Metals analysis of soil and vegetation was conducted from 2012 to 2016; all results have been within the expected range and below Project-specific thresholds, following the resampling of two stations in 2017 that were confirmed to be outliers.

3.4.2 Aquatic Wildlife

A freshwater aquatic baseline study was completed for the Project from 2005 and 2011. The results of this report are presented in Appendix 7C, Volume 7 of the Mary River FEIS, February 2012 and summarized at a high level in the sections below.

There are two key fish species in the freshwater environment: Arctic char (*Salvelinus alpinus*) and a minnow species named nine-spine stickleback (*Pungitius pungitius*). While both are generally abundant and widespread in distribution, ninespine stickleback are absent from the freshwater lakes and streams that were surveyed near the Milne Inlet coast. As all streams with the possible exception of large rivers freeze solid in winter, lakes provide the only overwintering habitat for both species and spawning habitat for Arctic char across the study areas. Many streams provide rearing and foraging habitat and potential protection from predators for juvenile Arctic char. Most of the drainage basins that support Arctic char either contain barriers preventing anadromous migrations and/or are distant from the coast and most populations in the five study areas are land-locked. Nearshore zones of larger lakes also provide rearing and foraging habitat and potential protection from predators for juvenile Arctic char, foraging and, in some cases, spawning habitat for adult Arctic char, and overwintering habitat for all life stages. Arctic char feed primarily on benthic invertebrates, although cannibalism occurs in a small proportion of at least some populations.

Mercury concentrations in Arctic char muscle exceeded guidelines for human consumption in some fish captured in the Mine Area, although concentrations were similar to those reported for other landlocked Arctic char populations. In general, the lower trophic level communities are similar to other areas of the Canadian Arctic. As is typical of Arctic ecosystems, the freshwater environment is relatively nutrient-poor and primary productivity is relatively low. In general, Arctic freshwater ecosystems are characterized by relatively low diversity of zooplankton communities due to low temperatures and nutrients; results of the baseline studies for Mine Area lakes are consistent with this generalization. The benthic invertebrate communities in the Mine Area are generally moderately diverse, although higher diversity is found in some small tributaries, and are dominated by chironomids.

Figures 7-4.2, 7-4.4, and 7-4.8 (FEIS Section 4.5) show the distribution of Arctic char in fresh water at the project sites.

Monitoring results to 2017 has identified impacts within the FEIS predictions, where FEIS predictions are exceeded, adaptive management is being applied to mitigate observed effects. At the Mine Site, while lake sedimentation rates in Sheardown Lake NW in 2016 and 2017 were greater than baseline, they remained within the range predicted in the FEIS, and monitoring of the biological communities (i.e., phytoplankton, benthic macroinvertebrates, and Arctic Char) conducted during the first three years of operation (2015-2017) indicated that there were no adverse mine-related influences on the biota of the Mine Site waterbodies and watercourses (Minnow Environmental Inc. 2016, 2017). Some issues regarding fish passage and condition of stream crossings along the Tote Road have been noted in the annual surveys conducted since 2009; as a result, Baffinland has implemented various mitigation measures to correct issues identified and will apply experience gained and lessons learned to the planning and design of the proposed North Railway watercourse crossings.

3.4.3 Terrestrial Wildlife

Terrestrial wildlife on north Baffin Island (described in the Mary River Project FEIS, Volume 6, Appendix 6F - Terrestrial Wildlife Baseline Report) includes caribou, wolves, foxes, Arctic hares, ermine, and small mammals. Terrestrial wildlife, caribou in particular, are an important part of the Inuit culture and are an important component of a subsistence lifestyle. Occurrence of most wildlife species on north Baffin Island is relatively sparse.

3.4.3.1 Caribou

A key terrestrial wildlife species (to both humans and within the broader ecology) is the North Baffin Island caribou. They currently occur in low densities and their abundance seems to be cyclical – harvest data and Inuit Qaujimajatuqangit (IQ – Inuit Knowledge) suggests a roughly 60- to 70-year cycle of abundance. The cyclical pattern of caribou abundance is similar to patterns described on Greenland and south Baffin Island. The cause of these changes in abundance is currently unknown. The last period of caribou abundance in the regional study area (RSA) was 1980 to 2000. According to IQ, and trail orientation and abundance, movement will predominantly be east-west and will occur within the southern half of the RSA Caribou numbers are expected to gradually increase in the Mary River Region, but might not recover to historical highs until the 2050s. There is evidence that caribou occur, and have historically occurred, throughout the entire region and, therefore, use most of the RSA as some form of habitat. The most-used habitat is in the southern and central portion of the RSA, as indicated by caribou sign (bones, antlers, tracks, and trails) and IQ. Trails observed along the proposed railway alignment suggest that some areas are better for movement. Analyses of habitat use show a greater probability of caribou occurrence for some habitats during the calving, growing, and winter seasons, but the probability of occurrence of caribou is relatively equal in many locations throughout the Project area. The caribou that currently occupy the RSA are not migratory. The local caribou on average move less than 4 km per day during all seasons with very few focused directional movements and all movements were at the scale of tens of kilometres — most caribou remained within the areas they were collared. Additional details on Caribou populations are summarized in Section 5 and Appendix 6F- Terrestrial Baseline Report of the Mary River FEIS.

The Terrestrial baseline report found in Appendix 6F of the Mary River FEIS is the most extensive and thorough summary of north Baffin Island caribou currently in existence. It summarizes and synthesizes the history of government surveys, local harvest, IQ, habitat use, and terrestrial wildlife surveys funded by Baffinland, and is one of the most in-depth analyses of caribou habitat selection completed in Nunavut.

In June 2013, a group of five caribou was observed in the PDA during height of land surveys; however, caribou have not been observed during surveys conducted between 2014 and 2017. Lack of caribou observations on site follows the trends of low numbers recorded in regional observations. Low numbers of incidental observations of caribou between the mine site and Milne Inlet between 2013 and 2017 also coincide with the lack of caribou observations during the height of land surveys.

3.4.3.2 Marine and terrestial Bird communites

The marine and terrestrial bird communities of north Baffin Island are described in the Bird Baseline Report found in Appendix 6E, Volume 6 of the Mary River FEIS.

Field surveys in the Project Area documented 54 bird species within the marine and terrestrial RSAs, five of them Species at Risk listed by COSEWIC (2010) or SARA (Environment Canada, SARA 2010) as identified during the time of baseline programs, including Peregrine Falcon, Short-eared Owl (documented within the terrestrial RSA but showing no signs of nesting there), and Ivory Gull, Ross's Gull and Harlequin Duck (all detected within the marine RSA, but no nesting sites were located). One additional Species at Risk, the Red Knot, has the potential to be found within the Project Area, but was not detected during baseline surveys.

Staging and breeding areas are found in the Project Area for numerous species of birds including Snow Geese, Common and King Eiders, Brant, and Long-tailed Ducks, and include a known moulting area for Snow Geese prior to fall migration. Twenty-five species were confirmed to breed throughout the marine and terrestrial study area. No large, conspicuous seabird nesting colonies were recorded during Project surveys; however, several are known to exist within and adjacent to the marine RSA, particularly on Bylot Island, in Foxe Basin, and along Hudson Strait. Marine surveys did locate a large breeding colony of Snow Geese (>5,000 individuals) on the southwestern shores of Steensby Inlet.

IQ surveys conducted in the surrounding communities indicated that the marine and terrestrial habitat contains several areas that are used seasonally by large numbers of various bird species. Community Elders indicated that most bird species in the area are migratory and typically arrive in late-April, May, and June, and start leaving in August. Breeding occurs throughout the area: most of the islands within the RSA are used as nesting grounds by various species of seabirds, gulls, terns and waterfowl, and some large colonies of seabirds and gulls are known along cliff habitats. Species such as geese, eiders, loons and ducks can be found nesting along coastlines or inland along freshwater lakes. Fall migration occurs between early August to late October depending on the species and the sex. Some birds, such as Common Raven, ptarmigan, and sometimes Snowy Owl, winter in the area, and some seabirds, such as Black Guillemot, also remain in the area year-round using the open shore leads in the winter.

Pre-clearing nest surveys in 2017 prior to development in expanded project footprint areas were conducted; no nests were identified within the new disturbance area. The addition of the 2017 results of the cliff-nesting raptor survey has indicated no evidence of a relationship between distance from the road/PDA and the number of birds observed. There has been no effect on cliff-nesting raptor nest occupancy rates since 2011, and distance to disturbance analysis suggests there is no negative effect on monitored raptor nesting productivity. Although annual variation in productivity for peregrine falcons and rough-legged hawks is apparent, it is most likely representative of natural variability associated with variation in prey availability and weather rather than due to any influence of disturbance.

3.4.3.3 Wolves and Foxes

Wolves and foxes are the dominant carnivores in the RSA and exist at low densities throughout the RSA. Very little information was collected on these midsize carnivores because they were so rarely observed. Fewer than 100 wolf and fox observations were recorded during extensive baseline surveys from 2006–2010. Information in published journal articles was supplemented with anecdotal and IQ information specific to the Project area for this baseline. Carnivore populations are tied to fluctuating prey densities (e.g., caribou and lemmings). Occurrence of carnivores might increase in the area if caribou populations return in large numbers. Additional details on midsize carnivores in the Project area can be found in Section 2.3, Appendix 6F-Terrestial Wildlife Baseline Report of the Mary River Project FEIS.

Lemming and Arctic Hare, Lemmings are a key prey species in Arctic ecosystems. Their abundance affects the behaviour, habitat use, and population dynamics of carnivores such as Arctic fox, red fox, wolf, Snowy Owls, and falcons. Lemming populations are considered Secure in Nunavut. Populations typically undergo large regular fluctuations in population size (every three to four years). Refer to Section 2.3, Appendix 6 F of the Mary River Project FEIS, February 2012 Arctic hare are a lagomorph found in treeless regions across North America and Greenland. They are restricted to mountains, tundra, and coastal barrens due to their apparent inability to use food resources in forested areas). They may occur in groups of 10–60, or up to thousands on Arctic islands the current population status of Arctic hare in Nunavut is classified as Secure by CESCC. In northern Baffin Island Arctic hare are locally abundant. Additional details on small prey mammals in Baffin Island can be found in Section 2.3, Appendix 6F-Terrestial Wildlife Baseline Report of the Mary River Project FEIS.

No caribou, wolf or other large mammal tracks were observed during snow tracking surveys conducted between 2014 and 2017; however, similar numbers of Arctic fox and Arctic hare tracks were observed throughout all survey years.

3.4.4 Marine Wildlife

The Mary River FEIS, Volume 8, Section 5.0 and Appendix 8A presents the marine baseline information for the Project area. In total twenty-two marine mammal species are known or expected to occur in the identified Regional Study Area (RSA) including the proposed shipping routes in Baffin Bay and Davis Strait. Species accounts are provided for all species; however, emphasis is placed on species which regularly occur within the Regional Study A. Only one mysticete or baleen whale species, the bowhead whale (*Balaena mysticetus*), occurs regularly in the RSA. Narwhal (*Monodon monoceros*) and beluga (*Delphinapterus leucas*) are abundant in the RSA; other Odontocetes that occur (albeit in low numbers) in the RSA include killer whales (*Orcinus orca*) and northern bottlenose whales (*Hyperoodon ampullatus*). Pinniped species which occur regularly in the RSA include ringed seal (*Pusa hispida*), bearded seal (*Erignathus barbatus*), harp seal (*Pagophilus groenlandicus*), and walrus (*Odobenus rosmarus*). Polar bears (*Ursus maritimus*) also occur throughout the RSA. For graphical representation in the RSA of which communities hunt which species of marine animals where, see Figure 3.8 – Land Use Information from DIAND (1982B) and Figure 3.9 – Wildlife Distribution found in Volume 4 of the Mary River Project FEIS.

Marine wildlife in the north Baffin Island (described in the Mary River Project FEIS, Volume 8, Marine Section 5) includes bowhead whale, beluga whale, narwhal, walrus, ringed seals, bearded seals, harp seals, and polar bears.

3.4.4.1 Bowhead Whale

Bowhead whales occur seasonally in the RSA and are typically found alone or in small groups. Bowheads are adapted to living in areas of heavy unconsolidated ice and can navigate extensive distances under ice although they are capable of breaking up to 20 cm of ice in order to breathe. Feeding and calving usually takes place in nearshore, sheltered, shallow waters in summer. During open-water periods bowhead distribution is likely driven by the distribution of the various prey species. Bowheads are baleen whales (filter feeders), eating pelagic crustaceans as well as epibenthic invertebrates. Traditionally, bowheads have been observed feeding along the floe edge and their presence is often dependent on the tides. There are four recognized bowhead stocks, one of which (the Eastern Canada-West Greenland stock) occurs within the RSA. This stock ranges throughout the eastern and central northern Arctic and from northern Baffin Bay to Hudson Strait. Bowhead whales within Davis Strait and Baffin Bay were commercially overexploited in the early 1900's, reduced from an estimated 11,800 whales to perhaps as low as 1,000. The stock has shown a significant recovery in recent decades and may now number greater than 14,000.

Along the proposed northern shipping route, bowhead whales occur during summer and fall. They may summer along the east coast of Baffin Island, or move westward through Lancaster Sound during June and July to feed and nurse calves in inlets and sounds within the Canadian arctic archipelago. The IQ suggests that the number of bowheads using Eclipse Sound appears to be increasing in recent years. It is thought that fall migrants wintering in Davis Strait follow the east coast of Baffin Island south to wintering areas, whereas whales that winter along the west coast of Greenland may cross north Baffin Bay and then move south.

The number of bowheads within the Foxe Basin-Hudson Bay region is estimated to be over 2,000. Bowheads congregate to feed and nurse calves in spring and summer around Southampton Island, along the western Hudson Bay coast, and in a relatively small area in northern Foxe Basin between Igloolik and Fury and Hecla Strait. The IQ indicates that bowheads observed near Hall Beach in spring migrate from southern Foxe Basin. Migrations are not well documented, though most movement is thought to take place through the western and central portion of Foxe Basin and may be influenced by ice cover. During summer, this species tends to select areas of high ice cover, presumably to reduce the risk of predation by killer whales. Northern Hudson Bay, Foxe Basin, and Admiralty Inlet have been identified as summering areas, with whales moving farther into inlets and bays as the ice breaks up. In summer months, bowhead whales north of Igloolik consist primarily of juveniles and females with calves, suggesting that this location is a nursing area. Aerial surveys of the Foxe Basin area identified small numbers of bowheads in northwest Foxe Basin but not Steensby Inlet.

Hudson Strait has been identified as a primary wintering area for bowhead whales. Bowheads begin winter migrations in October as the sea ice begins to form, heading south towards northeastern Hudson Bay and Hudson Strait. In 1981, over 1,300 bowheads were estimated in Hudson Strait and were observed during aerial surveys. Additional details on Bowhead Whales can be found in Section 5.1.5 Volume 8 of the Mary River FEIS.

3.4.4.2 Beluga Whale

Beluga whales have a circumpolar distribution and occur seasonally within the RSA. They are opportunistic feeders, consuming a wide array of fish and invertebrates. Mating is thought to peak prior to mid-April with calving likely occurring in offshore areas during late spring migration. A limited amount of calving may also occur near estuaries and bays that is supported by IQ indicating that Koluktoo Bay and the southern portion of Milne and Navy Board inlets may be calving areas.

Four of the seven recognized populations in Canada occur in the RSA, including the Eastern High Arctic-Baffin Bay, Western Hudson Bay, Eastern Hudson Bay population, and Ungava Bay populations. The Eastern High Arctic Baffin Bay population (estimated at >20,000) summers in the Canadian Arctic archipelago and winters in the loose pack ice of two distinct areas; along the west coast of Greenland and in the North Water Polynya in northern Baffin Bay. Beluga from the smaller population wintering in the North Water begin entering Lancaster Sound in late April or early May with peak movements occurring in late June to July depending on ice conditions. Belugas wintering off the west coast of Greenland generally occupy similar geographic areas between years. Large numbers from the Eastern High Arctic Baffin Bay population migrate past Bylot Island during spring on their way to summering areas concentrated near Somerset Island. Only a small number of animals move into areas inland of Bylot Island, ostensibly for calving and feeding. Eastward fall migrations begin in September, and are concentrated almost exclusively along the southern coast of Devon Island. Belugas were observed in Eclipse Sound, Eskimo Inlet, Koluktoo Bay, Milne Inlet, and White Bay during aerial surveys.

All four populations of beluga in the RSA are known or expected to occur along or in the vicinity of the southern shipping route. Beluga from the Eastern High Arctic Baffin Bay population enter into northern Foxe Basin during spring and remain in the general area of eastern Fury and Hecla Strait throughout the summer. These beluga typically remain in shallower waters where feeding is thought to occur.

The Western Hudson Bay and Eastern Hudson Bay populations occur in the southern shipping route waters from late October through April when the whales are in their wintering grounds, and during fall migrations from summering areas in late September and October. Beluga whales from both populations occur in the vicinity of Igloolik, Hall Beach, and likely Steensby Inlet during July to early September. The very small (possibly extirpated) Ungava Bay beluga population possibly occur year-round within the RSA. The most recent population estimate for the Western Hudson Bay population is about 57,000. The Eastern Hudson Bay population has been in decline.

The wintering location of the Western Hudson Bay beluga population has not been confirmed but it is thought to be primarily in Hudson Strait. Spring migration to summering areas occurs during late April to May. The majority of animals likely follow the eastern coast of Hudson Bay south to the Belcher Islands, and then across through the pack ice to the Manitoba coast in late May and early June. A small number move westwards towards Southampton Island. Belugas generally remain within estuaries along the coast and in September begin a northward migration towards Southampton Island.

Based on aerial survey results, beluga whales were widespread in Steensby Inlet, Foxe Basin and Hudson Strait but abundance varied with location and month. Additional details on Beluga Whales can be found in Section 5.1.3. Volume 8 of the Mary River FEIS.

3.4.4.3 Narwhal

Narwhals generally inhabit deep arctic waters of Baffin Bay, the eastern Canadian Arctic, and the Greenland Sea but are seldom found south of 61°. Their diet is thought to be similar to that of beluga, consisting primarily of small cod, flatfish such as Greenland halibut, squid, and other small fish and invertebrates.

Narwhals prefer coastal areas that provide deep water and protection from the wind during summer. They appear to favour deep fjords and the continental slope during winter, in areas where water depths are 1,000 to 1,500 m and marine water upwelling increases biological productivity. Narwhals are highly social animals and can be found in small numbers groups of hundreds or thousands during migration. Based largely on summer distributions, two tentative populations of narwhal occur in Canadian waters; the Hudson Bay population and the Baffin Bay population. However, narwhals are currently assessed as a single population in the eastern Arctic. Narwhals occur throughout the northern shipping route year-round but are found in the RSA primarily during the open-water period. Those that winter in Baffin Bay typically summer in the eastern Canadian Arctic, moving to summering areas in Melville Bay, Eclipse Sound, Smith Sound, and beyond Lancaster Sound. Important summering areas identified within Baffin Bay include Eclipse Sound, Inglefield Bredning, and Smith Sound-Kane Basin.

Recent estimates indicate that approximately 45,000 narwhal summer around Somerset Island, while over 27,000 inhabit waters in the Prince Regent and Gulf of Boothia area, with approximately 20,000 in the Eclipse Sound area, 10,000 in the East Baffin Island fjord areas, and 5,000 in Admiralty Inlet. Survey results from the late 1980's and early 1990's indicated that summer distribution of narwhal within Eclipse Sound, Milne Inlet, Koluktoo Bay, and Tremblay Sound is influenced by presence and distribution of ice and killer whales.

Narwhals begin to migrate out of their summering areas in groups of a few hundred to several thousand just before freeze-up begins in late September. Those summering near Somerset Island enter Baffin Bay north of Bylot Island in mid to late October. Populations summering in Pond Inlet begin migrating down the east coast of Baffin Island in late September. Narwhals generally arrive in their wintering areas in

November. The Baffin Bay narwhal population winters at two discrete areas in the pack ice in central Baffin Bay, and in polynyas at the north end of Baffin Bay.

Narwhals were identified in aerial surveys throughout in Eclipse Sound, Milne Inlet, and Koluktoo Bay. Narwhale observed during a typical survey often numbered in the thousands. Narwhals were also frequently seen in Tremblay Sound and White Bay. Aerial surveys documented fine scale movements of large groups of narwhal between various areas of Eclipse Sound and surrounding fjords.

A much smaller number of narwhal inhabit waters along the southern shipping route. The Hudson Bay population was estimated to be almost 2,000 in the year 2000, though it may be as many as 3,500 during summer months. The timing and routes of migration used by the Hudson Bay narwhal population are less understood than those of the Baffin Bay population. This population is thought to winter in eastern Hudson Strait and move towards summering areas located primarily in the Repulse Bay area north of Southampton Island during late June while some may move north towards Fury and Hecla Strait, in the vicinity of Igloolik.

Fall migrations to Hudson Strait begin in late August or early September, depending on ice conditions. A small number of narwhals that winter in Baffin Bay are thought to move through Fury and Hecla Strait into northern Foxe Basin during spring migrations in April and May.

Aerial surveys confirmed that narwhal occur in relatively low numbers in Foxe Basin; there were no sightings in Steensby Inlet. Narwhal were most abundant in Hudson Strait during April and June surveys when a small number of individuals were recorded. Additional details on Narwhal can be found in Section 5.1.4, Volume 8 of the Mary River FEIS. No significant change in overall narwhal abundance and distribution was observed in the area from 2014-2017.

3.4.4.4 WALRUS

Walrus have a discontinuous circumpolar distribution and are migratory, moving with the ice. They winter in the offshore pack ice of Davis Strait and along the west coast of Greenland, the North Water Polynya off eastern Devon Island and northern Labrador, as well as in Foxe Basin ranging from the floe edge along the north side of Rowley Island and south to the Melville Peninsula. Walruses are primarily benthic feeders on bivalve molluscs and other invertebrates, and are generally confined to shallow coastal waters up to 100 m.

Four extant stocks occur within Canadian waters however these may be further subdivided. Three of the four identified stocks occur within the confines of the RSA; the Baffin Bay (High Arctic) population, the Foxe Basin population, and the North Hudson Bay-Davis Strait population.

The Baffin Bay walrus population is estimated between 1,700 and 3,000 individuals with summering populations in Kane Basin, Buchanan and Princess Marie bays, Jones Sound, eastern Ellesmere Island, and the Lancaster Sound-Barrow Strait area. Walrus along the northern shipping route winter in the North Water and other polynyas among the Canadian Arctic islands, inhabiting northwest Baffin Bay north from

Pond Inlet to Kane Basin, Lancaster Sound, Barrow Strait, and Jones Sound. They are also distributed along the west coast of Greenland. Walrus move westward along the southern coast of Devon Island during spring to summering areas in the Canadian Arctic islands. Only a few individuals are now observed among the inlets and fjords south of Bylot Island. Aerial surveys within the vicinity of Eclipse Sound recorded two walrus; one in Eclipse Sound and one in Milne Inlet.

Walrus are considerably more abundant along the southern shipping route. They are year-round residents in northern Foxe Basin, overwintering in small polynyas and shore lead systems near the outlet of Fury and Hecla Strait, to the east of Hall Beach, and among the islands (Rowley, Koch, and the Spicer Islands) located farther to the east of Hall Beach and south of Steensby Inlet. Their distribution appears to be driven by ice and open-water conditions during winter. During the open water period, they move onto beaches and coasts among the islands south of Steensby Inlet and onto drifting pans of ice. Walrus have been observed within Steensby Inlet during late summer, but the degree to which they use other locations within Steensby Inlet is uncertain. The Foxe Basin walrus population is estimated to be approximately 5,500.

Walrus were abundant within northern Foxe Basin portion of the aerial survey route in 2006. They were observed in pack ice or open water with walrus densities in northwest Foxe Basin estimated at about seven times higher than those observed in northeast Foxe Basin or southern Foxe Basin. During the aerial surveys, two terrestrial walrus haulout sites were observed, one at Manning Islands (mid-way between Hall Beach and Spicer Islands) and the other at Bushnan Rock (a small sandy islet west of the gap between Rowley and Koch Islands). Walrus densities in Hudson Strait were lower than any observed in Foxe Basin. Additional details on Walrus can be found in Section 5.1.2, Volume 8 of the Mary River FEIS.

3.4.4.5 Ringed Seal

The ringed seal is an important element of the Arctic marine system, both as main prey of polar bears, and as a major consumer of marine fish and invertebrates. Ringed seals occur year-round along both proposed shipping routes and in the vicinity of both proposed port sites and are a major traditional food source for the Inuit.

Ringed seals establish a series of breathing holes and subnivean lairs, with many of these structures created shortly after fall freeze up. Birth lairs are constructed on the landfast ice in mid-March and pups are born in April. Landfast ice is preferred for breeding rather than pack ice. The population of ringed seals in the Canadian Arctic is estimated to be at least a few million.

Ringed seals are common throughout Baffin Bay as well as along the length of West Greenland. During winter and spring, ringed seals concentrate on stable shorefast ice, though in areas where fast ice is limited, as in Baffin Bay, increased numbers may occupy offshore pack ice. As ice breaks up during summer, they disperse as solitary animals or small groups throughout open-water areas or to coastal. Though ringed seals were originally thought to remain in the same general region throughout the year recent evidence suggests that some members of the population, particularly juveniles, may undertake extensive seasonal movements.

Ringed seals are abundant and have been observed throughout along the proposed northern shipping route, occurring throughout Baffin Bay and Davis Strait, Eclipse Sound, Koluktoo Bay, Navy Board and Pond Inlet.

Ringed seals are abundant along the proposed southern shipping route, occurring throughout Foxe Basin, including the landfast ice of Steensby Inlet and Hudson Strait. Southern Steensby Inlet, Igloolik, Hall Beach, Murray Maxwell Bay, and Rowley Island into Fury and Hecla Strait have been described as important hunting and/or pupping areas for ringed seal. Additional details on Ringed Seal can be found in Section 5.1.1, Volume 8 of the Mary River FEIS.

3.4.4.6 Bearded Seals

The bearded seal has a patchy circumpolar distribution as far north as 85°N. There is no reliable abundance estimate for bearded seals in Canadian waters; however, some have suggested an estimate of >190,000.

Bearded seals typically occur alone or in small groups. Whelping occurs between late April and early May, and pups are typically born on unstable pack ice where they are weaned after 12-18 days. Bearded seals eat a wide variety of foods and are generally considered to be benthic feeders that prey on an array of benthic invertebrates and fish, although pelagic fish are also a food source.

Bearded seal distribution is largely determined by the presence of shallow water but they usually move into areas of open water <200 m deep when the pack ice retreats, while some individuals associate with ice year-round. They are seldom found in fast ice areas, but are widely dispersed in open water areas of pack ice where leads and cracks are frequent, and where ice pans are sufficient for haul out sites.

Bearded seals are considered common in the RSA. Large numbers of bearded seals occur around north eastern Baffin Island and in Lancaster Sound. The many polynyas of northern Foxe Basin support several colonies of bearded seals and is thought to be an area of high density for bearded seals.

During aerial surveys in support of the Project, bearded seals were present in all areas of Foxe Basin and Hudson Strait, and most sightings occurred from April to August 2008 when they are easily observed basking on sea ice. During aerial surveys in June 2008, most bearded seals were sighted near the mouth of Steensby Inlet; densities were lower in northwest Foxe Basin, northeast Foxe Basin, southern Foxe Basin, and Hudson Strait. Bearded seals were observed in small numbers during springtime seal surveys in Eclipse Sound and Milne Inlet in 2007 and 2008. Additional details on Bearded Seal can be found in Section 5.1.7, Volume 8 of the Mary River FEIS.

3.4.4.7 Harp Seals

Harp seals occur in the northern Atlantic and Arctic oceans below 84ºN. Three geographically distinct populations occur in the North Atlantic Basin but only one of which occurs in the RSA, the Northwest Atlantic population. This is the largest population, including a total of ~5.9 million animals. This population spends the summer off west Greenland and in the Canadian Arctic. Harp seal whelping occurs from late February to mid March on first year ice or landfast ice offshore Newfoundland and Labrador and in the Gulf of St. Lawrence. Harp seals enter Lancaster Sound in July and August via migration routes along the fast ice edge off east Baffin or across Baffin Bay from Greenland.

Generally, harp seals enter Pond Inlet and Navy Board Inlet at the end of July. They concentrate at the mouth of Navy Board Inlet and occasionally within Eclipse Sound throughout August and September. Harp seals were sighted in relatively high numbers during aerial surveys in Eclipse Sound and Milne Inlet. Harp seals were seen frequently in large groups of 10-50, and in one case 400. Most sightings were in Eclipse Sound. The September exodus from Lancaster Sound proceeds along the north coasts of Devon and Ellesmere islands, and then either across Smith Sound to Greenland, or along the east coast of Baffin. By October, most seals have left the Canadian High Arctic and Greenland.

Smaller numbers of harp seals also move westward into Hudson Bay and Foxe Basin during spring. Some animals move south along the east coast of Hudson Bay, reaching Southampton Island and occasionally as far south as the Belcher Islands near James Bay. Others head west across northern Hudson Bay and disperse along the west coast of the bay and Foxe Basin. There were relatively few sightings of harp seals in Hudson Strait during aerial surveys in 2008. Additional details on Bowhead Whales can be found in Section 5, Volume 8 of the Mary River FEIS.

3.4.4.8 Polar Bear

Polar bears have a circumpolar distribution and occur in relatively low densities throughout most of the ice-covered areas in the RSA. Polar bears tend to be more abundant along shore lead systems and polynyas during winter, where less consolidated ice cover provides habitat for prey species. Non-pregnant females, juveniles, and adult males remain active on the pack ice throughout the year, often moving considerable distances with the ice. The distribution and population size of polar bears is likely regulated by the extent of sea ice and the distribution and numbers of their primary prey, the ringed seal.

Female polar bears give birth to 1-3 cubs every 3 to 4 years. Mating occurs from April to June, and females give birth the following December or January in maternity dens, which are excavated in accumulations of snow on stable parts of landfast ice, offshore pack ice, and most often on land within approximately 50 km of the coast. Dens are created in the fall and bears leave their dens in April.

The global polar bear population is estimated at 22,000 to 25,000, of which at least 15,500 occur in Canada or in subpopulations shared with Canada. Three subpopulations of polar bears occur within the RSA: Foxe Basin, Baffin Bay, and Davis Strait with each subpopulation numbering around 2,000.

Along the northern shipping route, polar bears are distributed throughout Baffin Bay, Lancaster Sound, and along coastal areas. Polar bears from the Baffin Bay subpopulation occupy drifting pack ice and landfast ice between Baffin Island and west Greenland during winter, but can concentrate along the Lancaster Sound fast ice edge. Bears are also concentrated along landfast ice edges across Pond and Navy Board inlets during spring. Bylot Island and coastal Baffin Island are used as summer retreats when sea ice melts and also provide denning habitat for pregnant females. The Davis Strait subpopulation occurs in the Labrador Sea, eastern Hudson Strait, Davis Strait south of Cape Dyer, and an undetermined portion of southwest Greenland. Polar bears are harvested domestically as well as during commercial spring sport hunt based out of Pond Inlet. Small numbers of polar bears were observed during aerial surveys during the open-water season in Milne Inlet, Eclipse Sound, and Eskimo Inlet and on landfast ice in Milne Inlet, Koluktoo Bay, and Navy Board Inlet.

Polar bears from the Foxe Basin subpopulation range over Foxe Basin, northern Hudson Bay and western Hudson Strait during winter and move ashore during the open-water period, concentrating on Southampton Island and along the Wager Bay and other coasts within Foxe Basin. During aerial surveys polar bears were observed on landfast ice, pack ice, terrestrial areas, and in open-water areas primarily in northern Foxe Basin but also in Hudson Strait. Additional details on Polar Bear baseline studies can be found in Section 5.1.6, Volume 8 of Mary River FEIS.

3.5 Socio-Economic Environment

The Inuit of the North Baffin region have experienced tremendous social and cultural change over the course of a few decades. Recent changes, particularly residential schools, have affected family integrity and by implication, social cohesion. Elders are becoming more engaged in community life and in the education of youth in traditional skills. At the same time, a shift toward Western middle-class expectations appears to be taking place among Inuit youth.

The land-based economy is a major part of the livelihoods of many residents of the North Baffin. Harvesting from the land and sea is estimated to produce food worth between $12 million and $20 million per year in this region. The amount of work to harvest this food is estimated to be similar to 350 full-time jobs.

In addition, residents of the region earn money through sales of arts and crafts, through employment, and from various government social programs such as Income Support. The personal income reported by residents of the five North Baffin communities amounted to $83 million per year.

Residents' demand for wage employment is very high. People want to work, even when this work requires flying to remote locations. However, job opportunities in the North Baffin are limited. Inuit employment in North Baffin is characterized by many individuals earning small levels of income, well under what full-time work would pay, and a small number earning full-time, year-round incomes. Most residents working in full-time jobs in Iqaluit do so year-round. In North Baffin, many more full-time workers are engaged in these jobs for only short periods. Women who work full-time jobs in North Baffin are more likely to work year-round than are men.

Nunavut relies on federal transfer payments for at least 90 % of its revenue. Government employment is a mainstay of the wage economy, with many of Nunavut's small businesses and retail outlets established to support government needs or those of public servants. The public sector accounts for a large portion of Nunavut's economic activity. Government jobs in administration, education, and health account for about half of all employment earnings in the territory. Construction has been growing as government infrastructure has been established.

These communities have a subsistence economy and have experienced dramatic population growth over the last 20 years. Over 70 % of the population is under 25. Underemployment and lack of opportunities is causing social stress. Community Elders recognize that the communities must position themselves to enter the wage economy.

For many North Baffin households, harvest of country food provides an important contribution to overall well-being. In all five communities, caribou, ringed seal, and Arctic char are of major importance. In addition, walrus is a major species of importance in Hall Beach and Igloolik, while narwhal is a key component of the harvest among households in Arctic Bay, Pond Inlet and, to a lesser degree, Clyde River.

3.5.1 Nearby Communities

There are five communities of north Baffin Island in the immediate vicinity of the Project, which have existing and historical socio-economic and/or ecosystemic ties to the Project area, and for which the Project has a direct effect on the traditional land use of their residents. Listed in alphabetical order, these communities (known as Category 1 communities in literature as they are closest to the Project) include Arctic Bay, Clyde River, Hall Beach, Igloolik, and Pond Inlet. The ties of these individual communities to the Project are described in more detail:

Arctic Bay is located on northern Baffin Island, 280 km northwest of the Mary River site. Harvest and land use patterns indicate that the effect of Project activities on these current patterns of Arctic Bay residents is less than what it would have been historically. Arctic Bay residents might use the Milne Inlet, Eclipse Sound, and Mary River areas for hunting on a sporadic or occasional basis but other geographic areas are more important to this community's land use.

Clyde River is located in northeastern Baffin Island, 415 km from the Project area. Historical land use information and discussions with Elders from various communities suggest that the people of the Clyde River area used to travel inland from Cambridge Fiord facing Baffin Bay, into the Raven River area east of Angajurjualuk Lake and southeast of Mary River. Harvest patterns suggest that contemporary land use activities are now concentrated closer to the community, however, historical ties to the Mary River area resulted in the inclusion of this community in the study area.

Hall Beach is located on the mainland just south of Igloolik, 192 km from the Steensby Port site and 288 km southwest of the Mary River site. Hall Beach harvest patterns are distinct from Igloolik despite their proximity, with a concentration of marine harvesting centred on the Hall Beach area. Some hunting occurs on Baffin Island intermixed with Igloolingmiut hunting, including in and around Rowley and Koch islands and Steensby Inlet; thus, the Project shipping route through this area could have both land use and ecosystemic effects on the community.

Igloolik is located on the mainland but is the closest community to the Steensby Port site (155 km) and second-closest geographically to the Mary River Project site (230 km). Historically, Igloolingmiut spent the summer hunting caribou along the western side of North and Central Baffin Island. Current harvest patterns show that while Igloolingmiut use the Baffin coast and marine areas at the mouth of Steensby Inlet, their activities are heavily concentrated around the community on Melville Peninsula and the closest Baffin Island shoreline to the north. Igloolingmiut still hunt around Rowley and Koch islands and even in Steensby Inlet; thus, the Project shipping route through this area could have both land use and ecosystemic effects on the community.

Pond Inlet is geographically the closest community to the Mary River mine site, located approximately 160 km northeast of Mary River. Pond Inlet relies on hunting in the marine environment of Eclipse Sound and Milne Inlet as well as caribou hunting through the Mary River area. As such, Pond Inlet has the closest land use, historical, and ecosystemic ties to the Mary River area. Details on the socioeconomic environment surrounding the Project area are described in detail in Volume 4 of the Mary River Project FEIS, February 2012.

3.5.2 Traditional Land Use

Human habitation of the region extends back at least 4,000 years. The historic period of a region is defined as that point where human activities are documented in written record.

The historic period of the North Baffin region begins in the late 16th century with the first European whaling and exploration in areas adjacent to Baffin Bay. Two ships that over-wintered in the Igloolik in 1822 and 1823 provide the first record of Euro-Canadian exploration in the Foxe Basin area. The Hudson Bay Company, the Royal Canadian Mounted Police, and the church established themselves at different times in the vicinity of each of the existing communities, as early as 1921). The establishment of these institutions, as with the whalers before, influenced land use and settlement patterns through the mid-twentieth century. The establishment of DEW-line sites in Foxe Basin also influenced land use patterns, with Inuit settling near the DEW-line sites seeking part time employment and for trade. Traditional land use patterns changed substantially with the movement of the Inuit into permanent settlements as a result of federal policy and housing initiatives in the 1950s Contemporary Inuit land use was determined through consideration of the Nunavut Wildlife Harvest Study interviews and discussions with local communities, and the results of the MRIKS. Connection with the land continues to be an important aspect of Inuit life and is evident in current land use patterns. Although Inuit now live in permanent settlements, travel and camping continue to be important aspects of Inuit life. Travel routes have been identified linking all the communities of north Baffin Island (Clyde River, Pond Inlet, Arctic Bay, Igloolik, and Hall Beach). Travel is an important land use practice of the Inuit as it enables the development of connections to the land, enables individuals to meet with family and friends from other communities, and enables hunting and gathering. For additional and a through breakdown of land use areas surrounding the project information refer to Figures 3.13 – Travel Routes – North Baffin Region (workshop results) and Figure 3.14 – Travel Route – North Baffin Region (interview results) from Appendix 4C – Land Use Report, Volume 4 of the Mary River Project FEIS.

Contemporary harvesting activities on North Baffin include wildlife hunting, marine mammal hunting, freshwater and marine fishing, berry picking, egg gathering, sea resource harvesting, and land resource harvesting such as soapstone. See the following figures from Appendix 4C – Land Use Report, Volume 4 of the Mary River Project FEIS for geographical representation of identified areas where harvesting activities occur:

- Figure 3.4 - Hall Beach/Igloolik Harvest Locations (Pre-1965)
- Figure 3.5 - Hall Beach/Igloolik Harvest Locations (1965-1974)
- Figure 3.6 - Arctic Bay/Pond Inlet Harvest Patterns (pre-1959)
- Figure 3.7 - Arctic Bay/Pond Inlet Harvest Locations (1959-1964)
- Figure 3.8 - Land Use information from DIAND (1982B) (showing Inuit land use by marine and terrestrial animal activity)
- Figure 3.9 - Wildlife distribution
- Figure 3.10 - Approximate Camp Areas (1930 - 1966) (not sure this is needed)
- Figure 3.19 - Berry Picking Locations - North Baffin Region (workshop results)
- Figure 3.22 - Ocean Resource Collection Areas - North Baffin Region (workshop results)
- Figure 3.31 - Reported Caribou harvest locations in North Baffin (1996 - 2001)
- Figure 3.33 - Reported marine mammal harvest locations on North Baffin (1996 - 2001)
- Figure 3.35 - Reported waterfowl and egg harvest locations in North Baffin (1996 - 2001)
- Figure 3.37 - Reported Fish Harvest Locations in North Baffin (1996 - 2001
- Figure 4.2 - DFO Arctic Char Commercial Fishing Quotas for North Baffin Rivers

3.5.2.1 Land Fast Ice

Ice is an important component of land use activities, as much of the travel engaged in by residents is on land fast ice. Land fast ice is often used to reduce travel time and to access the floe edge for hunting purposes. For more information refer to Figures 3.13 – Travel Routes – North Baffin Region (Workshop

Results); Figure 3.14 Travel Routes – North Baffin Region (interview results); and Figure 3.24 – Sea Ice Conditions – North Baffin from Appendix 4C – Land Use Report, Volume 4 of the Mary River Project FEIS.

Recreational Land use several parks exist in the vicinity of the Project. Sirmilik National Park of Canada, established in 2001, is one of Canada's newest national parks and covers a considerable landmass with four separate land parcels. The Bylot Island Bird Sanctuary is located within Sirmilik National Park, affording it overlapping legal protection and restrictions on land use. Tamaarvik Territorial Park, located adjacent to the community of Pond Inlet and Little Salmon River, is a relatively small park used mainly for camping. See Figure 7.1 – Parks and Conservation Areas from Appendix 4C – Land Use Report, Volume 4 of the Mary River Project FEIS for location of the parks relative to the Project.

Local outfitting resources are available in local communities for tourism activities such as kayaking, nature viewing and polar bear hunting. Cruise ships visit the North Baffin region each summer, specifically the region around Bylot Island and Sirmilik National Park.

3.5.3 Protected Areas

The Project does not overlap with any terrestrial protected areas and/or known critical habitats such as national or critical wildlife areas. Access to Milne Port would be through Baffin Bay into Eclipse Sound or around Bylot Island through Navy Board Inlet. Both paths are adjacent to Sirmilik National Park and Bylot Island Bird Sanctuary, and in proximity to key marine bird habitat sites near Cape Graham Moore or Cape Hay on Bylot Island. No interactions are expected along the southern shipping route through Hudson Straight and Foxe Basin.

For further information, see Appendix 4C (Land Use in the Vicinity of the Mary River Project Report), Volume 4 of the Mary River Project FEIS.

4 PROJECT INFORMATION

4.1 LOCATION AND ACCESS

The basis of the Project (the Project) is production and shipment of high grade iron ore from Deposit No. 1 located on North Baffin Island in the Qikiqtani Region of Nunavut. There are three (3) main project locations consisting of the Mine Site, Milne Port located north of the Mine Site, and, Steensby Port located south of the Mine Site. The Mine Site is located approximately 160 km south of Pond Inlet (Mittimatalik) and approximately 1,000 km northwest of Iqaluit, as shown on Figure 4.1. Milne Port is connected to the Mine Site by a 115 km Tote Road. A 149 km railway will eventually be constructed to connect Steensby Port to the Mine Site.

4.1.1 PROPONENT NAME AND ADDRESS

The proponent of this ICRP is:

Baffinland Iron Mines Corporation
2275 Upper Middle Road East, Suite 300
Oakville, ON, Canada L6H 0C3
Tel: (416) 364-8820 Fax: (416) 364-0193

4.2 PROJECT HISTORY

The Mary River iron ore deposits were originally discovered in 1962 by Murray Watts of British Ungava Explorations Limited (Brunex). Brunex staked ten claim groups in the Project area, including the Mary claims which cover the areas now known as Deposit No. 1. The private company Baffinland Iron Mines Ltd. (BIML) was established in 1963 by the financial participants and prospectors of the Brunex group to hold the Mary River claims and leases and to develop the prospects.

BIML undertook an exploration program from 1963 through 1966, with most of the field work carried out in the summers of 1964 and 1965. This work included the establishment of a 100 km tote road between Milne Inlet and the Mary River camp, and construction of gravel airstrips near the Mary River camp, at Milne Inlet, and a tundra strip at Katiktok Lake about 40 km northwest of Mary River and near Deposit No. 4. Apart from the required land surveys, some metallurgical test work, and re-examinations of project economics, no additional fieldwork was undertaken between 1965 and 2004.

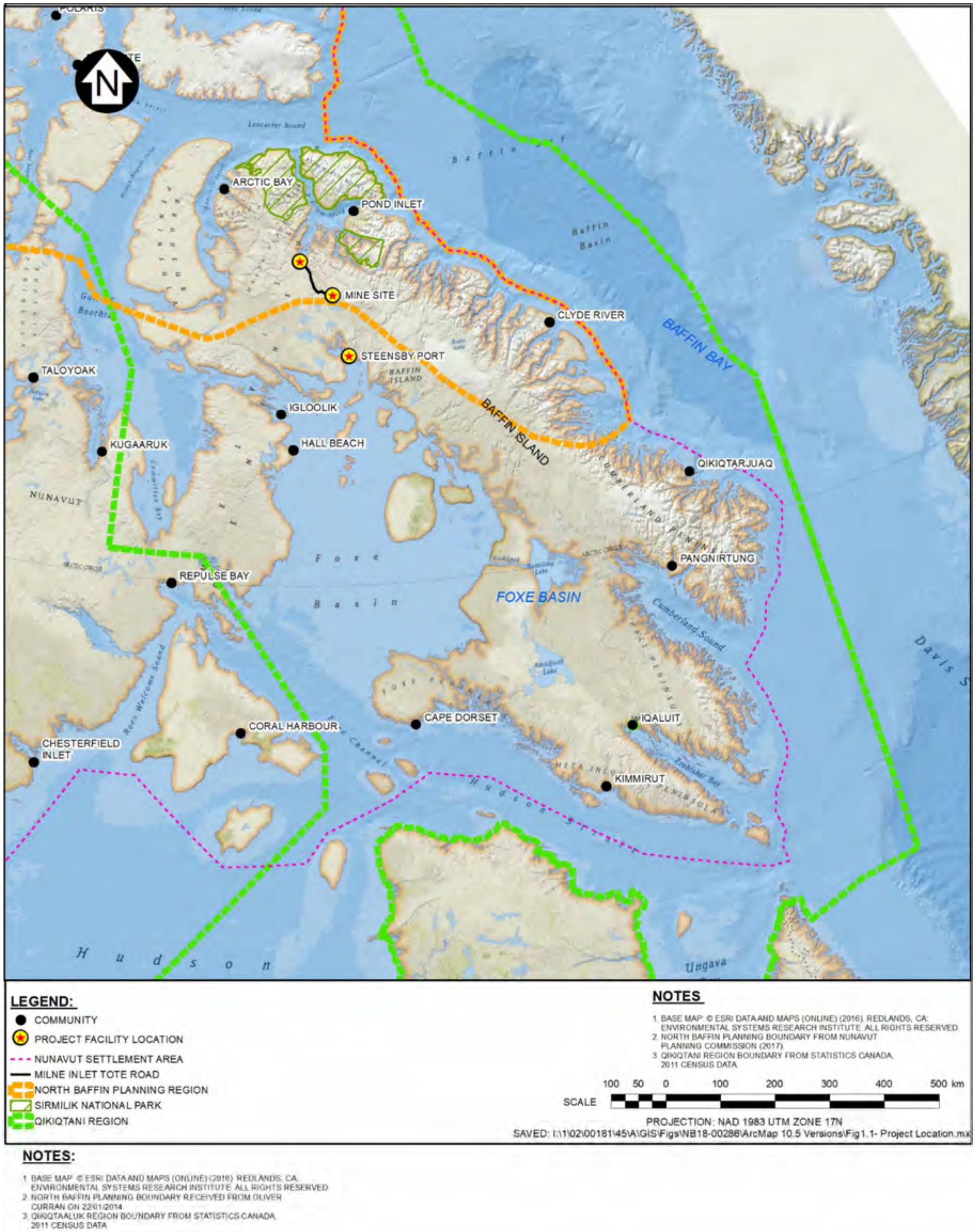

Figure 4.1 Site Location Map

In 2002, BIML interests were acquired by Baffinland, with the purpose of revitalizing the Project. The current Baffinland Iron Mines Corporation was formed in early 2004, which now holds exclusive rights to the ore deposits at Mary River. Continuous contemporary exploration work began in 2004. In 2007, a 250,000 tonne bulk sample program was approved by the Nunavut Impact Review Board, and a Memorandum of Understanding was signed with Nunavut Tunngavik Inc. to gain mineral rights over 16,695 ha surrounding Deposits No. 1, 2 and 3. In addition an agreement was signed with Fednav to develop and deliver shipping solutions for the Project and letters of intent for the future sale of iron ore were signed with 3 steel companies (Thyssen Krupp, Salzgitter and Voestalpine). A further agreement for future sale of the iron ore was signed with ROGESA Roheisengesellschaft Saar mbH ("ROGESA"), a pig iron producing company, in 2008.

The year 2008 also saw the completion of a drill program focused on geotechnical, exploration and geomechanical work, as well as further investigations at the Milne Inlet and Steensby Port sites and along the Railway. In addition, a bulk sampling program was undertaken to extract, transport and ship ore for testing in Europe. The results were used to prepare a definitive feasibility study, which found 'excessively robust economics' for a Project based on 18 Mtpa of iron ore production (Baffinland press release, February 23, 2009). In March 2008, the Company submitted a Development Proposal and associated initial permit applications in order to initiate the regulatory review of a Project based on currently defined iron ore reserves. In January 2011, Baffinland submitted a Draft Environmental Impact Statement (DEIS) for stakeholder comment and review including a Preliminary Mine Closure and Monitoring Plan (DEIS, Appendix 10G). In February 2012, Baffinland submitted the FEIS in support of the development of the Project.

The FEIS included the construction, operation, closure and post-closure activities associated with the mine and its related infrastructures, the construction of a 150 km railway to link the Mine Site to a new port facility at Steensby Inlet, and the construction of the Steensby port. On January 13, 2013, Baffinland informed the NIRB that, due to various business drivers, Baffinland was proposing to make changes to the schedule and specific activities in the initial stages of the development associated with the original Mary River Project (File No. 08MN053). Baffinland noted it understood that the request would potentially necessitate a reconsideration of the Terms and Conditions contained within Project Certificate No. 005 as issued by the NIRB on December 28, 2012 for the Mary River Project.

The changes consisted of the re-introduction of shipment of up to 4.2 Mtpa ore via Milne Port, road transport of ore from the Mine Site to Milne Port via the Tote Road, and the deferral of the full-scale development of the original Project (18 Mtpa production, with railway link to Steensby Port and the development of Steensby Port). This phase was termed 'the Early Revenue Phase'. Baffinland received NIRB approval for the ERP amending the Project Certificate in May 2014. The amended Project Certificate allows for the future development of the 18 Mtpa railway operation, for a total combined production rate of 22.2 Mtpa. In 2015, the Type A Water Licence 2AM-MRY 1325 was successfully amended to account for activities approved for the ERP in 2014. The Project is currently working toward the 4.2 Mtpa production rate via Milne Port associated with the ERP.

4.3 Site Geology

4.3.1 Regional Geology

The North Baffin Island region and Mary River area lie within the Committee Belt, a granite-greenstone terrane mixed with rift basin sediments and volcanic rocks. The belt lies within the Churchill Province, extending from Baker Lake to Greenland, and is divided into five main assemblages: the Archean, the Mary River Group, the Piling Group, the Bylot Supergroup, and the Turner Cliffs-Ship Formation (Aker Kvaerner, 2008).

The Mary River iron deposits are located within the Mary River Group, an assemblage of Late-Archean (2.76 to 2.72 Ga) metasedimentary to metavolcanic rocks that have been folded and preserved in greenstone belts (Aker Kvaerner, 2008). The Mary River Group greenstone belts are present as fragmented remnants stretching from Bylot Island south to Eqe Bay, with a maximum thickness of 4,000 m. Primary sequences within the Group consist of a lower series of metavolcanic rocks and an upper series of turbidite pelitic-greywacke; the stratigraphic position of iron formation, quartzite, conglomerate, minor marble, and volcanic breccia units within the belts, which varies across the region. The Mary River Group is part of the regional Committee Belt, an Archean-aged (2.9 to 2.5 Ga) assemblage of granite-greenstone terranes, granitic migmatites gneissic granitic intrusions, and clastic and carbonate sedimentary units reworked during the Paleo-Proterozoic (2.5 to 1.6 Ga).

4.3.2 Iron Ore Deposit Geology

Iron formations occur in varying thicknesses discontinuously within the Mary River Group metasedimentary units but are typically not present in economically extractable thicknesses or configurations except in the Mine Site area. The high-grade iron ore at Deposits No. 1, 2, 3 and 4 were discovered in 1962, and these initial hematite-magnetite mineralized zones were mapped within extensive belts of banded iron formation in the area over the next three years. Deposit No. 5 was discovered and surface mapped in 2009. The deposits are characterized by zones of massive layered to brecciated hematite to magnetite, variably intermixed with banded oxide to silicate facies iron formation. As typified at Deposit No. 1, the high-grade iron formations are interlayered with thin bands of chlorite-actinolite schist, staurolite-garnet-mica schist, amphibolite, and banded iron formation across their strike width, with the entire assemblage up to 400m thick.

The Mary River iron deposits are considered to belong to an Algoma-type iron formation (Aker Kvaerner, 2008) formed in a volcanic ark setting in an extensional or rift basin during the Archean. Algoma-type deposits are typically characterized by a lower series of volcanics followed by banded iron formation and/or interlayered to pure iron oxides of variable and potentially substantial thickness, in turn overlain by volcanics and volcaniclastic sediments (Gross, 1996).

4.3.3 Geotechnical Overview

4.3.3.1 Milne Port

The Milne Port area consists of a series of variably dipping, dissected terraces sloping towards the waters of Milne Inlet. The surficial deposits are marine and glacial marine sediments, ranging from coarse beach sediments (gravel and sand) to finer deltaic sediments (clay, silt, sand and gravel) to even finer deep water periglacial silt veneers (silt, clay and fine sand). The soils in the area are often covered by a thin layer of organics at the ground surface. The soils were noted to typically be frozen below 2 m depth and contain ice lenses (Mary River Project FEIS 2.1.3.1). Offshore drilling encountered loose to compact silty sand underlain by sand containing varying amount of gravel and cobbles.

4.3.3.2 Tote Road

The Tote Road generally follows a glacial valley, oriented northwest-southeast to the Mine Site. The surficial deposits along this alignment generally include the following materials:

- Till deposits: veneer (up to 2 m thick) or blanket (up to 10 m thick) with drumlins and moraines (in places);
- Glaciofluvial sediments: outwash gravel and sand forming braided floodplains, terraces and fans or stratified glacial drift (gravel and sand);
- Limited bedrock exposure: especially nearer to the Mine Site/Deposit No. 1 area; and
- Mary River flows across the glacial valley to the southeast of the Mine Site, and several thaw lakes and thermokarst depressions are located along the valley floor.

4.3.3.3 Mine Site

Deposit No. 1 is located along the top and margins of a bedrock hill on the north side of the valley, while the waste rock piles will be located along the west-facing and east-facing side slopes of the hill. Bedrock is exposed at the apex of the deposit with talus present on the upper slopes. The mid slopes on the east side of the deposit comprise up to 50 m (vertical depth) of glacial till, tapering out to near surface bedrock at the base of the slope. The till on the north and west side of deposit is shallower, in the 10 to 15 m range. The till around Deposit No. 1 is typically dominated by boulders, cobbles, gravel and trace to some organics and a moderately thick, wet organic layer is present over the majority of this upper area. The overburden materials are considered to be very ice-rich based on-site investigations, observations from bulk sample road construction and general understanding of the deposit.

Other Project-related infrastructure in the Mine Site area will be located on areas of glaciofluvial terrace along the valley floor directly south and southwest of Deposit No. 1. In addition to the glaciofluvial deposits, there appears to be some direct glacial deposition in and around the south-eastern portion of Sheardown Lake. Overburden depths over the majority of the valley floor are typically noted to be in the 10 to 20 m thickness ranges. Based on the investigations and surficial features in and around these deposits, evidence of ice-rich areas and localized massive ice bodies are present, particularly in the vicinity of the existing airstrip areas. A thin organic layer is present in some areas, over the till, in depressions and at the base of some slopes.

Underlying the glaciofluvial materials southwest of the deposit in the valley floor is weak, unconsolidated sandstone; gneissic bedrock to the south, west and north of Deposit No. 1; and amphibolite schists to the east. Often, the upper horizon of the bedrock is highly fractured and often contains ice lenses and/or infilling in the joints.

4.4 Project Summary

A detailed Project Description for the project has been presented in Volume 3 of the Mary River Project Final Environmental Impact Statement and its associated Addendum (Baffinland, 2013).

The Mary River Project consists of mining iron ore from the reserve at Deposit No. 1 at a production rate of 21.5 Million tonnes per year (Mtpa). The Project will be developed in two phases:

- **Early Revenue Phase (ERP):** Ore will be mined at a rate of 3.5 Mtpa and trucked via the Tote Road to Milne Port, from which it will be loaded onto ships during the open water season.
- **Full-scale (21.5 Mtpa) Approved Project:** As global markets improve for the prices of iron ore, the Company intends to proceed with the construction and operation of the larger Approved Project which includes the construction, operation, closure, and reclamation of a large scale mining operation (open-pit mine) and associated infrastructure for extraction, a railway link for the transportation of ore to Steensby Port, and, the construction and operation of a year around port facilities on Steensby Inlet for the shipment of iron ore.

It is expected that the Steensby Port facilities and the Railway will take four (4) years to construct. Upon completion of the Railway and Steensby port construction, an additional 18 Mtpa of iron ore will be transported by rail and transferred to ore carrier vessels from Steensby Port for shipment to international markets. Shipping of ore from Steensby Port will occur year-round and will require vessels with icebreaking capabilities.

The ERP includes a nominal 4.2 million tonnes per annum (Mtpa) road haulage operation from the Mine Site to Milne Port for shipping of iron ore during the open water season. There are 3 main project locations for the ERP – the mine site, Milne Port north of the mine site, and the Tote Road which connects the Mine Site to Milne Port. Only limited development has occurred at the Mine Site, sufficient to support the mining of 4.2 Mtpa of iron ore. The Tote Road has been upgraded to enable safe and efficient transportation of ore by truck from the Mine site to Milne Port. Milne Port has been fully developed and accommodates a 4.2 million tonnes ore stockpile, an ore dock, maintenance facility and associated infrastructure for the operation of the port facilities. Operational activities of the ERP include:

- Ore extraction;

- Ore processing via crushing;
- Transportation of the ore from the Mine site to Milne Port;
- Loading and shipping of ore from Milne Port;
- Stakeholder and Inuit community engagement; and
- Environmental monitoring and reporting.

Major infrastructure constructed to date at each of the locations consists of the following. Unless noted otherwise in Section 6, this infrastructure will remain in place throughout operation.

1. Milne Port:
   - Ore dock;
   - Ore stockpile;
   - Ore handling facilities (unloading, transfer and stockpiling, reclaiming, ship loading) and associated surface runoff ponds;
   - Camp and service buildings (field offices, maintenance shops, vehicle wash stations, ERT, warehouses, concrete batch plant);
   - Water supply (intake, transport, storage and distribution);
   - Sewage treatment plant and discharge;
   - Polishing Waste Stabilization Pond (PWSP);
   - Waste management facilities including temporary storage areas;
   - Incinerator;
   - Fuel tank farm and fuel dispensing facilities;
   - Hazardous material storage areas and explosives storage;
   - Landfarm; and
   - Power generation and distribution.
2. Mine Site:
   - Mine Site service roads, ore haul roads, laydown, drainage and diversions;
   - Camp Lake water supply (intake, transport, storage and distribution);
   - Quarries and borrow pits;
   - Power generation and distribution;
   - Permanent camp, construction camp and service buildings (field offices, temporary or transitional construction facilities, light vehicles maintenance shops, ore trucks maintenance shops, vehicle wash stations, ERT, warehouses, concrete batch plant);
   - Sewage treatment plants, PWSPs and discharge;
   - Mining fleet maintenance facilities;
   - Waste management facilities including temporary storage areas;
   - Incinerator;
   - Landfill;

- Hazardous material, explosives, and fuel storage areas;
- Temporary crushing facility (crusher trains);
- Airstrip;
- Emulsion plant;
- Waste rock storage with associated runoff control structure; and
- Transitional ore stockpile and runoff control.

3. Tote Road:
   - Road embankments and driving surface;
   - Water crossings including culverts+bridges and abutments;
   - Water withdrawal for dust control; and
   - Borrow Pits and Quarries.

In 2017, Baffinland focused on mine production from Deposit No. 1 with 4.54 million tonnes mined and hauled using the Tote Road. 2017 also marked the third season of open water shipping of iron ore at Milne Port with almost 4.1 million tonnes of iron ore shipped between August 2 and October 17. This represents a record-setting performance for the Company, and the largest shipping program by volume ever executed in the Canadian High Arctic.

The Project sites are shown on Figure 4.2, and the Major Project Components are listed in Table 4.1. The Mine site layout is shown on Figure 4.3. Unless otherwise noted in Section 6, all Major Project Components are intended to have a similar lifespan as that of the Project.

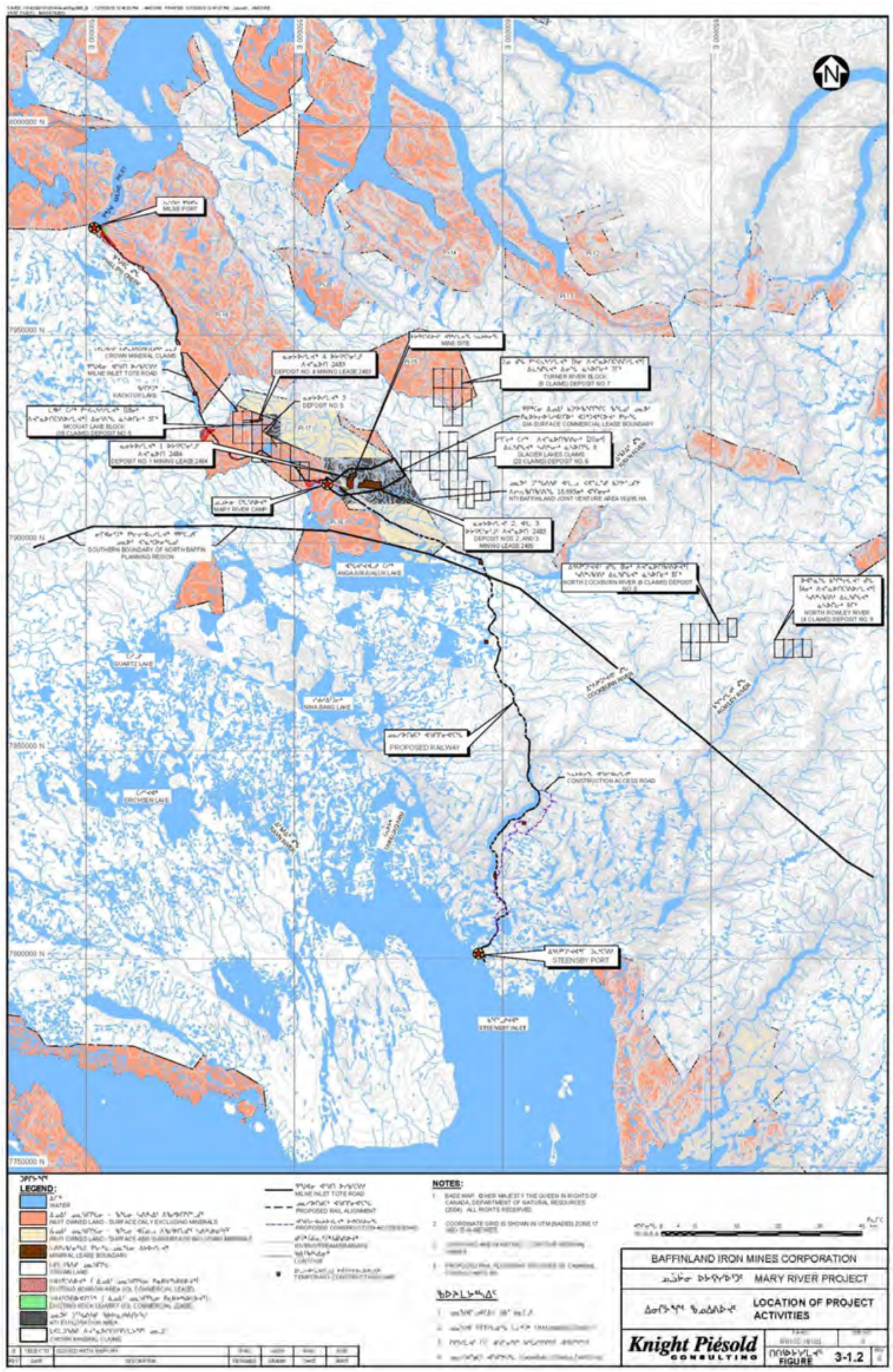

Figure 4.2 Relative Location of Project Areas

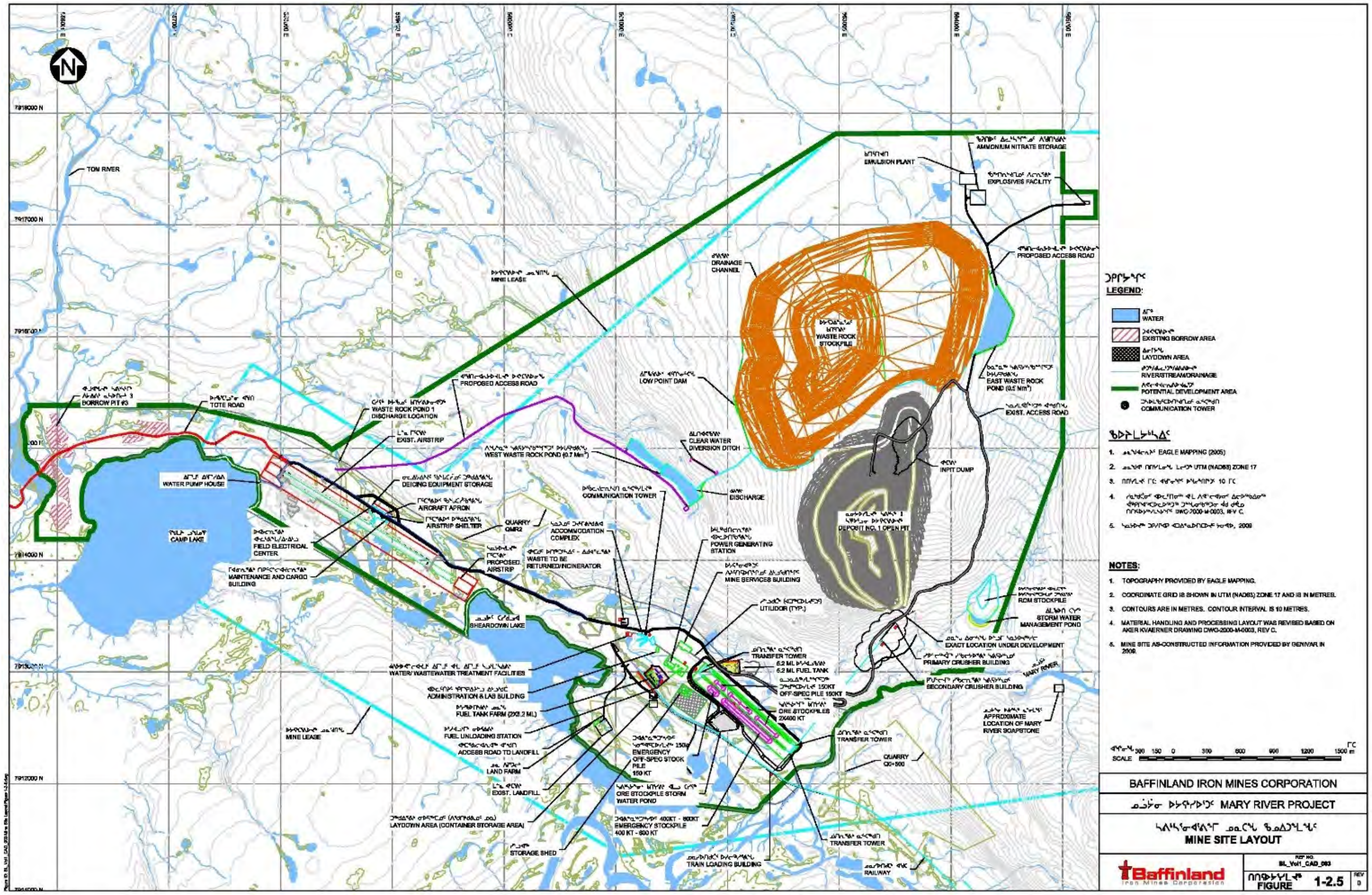

Figure 4.3 **Mine Site Layout**

Table 4.1: Major Project Components

Major Infrastructure Components	Authorized under Project Certificate No 005	Authorized under Project Certificate No 005, ERP Amendment[2]	Status of Development as of March 31, 2018	Land Ownership
Milne Port Site				
Ultimate development area	x	-	On going	IOL
Site development, grading, roads, laydown, drainage	x	x	Completed	IOL
Water supply (intake, transport, storage and distribution)	x	-	Completed	IOL
Quarries and borrow pits	x	-	On going	IOL
Camp	x	-	Completed	IOL
Sewage treatment plant and discharge	x	-	Completed	IOL
Polishing Waste Stabilization Pont (PWSP)	x	-	Completed	IOL
Incinerator	x	-	Completed	IOL
Service buildings (field offices, maintenance shops, vehicle wash stations, ERT, warehouses, concrete batch plant)	x	-	Completed	IOL
Waste management facilities including temporary storage areas	x	-	Completed	IOL
Landfarm	x	-	Completed	IOL
Power generation and distribution	x	-	Deferred	IOL
Transitional power generation and distribution	x	-	Completed	IOL
Hazardous material storage areas	x	-	Completed	IOL
Fuel tank farm and fuel dispensing facilities (Arctic Diesel, Jet-A Fuel)	x	-	Completed	IOL
Fuel tank farm and fuel dispensing facilities (Marine Diesel)	-	x	Not started	IOL
Ore stockpile	-	x	Completed	IOL
Ore handling facilities (unloading, transfer and stockpiling, reclaiming, ship loading) and associated surface runoff ponds	-	x	Completed	IOL
Ore dock	-	x	Completed	Crown Land
Freight dock	-	x	Not started	Crown land
Explosives storage	x	-	Completed	IOL
Tote Road				
Realignment and grade improvement	x	-	In progress	IOL/Crown
Water crossings improvement/replacement	x	-	On going	IOL/Crown
Bridge construction	x	-	Completed	IOL
Borrow Pits and Quarries	x	-	In progress	IOL/Crown

Major Infrastructure Components	Authorized under Project Certificate No 005	Authorized under Project Certificate No 005, ERP Amendment[2]	Status of Development as of March 31, 2018	Land Ownership
Water withdrawal for dust control	x	x	On going	IOL
Mine Site				
Mine Site development, grading, service roads, ore haul roads, laydown, drainage and diversions	x	-	Completed	IOL
Camp Lake water supply (intake, transport, storage and distribution)	x	-	Completed	IOL
Water crossings and surface water diversions	x	-	On going	IOL
Quarries and borrow pits	x	-	On going	IOL
Transitional Camps (early development)	x	-	Completed	IOL
Sewage treatment plants, PWSPs and discharge	x	-	Completed	IOL
Incinerator	x	-	Completed	IOL
Permanent camp and construction camp	x	-	Completed	IOL
Service buildings (field offices, temporary or transitional construction facilities, light vehicles maintenance shops, ore trucks maintenance shops, vehicle wash stations, ERT, warehouses, concrete batch plant)	x	-	Completed	IOL
Mining fleet maintenance facilities	x	-	Completed	IOL
Mining activities	x	-	On going	IOL
Waste rock storage with associated runoff control structure	x	-	In progress	IOL
Waste management facilities including temporary storage areas	x	-	Completed	IOL
Landfill	x	-	Completed	IOL
Landfarm	x	-	Deferred	IOL
Transitional power generation and distribution	x	-	Completed	IOL
Power generation and distribution	x	-	Deferred	IOL
Hazardous material storage areas	x	-	Completed	IOL
Permanent fuel tank farms and fuel dispensing facilities (arctic diesel, jet A fuel – 15.5 ML)	x		Deferred	IOL
Transitional fuel storage facilities (multiple fuel storage tanks for construction phase)	x	-	Completed	IOL
Temporary crushing facility (crusher trains)	x	-	On going	IOL
Permanent crushing facilities	x	-	Deferred	IOL
Transitional ore stockpile and runoff control	-	x	In progress	IOL
Ore stockpiling (run of mine, crushed ore) and associated runoff control ponds	x	-	Deferred	IOL

Major Infrastructure Components	Authorized under Project Certificate No 005	Authorized under Project Certificate No 005, ERP Amendment[2]	Status of Development as of March 31, 2018	Land Ownership
Ore handling facilities (unloading, transfer, tertiary crushing and screening, stockpiling, reclaiming, railway loading) and associated surface runoff ponds	x	-	Deferred	IOL
Airstrip extension	x	-	Completed	IOL
Explosives storage	x	-	Completed	IOL
Emulsion plant	x	-	Completed	IOL
Railway				
Service road (up to 25 km south of Mine Site)	x	-	Deferred	IOL
Railway embankment (up to 25 km south of Mine Site)	x	-	Deferred	IOL
Borrow pits and quarries (up to 25 km south of Mine Site)			Deferred	IOL
Water crossings (bridges and culverts)	x	-	Deferred	IOL
Winter road (up to 25 km south of Mine Site)	x	-	Deferred	IOL
Service road	x	-	Deferred	Crown land
Railway embankment	x	-	Deferred	Crown Land
Winter road	x	-	Deferred	Crown Land
Railway construction and operation	x	-	Deferred	Crown Land
Railway construction camps, sewage treatment facilities, emergency ponds and incinerator	x	-	Deferred	Crown Land
Railway camps associated services facilities	x	-	Deferred	Crown Land
Water crossings (bridges and culverts)	x	-	Deferred	Crown Land
Multiple construction fuel storage units	x	-	Deferred	Crown Land
Mobile explosive units	x	-	Deferred	Crown Land
Tunnel construction and disposal of waste rock	x	-	Deferred	Crown Land
Borrow pits and quarries	x	-	Deferred	Crown Land
Steensby Port Site				
Site development, grading, roads, laydown, drainage	x	-	Deferred	Crown Land
Water supply (intake, transport, storage and distribution)	x	-	Deferred	Crown Land
Water crossings and diversions	x	-	Deferred	Crown Land
Quarries and borrow pits	x	-	Deferred	Crown Land
Camp	x	-	Deferred	Crown Land
Sewage treatment plant, PWSPs and discharge	x	-	Deferred	Crown Land
Incinerator	x	-	Deferred	Crown Land

Major Infrastructure Components	Authorized under Project Certificate No 005	Authorized under Project Certificate No 005, ERP Amendment[2]	Status of Development as of March 31, 2018	Land Ownership
Service buildings (field offices, temporary construction facilities, light vehicles maintenance shops, ore trucks maintenance shops, vehicle wash stations, ERT, warehouses, concrete batch plant)	x	-	Deferred	Crown Land
Waste management facilities including temporary storage areas	x	-	Deferred	Crown Land
Landfill	x	-	Deferred	Crown Land
Landfarm	x	-	Deferred	Crown Land
Power generation and distribution	x	-	Deferred	Crown Land
Hazardous material storage areas	x	-	Deferred	Crown Land
Fuel tank farms and fuel dispensing facilities (Arctic Diesel, Jet A-Fuel and Marine Diesel)	x	-	Deferred	Crown Land
Railway switch yard	x	-	Deferred	Crown Land
Railway terminal maintenance shop	x	-	Deferred	Crown Land
Ore stockpile	x	-	Deferred	Crown Land
Ore handling facilities (unloading, transfer, tertiary crushing and screening, stockpiling, reclaiming, ship loading) and associated surface runoff ponds	x	-	Deferred	Crown Land
Ore dock	x	-	Deferred	Crown Land
Freight dock	x		Deferred	Crown Land
Airstrip	x	-	Deferred	Crown Land
Explosives storage	x	-	Deferred	Crown Land
Emulsion plant	x	-	Deferred	Crown Land
Overwintering of fuel barge	x	-	Deferred	Crown Land
Dredged sediment disposal area	x	-	Deferred	Crown Land

Note 1: Includes additional authorizations under Type A Water Licence 2AM-MRY1325 – Amendment No. 1

Note 2: Includes additional authorizations under Type A Licence 2AM-MRY1325 – Amendment No. 1, and Type B Licence 8BC-MRY1416

4.4.1 Site Plans

The Mine Site, Milne Port and Steensby Port, final connecting infrastructure and principal camp locations site plans are shown on the series of drawings in Appendix A and described in Table 4.2. These figures represent the intended site layouts upon completion of Project operations including the Railway Execution Phase. Project components that are planned to be progressively rehabilitated following the construction phase are quantified separately, as are components that are located on Inuit Owned Land.

There has been no change to the closure strategy for the approved Railway Execution Phase of the Project (as approved under the Project Certificate No. 005). For drawings to account for interim closure and reclamation adjustments to reflect project development phases until such a time planned closure commences, see documents/figures associated with the Annual Security Review (ASR) process conducted in accordance with Schedule C of Type “A” Water License 2AM-MRY1325 - Amendment No. 1 and Section 9.2 of the Commercial Lease, No. Q13C301, agreed to between Baffinland and the QIA.

Until such time the Railway Execution Phase commences, Steensby Camp and other explorations camps along the proposed railway corridor and exploration areas will be governed by the Exploration Closure and Reclamation Plan (BAF-PH1-830-P16-0038).

Table 4.2: Drawings for Mine Closure and Reclamation

Drawing Number	Drawing Title
E349000-2000-07-014-00001	Areas of Reclamation – Milne Port Layout
H337697-0000-07-126-0014 (Figure 8.10)	Preliminary Mine Closure and Reclamation Plan – Tote Road
H337697-4210-07-012-0001	Preliminary Mine Closure and Reclamation Plan – Mine Site Construction Phase
H337697-4210-07-012-0002	Preliminary Mine Closure and Reclamation Plan – Mine Site Final Closure Phase
H337697-2000-07-012-0001	Preliminary Mine Closure and Reclamation Plan – Railway Alignment
H337697-7000-07-012-0002	Preliminary Mine Closure and Reclamation Plan – Ravn River Rail Camp
H337697-7000-07-012-0003	Preliminary Mine Closure and Reclamation Plan – North Cockburn Camp – Tunnels
H337697-7000-07-012-0004	Preliminary Mine Closure and Reclamation Plan – South Cockburn Lake Rail Camp
H337697-4510-07-012-0001	Preliminary Mine Closure and Reclamation Plan – Steensby Port Construction Phase
H337697-4510-07-012-0002	Preliminary Mine Closure and Reclamation Plan – Steensby Port Final Closure Phase

4.4.2 Inuit Owned Lands

The Inuit Owned Lands (IOL) surrounding the Project area are shown on Figure 4.2. The Commercial Lease, No. Q13C301, to the Project is held by Baffinland and is leased from the Qikiqtani Inuit Association (QIA). In accordance with this and any future surface leases held with the QIA, this ICRP incorporates the guidelines developed for the Qikiqtani lands entitled the Abandonment and Reclamation (A&R) Policy for Inuit Owned Lands (Version 3.0, QIA 2013). The guiding principles of the A&R Policy require that all disturbed IOL be returned to a safe and stable condition capable of supporting human and wildlife needs consistent to social and cultural needs of the Inuit for the undisturbed lands within that area. The QIA guidelines used for this ICRP are summarized in Appendix B. Milne Port and the Mine Site are entirely located on Inuit Owned Land. The first 25 km of the Railway and access roads are located on Inuit Owned Land. All remaining Project areas are located on Crown land.

5 PERMANENT CLOSURE AND RECLAMATION

5.1 DEFINITION OF PERMANENT CLOSURE AND RECLAMATION

Permanent closure is defined in the MVLWB Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories (MVLWB/AANDC 2013) as follows:

"Permanent closure is the final closure of a mine site with no foreseeable intent by the existing proponent to return to either active exploration or mining."

Reclamation is defined in the MVLWB Guidelines as follows:

"The process of returning a disturbed site to its natural state or which prepares it for other productive uses that prevents or minimizes any adverse effects on the environment or threats to human health and safety."

Baffinland acknowledges that due to various economic drivers (commodity prices, escalation of construction and production costs, extended maintenance shutdown, others), Baffinland may be forced into a temporary or permanent closure scenario. For planning purposes, Baffinland defines two types of temporary closure as follows:

- **Short-term Closure (described in Sections 7.1 and 7.2):** Cease commercial operation for a period of up to one (1) year while maintaining all equipment and facilities in a state of readiness to resume operation with minimal delay or have project components at the ready for use to support closure activities.
- **Long-term Closure (described in Section 7.3):** Extension of a short-term closure to over (1) year for an indefinite period while all Project sites are maintained in a secure condition and all facilities and equipment are de-energized and winterized until the operation resumes or the site is reclaimed as part of permanent closure.

Consideration of future land use is an important closure principle in the continuous refinement of this ICRP. To date, future land use has been considered in numerous aspects of the mine planning, such as:

- Adopting environmental management best practices during mining to reduce impacts where possible;
- Development of additional management plans to address specific land user concerns (e.g. ballast water management);
- Major project considerations such as the avoidance of winter shipping during operations;
- Various planned reclamation activities which are not required to establish physical and chemical stability, such as:
    - Scarification to promote natural revegetation

- Removal of above-grade buildings
- Re-establishing pre-existing drainage pathways where practical

- Clean up of pre-existing waste (e.g. non-hazardous debris and barrel dump) at Mary River

Moving forward Baffinland will seek further input from communities on potential closure options that promote the desired post-closure land use. Feedback via engagement activities will be compiled and considered within the MCWG to identify feasible options that can be incorporated into future revisions of the ICRP. Baffinland has committed to several closure objectives focusing on land use, which are presented in Table 5.1.

In keeping with the closure principles, the objectives and criteria presented below avoid introducing designs which would require long term active care. This closure principle was adopted with the inclusion of the MVLWB Guidelines following the preparation of the PCRP and FEIS process, resulting in a modified closure approach at the Open Pit from long term passive flooding to include a combination of natural flooding and pumping.

5.1.1 Closure Objectives and Criteria

A description of the closure criteria and applicable monitoring program that is proposed to be implemented to confirm that the objectives were met for each Project component is summarized in Table 5.1 for permanent and temporary closure. In addition to the specific criteria listed below to measure reclamation success, QIA's approval is also required to achieve mine closure as a condition of the Commercial Lease (Q13C301).

As the Project is in the initial years of operations, closure planning is expected to be refined over time using findings from engagement efforts (e.g. MCWG), site-specific operational knowledge, environmental monitoring programs, progressive reclamation, and reclamation research studies.

An important aspect of ongoing closure planning will be periodic assessment of predicted impacts to the biophysical environment, and the assumed reclamation performance for planned closure activities. This process will reduce uncertainties in post closure conditions and allow for increasing detail in the closure design leading up to a FCRP. As outlined in the Project Certificate No 005, one of the primary purposes of the NIRB Monitoring Program for the Project is to assess the accuracy of predictions contained in the environmental impact statements. As a result, the findings of Baffinland's ongoing monitoring and management plans are compared to the predictions made as part of the FEIS and the ERP on a continual basis within the NIRB annual reporting process which allows for comment by Project stakeholders. Tracking and understanding of project impacts/effects is also a focus of the Marine and Terrestrial Environment Working Groups (MEWG, TEWG). These processes and groups are expected to play important roles in informing ongoing closure planning and ICRP updates.

Table 5.1: Closure Objectives, Criteria and Actions by Major Project Components (Based on ERP – 4.2 Mtpa Nominal)

Project Component	Closure Objectives	Closure Criteria	Actions/Measurements
Site Wide[2]	Drainage pathways for surface runoff are physically stable to limit risk to humans and receiving environment[1].	Drainage pathways will be designed by a professional engineer for long-term stability to mitigate against erosion. No significant signs of deformation, degradation and/or erosion and sedimentation which could contribute to physically unstable conditions as visually observed during geotechnical inspections by a qualified professional engineer. Inspection criteria and schedule will be refined based on the final engineering designs for site grading and specific engineered drainage controls.	Geotechnical assessment, analysis and/or monitoring of the drainage pathways will occur as part of the Geotechnical/Engineering Monitoring Program (Section 9.2). Surface water quality monitoring will be completed post-closure at applicable drainage pathways to ensure all relevant closure objectives and criteria have been met. See closure objective relating to Site Wide Surface Water.
	Mine areas are physically stable for use by humans and receiving environment[1].	No significant signs of deformation or degradation at remaining engineered structures and/or other disturbed areas which could contribute to physically unstable conditions. This will be confirmed by visual monitoring as part of site geotechnical inspections. Inspection criteria and will be refined based on the post closure stability assessment for remaining mine structures and Final Grading Plan.	Geotechnical assessment, analysis and/or monitoring of the mine areas will occur as part of the Geotechnical/Engineering Monitoring Program (Section 9.2). The expected level of effort associated with the different mine areas is included in Section 9. Monitoring scope and duration will be informed by operational performance results where possible, and detailed in the final grading and engineering designs for remaining structures.
	Surface water runoff and seepage that is safe for humans and the receiving environment[1].	Closure water quality meets Type A Water Licence effluent criteria, territorial/federal guidelines, MDMER, and/or site-specific risk-based criteria, as relevant to the specific mine areas and components. At present, water quality predictions for the Open Pit and Waste Rock Stockpile discharges and receiving waterbodies indicate that risk based criteria and/or risk management strategies may be required. Criteria will be refined based on water quality monitoring results during operations and research studies.	Monitoring activities as part of the Closure and Post-Closure Aquatic Monitoring and Reporting Program. Specific testing parameters, frequencies, locations and program durations will be refined over time based on findings of operational monitoring programs and research studies.
	Remaining area will be safe for humans and the receiving environment[1].	No buildings or equipment remain above surface grade following final closure (excluding Ore Dock and Tote Road). Completion of an approved Final Grading Plan that has considered input from MCWG. This criteria is supplemented by several other closure criteria focusing on additional aspects of closure (e.g. chemical and physical stability) Areas with risk to humans, terrestrial wildlife and/or aquatic biota will be managed to reduce hazards to an acceptable level. This criteria will be refined based on the results of planned research studies. Additional, more specific criteria may be added prior to closure to focus on activities such as fish consumption and drinking water quality in particular areas of interest (e.g. Mary's River, Sheardown Lake). These additions will require updated residual effect predictions.	Geotechnical assessment, analysis and/or monitoring of the mine areas will occur as part of the Geotechnical/Engineering Monitoring Program (Section 9.2). The expected level of effort associated with the different mine areas is included in Section 9. Monitoring activities as part of the Closure and Post Closure Aquatic Monitoring and Reporting Program and Post-Closure Fauna and Flora Monitoring Final inspection by a qualified professional[3] and representative of Designated Inuit Organization.

Project Component	**Closure Objectives**	**Closure Criteria**	**Actions/Measurements**
	Area facilitates the desired wildlife movement	Completion of an approved Final Grading Plan that has considered input from MCWG. To the extent possible, disturbed areas to be scarified to promote natural revegetation. Use of the site by wildlife (i.e. birds, mammals) will be consistent with FEIS, or updated predictions. Detailed metrics will be developed in concert with MCWG and included in the FCRP. Current residual effect predictions for individual wildlife and specific site areas are presented in Appendix G.	Geotechnical assessment, analysis and/or monitoring of the mine areas will occur as part of the Geotechnical/Engineering Monitoring Program (Section 9.2). The expected level of effort associated with the different mine areas is included in Section 9.2 Final inspection by a qualified professional[3] and representative of Designated Inuit Organization. Post closure flora and fauna monitoring (Section 9.5) will address selected metrics to assess wildlife presence and use in comparison with FEIS or updated impact predictions.
	Air quality safe for humans and wildlife	Mean Total Suspended Particulate concentrations and PM 2.5 closure criteria will be developed based on site-specific risk based criteria, in consideration of the NU Ambient Air Quality Standard).	Post-closure dustfall and active ambient monitoring at appropriate locations, for a limited duration post-closure as part of the Air Quality Monitoring Program (Section 9.9)
	Natural revegetation is promoted	Grading and scarification completed as outlined by an approved Final Grading Plan. Baffinland has committed to completing reclamation activities that will promote natural revegetation over long timelines, but specific criteria or goals for vegetation growth post-closure are not planned.	Final inspection by a qualified professional[3] and representative of Designated Inuit Organization.
	Aesthetic conditions of the project areas are similar to surrounding natural conditions	No visible buildings, equipment, or non-local materials. This excludes structures remaining at, and below grade (i.e. concrete foundations) and those which stakeholders have agreed should remain post closure, such as the Ore Dock, Tote Road, and select water crossing abutments. Final grading reflects surrounding topography where possible (i.e. limit steep slopes) and re-establish pre-existing drainage pathways. Activities to promote natural revegetation to the extent possible as outlined in the Final Grading Plan. Criteria may be refined through discussions in the MCWG.	Final inspection by a qualified professional[3] and representative of Designated Inuit Organization.
Open Pit and Mine Workings (including spillway to remain post closure)	Physically stable Open Pit Mine Workings and Spillway to limit risk of failure that could impact humans and receiving environment[1].	Final Open Pit, mine workings and spillway are within final long term stability assessment assumptions/design constraints. No visual indications of significant deformation and degradation is observed during final inspections by a professional engineer. Inspection/monitoring criteria and schedule will be refined based on the final engineering assessments.	Geotechnical assessment, analysis and/or monitoring of the Open Pit, mine workings and spillway will occur as part of the Geotechnical/ Engineering Monitoring Program (Section 9.2). The expected level of effort associated with the different mine areas is included in Section 9.2 Final inspection completed by Inspector of Mines (WSCC).

Project Component	Closure Objectives	Closure Criteria	Actions/Measurements
	Open Pit Lake water quality is not a risk to humans and receiving environment[1]	The FEIS predictions for pit water quality indicate that there could be potential exceedances for substances that could cause a risk to humans (such as mercury) and the receiving environment (Appendix H, Table 4). To understand this potential risk and mitigation/management options further, Baffinland plans to refine the Pit flooding estimates and water quality predictions in the future using site data. This work is required to develop meaningful criteria.	Monitoring activities as part of the Closure and Post Closure Aquatic Monitoring and Reporting Program and Post-Closure Fauna and Flora Monitoring Specific testing parameters, frequencies, locations and program durations will be developed over time based on findings of operational monitoring programs and pit flooding and water quality research studies (Appendix D).
	Surface runoff and seepage water quality is safe for humans and receiving environment[1].	Achieve "Recognized Closed Mine" status per Section 4 of MDMER. Effluent discharge quality is consistent or improved from the initial FEIS predictions. To understand this potential risk and mitigation/management options further, Baffinland plans to refine the Pit flooding estimates and water quality predictions in the future using site data. This work is required to develop meaningful criteria.	Monitoring activities as part of the Closure and Post Closure Aquatic Monitoring and Reporting Program and Post-Closure Fauna and Flora Monitoring Specific testing parameters, frequencies, locations and program durations will be developed over time based on findings of operational monitoring programs and pit flooding and water quality research studies (Appendix D).
Waste Rock Stockpile	Physically stable Waste Rock Stockpile and to limit risk of failure that would impact humans and receiving environment[1].	Final Waste Rock Stockpile is within final long term stability assessment assumptions/design constraints. No visual indications of significant deformation and degradation is observed during final inspections by a professional engineer. Inspection/monitoring criteria and schedule will be refined based on the final engineering assessments.	Geotechnical assessment, analysis and/or monitoring of the Waste Rock Stockpile will occur as part of the Geotechnical/Engineering Monitoring Program (Section 9.2). The expected level of effort associated with the different mine areas is included in Section 9.2
	Chemically stable Waste Rock Stockpile to limit risk of failure that would impact humans and receiving environment[1].	Confirmation of PAG placement has occurred as outlined in the approved management plans. Golder (2018) outlines the current deposition strategy. Effluent discharge quality is consistent, or improved from FEIS predictions. Achieve "Recognized Closed Mine" status per Section 4 of MDMER. To understand this potential risk and mitigation/management options further, Baffinland plans to refine the water quality predictions in the future using site data. This work is required to develop meaningful criteria.	As-built drawing and confirmatory geochemical sampling results (confirming PAG placement) is deemed acceptable by a professional engineer. Monitoring activities as part of the Closure and Post Closure Aquatic Monitoring Program. Specific testing parameters, frequencies, locations and program durations will be developed over time based on findings of operational monitoring programs and pit flooding and water quality research studies (Appendix D).
Infrastructure and Ancillary Areas **Subcomponents:** • **Quarries and Stockpiles** • **Buildings and Equipment** • **Mine Infrastructure (e.g. pads and laydowns, secondary roads, airstrip, crusher)** • **Transportation Routes (Tote Road, Southern Railway and Ore Dock)**	Physically stable disturbed areas to limit risk of failure that would impact humans and receiving environment[1]	No significant signs of deformation or degradation at remaining engineered structures (e.g. Tote Road sections and select abutments at water crossings, Ore Dock) and/or other disturbed areas (e.g. quarries, laydowns, decommissioned landfills and landfarms) which could contribute to physically unstable conditions. This will be confirmed by visual monitoring as part of site geotechnical inspections. Surface contouring at disturbed areas is completed as outlined in an approved Final Grading Plan.	Geotechnical assessment, analysis and/or monitoring of the infrastructure and ancillary areas will occur as part of the Geotechnical/Engineering Monitoring Program (Section 9.2). The expected level of effort associated with the different mine areas is included in Section 9.2

Project Component	Closure Objectives	Closure Criteria	Actions/Measurements
• **Waste Management Areas (e.g. landfarms and landfills)** • **Water Management Areas (water treatment systems, settling ponds, pit dewatering system)** • **Quarries and borrow areas**	Chemically stable disturbed areas to limit risk impact to humans and receiving environment[1]	Chemical contaminant sources are removed from site. Residual soils meet federal/territorial soil quality guidelines or site-specific risk based criteria as required (CCME agricultural is assumed at this time). If soil exceeds the adopted criteria it will be removed or risk managed to the satisfaction of a qualified professional[3] to achieve protection of ecological and human health. For areas such as quarries and landfills that will have runoff, closure runoff water quality meets territorial/federal guidelines and/or site-specific risk-based criteria. Mine areas subject to MDMER (e.g. Crusher area).	Post Closure Site Assessment will include an ESA component at potentially impacted areas (e.g. equipment and fuel storage areas). If required, HHERA would also be undertaken. Monitoring activities as part of the Closure and Post Closure Aquatic Monitoring Program. Specific testing parameters, frequencies, locations and program durations will be refined over time based on findings of operational monitoring programs and research studies.

Notes:

[1]Receiving Environment – includes aquatic (freshwater and marine) biota and terrestrial biota.

[2]Site Wide project component – Discussion under this heading includes all project areas.

[3]Qualified Professional assumes a minimum of 3 years experience in the relevant field.

No closure activities are anticipated for the marine environment, consequently no specific closure objectives have been included. Future updates here may be completed as informed by the MEWG.

5.2 Permanent Closure and Reclamation Requirements

The closure and reclamation approach for the Project was developed on the basis of:

- MVLWB/AANDC Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the NWT (MVLWB/AANDC, 2013); and
- QIA Abandonment and Reclamation Policy for Inuit Owned Lands (2013).

It adheres to generally-accepted rehabilitation criteria and focuses on both physical and chemical stabilization of the site. Land disturbances not needed to support active operations will be concurrently reclaimed.

The main work items for final mine closure and reclamation include:

- Filling the open pit with water to stabilize the pit walls and mitigate falling hazards.
- Installation of a boulder fence and signage around the open pit to prevent inadvertent access.
- Removal of all mining and transportation infrastructure other than the Open Pit, Waste Rock Pile, Milne Port Tote Road, and Milne Port Ore Dock. The Milne Port Tote Road and Ore Dock will be left in place after the Project life, but not maintained.
- Demolition and removal of all buildings and foundations.
- All mining materials and equipment will either be removed from site or disposed of in on-site landfills/approved waste disposal areas.
- Removal of all hazardous materials and wastes will be removed from site to licensed disposal facilities.
- Storage of non-hazardous wastes on site.
- Capping of all landfills and other disposal areas.
- Removal of water management systems and infilling of mine water ponds.
- Roads, airstrips, and development areas will be re-contoured as required to provide long-term stability and reduce the potential for erosion.
- Removal of water crossings and regrading of disturbed project areas to restore natural drainage patterns.
- Scarification of disturbed areas of former mine infrastructure to encourage natural revegetation.
- Monitoring during closure and post closure up until the post-closure site assessment shows that the closure works been successful in meeting the closure criteria.

These following sub-sections describe each of the mine components, how they are to be rehabilitated and what options were considered, what uncertainties there are with respect to the closure and management, monitoring of the project component following closure.

Project components will be considered closed and reclaimed when closure criteria outlined in Section 5.1.1 are met. As the Project advances through the detailed design phase, changes to the Project may occur that will alter the Interim Mine Closure and Reclamation Plan. Though changes may occur, at this time it is anticipated that the major components of the Project will remain the same.

5.2.1 Open Pit Mine Workings

5.2.1.1 Project Component Description

Mining commenced on a hill crest outcrop, and will progress until Year 10 to 12 of operation at full production volume (based on a nominal 21.5 Mtpa) before an open pit is formed. The mine plans call for conventional open-pit mining methods utilizing 7.5 m benches.

Ore is delivered to the primary crusher (discussed in Section 5.2.5) located south of the deposit via the east main haul road.

The general configuration of the mine pit, haul road and waste rock dump is presented in Figure 5.1.

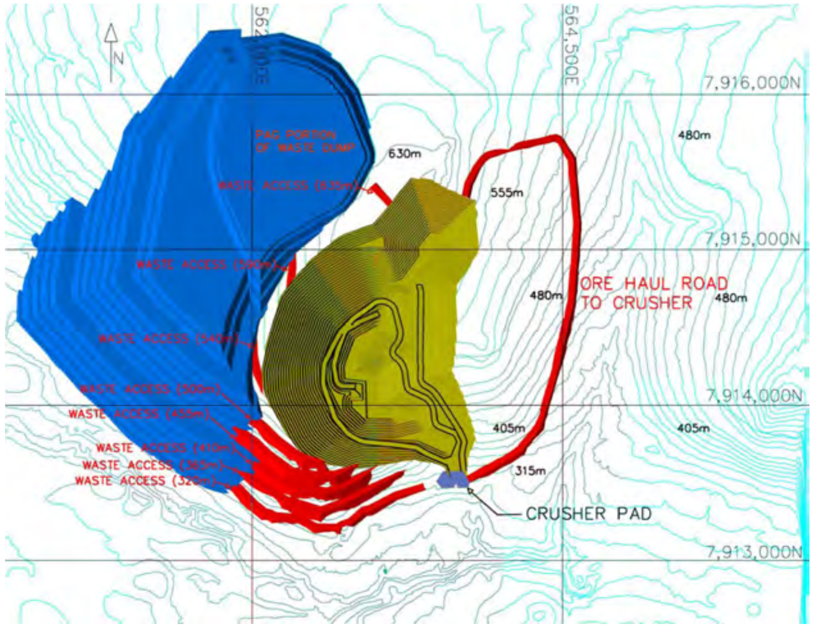

Figure 5.1 General Layout and Development Of Deposit 1 Pit

5.2.1.2 Pre-Disturbance, Existing, and Final Site Conditions

The pre-disturbance site conditions are summarized in Section 3. The current mine workings are free draining and there is no open pit, rather there are the development of benches on the hillside that are largely free draining. Appendix C provides a photolog showing the current mining operations.

The final site condition of the open pit will be a pit lake that drains to the natural environment through the spillway and natural drainage from the southeast corner of the open pit (KP 2008). It is currently anticipated that the discharge from the open pit will not require treatment (AMEC 2010).

The predictions of residual environmental effects presented in the FEIS assumed that upon cessation of operations, the perimeter of the open pit would be barricaded and remain restricted. The need for this restriction is uncertain, and will be assessed during ongoing closure planning.

5.2.1.3 Closure Objectives and Criteria

The closure objectives are presented in Section 5.1.1 and closure criteria are presented in Table 5.1.

5.2.1.4 Consideration of Closure Options and Selection of Closure Activities

BIML considered two options to address the closure objectives for the Open Pit, including (ensuring the site is physically stable against pit wall slope failure and mitigating the falling risk the void poses to humans and wildlife), including:

- Backfilling the open pit with waste rock; and
- Filling the pit with water (flooding).

Backfilling of open pits at closure is rarely conducted at mine sites due to the high cost even when sufficient materials are present on the property. The open pit at final closure will have an estimated volume of 43,400,000 m^3 below the lip of the pit, and backfilling this volume of material into the pit is not considered economically viable.

Flooding the pit was found to be more economically viable. The timeline for this process is uncertain, but preliminary estimates suggest that passive pit flooding with water from natural sources such as seepage into the pit, direct precipitation and surface runoff may take between 85 to 150 years (KP 2008). An enhanced pit filling alternative (i.e. active pumping) has also been assessed and suggests that pit filling could be completed in as few as 2 years. This is discussed below in greater detail.

The mining plan and the ongoing waste rock characterization plan will inform the prediction modeling of the mine pit water quality at the end of mine life. Should the modeling indicate potential exceedance of water quality objectives due to prolonged oxidation of the pit walls, alternative pit filling scenarios will be considered to mitigate this effect, including accelerated pit filling. The discussion below regarding accelerated pit filling is largely theoretical as there will be significant limitations and challenges to undertaking an ongoing, year-round pumping operation on the scale that would be required.

Enhanced Pit Filling Alternative

The filling of the pit can be accelerated via pumping water from a nearby water source – thereby complementing the accumulation of natural precipitation and ground water accumulation.

Assisted pit filling is governed by two parameters – technical limitations that drive pumping costs and water source locations/drawdown limits. Costs are driven by materials and equipment required for the operation (e.g., heat-traced piping, pumps, generators, and fuel requirements) as well as the construction and maintenance of the necessary roads and berms. Pumping water to the pit is uphill and therefore significant elevation head will provide technical challenges to any pumping design. Water source drawdown limits are designed to ensure that the volume of water extracted from a given source does not significantly lower the water table and has minimal impact on the aquatic ecosystem. Key factors to consider when calculating maximum acceptable drawdown of a lake include: potential spawning habitat as well as the residency time of the water body. The Department of Fisheries and Oceans (DFO) – Protocol for Winter Water Withdrawal from Ice-covered water bodies in the Northwest Territories and Nunavut, 2010 recommends, in the absence of a waterbody-specific assessment, that water withdrawals should not exceed 10% of the under ice lake water volume. Using this guidance as a proxy, Baffinland evaluated potential lake water sources for pit filling using annual water withdrawal of 10% of the total lake volume. Another consideration is distance to the pit and level terrain, in order to reduce pumping costs.

The Project pit has identified four potential water sources that can theoretically be used for filling the pit – Sheardown Lake, Camp Lake, Mary Lake and Mary River. This information is summarized in Table 5.2.

Table 5.2: Potential Water Source Pit Fill Data (Conceptual Level)

Water Source	Pumping Distance	Total Volume/ Annual Flow (m^3)	Permissible Annual Water Take (m^3)	Number of Years to Fill Pit
Sheardown Lake (NW Basin)	2 km	8,175,410[1]	820,000	53
Camp Lake	4.7 km	27,511,100[2]	3,000,000	15
Mary Lake	12 km	169,606,250[3]	11,200,000	4
Mary River (at MR-12, east pond discharge location)	< 1 km	78,185,678 (mean)[4] 53,166,261 (10-year dry)[4]	23,000,000 (30% of Mean Annual Discharge)	2

Source:

1. Based on Mary River Project FEIS, Appendix 7C, Figure 4.1-3
2. Based on Mary River Project FEIS, Appendix 7C, Figure 4.1-1
3. Based on Mary River Project FEIS, Appendix 7C, Figure 4.1-7
4. Based on Mary River Project FEIS, Volume 7, Table 7-3.18 – Calculated from the Mary River MAD plus annual inputs from the east pond

Sheardown Lake and Camp Lake are closer to the proposed final pit at a distance of 2 km and 4.7 km respectively, as opposed to Mary Lake which sits at a distance of 12 km from the pit. This results in Sheardown and Camp Lakes having shorter pumping distances than Mary Lake. Unfortunately, Sheardown and Camp Lakes have total volumes of 8,175,410 m^3 and 29,690,200 m^3, allowing to draw maximum volumes of only 820,000 m^3 and 3,000,000 m^3 per annum, thus resulting in a total theoretical pit fill times of 53 and 15 years respectively. In addition to this, Sheardown and Camp Lakes have a very long “residence” time for the water in the lake to completely recycle itself. As a result, it may be necessary to draw even less than 10% of the total lake volume in order to ensure no significant impact to the Sheardown or Camp Lake ecosystem.

The main basin of Mary Lake has a volume of 112,000,000 m^3 providing a total draw volume of 11,200,000 m^3 per annum. Assuming the maximum available volume of water is drawn this will result in a pit fill time of approximately four (4) years. In addition to this Mary Lake has a very high recharge rate completely “recycling” approximately every 1.5 years – resulting in minimal impact to the lakes ecosystem. Unfortunately, Mary Lake is located 12 km from the pit, which would result in substantial pumping costs and technical challenges – which are not expected to be economically feasible.

The Mary River offers the fourth pit filling alternative. DFO (2010) provides guidance on determining ecological flow requirements to establish water withdrawal volumes and rates that are not expected to have an impact. Withdrawals greater than 10% of the instantaneous flow and 30% of the Mean Annual Discharge (MAD) require rigorous assessment. To determine the potential viability of Mary River as a water source, 30% of the MAD has been applied in Table 5.2 to establish a 2-year pit filling period. Pumping may not be possible in low flow years. Between approximately 60 to 70% of the annual flow in the Mary River occurs during a 30 to 35 day freshet period in most years, so much of the annual withdrawal would need to take place during this brief period. Given the shorter length of pipeline, Mary River would likely be the preferred option for pit filling, subject to further study.

Periodic pumping involves pumping from the Mary River during the summer months only, when ice cover is not an issue. This period, June to September provides us with a maximum four month pumping window. Pumping during this time is essential as Mary River freezes solid during the winter months. Warm weather pumping also reduces the cost of constructing and maintaining a pipeline.

Assuming pumping continues 24 hours a day for the entire summer period this would require a pumping system that could deliver 8,700 m^3/hour, over approximately a 1 km distance and an approximate elevation head of 200 m. During the winter months the pump and pipeline would be drained and locked out to ensure that the equipment is not damaged by the winter conditions.

Continuous pumping assumes that water will be pumped to the Mine Site pit 24 hours a day all year long. Mary River is not an option for this scenario as it freezes during the winter, leaving Mary Lake the only option for continuous pumping. Technical and economic feasibility is unlikely assuming 24-hour continuous pumping with no delays or malfunctions for the entire year at a pumping rate of 1,300 m^3/hour, over a 12 km distance and 250 m elevation head.

Over winter pumping also presents other challenges including: the heating of pipelines, snow removal, ice removal from discharge and intake points, extreme weather conditions, increased maintenance costs and risk to personnel. Given these conditions it is expected that continuous pumping would not be a technically and economically feasible option.

5.2.1.5 Engineering Work Associated with Closure Activity

The main work items for closing the open pit are as follows:

- Conducting an engineering stability analysis to confirm the long-term stability of the pit walls;
- Barricading the ramps into the pit, construction of a perimeter boulder fence (or equivalent), and installation of hazard signage to mitigate the potential for inadvertent access;
- Removal of dewatering infrastructure used during operation (i.e., pumps, surge box and pipelines);
- Cleanup of any soil contamination (i.e. hydrocarbons, etc.) – see Section 9.6;
- Filling the open pit with water, either naturally or by enhanced filling; and
- Construction of a spillway at the southeast corner of the Open Pit.

The proposed closure activities for the open pit suggest that the open pit be allowed to naturally flood to form a "pit lake". At closure, inert wastes (i.e., material having insignificant leachability and pollution content) may be disposed of in the open pit. It is anticipated that the open pit will take an estimated 85 to 150 years to passively fill with water from natural sources such as seepage into the pit, direct precipitation and surface runoff (KP 2008). There are a number of different potential scenarios for accelerating the pit filling which are presented above in Section 5.2.1.4. These will be further assessed prior to final closure if accelerated filling is deemed required.

Once the open pit fills to the point of overflow, pit drainage will enter the natural environment through the spillway and natural drainage from the southeast corner of the open pit (KP 2008), eventually reaching the receiving waters of Mary River. It is currently anticipated that the discharge from the open pit will not require treatment (AMEC 2010). However, if treatment is required several effective technologies are currently available to manage metal leaching and/or acid rock drainage (ML/ARD). If ML/ARD were to develop, batch treatments will be carried out to adjust the pH and/or metal concentrations of the water in the pit so that it meets discharge requirements before overflow into the environment. The overflow location at the southeast area of the pit will provide emergency access to and from the open pit/pit lake.

5.2.1.6 Predicted Residual Effects

The predicted residual effects at planned closure, including those encompassing the open pit mine workings, were assessed as part of the FEIS with respect to VEC/VSEC. These effects, and the methods for their assessment are summarized in Appendix G.

As the project progresses, data will be collected through the environmental monitoring programs which can provide an indication of the accuracy of the predicted effects. These data can also be used to give an indication of the performance of the site mitigative measures and management systems, used as the basis for revising the prediction of residual effects, or implementing adaptive management.

5.2.1.7 Uncertainties

As noted in Section 5.2.1.4, there is uncertainty as to the long-term water quality in the open pit. Baffinland will conduct monitoring and research as necessary to resolve uncertainties pertaining to residual effect assessments and environmental risks that may have closure implications. Uncertainties related to the open pit mine workings include whether or not there is potential for the generation of ML/ARD from the contact of water with the final pit. It is currently anticipated that the discharge from the open pit will not require treatment (AMEC 2010); however, there is uncertainty. The mining plan and the ongoing geochemical characterization plan will inform the prediction modelling for mine pit water quality at the end of mine life as presented in the Life-of-Mine Waste Rock Management Plan (Appendix 5 , BAF-PH1-830-P16-0031) and Section 5.2.1.8, Appendix D of the FEIS.

This uncertainty has been highlighted by stakeholders and Baffinland has committed to addressing the concern within the Reclamation Research Plan. A detailed description of the planned research is presented in Appendix D.

There is uncertainty regarding the infilling rate of the open pit. There are two proposed options for options for pit infilling, natural flooding and enhanced pit filling (which uses pumps from nearby lakes. For both methods, the total time to flood the pit is uncertain, and for the enhanced pit filling alternative, the source for the water for flooding has only been identified at a conceptual level. This concern has been highlighted by stakeholders, and Baffinland will proactively address this issue within the Reclamation Research Plan. A detailed description of the planned research is presented in Appendix D.

5.2.1.8 Post Closure Monitoring, Maintenance and Reporting

Conceptual modelling of the pit water quality is presented in the Mary River Project FEIS. Open pit monitoring will be done throughout of the life of the Project as per the Type A Water Licence and in accordance with MDMER requirements. Predictions of pit water quality will be updated throughout the life of the Project as more information comes available on the geochemistry of the waste rock and the pit wall. Although indications to-date demonstrate a low probability of ML/ARD, if monitoring results during Operations suggest a potential ML/ARD it shall be dealt with at that time and any associated impacts that ARD and/or ML would have on closure and reclamation planning, monitoring, Long-term maintenance and bonding will be addressed. If there are no indications from test programs or ongoing monitoring of ML/ARD throughout the Operation Phase, at final closure the open pit will be inspected by a qualified engineering professional to assess the physical stability of the pit walls and pit lake and to reconfirm no indicators of ML/ARD.

ARD and ML will be periodically reassessed as a potential issue in the future ICRP revisions and in the Final MCRP. The Final MCRP will present a time frame for the potential development of ML/ARD conditions, if any, and discuss the impact of ML/ARD release on final closure identifying the need for ongoing monitoring, treatment, and potential mitigations

Post-closure monitoring of open pit mine workings includes geotechnical/engineering monitoring (Section 9.2), aquatic monitoring (Section 9.3), Environmental Site Assessment (Section 9.4), fauna and flora monitoring (Section 9.5), and safety compliance inspection (Section 9.7). Maintenance required will depend on the outcome of the monitoring programs, and would be completed as outlined in Section 9. Baffinland will report on the results of all monitoring programs on an annual basis to the NIRB (as per Project Certificate No. 005 and its Amendment), AANDC Land Lease 47H/16-1-2, the NWB (as per Type ‘A’ Water Licence 2AM-MYR-1325 Amendment No. 1) and the Land Owners (as per Commercial Lease Q13C301).

5.2.1.9 Contingencies

There are two contingencies to address potential water quality concerns in the open pit:

- accelerated pit filling (discussed in Section 5.2.1.4);
- and treatment of water before discharge (discussed below).

Conceptual modelling of the pit water quality is presented in the Life-of-Mine Waste Rock Management Plan (Appendix 5, BAF-PH1830-P16-0031). Open pit monitoring will be done throughout of the life of the Project as per Type A Water Licence Amendment No. 1 requirements and in accordance with MDMER requirements. Predictions of pit water quality will be periodically updated throughout the life of the Project as more information becomes available on the geochemistry of the waste rock and the pit wall.

Although indications to-date demonstrate a low probability of ML/ARD, in the event that ongoing water quality modelling or field monitoring shows a trend toward exceedance of discharge requirements, then water treatment options will be determined and implemented. Details regarding theoretical treatment options are provided in the Life-of-Mine Waste Rock Management Plan (Section, 3.6.4, BAF-PH1830-P16-0031) and were considered for both metal and ammonia/nitrate removal. Theoretical treatment options for metals removal included:

- Resins
- Polymer Addition
- Sodium Hydrosulfite Treatment
- Ozonation
- Biofilters-Sulphide Precipitation
- Activated Carbon
- Lime Precipitation

Theoretical treatment options for ammonia/nitrate removal include:

- Biological De-nitrification (for removal of both ammonia and nitrate)
- Ion Exchange
- Electro-Chemical Ion Exchange
- Breakpoint Chlorination of Ammonia

If there are no indications from test programs or ongoing monitoring of ML/ARD throughout the Operation Phase, at final closure, the open pit will be inspected by a qualified engineering professional to assess the physical stability of the pit walls and pit lake and to reconfirm no indicators of ML/ARD.

ML/ARD will be periodically reassessed as a potential issue in the future ICRP revisions and in the Final CRP. Reclamation Research to address the uncertainty of what closure and post closure activities are required to ensure open pit runoff water quality meets closure objectives and criteria, including ML/ARD issues, is expected to commence at approximately Year 10 of Operations (when an Open Pit is expected to exist associated with the Project). Based results of this research, the ICRP will be updated to present a time frame for the potential development of ML/ARD conditions, if any, and discuss the impact of ML/ARD release on final closure identifying the need for ongoing monitoring, treatment, and potential mitigations.

5.2.2 Waste Rock and Overburden Piles

5.2.2.1 Project Component Description

A waste rock disposal area designed for permanent storage of waste rock is located north of the open pit. Based on the current mine plan, an estimated 600 Mt of waste rock and 30 Mt of overburden will be generated from the mining of Deposit No. 1.

The Waste Rock Stockpile design has sufficient capacity to stockpile the entire volume of waste produced by the mine plan. As described in Section 3.3.3, the majority (approximately 85%) of the LOM waste rock produced by the mine is anticipated to be non-potentially acid generating (Non-PAG).

Waste characterization, volume estimation, and monitoring of the Waste Rock ML/ARD is ongoing. The design of the waste rock facility will be updated periodically as necessary throughout the LOM.

The PAG, Non-PAG, and Overburden are handled as three separate streams and are placed in zones within the Waste Rock Facility. Figure 5.2 presents the distribution of PAG, non-PAG, and Overburden in the Waste Rock pile. Figure 5.3 presents the progressive development (construction steps) for the Waste Rock Pile.

The deposition strategy for the water rock area is to promote permafrost aggradation. To support this natural process, the following guidelines for placement and development have been adopted:

- The pile will be constructed in lifts from the bottom up with lift and bench characteristics appropriate for the geotechnical conditions and waste handling equipment. These characteristics will be approved by Mine Operations.
- Waste rock placed within 25 m of the outer edge of the pile should be Non-PAG and be placed during the winter months in lifts of no greater than 2 to 3 m to help advection within the pile.
- A 2 to 3 m thermal barrier of Non-PAG waste rock will be placed during the winter months to the extent practical to protect the permafrost layer during the summer months and allow development of the permafrost into the pile.
- Prior to the placement of any Non-PAG rock on natural ground within 25 m of the outer edge of the pile, snow and non-frozen material will be removed from the footprint to the extent practical.
- PAG rock should all be placed in the same watershed in the waste rock pile (may be modified in future updates to the Waste Rock Management Plan).
- PAG waste rock placement will be segregated from non-PAG rock placement and the location of PAG material documented.
- Waste rock will be placed in lifts while minimizing the overall thickness of the unfrozen material.

- PAG waste rock should be deposited such that permafrost aggradation in the following seasons occurs to the extent practicable.
- The perimeter of the pile will be a minimum of 31 m from any natural water body.
- Haul ramps for the waste stockpile will be similar in design to those within the pit and will be approximately 20 m wide at maximum 10% grades.

The existing disposal area within the LOM WRF footprint is within the western watershed which drains into Camp Lake. For Phase 1, a pond was constructed to the north of the disposal area as well as collection and diversion ditches along the perimeter of the waste rock pile. Water is discharged from the pond to the Mary River watershed via a lay flat hose to convey the water to an existing water course draining into a tributary of Mary River.

The expanded footprint outlined in the Phase 1 Extension plan is also located in the western watershed up-gradient of the existing WRF and WRF pond. As part of the Phase 1 Extension, the existing WTF pond will be upgraded to accommodate the additional flows attributed to the footprint expansion. Collection ditches and diversion ditches will be constructed considering the pile expansion; a water treatment system is built and is currently operational. The temporary water runoff management plan to be completed in spring 2018 is shown and the permanent upgrade to the water management system is scheduled for fall 2018.

Further phased surface water management (ditches and ponds) will be designed as mining progresses. All phases of the run off management system will be designed such that water discharged from the WRF will be in compliance with applicable water quality discharge criteria outlined in the Type A Water Licence and the MDMER.

Surface water collection systems consisting of collection channels, diversion channels and settlement ponds are implemented as part of the waste dump water management system. In addition to sediment control, these collection systems will minimize the introduction of water into the waste dump foundations, where standing water may adversely affect the thermal regime and, therefore, chemical stability. Runoff water quality will be monitored. Discharge from the sedimentation ponds will be channeled to the Camp Lake Tributary (West pond) and to Mary River (East pond). Figure 5.4 presents the drainage features of the Waste Rock Pile.

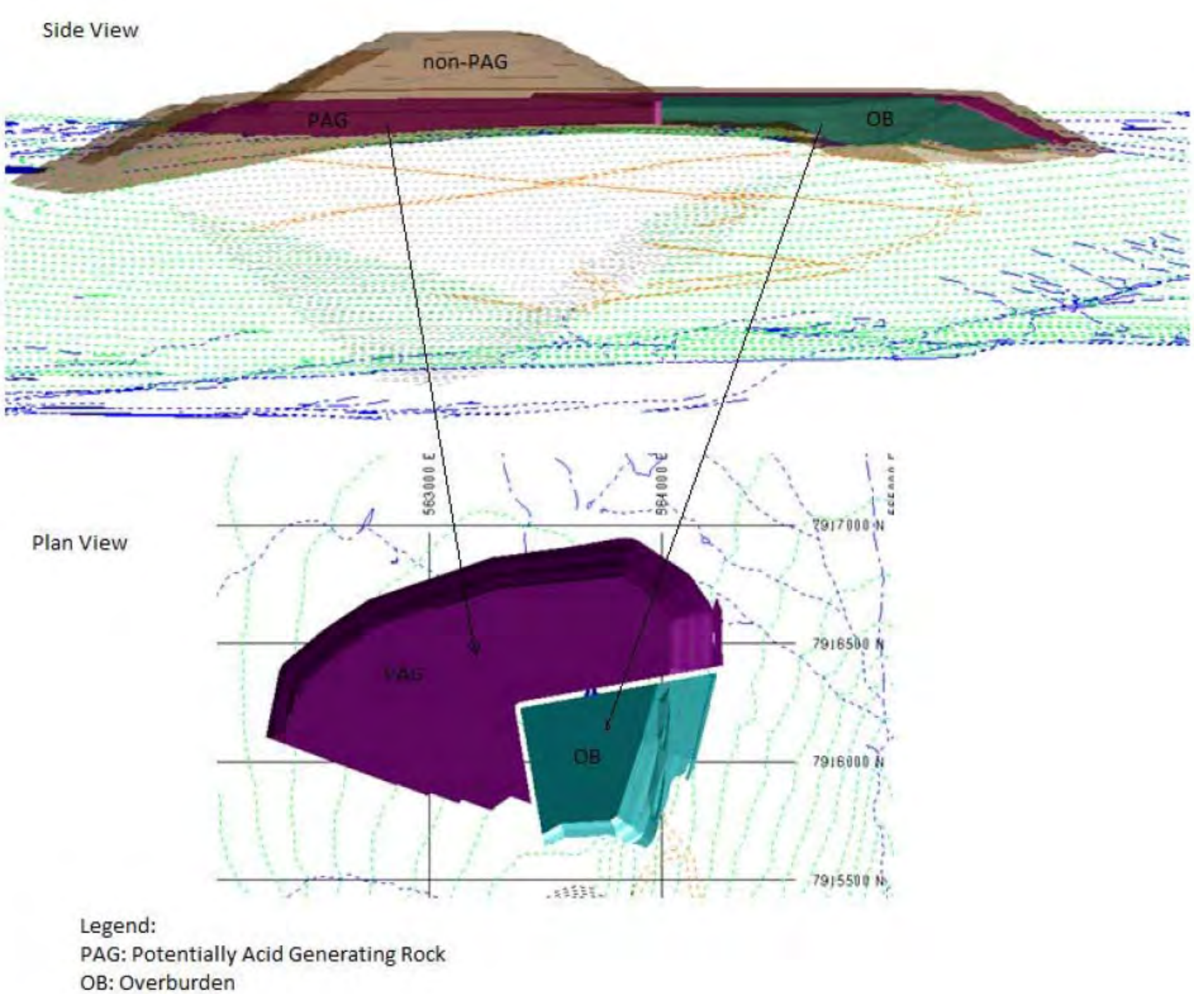

Figure 5.2 Placement of Waste Rock and Overburden

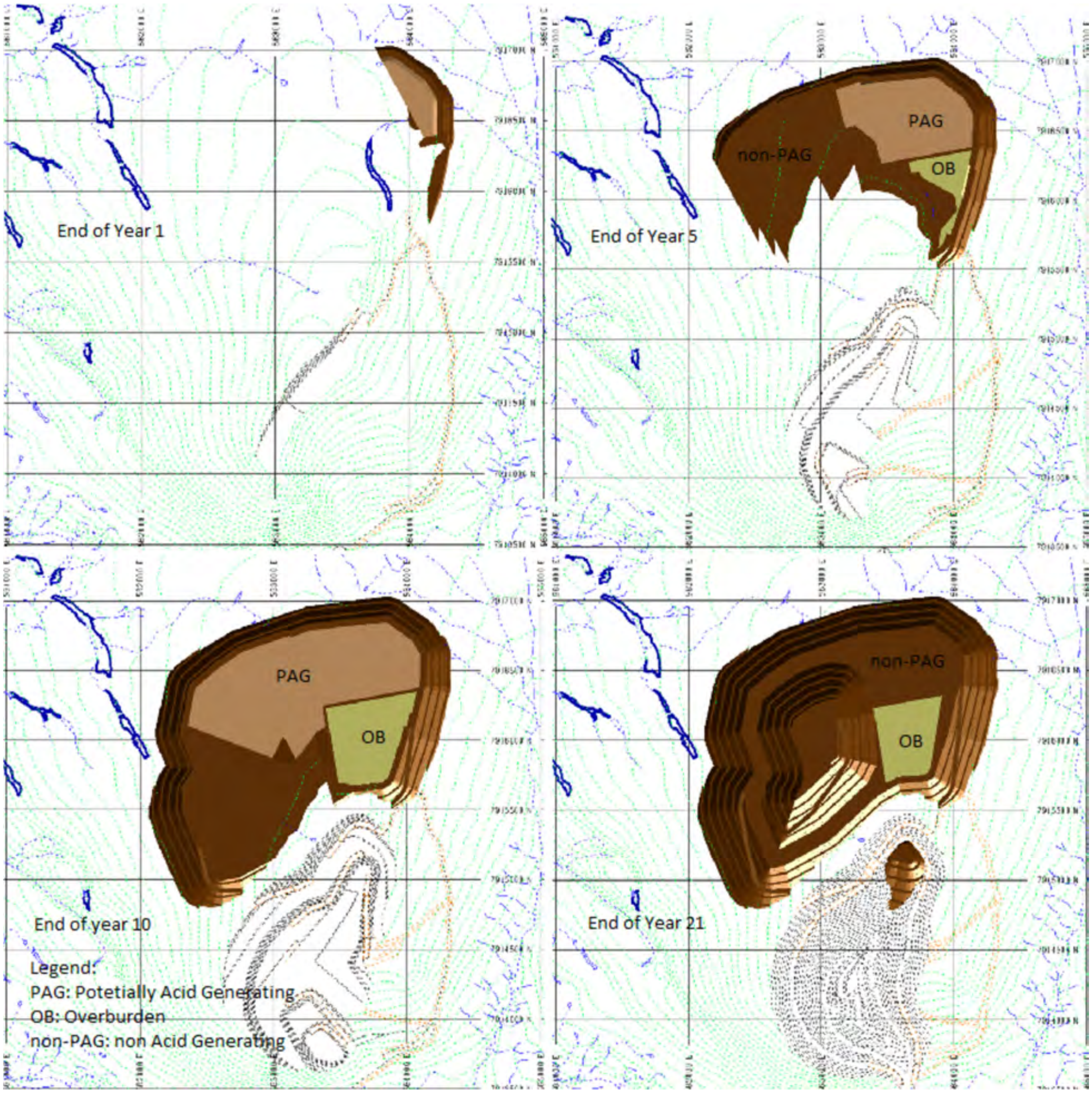

Figure 5.3 Evolution of the Waste Rock Stockpile Over the Life-Of-Mine

Figure 5.4 **Water Management Structures for the Waste Rock Storage Area**

5.2.2.2 Pre-Disturbance, Existing, and Final Site Conditions

The pre-disturbance site conditions are summarized in Section 3.

Figure 5.5 shows the summer 2018 waste rock deposition plan, which provides an oblique view of the existing waste rock pile with superimposed deposition locations noted. In addition, Appendix C provides a photolog showing the current mining operations.

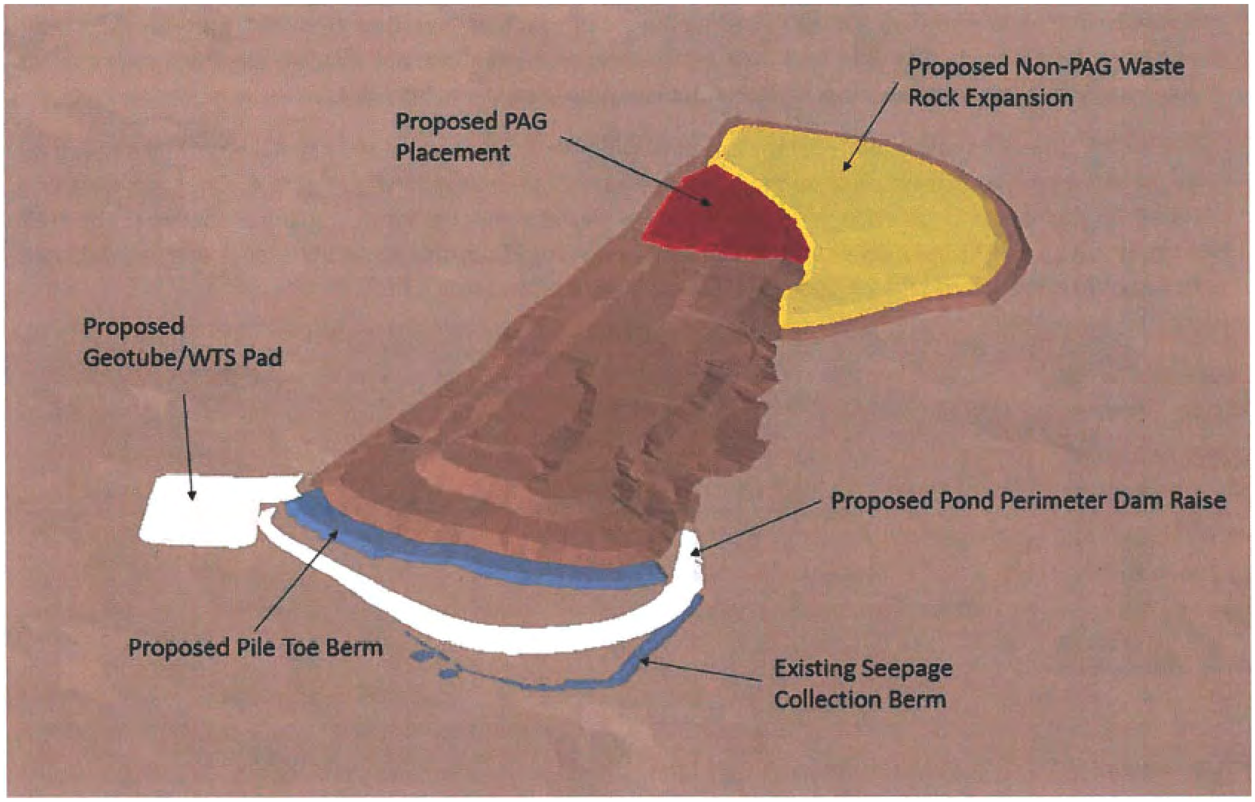

Figure 5.5 Waste Rock Deposition Plan – Summer 2018 – Plan View

At closure, the Waste Rock Stockpile will remain on site. It will contain approximately 630 Mt of waste rock and overburden, with average side slopes of 2H: 1V. As the surrounding terrain is rugged and rocky with minimal vegetation, no active revegetation or contouring is anticipated to be required to enhance its similarity to the surrounding terrain.

5.2.2.3 Closure Objectives and Criteria

The closure objectives are presented in Section 5.1.1 and closure criteria are presented in Table 5.1.

5.2.2.4 Consideration of Closure Options and Selection of Closure Activities

Detailed alternative analysis of other closure options have not been completed by Baffinland due to the early stage of the Project and the absence of Project components which represent the largest uncertainty at closure (Open Pit, Permanent Waste Rock Stockpile). As data are collected and analysis is conducted, the ICRP will be updated as required. Please refer to Appendix D for more detail on reclamation research plans relevant to the Project to address uncertainties related to final closure.

Relevant closure options at the Waste Rock Stockpile will likely be limited to minor changes in PAG/non-PAG material placement occurring as part of the ongoing management of waste materials within the required set backs as outlined within approved management plans.

5.2.2.5 Engineering Work Associated with Closure Activity

The main work items for closing the Waste Rock and Overburden Stockpiles are as follows:

- Cleanup of any soil contamination (i.e. hydrocarbons, etc.) – see Section 9.6, if applicable;
- Monitoring and confirming the freezing (permafrost aggradation) of the pile, with the exception for a shallow “active” zone;
- Monitoring the water quality of any seepage emanating from the waste rock stockpile;
- Conducting an engineering stability analysis ((Section 9.2) to confirm the long-term stability of the slopes of the waste rock pile, and recontouring (if necessary) to ensure the slopes are physically stable;
- Grading at associated water management structures (e.g. two Waste Rock Stockpile Ponds, potential temporary dams) to establish final drainage pathways;
- Accumulated sediments at the Waste Rock Stockpile management ponds will be assessed for leaching and potential impacts to downgradient water quality. Options for managing potential risk from sediments include but are not limited to: covering, excavation, disposal at approved facility.

Mine planning will ensure that at closure the exterior of the dump consists of a layer of non-PAG material up to 50 m thick. To minimize active layer thickness, a stockpile of overburden will be retained to spread a layer of less permeable material over the top of the dump.

Studies of waste rock in permafrost demonstrate that permafrost forms an effective long-term barrier to water and oxygen, thereby preventing significant oxidation of sulphidic waste rock located below the surficial active zone. The surficial “active” zone, which will be subject to seasonal freeze-thaw, will not reach the 50 m thickness of non-PAG material in the long-term (within 200 years) under the influence of climate change (Intergovernmental Panel on Climate Change, 2007). Therefore, over the long term, runoff water quality which is influenced by contact water that flows through the active layer in the waste rock stockpile will not be affected. Following closure, generation of ML/ARD is not anticipated.

The physical stability of the waste rock stockpile will be investigated at the onset of closure. This investigation will take into account the final geometry of the stockpile, including the aerial extent, height, cross-sections and the volume in place. If geotechnical investigations indicate it necessary, the waste rock stockpile may undergo re-contouring to ensure physical stability. Following re-contouring and stabilization investigations and activities, as required, the waste rock stockpiles will be considered closed.

Based on the current state of the Mine Site prior to mining activities, the Mine Site is characterized by a rugged rocky terrain with minimal vegetation. Therefore, an uncovered waste rock stockpile is considered environmentally compatible with the current undisturbed surrounding areas.

Runoff from the Waste Rock Stockpile will continue to be monitored until runoff meets water quality objectives for closure (described in Section 9.5). Once water quality objectives have been met, the Waste Rock Stockpile ponds will be decommissioned, and runoff will be allowed to discharge directly to the environment.

5.2.2.6 PREDICTED RESIDUAL EFFECTS

The predicted residual effects at planned closure, including those encompassing the waste rock pile, were assessed as part of the FEIS with respect to VECs/VSECs. A detailed breakdown of these effects, and the methods for their assessment are summarized in Appendix G. Key FEIS residual effects predictions regarding surface water discharges from the WRF post closure are that any substantive impacts will be localized (see below) and adverse environmental effects on water quality or Arctic Char in the Mine Site LSA are not expected post-closure.

As reported in the Interim Waste Rock Stockpile Seepage Quality model (Appendix 4, BAF-PH1830-P16-0031), predictions indicate that the concentrations of arsenic, copper, lead, nickel, and zinc concentrations in the waste rock stockpile seepage will be below MDMER values. However, there is uncertainty in this model as follows:

- The water quality model is based on the mine plan, waste rock stockpile configuration, water balance and geochemical data. Changes to these assumptions may result in differing water quality;
- A number of assumptions made to develop the model (permafrost extent, stockpile hydrology, acid drainage source terms, etc.) that should be updated where more appropriate data becomes available;
- The current model has considered the surface area based on a review of published and unpublished data from other mine projects which could be different from the actual surface area of the Project waste rock; and
- Current model estimates are based upon simplified estimates of the seepage pH. These pH values can have a significant impact on the estimated loadings and concentrations of metals predicted in the model.

Details on thresholds and modelled water quality of the specific waters that will receive stormwater from the waste rock stockpile via the east and west ponds are provided in Appendix H. The West Waste Rock Stormwater will discharge to Camp Lake via its tributaries, with increasing dilution and mixing along the way. Conservative modelling of the anticipated water quality of the west pond discharge and the predicted water quality in the receiving waters identified potential exceedances of water quality thresholds (CCME PAL) of mercury and selenium in Camp Lake and tributary L1 and L0 under mean flow and dry year conditions (HQ of 1 and 2, respectively in Camp Lake, higher in the tributaries; see Tables 9 and 10 in Appendix H). HQ (Hazard Quotient) is the ratio of the potential exposure to a substance and the level at which no adverse effects are expected. If the Hazard Quotient is calculated to be less than 1, then no adverse effects are expected as a result of exposure. The same conservative modelling approach completed for the east pond discharge to Mary River (containing fish habitat) identified potential exceedances of water quality thresholds (CCME PAL) of mercury, selenium, and silver under both mean flow and dry flow year conditions (HQ of 4, 1, and 1, respectively). The reason these results are considered highly conservative is explained in Appendix H. The residual effects are considered partially reversible because reversibility may require ongoing water treatment, and the duration of any required treatment is unknown at this time. The QIA has inquired if there will be changes in water quality that may affect the ability to safely consume fish from waterbodies near the Waste Rock Stockpile and Open Pit. The risk associated with consuming arctic char in the Project area is difficult to assess, as baseline sampling results reported in the FEIS found that 29% of arctic char exceeded Health Canada guidelines for mercury (this is not an unusual finding for land-locked char). Nevertheless, as the project progresses, data will be collected through the environmental monitoring programs which can provide an indication of the accuracy of the predicted effects. These data can also be used to give an indication of the performance of the site mitigation measures and management systems, used as the basis for revising the prediction of residual effects, or implementing adaptive management.

5.2.2.7 UNCERTAINTIES

Baffinland will conduct monitoring and research as necessary to resolve uncertainties (described above) pertaining to residual effect assessments and environmental risks that may have closure implications.

The primary uncertainties related to the waste rock and overburden pile are:

- whether or not there is potential for the generation of ML/ARD from contact water at the end of life; and
- the rate at which the waste rock pile will aggrade of permafrost and the thickness of the active layer (layer that will be unfrozen during the warmer months of the year).

The mining plan and the ongoing waste rock characterization plan will inform the prediction modeling of the Life-of-Mine Waste Rock Management Plan (Appendix 4, BAF-PH1830-P16-0031).

Reclamation research programs (Appendix D) have been designed to improve understanding of the expected performance of the waste rock pile closure concept with respect to both drainage water quality as well as with respect to permafrost aggradation through operation and closure.

5.2.2.8 Post Closure Monitoring, Maintenance and Reporting

Post-closure monitoring of waste rock and overburden piles includes geotechnical/engineering monitoring (Section 9.4), aquatic monitoring (Section 9.5), Environmental Site Assessment (Section 9.6), fauna and flora monitoring (Section 9.7), safety compliance inspection (Section 9.9), and air quality monitoring (Section 9.11). Maintenance required will depend on the outcome of the monitoring programs, and would be completed as outlined in Table 5.1. Baffinland will report on the results of all monitoring programs on an annual basis to the NIRB (as per Project Certificate No. 005 and its Amendment), AANDC Land Lease 47H/16-1-2, the NWB (as per Type 'A' Water Licence 2AM-MYR-1325 Amendment No. 1) and the Land Owners (as per Commercial Lease Q13C301).

5.2.2.9 Contingencies

5.2.2.9.1 Waste Rock Stockpile Runoff Water Quality

In the event that research, ongoing water quality modelling, or field monitoring shows a trend toward exceedance of discharge requirements, then water treatment options will be determined and implemented.

Details regarding theoretical treatment options are provided in the Life-of-Mine Waste Rock Management Plan (Section, 3.6.4, BAF-PH1830-P16-0031) and were considered for both metal and ammonia/nitrate removal. Theoretical treatment options for metals removal included:

- Resins
- Polymer Addition
- Sodium Hydrosulfite Treatment
- Ozonation
- Biofilters-Sulphide Precipitation
- Activated Carbon
- Lime Precipitation

Theoretical treatment options for ammonia/nitrate removal include:

- Biological De-nitrification (for removal of both ammonia and nitrate)
- Ion Exchange
- Electro-Chemical Ion Exchange

- Breakpoint Chlorination of Ammonia

Regular updates on waste rock characterization and prediction of runoff water quality will be provided in future updates of the Life-of-Mine Waste Rock Management Plan (BAF-PH1-830-P16-0031) as they are developed and will be incorporated into future versions of the ICRP as appropriate.

5.2.3 Quarries and Ore/Aggregate Stockpiles

5.2.3.1 Project Component Description

This project component includes:

- Mine Site:
  - Quarry D1Q1
  - Quarry D1Q2
  - Quarry QMR2
  - KM 97 Borrow Locations
  - Ore Stockpile
  - ROM Stockpile
- Tote Road:
  - Extended cuts in bedrock along road corridor
- Milne Port:
  - MP-Q1-01
  - MP-Q1-02
  - Borrow Source No. 1
  - Quarry No. 1
  - Ore Stockpiles

The quarries and borrow sources at the Mine Site and Milne Port were developed to construct the site.

The Run of Mine (ROM) stockpile is a small stockpile which is used to temporarily store mined ore prior to feeding it to the primary crusher. Ore is then either crushed to a fine ore product, or left as lump ore. The ore (fine and lump) is moved to the mine site Ore Stockpile is used to temporarily store ore that is ready to haul to Milne Port. Once the ore reaches Milne Port, the crushed ore is stored in a large stockpile until such time that it can be loaded onto a ship. Ore may be stored at the Milne Port ore stockpile for several months over the winter until open water conditions permit shipping.

5.2.3.2 Pre-Disturbance, Existing, and Final Site Conditions

The pre-disturbance site conditions are summarized in Section 3. Appendix C provides a photolog showing the current mining operations.

Each quarry permit application presents a quarry development plan, drainage information as well as a closure plan. All borrow areas and quarries will be progressively reclaimed maintaining stable side slopes in accordance with the individual site permit. At the onset of closure the borrow areas and quarries will be investigated to assess for potential thermal damage and instability due to thaw impacts. At closure, re-contouring and filling with overburden may be required to ensure slope stability and restore the natural drainage due to thermal disruptions.

The ore/aggregate stockpiles will be depleted upon closure. Soils below the stockpiles will be sent for testing and treatment, if required, as discussed in Section 9.4. The ore/aggregate stockpile bases will be re-contoured as necessary, scarified, and allowed to naturally re-vegetate. If ore/aggregate stockpiles remain at closure, they will be graded and re-contoured for long-term physical stability. There are currently no plans to place a cover material over residual ore for aesthetic purposes unless aesthetic values identified through community engagement on mine closure determine the need for fill placement. Construction of a clean fill cover, and/or placement of residual ore as backfill will be assessed if water quality concerns are present.

5.2.3.3 Closure Objectives and Criteria

The closure objectives are presented in Section 5.1.1 and closure criteria are presented in Table 5.1.

5.2.3.4 Consideration of Closure Options and Selection of Closure Activities

Detailed alternative analysis of other closure options have not been completed by Baffinland due to the early stage of the Project and the absence of Project components which represent the largest uncertainty at closure (Open Pit, Permanent Waste Rock Stockpile). As data are collected and analysis is conducted, the ICRP will be updated as required. Please refer to Appendix D for more detail on reclamation research plans relevant to the Project to address uncertainties related to final closure.

Relevant closure options to consider in the future will likely include grading and drainage options assessed as part of the Final Grading Plan.

5.2.3.5 Engineering Work Associated with Closure Activity

Quarries and borrow pits will no longer be needed at closure. Closure of active quarry faces will involve removing all materials, equipment and infrastructure. Active quarry walls will be terraced during operation to closely manage issues related to drainage and will not be altered for closure. The quarry development will reduce the creation of pits and depressions to the degree practicable to reduce the potential for standing water. The quarry pit floor will be left as free draining.

All site waste will be collected and placed in appropriate containers for removal. Pre and post waste removal inspections will be made to ensure the thoroughness of the program. Waste will include metallic waste, construction material waste and domestic waste.

At the current time, no washroom facilities for personnel are expected at the quarry site. Any requirement for such facilities will be met by easily removable portable toilets. These will be operated in a manner consistent with regulations, and disposal will be in accordance with Baffinland's Waste Management Plan (BAF-PH1-830-P16-0028).

Quarrying activities will be closely managed to avoid the accumulation of unnecessary stockpiles of aggregate. Any stockpiles that do remain will be dealt with as follows:

- Large rock will be spread out on the landscape or used as rip-rap for erosion control
- Medium sized rock will be used to re-contour affected areas to re-establish a more natural appearance to the area
- Small crushed rock will be used to assist in drainage restoration, and spread on the landscape to re-establish more natural contours
- Any collected soils will be spread to allow for the re-establishment of vegetation. No vegetation planting or seeding operations will take be undertaken and natural re-vegetation will be allowed to take place

Quarry access roads will typically be relatively short aggregate structures. The entire road bed will be removed to re-establish desired drainage.

A pre-closure inspection for potentially impacted soils will be completed at the entire site. Any contaminated soils, snow or ice packs, or overburden will be flagged. The extent of the contamination will be assessed, and the material removed for treatment at a site-landfarm or containerized for shipment to a licenced off-site facility.

Other contamination, such as heavy metals or toxins, will require containerization for shipment off site to an appropriate facility (refer to Interim Closure and Reclamation Plan).

Reclamation of uncovered permafrost and ground/ice will involve removing any ponding water and backfilling the impacted permafrost and/or ground ice with available material.

At the end of mining, ore and aggregate stockpiles will have all been used up. The former stockpile areas will be recontoured to match the surrounding terrain (where possible), and scarified to promote natural revegetation and allow vegetation to re-establish through natural processes.

5.2.3.6 Predicted Residual Effects

The predicted residual effects at planned closure, including those encompassing quarries and ore/aggregate stockpiles, were assessed as part of the FEIS with respect to VEC/VSEC. These effects, and the methods for their assessment are summarized in Appendix G.

As the project progresses, data will be collected through the environmental monitoring programs which can provide an indication of the accuracy of the predicted effects. These data can also be used to give an indication of the performance of the site mitigative measures and management systems, used as the basis for revising the prediction of residual effects, or implementing adaptive management.

5.2.3.7 Uncertainties

Uncertainties related to the closure of quarries include whether or not the remaining exposed aggregate is PAG, which is addressed in the individual quarry management plans. Ore/aggregate stockpiles have the potential to result in contaminated soils (Section 9.6), and there may be uncertainty in revegetation success, addressed in a reclamation research program (Appendix D).

5.2.3.8 Post Closure Monitoring, Maintenance and Reporting

Post-closure monitoring of quarries and ore/aggregate stockpiles includes geotechnical/engineering monitoring (Section 9.4), aquatic monitoring (Section 9.5), Environmental Site Assessment (Section 9.6), fauna and flora monitoring (Section 9.7), safety compliance inspection (Section 9.9), and air quality monitoring (Section 9.11). Maintenance required will depend on the outcome of the monitoring programs, and would be completed as outlined in Table 5.1. Baffinland will report on the results of all monitoring programs on an annual basis to the NIRB (as per Project Certificate No. 005 and its Amendment), AANDC Land Lease 47H/16-1-2, the NWB (as per Type ‘A’ Water Licence 2AM-MYR-1325 Amendment No. 1) and the Land Owners (as per Commercial Lease Q13C301).

5.2.3.9 Contingencies

Contingencies related to the revegetation efforts have not been completed by Baffinland due to the early stage of the Project and the absence of Project components which represent the largest uncertainty at closure (Open Pit, Permanent Waste Rock Stockpile). As data are collected and analysis is conducted, the ICRP will be updated as required.

5.2.4 Buildings and Equipment

5.2.4.1 Project Component Description

To the extent possible, buildings have been consolidated to hold accommodation, administration, maintenance and laboratory complexes to reduce outside travel of in-building workers. The accommodation buildings consist of a prefabricated modular unit supported on timber cribbing foundations, and house personnel in single dormitory wings. A central core area comprises: kitchen/dining facilities, recreational facilities, and general service space. The fire protection system includes a primary fire pump (with backups) and sprinkler systems for the accommodation, administration, laboratory, and warehouse facilities. See Section 5.2.5 for mining infrastructure, including associated buildings.

Haul trucks equipped with side dump trailers dump directly on the ground. Front end loaders are used to transport the dumped ore to portable feeders, which transfer the ore to telescopic portable radial stackers, which in turn deposit the ore in the stockpiles. There are sets of portable feeders and portable radial stackers, each with a capacity of 1,500 tph. The feeders and stackers are powered by an onboard diesel generator.

5.2.4.2 Pre-Disturbance, Existing, and Final Site Conditions

The pre-disturbance site conditions are summarized in Section 3. Appendix C provides a photolog showing the current mining operations.

Upon Final Mine Closure, buildings and infrastructure will be decommissioned and no longer be features on site. Associated pads and laydown areas will be re-graded to restore natural drainage patterns where possible, and scarified to allow for natural re-vegetation at closure.

5.2.4.3 Closure Objectives and Criteria

The closure objectives are presented in Section 5.1.1 and closure criteria are presented in Table 5.1.

5.2.4.4 Consideration of Closure Options and Selection of Closure Activities

Detailed alternative analysis of other closure options have not been completed by Baffinland due to the early stage of the Project and the absence of Project components which represent the largest uncertainty at closure (Open Pit, Permanent Waste Rock Stockpile). As data are collected and analysis is conducted, the ICRP will be updated as required. Please refer to Appendix D for more detail on reclamation research plans relevant to the Project to address uncertainties related to final closure.

5.2.4.5 Engineering Work Associated with Closure Activity

To permit the reclamation of the land area they cover, improve aesthetics, remove the physical hazard they pose to humans and the environment, and address any chemical concerns they may pose, buildings at the Mine Site, Tote Road, and Milne Port will be removed.

Mechanical equipment will be considered closed and reclaimed when they no longer pose a risk of contamination to the environment, will not be a safety hazard to humans and wildlife, and no longer need long term care.

Removal of the buildings and equipment will involve the following works:

- Decontaminate buildings and equipment as necessary to permit safe working conditions and mitigate the potential for uncontrolled releases;
- Demolish buildings and haul away the refuse;
- The foundations of buildings and equipment (and infrastructure) will be demolished:
  - Concrete foundations will be demolished to grade and exposed rebar will be cut to grade to prevent safety hazards;
  - Concrete foundation areas will be drilled to allow for water infiltration; and
  - Any remaining concrete piles will be cut to grade and covered with overburden,
- Relocate all equipment to the mainland for resale, dispose of on-site as refuse, or donate to the local community;
- Cleanup of any soil contamination (i.e. hydrocarbons, etc.) – see Section 9.6;
- Re-grade the area to restore the natural drainage patterns; and
- Scarify the ground surface around the buildings to support natural revegetation.

Refuse from the demolished buildings and Milne Port will be removed and either:

- Transported to Milne Port for shipment to the mainland for either disposal or salvage
- Disposed of in the open pit (including concrete and rebar)
- Disposed of in the onsite landfills or other approved repository

5.2.4.6 Predicted Residual Effects

The predicted residual effects at planned closure, including those encompassing buildings and equipment, were assessed as part of the FEIS with respect to VEC/VSEC. These effects, and the methods for their assessment are summarized in Appendix G.

As the project progresses, data will be collected through the environmental monitoring programs which can provide an indication of the accuracy of the predicted effects. These data can also be used to give an indication of the performance of the site mitigative measures and management systems, used as the basis for revising the prediction of residual effects, or implementing adaptive management.

5.2.4.7 Uncertainties

Uncertainties related to buildings and equipment are limited to whether or not any such facilities will be left in place, and whether or not any associated contaminated soils may be present upon closure ((Section 9.5). There may be uncertainty in revegetation success, addressed in a reclamation research program (Appendix D).

5.2.4.8 Post Closure Monitoring, Maintenance and Reporting

Post-closure monitoring of buildings and equipment includes geotechnical/engineering monitoring (Section 9.4), aquatic monitoring (Section 9.5), Environmental Site Assessment (Section 9.6), fauna and flora monitoring (Section 9.7), safety compliance inspection (Section 9.9), and air quality monitoring (Section 9.11). Maintenance required will depend on the outcome of the monitoring programs, and would be completed as outlined in Table 5.1. Baffinland will report on the results of all monitoring programs on an annual basis to the NIRB (as per Project Certificate No. 005 and its Amendment), AANDC Land Lease 47H/16-1-2, the NWB (as per Type 'A' Water Licence 2AM-MYR-1325 Amendment No. 1) and the Land Owners (as per Commercial Lease Q13C301).

5.2.4.9 Contingencies

The need for contingencies for the reclamation of buildings and equipment has not been identified by Baffinland at this time. As the project progresses, the need for adaptive management and contingency alternatives may arise due to the outcomes of discussions with the Mine Closure Working Group.

5.2.5 Mining Infrastructure

5.2.5.1 Project Component Description

Mining Infrastructure is comprised of the following main elements:

- Mine Site
  - Camp Pads
  - Laydowns
  - Air Strip
  - Site Roads
  - Water crossings
  - Conduit berms
  - Utilidor / corridor
  - Crushing plant (primary jaw crusher and secondary cone crusher and primary and secondary screens)
- Milne Port
  - Camp Pads
  - Laydowns

   - Freight Dock
   - Site Roads
   - Water crossings
   - Conduit berms

- Tote Road
   - Laydown Areas

Two mobile, self-contained crushing units are used for primary and secondary ore crushing and screening at the Mine Site. This equipment does not require concrete foundations or structural steel feed bins, except that a sacrificial ore pad was prepared as a base for the ore stockpiling. The mobile crushing/screening units are designed to operate year-round. The crusher trains are equipped with one jaw crusher, one cone crusher, one primary screen and one secondary screen. After crushing and screening, the product is reclaimed and loaded into tractor/trailer units for haulage to Milne Port.

Two products are produced, lump and fines, with fines being material smaller than 6.3 mm. Initial bulk tests indicated that a ratio of 3:1 lump to fines was expected on average. Ore is crushed and screened following delivery to the primary crusher and subsequently transported to customers without further processing.

The crushing and screening assembly is located approximately 2.5 km south of the open-pit mine and connected by a 7 km road. The lump product (< 31.5 mm/>6.3 mm) and fines product (<6.3 mm) discharge onto the lump collection conveyor and fines collection conveyor, respectively, for transfer to the local stockpiling area.

Due to the short and variable shipping season (60 – 90 days/season) the Milne Port stockpiles hold the full year's production (up to 3.2 Mt). The two lump stockpiles contain up to 1,200,000 tonnes; the fines stockpiles hold up to 400,000 tonnes. The longitudinal piles are located adjacent to each other in two rows with each row separated into two piles. The stockpile is located close to the ore dock.

A ship loader with two (2) discharge loaders is provided. These loaders rotate 180° and shuttle in and out giving the full loading coverage of the holds without having to reposition the ship. The loaders are anchored to the ore dock and are tall enough to give 15.2 m of air draft. Stairs and/or ladders and catwalks provide access to all operating and maintenance areas of the loaders. Each tower has a set of stairs from the dock to the main deck of the ship loader. Each loader has an adjustable deflector plate in the head box to deflect iron ore straight down and inward (toward shore) for trimming the shore side of the holds.

Where possible, permanent support infrastructure was built at the onset of construction, and used during both the construction and operation phases of the Project. Temporary infrastructure constructed or positioned at Project sites needed only for the construction phase are removed once construction is complete. In line with this strategy, most of the infrastructure developed at the onset of construction activities remains in service for the Life of the Project.

5.2.5.2 Pre-Disturbance, Existing, and Final Site Conditions

The pre-disturbance site conditions are summarized in Section 3. Appendix C provides a photolog showing the current mining operations.

Relative to pre-development conditions at Milne Port, the remnants of infrastructure including buildings will be removed and laydown areas re-graded to restore natural drainage patterns where possible, and scarified to allow for natural re-vegetation at closure. Milne Port ore dock will remain in place to provide ongoing fish habitat. The water crossings along the Milne Inlet Tote Road will be removed.

The causeway and docks at Milne Port will be left in place. Dock infrastructure at Milne Port will be removed and either recycled, shipped offsite to an appropriate facility for disposal, or deposited within onsite landfill, the open pit or other approved repositories.

The lighting associated with the airstrips will be removed. The airstrips will be re-graded and reclaimed unless otherwise directed by regulatory agencies or the Land Owner to provide emergency/rescue landing spots for regional aircraft, when no other options are available.

The Mine Site utilidor/corridor will be dismantled and disposed of in either the Mine Site landfill or transported offsite to the mainland via sealift for disposal at an approved facility.

The airstrips at the Mine Site and Milne Port will be removed unless otherwise directed by regulatory agencies, Land Owner, or the Mine Closure Working Group to remain in place and left in operating condition. Abandoned airstrips may provide emergency landing locations for regional aircraft or helicopters, when other options are unavailable.

5.2.5.3 Closure Objectives and Criteria

The closure objectives are presented in Section 5.1.1 and closure criteria are presented in Table 5.1.

5.2.5.4 Consideration of Closure Options and Selection of Closure Activities

Detailed alternative analysis of other closure options have not been completed by Baffinland due to the early stage of the Project and the absence of Project components which represent the largest uncertainty at closure (Open Pit, Permanent Waste Rock Stockpile).

Baffinland has committed to the establishment of a "Mine Closure Working Group" in order to best incorporate considerations for post-closure land use of the Project site. The role of this Mine Closure Working Group will be to facilitate the integration of community representation and technical expertise by drawing on Inuit knowledge, arctic experience for similar mining operations, and discussion of alternative uses for decommissioned facilities into the reclamation options for various Project components. Several infrastructure components may be of use to the local communities, including the Milne Port ore dock, airstrips at Milne Port, the Mine Site, and at Steensby Port.

5.2.5.5 Engineering Work Associated with Closure Activity

To permit the reclamation of the land area they cover, improve aesthetics, remove the physical hazard they pose to humans and the environment, and address any chemical concerns they may pose, mine infrastructure at the Mine Site, Tote Road, and Milne Port will be removed.

Removal of mine infrastructure will involve the following works:

- Decontaminate buildings and equipment as necessary to permit safe working conditions and mitigate the potential for uncontrolled releases;
- Salvage infrastructure that could be sold (crushers, etc.) on or donated to the local community;
- Demolish structures (ex: mine site utilidor/corridor) and haul away the refuse;
- Demolish foundations of infrastructure:
  - Concrete foundations will be demolished to grade and exposed rebar will be cut to grade to prevent safety hazards;
  - Concrete foundation areas will be drilled to allow for water infiltration; and
  - Any remaining concrete piles will be cut to grade and covered with overburden,
- Remove culverts and bridges that form water crossings for mine site and Milne Port site roads;
- Relocate crushers and screening plants to the mainland for resale, for disposal on-site, or donate to the local community;
- Cleanup of any soil contamination (i.e. hydrocarbons, etc.) – see Section 9.6;
- Re-grade the area to restore the natural drainage patterns; and
- Scarify the ground surface around the buildings to support natural revegetation.

Refuse from the mine infrastructure will be removed and either:

- Transported to Milne Port for shipment to the mainland for either disposal or salvage
- Disposed of in the open pit (including concrete and rebar)
- Disposed of in the onsite landfills or other approved repository

5.2.5.6 Predicted Residual Effects

The predicted residual effects at planned closure, including those encompassing mining infrastructure, were assessed as part of the FEIS with respect to VEC/VSEC. These effects, and the methods for their assessment are summarized in Appendix G.

As the project progresses, data will be collected through the environmental monitoring programs which can provide an indication of the accuracy of the predicted effects. These data can also be used to give an indication of the performance of the site mitigative measures and management systems, used as the basis for revising the prediction of residual effects, or implementing adaptive management.

5.2.5.7 Uncertainties

Uncertainties related to mining infrastructure are limited to whether or not any such facilities will be left in place, and whether or not any associated contaminated soils may be present upon closure ((Section 9.5). There may also be uncertainty in revegetation success, addressed in a reclamation research program (Appendix D).

5.2.5.8 Post Closure Monitoring, Maintenance and Reporting

Post-closure monitoring of mining infrastructure includes geotechnical/engineering monitoring (Section 9.4), aquatic monitoring (Section 9.5), Environmental Site Assessment (Section 9.6), fauna and flora monitoring (Section 9.7), safety compliance inspection (Section 9.9), and air quality monitoring (Section 9.11). Maintenance required will depend on the outcome of the monitoring programs, and would be completed as outlined in Table 5.1. Baffinland will report on the results of all monitoring programs on an annual basis to the NIRB (as per Project Certificate No. 005 and its Amendment), AANDC Land Lease 47H/16-1-2, the NWB (as per Type 'A' Water Licence 2AM-MYR-1325 Amendment No. 1) and the Land Owners (as per Commercial Lease Q13C301).

5.2.5.9 Contingencies

The need for contingencies for the reclamation of mine infrastructure has not been identified by Baffinland at this time. As the project progresses, the need for adaptive management and contingency alternatives may arise due to the outcomes of discussions with the Mine Closure Working Group.

5.2.6 Transportation Routes

5.2.6.1 Project Component Description

Transportation routes on site include the Mine Haul Road, Tote Road and the Ore Dock at Milne Port. A southern rail route to Steensby Port has been approved, but a specific timeline to begin construction on this aspect of the project has not been developed.

The total estimated length of the Mine Haul Road is approximately 10 km from the open-pit to the primary crusher and the waste dump areas and was constructed based on the following design criteria:

- Width three times the width of haul trucks (20 m)
- Design speed: 50 km/h
- Maximum gradient: 10 %
- Runaway lanes as required

The Mine Haul Road was constructed with a minimum granular fill thickness of 1.5 m. The road structure consists of 300 mm surface course of Granular A, overlying a 300 mm layer of base fill, overlying a 900 mm layer of sub-base rock fill.

The Tote Road, a gravel all-season road, is approximately 98.5 km. Kilometer marking "0" begins at the ore stockpile located approximately 2.5 km from the Milne Port ore dock. The Tote Road ends at kilometer marking "98.5" at the Mine Site ore crushing and loading pad. A fleet of highway trucks is used for ore hauling along the Tote Road and consist of a 600 HP tri-drive tractor and two identical side-tipping trailers with a combined payload of approximately 150 t. The trucks and trailers assembly are custom designed for Arctic conditions.

The four (4) single lane modular bridge crossings constructed as part of the Tote Road upgrade program were constructed to replace the pre-existing side-by-side sea-can style bridge crossings. These bridges are designed to suit the mobile equipment and trucks used on the Tote Road during construction and operations. The bridges are located at chainages km 17, km 62, km 80 and km 97 along the Tote Road between Milne Port and the Mary River Mine Site. These bridges are single lane sized to meet the Nunavut Mine Health and Safety Act requirements for the design vehicles' widths. The bridge span was designed to meet the water's design volume and flow rate. The deck height was designed to meet the requirements of the Navigable Waters Protection Act (NWPA) by Transport Canada.

5.2.6.2 Pre-Disturbance, Existing, and Final Site Conditions

The pre-disturbance site conditions are summarized in Section 3. Appendix C provides a photolog showing the current mining operations.

Bridges, culverts and other water crossings along the Milne Inlet Tote Road will remain in place until all the closure activities requiring Milne Port access at the Mine site are completed. This road is part of the Inuit-Owned Lands referenced in the Nunavut Land Claims Agreement. It is designated for public use and communication to communities has indicated the road will be left in good physical condition in accordance with Project requirements, with water crossings removed. The final decision on the removal of the water crossings will remain with the Land Owner although the removal cost of the bridge spans has been included for closure planning. Bridge abutments will be left in place where needed to maintain long-term stability of the section of the road abutting the watercourse; however, this strategy will be reviewed at each location based on the performance of the structure throughout the Project life cycle. For example, bridge abutments at the Mary River crossing are within the river and will need to be removed to restore the stream bed and banks as described below. Ongoing engagement with communities and discussions with QIA will occur to confirm an approach for the Tote Road and water crossings such that an acceptable level of liability exists for transfer of these remaining structures.

Milne Port ore dock will remain in place to provide ongoing fish habitat and will potentially be utilized for local community use following closure.

5.2.6.3 Closure Objectives and Criteria

The closure objectives are presented in Section 5.1.1 and closure criteria are presented in Table 5.1.

5.2.6.4 Consideration of Closure Options and Selection of Closure Activities

Detailed alternative analysis of other closure options have not been completed by Baffinland due to the early stage of the Project and the absence of Project components which represent the largest uncertainty at closure (Open Pit, Permanent Waste Rock Stockpile).

Baffinland has committed to the establishment of a "Mine Closure Working Group" in order to best incorporate considerations for post-closure land use of the Project site. The role of this Mine Closure Working Group will be to facilitate the integration of community representation and technical expertise by drawing on Inuit knowledge, arctic experience for similar mining operations, and discussion of alternative uses for decommissioned facilities into the reclamation options for various Project components. Several infrastructure components may be of use to the local communities, including the Tote Road and water crossings, Milne Port ore dock, airstrips at Milne Port, the Mine Site, and at Steensby Port.

Future closure options assessment for the bridge abutments at water crossings will consist of evaluating which structures will remain, and which will be removed/graded, based on long term stability considerations. Additional discussion on the approach for assessing structures prior to final closure, and focus areas for post-closure monitoring are presented in Section 9.

5.2.6.5 Engineering Work Associated with Closure Activity

To permit the reclamation of the land area they cover, improve aesthetics, remove the physical hazard they pose to humans and the environment, and address any chemical concerns they may pose, mine infrastructure at the Mine Site, Tote Road, and Milne Port will be removed.

Closure of transportation infrastructure will involve the following works:

- Water crossings, including bridges, along the Tote Road may be left in place at the land owners request. Ongoing engagement with communities and discussions with QIA will occur to confirm an approach for the Tote Road and water crossings such that an acceptable level of liability exists for transfer of these remaining structures.
- The ore dock at Milne port will remain in place with all surface infrastructure removed. The ore dock may potentially be used by communities subject to approval by the land owner CIRNAC.
- Remove road embankment fill from within the high water limits of the water body.
- Relocate excavated material from the water crossing location and place in areas located more than 30 metres from any water body. This material could be used at nearby grading in borrow areas and quarries.

- Streambed and banks will be restored and stabilized. This will require communication with DFO prior to commencing work.
- Removed culverts will be flattened and disposed of in on-site landfills or demobilized. Ditching will be subject to grading as necessary to establish post-closure drainage pathways.
- Abandoned sections of the Tote Road are expected to be transferred 'as is'. If any additional closure activities are desired by the parties receiving responsibility for the structures, this will be confirmed via ongoing engagement with the applicable communities and QIA.
- Cleanup of any soil contamination (i.e. hydrocarbons, etc.) – see Section 9.6

In the even construction the southern rail route to Steensby Port is constructed, the following closure activities have been assumed in mine planning and environmental impact predictions:

- Environmental site assessments at railroad maintenance and fueling facilities where impacts are expected.
- Geochemical sampling of ballast materials to understand potential ML/ARD concerns.
- Removal of ore spillage into the ballast from movement of trains.
- Ballast cleaning and disposal of recovered fines.

5.2.6.6 Tie replacement and disposal of used ties. Predicted Residual Effects

The predicted residual effects at planned closure, including those encompassing transportation routes, were assessed as part of the FEIS with respect to VECs/VSECs. These effects, and the methods for their assessment are summarized in Appendix G.

As the project progresses, data will be collected through the environmental monitoring programs which can provide an indication of the accuracy of the predicted effects. These data can also be used to give an indication of the performance of the site mitigative measures and management systems, used as the basis for revising the prediction of residual effects, or implementing adaptive management.

5.2.6.7 Uncertainties

Uncertainties related to the transportation routes may include which infrastructure may be left in place and whether or not any associated contaminated soils may be present upon closure (Section 9.6). There may also be uncertainty in revegetation success, addressed in a reclamation research program (Appendix D).

5.2.6.8 Post Closure Monitoring, Maintenance and Reporting

Post-closure monitoring of transportation routes includes geotechnical/engineering monitoring (Section 9.4), aquatic monitoring (Section 9.5), Environmental Site Assessment (Section 9.6), fauna and flora monitoring (Section 9.7), safety compliance inspection (Section 9.9), and air quality monitoring (Section 9.11). Maintenance required will depend on the outcome of the monitoring programs, and would be completed as outlined in Table 5.1. Baffinland will report on the results of all monitoring programs on an annual basis to the NIRB (as per Project Certificate No. 005 and its Amendment), AANDC Land Lease 47H/16-1-2, the NWB (as per Type 'A' Water Licence 2AM-MYR-1325 Amendment No. 1) and the Land Owners (as per Commercial Lease Q13C301).

5.2.6.9 Contingencies

The need for contingencies for the reclamation of mine infrastructure has not been identified by Baffinland at this time. As the project progresses, the need for adaptive management and contingency alternatives may arise due to the outcomes of discussions with the Mine Closure Working Group.

5.2.7 Waste, Landfills and other Disposal Areas

5.2.7.1 Project Component Description

This mine closure component includes:

- Milne Port
  - Landfarm
  - Contaminated snow containment area
  - Non-hazardous waste disposal locations
- Mine Site
  - Non-Hazardous Waste Disposal Locations
- Milne Port and Mine Site disposal of fuel and hazardous materials, including:
  - Fuel Tank Farm and Fuel Dispensing Facilities (Arctic Diesel, Jet–A Fuel)
  - Hazardous Material Storage Areas
  - Waste Management Facilities Including Temporary Storage Areas
  - Hazardous Waste and Hazardous Chemicals
  - Fuel
  - Explosives Storage

Landfarm and Contaminated Snow Containment Area

The Milne Port landfarm package includes the landfarm containment area and the contaminated snow containment area constructed south of the accommodation camp, near the Milne Inlet Quarry (Q1). The landfarm containment area was constructed to store/remediate the petroleum hydrocarbon (PHC) contaminated sand/gravel materials removed from the old bulk fuel bladder farm during decommissioning, and for storage of contaminated soils during continuing mining operations. This remediation occurs through volatilization and natural biological processes. The contaminated snow containment area was constructed as a storage location for contaminated snow removed from the tank farm's berm containment areas and subsequent snow contaminated during mine operations. The landfarm containment area grade slopes towards the sump in the southwest corner to facilitate draining of the soil material.

The design basis for the landfarm containment area water capacity is 3,383 m^3 with 0.3 m of design freeboard. The design basis for the contaminated snow containment area water capacity storage is 929 m^3 with 0.3 m of design freeboard.

The landfarm and contaminated snow containment has been constructed as primarily rectangular in shape to optimize the earthworks materials (granular fills and liner installation). The berms have side slopes not steeper than 2H:1V and a 1.0 m wide horizontal liner length for appropriate liner anchoring in the outer berm. Access to the landfarm package is from the old Tote Road just north of the Q1 quarry site to the south side. The access road contains a 500 mm diameter culvert crossing over a seasonal drainage that is not fish habitat.

The landfarm package was constructed using raised earthworks. All earth fill materials used during construction were compacted during above-freezing summer temperatures to achieve the design compaction required. Both the soil containment and the snow containment compartments were sealed with HDPE liner material for storage of the runoff/seepage, and covered with a layer of fill material. Trucks deposit contaminated soils and snow inside each compartment by driving inside the appropriate area and dumping into the surface gravels as called for in the design.

FUELS AND TANK FARM

The Milne Port Tank Farm and dispensing infrastructure includes the marine pipeline (connecting the marine manifold building to the arctic diesel system), the arctic diesel system, the Jet-A1 system, the fuel dispensing systems, the secondary containment earth dyke with synthetic liner, and all interconnecting piping. The package was designed for marine loading/offloading, tank truck loading/offloading, vehicle fueling, and genset fuel feed at the port facility. The tank farm includes:

- Three (3) 12 ML arctic diesel field-fabricated tanks with tag numbers 2613-TK-004, 2613-TK-005, and 2613-TK-006, and two (2) 5 ML arctic diesel field-fabricated tank with tag number 2613-TK-001 and 2613-TK-002
- Three (3) 0.75 ML Jet-A1 fuel pre-fabricated tanks with tag numbers 2614-TK-007, 2614-TK-008, and 2614-TK-009

These tanks are all vertical single wall steel construction, designed to API 650, located within an earth dyke with synthetic liner. The secondary containment dyke is designed to the requirements of the National Fire Code of Canada. The tank farm includes space for two extra tank pads for future expansion of one additional 0.75ML Jet-A1 tank (2614-TK-010) and one additional 12 ML arctic diesel tank (2613-TK-003). The tanks are equipped with spiral access stairways and guardrails at the roof of each tank.

The Milne Port tank farm is refuelled annually by ocean going tanker. A floating hose is deployed from the ship and connected to the onshore manifold. An aboveground steel marine pipeline transfers the fuel from the shore manifold to the tank farm. The ship floater manifold connection is equipped with a gate valve and check valve assembly to enable ship-to-shore connection and to prevent backflow. All connections are contained within a spill containment assembly with a hinged and lockable cover.

The fuel dispensing system includes two (2) prefabricated fuel dispensing modules: the Arctic Diesel Fuel Module, and the JetA1 Fuel Module. The existing Arctic Diesel Fuel Module is located to the west side of the tank farm. The new modules are insulated and heated 40 ft ISO shipping containers, complete with piping, fuel transfer equipment, temperature corrected delivery systems, electrical and control components, and code compliant fire suppression systems. Access to the fuelling equipment is through lockable equipment doors and side rollup door.

The Milne Port tank farm was constructed as a rectangular shape to optimize the earthworks materials (granular fills and liner). The tank farm is surrounded by dykes with side slopes not steeper than 2H:1V and the berm top width is 600 mm. The secondary containment area includes ten (10) tank foundation pads, ramp loading areas, dyke access roads and dyke walls, and dyke access stairs on the east side behind the fuelling module. Inside the primary dyke containment area, there is a 1% slope towards the sump.

There are two (2) access ramps into the dyke containment area to allow emergency vehicle and maintenance vehicle access. One ramp is on the south side, into the existing/modified dyke area. The second ramp is on the east side, leading from the fueling area down into the new dyke area. The containment area around the tank farm and dispensing package has been constructed with raised earthworks and synthetic welded liner for the containment of spills. Additionally, the facility is designed for containment of rainwater and snowmelt that can potentially be contaminated by contact with fuel originating from leakage or spills. Contact water is removed and treated if required before it is discharged to the receiving environment. A mobile oil-water separator (OWS) water treatment system is used to treat storm water runoff, overfills, or spills from within the secondary containment area in order to meet the water licence discharge criteria. The liner is buried 450 mm below the floor of the dyke.

The facility was designed and constructed to the following codes and standards:

- Tank construction will adopt the API 650 12th Edition, 2013, Welded Steel tanks for Oil Storage
- Tank inspection, repair, alteration and reconstruction will use API 653 4th Edition, 2009; including Addendums 1 and 2
- National Building Code of Canada 2010
- National Fire Code of Canada 2010
- NFPA 30, 2012 Edition, Flammable and Combustible Liquids Code
- CCME Environmental Code of Practice for Aboveground Storage Tank Systems containing Petroleum Products, 2003

- ANSI B31.3-2012, Process Piping
- CSA W47.1-09, Certification of Companies for Fusion Welding of Steel
- CSA W59-03 (R2008) – Welded Steel Construction (Metal Arc Welding)
- *Canadian Environmental Protection Act* 1999 (2008 Update)
- Storage Tank System for Petroleum Products and Allied Petroleum Products Regulations
- CSA W178.2-08, Certification of Welding Inspectors

Fuel is delivered to the mine site via bulk fuel truck loaded from the project's Milne Port facility. The Mine Site Tank Farm and dispensing infrastructure includes a tank farm facility within a secondary containment earth dyke with synthetic liner, fuel dispensing system, and all interconnecting piping. The package was designed for tank truck loading/offloading, vehicle fueling, and genset fuel feed at the Mine Site camp facility.

The Mine Site tank farm includes four (4) arctic diesel pre-fabricated storage tanks with tag numbers 4613-TK-001, 4613-TK-002, 4613-TK-003, and 4613-TK-004. These tanks are 0.5 ML each, vertical single wall steel construction, designed to API Standard 650. The secondary containment dyke is designed to the requirements of the National Fire Code of Canada. The tanks are equipped with spiral access stairways and guardrails at the roof of each tank.

The fuel dispensing system includes one (1) prefabricated fuel dispensing module: the Arctic Diesel Fuel Module. This module is an insulated and heated 40 ft ISO shipping container, complete with piping, fuel transfer equipment, temperature corrected delivery system, electrical and control components, and code compliant fire suppression system. The diesel dispensing module is located on the plant-south side of the tank farm. Access to the fueling equipment is through lockable equipment doors and side rollup door. The refueling area consists of a ramp up to and down from the fuel modules with a vehicle containment area surrounding the fuel module to ensure appropriate management of potential spills during fueling operations. The lined refueling area drains into the secondary containment dyke.

The Mine Site tank farm was constructed as rectangular shaped to optimize the earthworks materials (granular fills and liner). The tank farm is surrounded by dykes with side slopes not steeper than 2H:1V and a berm top width of 600 mm. The secondary containment area includes four (4) tank foundation pads, ramp loading areas, dyke access roads and dyke walls, and dyke access stairs on the south side behind the fueling module. The containment area around the tank farm and dispensing package was constructed with raised earthworks and synthetic welded liner for the containment of spills. Additionally, the facility is designed for containment of rainwater and snowmelt that can potentially be contaminated by contact with fuel originating from leakage or spills. Contact water is removed and treated if required before it is discharged to the receiving environment. The liner is buried 450 mm below the floor of the dyke.

SOLID WASTE MANAGEMENT INFRASTRUCTURE

Solid waste management infrastructure includes the incinerators, waste management buildings, and the hazardous waste containment areas. The incinerator is used to dispose of applicable non-hazardous waste. The waste management building provides a heated indoor area for waste to be appropriately sorted to meet the incinerator's burning 'recipe' requirements. The hazardous waste containment areas are lined containment cells used to store hazardous waste/contaminated material in support the Project's site drainage monitoring strategy. The incinerator equipment is modular and operates within three sea containers attached to the rear of the waste management buildings. Residual ash from the incinerators are sent to the project's landfill for disposal.

Each of the three sea containers housing the incinerator equipment has an access port that penetrates the rear wall of the foldaway building. The waste management buildings are rectangular in shape with truck door access on one side.

The hazardous waste containment areas have been constructed rectangular in shape to optimize the earthworks materials (granular fills and liner installation). The berms have side slopes not steeper than 1.5H:1V and a 1.0 m wide horizontal liner length for appropriate liner anchoring in the outer berm. The containment area has a 4% grade access ramp on the west side and a drainage pond on the east side.

The waste management building pad and the hazardous waste containment areas have all been constructed using raised earthworks. The pre-cast concrete block foundation arrangement in the waste management building and poured concrete floor with sumps in each half of the building serves as effluent containment. The hazardous waste containment areas have been sealed with liner material for storage of the runoff/seepage or spills, and been covered with a layer of fill material.

LANDFILLS

The project's landfill has been designed in accordance with the "Guidelines for the Planning, Design, Operations and Maintenance of Modified Solid Waste Sites in the Northwest Territories" (Ferguson, Simek Clark Engineers & Architects, 2003). Only non-hazardous, non-organic and inert waste is disposed of in the facility. All liquid industrial waste and hazardous waste is diverted for proper hazardous waste disposal to a licensed facility off site.

The area method is used for waste disposal wherein a low height berm will be constructed along two sides of the landfill site and then waste will be disposed of against the berms and directly onto the ground downstream of the berms. Sand and gravel will be used as the cover material. In order to achieve permafrost encapsulation in the landfill site, the final cover will be thicker than the active layer. No fencing will be required as the inert waste should not attract wildlife, and public access to the area is restricted. Because of permafrost in the area, no groundwater protection system is included. In addition, landfill gas is not expected to be an issue as the deposited waste will be non-hazardous and inert. Therefore, a landfill gas collection system was not installed in the landfill site.

EXPLOSIVES FACILITY

The explosives facility package includes the explosives plant building (i.e., the emulsion plant) and the explosives shop (storage for raw materials). These facilities were designed for modular installation in arctic conditions. In support of the overall Mary River project development the use of explosives is required to produce construction aggregate and to facilitate mining activities. The facility's purpose is to manufacture and store the explosives and materials required to facilitate this objective and to minimize potential environmental impacts, specifically for water quality and wildlife during the period where blasting operations are conducted. The design premise for these facilities is based on achieving a zero effluent process. Contaminated waste water generated from the manufacturing operations are collected and re-used in the process, including truck wash water. The explosives facility and the operational policies in place meet or exceed the applicable regulations as part of the following acts:

- *Canada Explosives Act*
- *Transport of Dangerous Goods Act*
- Occupational Health & Safety, Nunavut – *Explosives Use Act*
- Northwest Territories/Nunavut *Mine Health and Safety Act* and Regulations

All infrastructure and manufacturing processes are licensed and approved by Natural Resources Canada (NRCan) – Explosives Regulatory Division. Magazine storage sites are licensed by the Nunavut Workers Safety and Compensation Commission (WSCC).

The explosives facility is located south of the Mine Site stockpile. The access road intersects the treated effluent pond access road mid-way between the stockpile and the treated effluent's approved discharge point. The explosives facility is located more than 65 m away from the facility's storage containers, more than 350 m from the explosives magazine, and more than 970 m from the ore crushing and screening pad. The facility pad was constructed of raised earthworks complete with drainage culverts and access ramps.

5.2.7.2 PRE-DISTURBANCE, EXISTING, AND FINAL SITE CONDITIONS

The pre-disturbance site conditions are summarized in Section 3. Appendix C provides a photolog showing the current mining operations.

The landfarm and contaminated snow containment area located at Milne Port provides onsite treatment of contaminated soils. Once no longer required, the landfarm and contaminated snow containment area will be closed to physically and geotechnically stabilize for the long term, make surface runoff and seepage water quality safe for humans and wildlife, and to encourage the desired wildlife movement. Post-closure water quality run-off objectives in receiving water bodies from landfarms will be met and no long-term active care is expected to be required.

The fuels and tank farm at Milne Port and Mine Site, assuming they are not to be maintained, will be decommissioned and removed during closure. Soils will be tested for contamination. The area will be regraded to restore natural drainage patterns where possible, and scarified to allow for natural re-vegetation.

Solid waste management infrastructure includes the incinerators, waste management buildings, and the hazardous waste containment areas. The incinerators and waste management buildings will be decommissioned and removed from the site and affected footprint regraded to restore natural drainage patterns where possible and scarified to allow for natural re-vegetation. The hazardous waste containment areas will be evaluated for any remaining hazardous material/soils and addressed as per the Hazardous Materials and Hazardous Waste Management Plan. The area will be re-graded and scarified to allow for natural re-vegetation at closure.

The Mine Site Landfill Facility is operated to house only non-hazardous material. Project landfills will be progressively covered with overburden, as cells are completed, to allow the contents of the landfill to remain permanently frozen to physically and geotechnically stabilize in the long term, make surface runoff and seepage water quality safe for humans and wildlife, and encourage the desired wildlife movement upon site abandonment, such that post-closure water quality run-off objectives in receiving water bodies are met and no long-term active care is required.

The explosives facility will be removed from the site. The associated footprint will be re-graded to restore natural drainage patterns where possible, and scarified to allow for natural re-vegetation at closure.

A list of non-salvageable materials has been developed and will be provided annually as part of the Annual Security Review process conducted in accordance with Schedule C of Type “A” water licence 2AM-MRY1325.

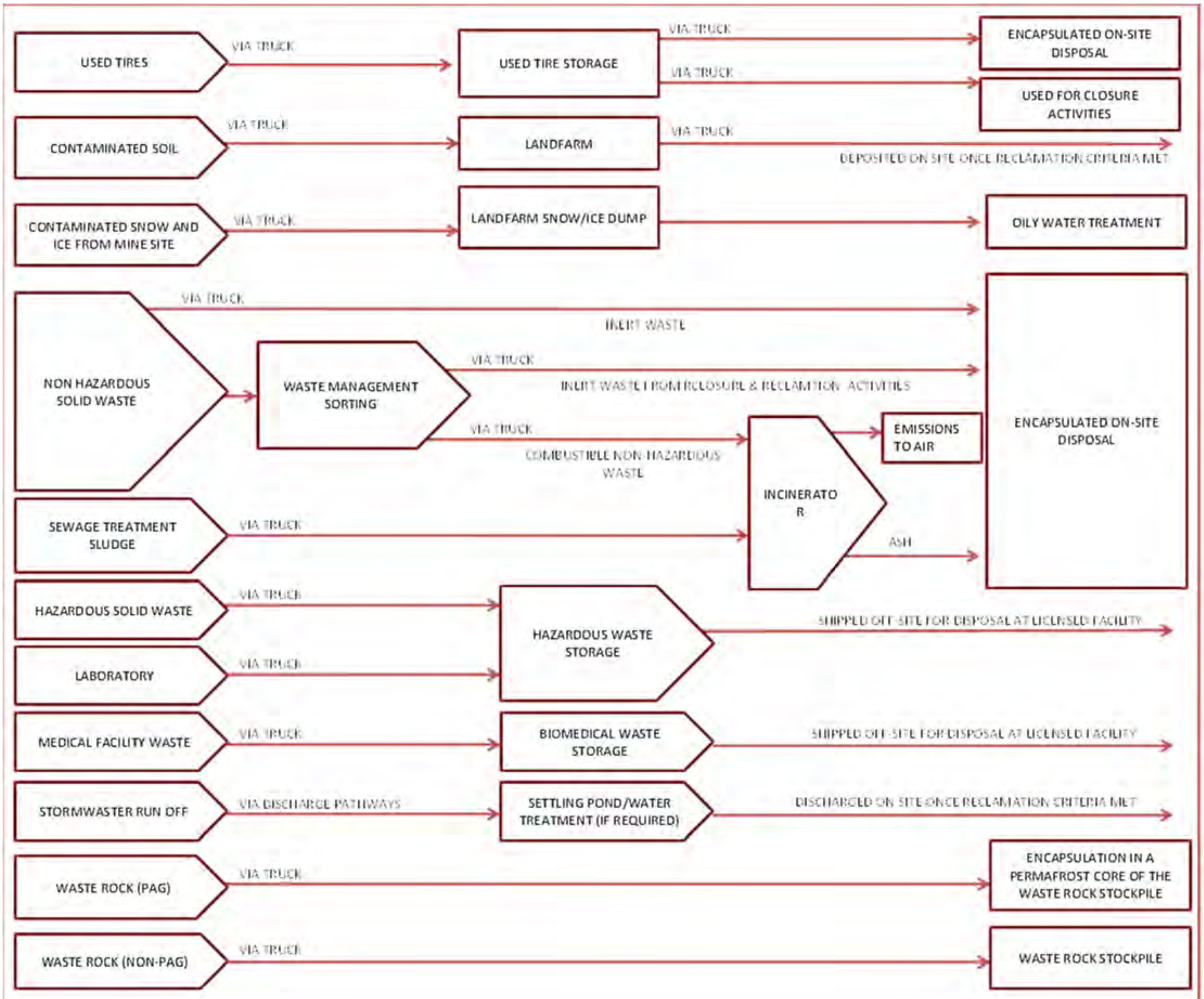

Figure 5.6 Major Waste Streams and Methods of Transportation

5.2.7.3 Closure Objectives and Criteria

The closure objectives are presented in Section 5.1.1 and closure criteria are presented in Table 5.1.

5.2.7.4 Consideration of Closure Options and Selection of Closure Activities

Detailed alternative analysis of other closure options have not been completed by Baffinland due to the early stage of the Project and the absence of Project components which represent the largest uncertainty at closure (Open Pit, Permanent Waste Rock Stockpile). As data are collected and analysis is conducted, the ICRP will be updated as required. Please refer to Appendix D **Error! Reference source not found.**for more detail on reclamation research plans relevant to the Project to address uncertainties related to final closure.

No major closure options are being considered for this mine component. The closure activities discussed below is expected to be relevant for all existing and any future changes to project infrastructure within this mine component (e.g. additional non-hazardous landfills).

5.2.7.5 Engineering Work Associated with Closure Activity

At final closure, Baffinland will undertake a comprehensive site Phase 1 Environmental Site Assessment (ESA) to determine extent of contaminated areas and appropriate techniques and methods to deal with such sites.

The onsite landfill located at the Mine Site will be reclaimed by capping the landfill with 1.5 m of overburden or equivalent material to freeze the core of the landfill. The landfill sites will be scarified to encourage natural re-vegetation.

At the end of Project life, Baffinland will consider transferring the facilities to a third party, should a third party express such an interest. The rationale for the approach is to eliminate sources of contamination on-site to the extent reasonably possible. Figure 5.6 demonstrates the major waste streams expected to be generated during closure and reclamation activities and the respective expected transportation and disposal approach.

The stock of explosives will be depleted towards the end of the operations phase and any remaining explosives will be securely contained and shipped from the site by a licensed contractor to an approved facility for disposal or reuse or detonated in a controlled and safe fashion by experienced and licensed personnel at appropriate locations away from sensitive receptors.

Oil, grease, ammonium nitrate and chemicals will be transported offsite for disposal at an approved facility or where applicable for reuse. All batteries and hazardous waste will be removed and disposed of or recycled at an approved facility offsite.

Combustible non-hazardous wastes will be incinerated at the Project incinerators. Once the incinerators are no longer required, they will be disposed of in one of the site non-hazardous landfills, or shipped to the mainland to be disposed of off-site.

Liners will be removed from polishing ponds and Polishing Waste Stabilization Ponds (PWSPs), and berms will be re-graded and levelled.

A list of non-salvageable materials has been developed and will be provided annually as part of the Annual Security Review process conducted in accordance with Schedule C of Type “A” water licence 2AM-MRY1325.

5.2.7.6 Predicted Residual Effects

The predicted residual effects at planned closure, including those encompassing landfills and other disposal areas, were assessed as part of the FEIS with respect to VEC/VSEC. These effects, and the methods for their assessment are summarized in Appendix G. Following closure, no residual effects related to landfills and other disposal areas are anticipated with the required mitigation (e.g. reclamation/remediation, as required), with the exception of vegetation. Loss of vegetation within the PDA is a residual effect — it is not expected that disturbed areas will become re-vegetated until after closure of the mine. Regeneration of the disturbed area is a slow process and will not occur until beyond the life of the project.

As the project progresses, data will be collected through the environmental monitoring programs which can provide an indication of the accuracy of the predicted effects. These data can also be used to give an indication of the performance of the site mitigative measures and management systems, used as the basis for revising the prediction of residual effects, or implementing adaptive management.

5.2.7.7 Uncertainties

Uncertainties related to the closure of landfills and other waste disposal areas is whether or not the remaining land contains contaminated soils (Section 9.6), and there may be uncertainty in revegetation success, addressed in a reclamation research program (Appendix D).

5.2.7.8 Post Closure Monitoring, Maintenance and Reporting

Post-closure monitoring of landfills and other waste disposal areas includes geotechnical/engineering monitoring (Section 9.4), aquatic monitoring (Section 9.5), Environmental Site Assessment (Section 9.6), fauna and flora monitoring (Section 9.7), safety compliance inspection (Section 9.9), and air quality monitoring (Section 9.11). Maintenance required will depend on the outcome of the monitoring programs, and would be completed as outlined in Table 5.1. Baffinland will report on the results of all monitoring programs on an annual basis to the NIRB (as per Project Certificate No. 005 and its Amendment), AANDC Land Lease 47H/16-1-2, the NWB (as per Type ‘A’ Water Licence 2AM-MYR-1325 Amendment No. 1) and the Land Owners (as per Commercial Lease Q13C301).

5.2.7.9 Contingencies

The need for contingencies for the reclamation of waste, landfills, and other disposal areas has not been identified by Baffinland at this time. As the project progresses, the need for adaptive management and contingency alternatives may arise due to the outcomes of discussions with the Mine Closure Working Group.

5.2.8 Water Management Systems

5.2.8.1 Project Component Description

The water management systems on site include:

- Milne Port and Mine Site
  - Stockpile settling ponds
- Milne Port
  - Water Treatment System
  - Sewage Treatment System
- Mine Site
  - Raw Water System
  - Contact Water Ponds
    - (1) Open Pit Dewatering System
    - (2) Stockpile Settling Ponds
  - Water Treatment System
  - Sewage Treatment System

Stockpile Settling Ponds

The stockpile settling ponds were constructed to temporarily retain the runoff water from stockpile areas and contain the sediment load to meet the water quality standards in accordance with applicable effluent quality criteria. During normal operation, runoff from the stockpile area drains to the stockpile settling ponds. The ponds are equipped with overflow weirs designed to allow the unloaded surface water to drain through a controlled discharge to permitted discharge point(s). The ponds were designed with sufficient retention time to ensure the sediment would gravity-settle to the bottom of the pond before the water reaches the overflow weirs. Water in the stockpile settling ponds will be monitored as part of the site drainage monitoring strategy to meet applicable effluent quality criteria.

The ponds have been constructed rectangular in shape to optimize the earthworks materials (granular fills and liners) and to fit within the foreshore areas and not encroach near the shoreline. The pond berms have design side slopes not steeper than 3H:1V and the berm top width is 2.0 m to meet the access and liner anchoring requirements. The overflow weir design slopes are 5H:1V exiting the pond. The ponds were excavated to meet the elevation requirements of the design, and the berms constructed with raised earthworks. It has been sealed with exposed HDPE liner material for storage of the runoff and sediments without any leakage.

Milne Port – Water Treatment System

The Milne Port water treatment system includes an adsorption clarifier water treatment plant designed to treat raw water for the removal of colour, turbidity and other impurities to provide a high-quality effluent. The high-quality effluent from the adsorption clarifier is then disinfected for potable and domestic use. The process combines flocculation and clarification in the mono-media roughing filter. Flocs are formed and retained in the coarse mono-media. The dual media filter provides polishing of the pre-treated water to provide a high-quality effluent. Disinfection involves UV and chlorination.

The Milne Port water treatment building is a foldaway building located west of the new accommodation facilities. There is an overhead door on the west side of the building and a man door on the east and west. The system includes the outdoor piping connecting the water treatment plant to the sewage treatment plant, and the piping between the water treatment plant and the accommodations facility. These pipes are HDPE DR11, pre-insulated with 50 mm (2 inch) insulation and heat traced for year-round use. The system is fed by water truck. The project is approved to source water from km 32 Lake and from Phillips Creek (summer months only).

Milne Port – Sewage Treatment System

The Milne Port sewage treatment plant (STP) is a membrane bioreactor (MBR) wastewater treatment plant designed for treatment of domestic wastewater. The STP is a packaged plant that comes with containerized inlet screen, equalization tank, post equalization tank screen, aeration tank, membrane tanks, UV disinfection systems and a sludge dewatering unit. The plant is housed inside six (6) 40 ft modified high-cube shipping containers that were interconnected when installed. The system includes the outdoor piping connecting the accommodations facility to the sewage treatment plant, the effluent discharge piping and the potable water inlet. These pipes are HDPE DR11, pre-insulated with 50 mm (2 inch) insulation and heat traced for year-round use.

During normal operation, the treated effluent from the sewage treatment plant (STP) is pumped to the permitted discharge point at Milne Inlet via the treated effluent discharge pipeline. The pumps and motors (duty/standby) start and stop as required to empty the containment tanks inside the STP. The treated effluent discharge pipeline is a 50 mm (2 inch) diameter HDPE DR11 pipeline. The pipeline is approximately 750 m long, above ground, pre-insulated with 50 mm (2 inch) insulation and heat traced for year-round use.

In the event that the treated effluent does not meet discharge requirements, the off-spec effluent is pumped to the effluent pond located south of the fuel tank farm. Once the ‘problem’ in the STP is corrected, the off-spec effluent from the pond will be treated insitu or transported via vacuum truck and re-processed through the STP before directly discharging to Milne Inlet.

The Mine Site Water Systems include the facility’s raw water system (including the raw water jetty), water treatment system, sewage treatment system, and the treated effluent discharge system.

OFF-SPEC EFFLUENT PONDS

The off-spec effluent pond(s) have been constructed to store the off-spec effluent from the Project Sewage Treatment Plant (STP). During normal operation, the treated effluent from the STP will be directed to the permitted discharge point(s). In the event that the treated effluent does not meet discharge requirements, the off-spec effluent will be pumped to the pond. Once the problem in the STP is corrected, the off-spec effluent from the pond will be transported via vacuum truck and re-processed through the STP before directly discharging to the permitted discharge point(s).

The pond(s) have been constructed as rectangular shape to optimize the earthworks materials (granular fills and liner). The pond berms have side slope not steeper than 3H:1V and the berm top width is 3.0 m to meet the access and liner anchoring requirements. The pond(s) have been constructed with raised earthworks on top of the laydown pads. It has been sealed with liner material for storing the off-spec effluent without any leakage. In general, the following materials are used to construct a PWSP:

- Type 8 (150 mm minus) as main/core material of berm
- Type 5 (32 mm minus) for covering the core material on top and inside surface of the berm
- Type 6/Type 9 (9.5 mm minus) for liner bedding and anchoring
- Type 4 Geomembrane (Enviro liner 6060 HD)
- Non-woven geotextile (Layfield LP7) for protection of the liner material
- Jersey barrier for truck safety (if applicable)

MINE SITE – RAW WATER SYSTEM

The Mine Site raw water system is a pumping arrangement that draws water from Camp Lake (west of the main accommodation facilities) to the water treatment system for treatment and distribution. The raw water system includes a raw water pumphouse (a heated and insulated sea container) installed on a jetty built out from the east side of Camp Lake. The pump draws water up through the wet well below the pumphouse, and pumps the water through a 100 mm (4 inch) HDPE DR11 pipeline over 4 km to the water treatment building. This pipeline is pre-insulated and heat traced for year-round use.

MINE SITE – WATER TREATMENT SYSTEM

The Mine Site water treatment system includes an adsorption clarifier water treatment plant designed to treat raw water for the removal of colour, turbidity and other impurities to provide a high quality effluent. The high quality effluent from the adsorption clarifier is then disinfected for potable and domestic use. The process combines flocculation and clarification in the mono-media roughing filter. Flocs are formed and retained in the coarse mono-media. The dual media filter provides polishing of the pre-treated water to provide a high quality effluent. Disinfection involves UV and chlorination. The system is fed by the raw water system drawing from Camp Lake.

The Mine Site water treatment building is a foldaway building located south of the fuel tank farm and southwest of the sewage treatment building. The system includes the outdoor piping connecting the water treatment plant to the sewage treatment plant, and the piping between the water treatment plant and the accommodations facility. These pipes are HDPE DR11, pre-insulated with 50 mm (2 inch) insulation and heat traced for year-round use.

Mine Site – Sewage Treatment System

The Mine Site sewage treatment plant is a membrane bioreactor (MBR) wastewater treatment plant designed for treatment of domestic wastewater. The STP is a packaged plant that comes with containerized inlet screen, equalization tank, post EQ screen, aeration tank, membrane tanks, UV disinfection systems and a sludge dewatering unit. The plant is housed inside six (6) 40 ft modified high-cube shipping containers that were interconnected when installed. The Mine Site sewage treatment plant is located southeast of the fuel tank farm, north east of the water building, and south of the accommodations facility. The system includes the outdoor piping connecting the accommodations facility to the sewage treatment plant and the connection for the effluent discharge piping. These pipes are HDPE DR11, pre-insulated with 50 mm (2 inch) insulation and heat traced for year-round use.

Mine Site – Treated Effluent Discharge

During normal operation, the treated effluent from the sewage treatment plant (STP) is pumped to the permitted discharge points at Mary River via the treated effluent discharge pipeline. In the event that the treated effluent does not meet discharge requirements, the off-spec effluent would be trucked from the STP to one of the three existing PWSPs for storage and eventual treatment/discharge as required. Once the 'problem' in the STP is corrected, the off-spec effluent from the pond(s) will be treated insitu or transported via vacuum truck and re-processed through the STP before directly discharging to Mary River. The treated effluent discharge pipeline is a 50 mm (2 inch) diameter HDPE DR11 pipeline from the STP to the tee connection (valve box/branch) with the remainder of the pipeline (from the valve box/branch to the Mary River discharge) being 75 mm (3 inch) diameter HDPE DR11. The pipeline is approximately 2 km long, above ground, pre-insulated with 50 mm (2 inch) insulation and heat traced for year-round use.

5.2.8.2 Pre-Disturbance, Existing, and Final Site Conditions

The pre-disturbance site conditions are summarized in Section 3. Appendix C provides a photolog showing the current mining operations.

Disturbances to the surrounding areas of the Project may cause thermal disruptions to the permafrost zone resulting in ponding, settlement and/or subsidence due to changes in the active zone (the upper 1 to 2 m of soil). During closure these areas will be drained of excess water, filled with clean material to insulate and re-establish the active layer and graded, restoring the natural drainage of the area as necessary. The natural drainage of water courses will be re-established for long-term stability.

Stockpile settling ponds will be removed during closure, following decommissioning of the ore stockpiles, when management/treatment of site drainage is no longer required.

The Milne Port and Mine Site water treatment systems buildings will be removed and re-used. Outdoor piping will also be removed and affected footprints regraded to restore natural drainage patterns where possible, and scarified to allow for natural re-vegetation.

The Milne Port and Mine Site sewage treatment plants will be removed and potentially reused. Outdoor piping including the treated effluent discharge system will also be removed and affected footprints regraded to restore natural drainage patterns where possible, and scarified to allow for natural re-vegetation.

The off-spec effluent pond(s) will be removed concurrently with the decommissioning of the sewage treatment plants. The affected footprints will be regraded to restore natural drainage patterns where possible, and scarified to allow for natural re-vegetation.

5.2.8.3 Closure Objectives and Criteria

The closure objectives are presented in Section 5.1.1 and closure criteria are presented in Table 5.1.

5.2.8.4 Consideration of Closure Options and Selection of Closure Activities

Detailed alternative analysis of other closure options have not been completed by Baffinland due to the early stage of the Project and the absence of Project components which represent the largest uncertainty at closure (Open Pit, Permanent Waste Rock Stockpile). As data are collected and analysis is conducted, the ICRP will be updated as required. Please refer to Appendix D for more detail on existing reclamation research plans relevant to the Project to address uncertainties related to final closure.

Although modifications to the existing water management infrastructure and corresponding sequencing of their closure may change, no significant closure options are expected to be considered for this mine component as no structures are planned to remain following reclamation.

5.2.8.5 Engineering Work Associated with Closure Activity

The water supply system at the Mine Site and Milne Port will be demolished, removed and either sealifted to the mainland for disposal/salvage or will be disposed of in the onsite landfills or other approved repository.

The sewage treatment plants located at the Mine Site and Milne Port will be decommissioned as per the manufacturer's specifications. The remaining sewage treatment plant components will be either transported for sealift to the mainland for disposal or salvaged or disposed of in the onsite landfill.

The site water management ponds (Off-spec, Stockpile Settling Ponds, etc.) will be decommissioned when they are no longer required and water quality is found to consistently meet effluent criteria ((Section 5.1.1). Ponds will be decommissioned as follows:

- Soils and sediment will be tested as part of the Site Environmental Assessment work and impacted soils and sediment will be cleaned up as necessary (Section 9.6);

- Liners, where present, will be removed and disposed of in non-hazardous waste containment area;
- The ponds will be filled with clean material and perimeter berms will be regraded to restore natural drainage patterns;
- The ground will be scarified around the pond areas to encourage natural revegetation.

Water crossings (bridges and culverts) will be decommissioned and the drainage channels restored to natural drainage conditions.

As pumping equipment is no longer required (cessation of mine dewatering, decommissioning of a pond, decommissioning of a water treatment plant, etc.), the associated pumps and pipes will be decommissioned. Pipes will be disposed of in the non-hazardous waste areas and ownership of pumps will either transferred (sold) off-site or donated to the local communities.

5.2.8.5.1 Materials Suitability for Closure Needs

Reclamation activities shall restore the physical and chemical stability of areas where material was removed or altered for Project purposes (i.e., excavation activities). Reclamation activities may include, but are not limited to, replacing those affected areas with suitable cover materials sourced locally, importing/producing fill, restoring drainage to limit unnatural standing water through re-grading, routing of any trapped surface water and scarification. All such reclamation activities shall be performed in a manner that will reduce the risk of erosion and sedimentation to the surrounding environment and limit disturbance to the permafrost.

Criteria for sourcing suitable materials for closure needs requires consideration of several chemical (i.e., pH, sodicity, salinity, saturation, etc.) and physical (i.e., texture, moist consistency, content, etc.) properties. A comprehensive assessment of suitable materials for closure needs will be completed prior to the use of any material for cover purposes focusing on the following objectives:

- Identifying and mapping suitable locations of material as well as its distribution. Locations will be evaluated for chemical and physical stability, impact to natural environment, etc.
- Geochemical and physical characteristics for suitability for reclamation such as the consistency to prevent erosion, porosity, ability to alter natural snow and water runoff conditions, stability, etc.
- Determining depth and volumes of material types
- Development of a schedule of availability.

5.2.8.6 Predicted Residual Effects

The predicted residual effects at planned closure, including those encompassing water management, were assessed as part of the FEIS with respect to VEC/VSEC. These effects, and the methods for their assessment are summarized in Appendix G. With the removal of facilities and rehabilitation of the previously disturbed land, residual effects are expected to be limited to loss of vegetation within the PDA;

it is not expected that disturbed areas will become re-vegetated until after closure of the mine. Regeneration of the disturbed area is a slow process and will not occur until beyond the life of the project.

As the project progresses, data will be collected through the environmental monitoring programs which can provide an indication of the accuracy of the predicted effects. These data can also be used to give an indication of the performance of the site mitigative measures and management systems, used as the basis for revising the prediction of residual effects, or implementing adaptive management.

5.2.8.7 Uncertainties

Uncertainties related to the decommissioning of water management systems include whether or not there are associated contaminated soils (Section 9.6), and there may be uncertainty in revegetation success, addressed in a reclamation research program (Appendix D).

5.2.8.8 Post Closure Monitoring, Maintenance and Reporting

Post-closure monitoring of waste rock and overburden piles includes geotechnical/engineering monitoring (Section 9.4), aquatic monitoring (Section 9.5), Environmental Site Assessment (Section 9.6), fauna and flora monitoring (Section 9.7), safety compliance inspection (Section 9.9), and air quality monitoring (Section 9.11). Maintenance required will depend on the outcome of the monitoring programs, and would be completed as outlined in Table 5.1. Baffinland will report on the results of all monitoring programs on an annual basis to the NIRB (as per Project Certificate No. 005 and its Amendment), AANDC Land Lease 47H/16-1-2, the NWB (as per Type 'A' Water Licence 2AM-MYR-1325 Amendment No. 1) and the Land Owners (as per Commercial Lease Q13C301).

5.2.8.9 Contingencies

The need for contingencies for the reclamation of mine infrastructure has not been identified by Baffinland at this time. As the project progresses, the need for adaptive management and contingency alternatives may arise due to the outcomes of discussions with the Mine Closure Working Group.

6 PROGRESSIVE RECLAMATION

6.1 Definition of Progressive Reclamation

Most of the Project areas will be actively used during the Construction and Operation phases of the Project, although where practical, areas which are no longer needed to carry out Project activities will be progressively reclaimed. As per CIRNAC Guidelines[6], "Progressive reclamation takes place prior to permanent closure to reclaim components and/or decommission facilities that no longer serve a purpose. These activities can be completed during operations with the available resources to reduce future reclamation costs, minimize the duration of environmental exposure, and enhance environmental protection. Progressive reclamation may shorten the time for achieving closure objectives and may provide valuable experience on the effectiveness of certain measures that might be implemented during permanent closure."

6.2 Opportunities for Progressive Reclamation

This section describes the proposed progressive rehabilitation measures that will be completed during the construction and/or operation phases of the Project. In accordance with the objectives and guidelines presented in Section 5.1.1, progressive rehabilitation will be implemented to achieve the Projects site abandonment goal and closure principles. Table 6.1 presents Baffinland's proposed progressive rehabilitation schedule. This schedule will be updated in future ICRPs as additional opportunities are identified.

Table 6.1: Summary of Conceptual Current and Proposed Progressive Rehabilitation Schedule

Phase:	Construction (ERP)				Operation (ERP)				Operation (ERP & Rail Phase)			
Year:	1	2	3	4	1*	2*	3*	4*	1	2	3	4
Milne Port												
PWSP (exploration)												
Bladder Farm												
Quarry (Q1)												
Mary River Mine Site												
Bladder Farm												
Quarry (QMR2)												
Laydown Areas												
Borrow Pits												

[6] MVLWB/AANDC, Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories, November 2013

Phase:	Construction (ERP)				Operation (ERP)				Operation (ERP & Rail Phase)			
Rail Route												
Rail Access Road												

***Rail phase construction begins**

6.2.1 Proposed Progressive Rehabilitation Measures

The overall intent of the proposed progressive rehabilitation measures is to assist in achieving Baffinland's site abandonment goal to return project sites and affected areas to viable and, wherever practicable, self-sustaining ecosystems that are compatible with a healthy environment and with human activities in as minimal duration as reasonably practical. The progressive rehabilitation measures proposed as part of the ICRP are expected to be technically and economically feasible and reflect Project closure principles. Closure criteria, to determine if the closure objectives outlined in subsections below have been achieved by closure activities, are consistent with the closure criteria described in Table 5.1. It should be noted participation of the local communities, through their QIA representatives, and other applicable government stakeholders, in the consideration of alternative progressive reclamation activities is encouraged via the Mine Closure Working Group (refer to Section 2.4 for more information). The experience gained and lessons learned from the closure of the Nanisivik and Polaris mine sites, which are located in a similar climate zone, will be used, where applicable, as a benchmark for the progressive rehabilitation of disturbed Project areas.

6.2.1.1 Landfarm Operation

Hydrocarbon-contaminated soils will be excavated and treated in the Project landfarm(s) throughout the life of the Project to maintain the chemical stability of the site and any discharges. During Operations, soils treated in Project landfarm(s) that meet Nunavut Contaminated Site Remediation Tier-1 Guidelines[7] for industrial/commercial land uses will be used in select locations. The use of treated soils meeting these criteria is restricted to areas deemed as a low risk of exposure to transportation pathways and a defined in prescribed operational control procedures. During Operations, soils treated in Project landfarm(s) that meets Nunavut Contaminated Site Remediation Guidelines[8] for agricultural or residential land uses will be spread over land as or used of as cover material. Soils treated in Project landfarm(s) that do not meet Nunavut Contaminated Site Remediation Guidelines[8] for industrial/commercial land uses will be kept in containment for further treatment. Another approach that may be utilized is a risk-based methodology for the establishment of hydrocarbon criteria that are protective of human and ecological health. The

[7] Environmental Guideline for Contaminated Site Remediation, Department of the Environment, Government of Nunavut, March 2009

methods to be followed are outlined Canadian Council of Ministers of the Environment (CCME) Canada-Wide Standards for Petroleum Hydrocarbons (PHC) In Soil (2008).

Once no longer required, landfarms will be closed as described in Section 5.2.7.

6.3 Completed Progressive Reclamation

To date, progressive reclamation efforts have commenced, or been completed, at several areas on site. Reductions in reclamation security in response to successfully demonstrating closure criteria have been met. The following lists progressive reclamation works have occurred to date, as well as the publicly available reports summarizing completed activities:

- Fuel Bladder Farm at Milne Port. See Appendix E.8 of the 2014 QIA and NWB Annual Report for Decommissioning Reports related to this activity.
- Quonset Hut at the Mine Site. See Appendix E.8 of the 2014 QIA and NWB Annual Report for Decommissioning Reports related to this activity.
- Calcium chloride salt storage. Ongoing long-term management of calcium chloride salt storage and use at the Project Site includes waste segregation of salt bags and proper disposal of collected materials in accordance with Baffinland's Waste Management Plan (BAF-PH1-830-P16-0028) as well as identifying and containing compromised salt packages to prevent materials being distributed around the site. Currently salt is stored at both the Mary River Mine Site and Milne Port Site for use in future exploration drilling as well as for dust suppression on Project roads and camp pads.
- Km 97 Borrow Source. Borrowing in this area has led to thawing of the underlying permafrost soils, which has caused considerable increase in ponded water; and, there is settlement resulting from thaw of both the ground ice in the soil matrix and thaw of ice wedges. Although approved, due to resource limitations, only minor work was completed thus far. See the Borrow Source Reclamation Plan, Milne Inlet Tote Road, Km 97, submitted to AANDC on June 19th, 2015.
- Disposal and off-site transport of historical inventory of remaining incinerator bottom ash at the Mine Site and Milne Port. Ash that was tested and determined to be non-hazardous was disposed of at the Landfill Facility while ash that was identified as hazardous was transported off-site for disposal in a licenced facility in Southern Canada. See Appendix E.2 of the 2015 QIA and NWB Annual Report for more information related to this activity.
- Demobilization of equipment and supplies not required for near term activities, as well as the current inventory of hazardous waste and other materials by means of sealift from Milne Port Site was undertaken in 2015. See Appendix E.4 of the 2015 QIA and NWB Annual Report for more information related to this activity.

- Decommissioning activities completed for former contractor (Nuna) work shop no longer required at Milne Port to provide for the completion of the southeast extent of Ore Stockpile Pad. Decommissioning activities included disassembly of the building structure, remediation of the underlying soil footprint, removal of structure power supply (generators) and remediation of the underlying soil footprint of the west generator. Refer to Appendix E.8.1 of the 2015 QIA and NWB Annual Report for the Nuna Shop Decommissioning Report.
- Former Rotary Biological Contactor (RBC) sewage treatment plant was removed from the site by the contractors.
- Commencement of decommissioning of the Mine Site Bladder Farm and Generator Berm Bladder at the Mine Site exploration camp. The bladders and piping was removed from these facilities. A single bladder containing oily water remains in the Mine Site Bladder Farm. The lined berms will be converted to other uses such as the storage of drummed fuel.
- Ongoing management of hydrocarbon impacted soils from historical decommissioning efforts, as well as from period spills resulting from day-to-day fuel handling and management activities at both the Mine site and Milne Port. These soils have been placed in the Milne Port Landfarm Facility for biotreatment to meet the objectives as outlined in the Government of Nunavut's Environmental Guideline for Site Remediation, 2010. For approximate quantities of hydrocarbon impacted soils deposited in the Landfill Facility during 2015, refer to Table 2.5.2 of the 2015 QIA and NWB Annual Report.
- Disassembly of contractor (Anmar) tent structure and equipment was completed after a large-scale fire at Milne Port. The fire debris, residual waste material, and soils were characterized under the direction of a qualified consultant provided by Qikiqtaaluk Environmental Inc. (QE). The hazardous and potentially hazardous waste material was sorted and packaged for off-site transport to waste receiving facilities in Quebec. Refer to Appendix E.8.2 of the 2015 QIA and NWB Annual Report for QE's final summary report for the remediation conducted. The report includes the manifests and Certificates of Disposal/Recycling provided by the receiving facilities.

7 TEMPORARY CLOSURE

7.1 Short-Term Temporary Mine Closure – Care and Maintenance

Short-Term Temporary "Care and Maintenance" activities will occur when the Project ceases operations for a period of less than one (1) year with the intent of resuming operational activities or final closure activities. When entering a "Care and Maintenance" phase, the main objective is to maintain all equipment and facilities in a state of readiness to resume operation with minimal delay or have project components at the ready for use to support closure activities.

Care and maintenance of the Project sites will be implemented and executed by operational maintenance staff and other support personnel on site and will be carried out within approximately six (6) months of the initiation of the Temporary Closure Care and Maintenance phase based on the level of effort required. Access to the Project sites, buildings and structures will be restricted to authorized persons only, as during operations. Buildings where potential hazards exist will be locked or otherwise secured.

The Mine Site Reclamation Policy for Nunavut (2002) and the Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories (2013) require that contingency measures be established in the ICRP for Temporary Closure of a mine site. Temporary closure is defined as the planned shutdown of a mine site for a period of less than one (1) year. This section of the report presents the plans for suspension of activities of less than one (1) year. Section 0 below covers Long-term Temporary Closure beyond one year.

7.1.1 Health and Safety of Workers and the Public During Temporary Closure

The health and safety of workers and the Public will be ensured during Temporary Closure Care and Maintenance. Infrastructures will be kept secure by routine maintenance and inspections to eliminate any hazard to the public health and safety or material erosion to the terrestrial or aquatic receiving environment at concentrations that are harmful. Access to buildings and infrastructures will be restricted to authorized personnel only (Section 7.1.2).

Employees on site will be trained in site-specific health and safety requirements. Baffinland commits to abide by all applicable *NWT/Nunavut Mines Safety Act* and Regulations, and the *Explosives Use Act*.

Baffinland will ensure that emergency procedures are updated, if required, and implemented and that all equipment necessary to properly carry out these procedures will be accessible and kept in good working condition.

7.1.2 Restriction of Access and Site Security

During Temporary Closure Care and Maintenance, the Mine Site and Milne Port will be maintained in a secure condition through the provision of on-site site security. Mine dewatering and water treatment, where required, will be ongoing. As a result, a number of operational maintenance staff, environmental personnel and other support personnel will be onsite at the Mine Site and Milne Port. Access to buildings, structures, and storage compounds will be restricted to authorized persons, as during operations. Buildings where potential hazards exist will be locked or otherwise secured. Fences and/or barriers with signs will be constructed to restrict access as required.

Security personnel will carry out routine inspections of security, safety and environmental measures and maintain a record of these inspections. Contact information will be provided to pertinent government and Inuit agencies to facilitate their communication and potential access to the Mine Site and/or Milne Port, if and when necessary.

The explosives contractor will manage explosives in accordance with applicable regulatory requirements as per NRCan Permit and the *Mine Safety Act*.

During Temporary Closure Care and Maintenance, reclamation activities such as re-grading may continue as per the progressive reclamation plan (Section 6). Erosion and discharge streams will be controlled as part of regular maintenance activities. Additionally, all unused pipelines will be drained and/or care will be taken that lines and pipes do not freeze and rupture.

7.1.3 Security of Mine Openings

Due to the current configuration of Deposit No 1 as an above grade deposit, an open pit is not expected to occur until years 10 to 12 of operation at full production volume (21.5 Mtpa nominal). If a pit exists, the entrance ramp to the open pit will be fenced using boulders or other means to prevent inadvertent access. Signage indicating an "Open Hole" will already be in place around the open pit perimeter during operations as per NWT/Nunavut *Mines Safety Act* Regulations. In a short-term temporary closure scenario where suspension of mining activities is expected to last less than one year, pit dewatering and the subsequent treatment and discharge would likely continue in a manner consistent with ongoing operations at the time.

7.1.4 Security of Mechanical, Hydraulic Systems and Electrical Systems

During Temporary Closure Care and Maintenance, equipment required for the security and safety of the infrastructure systems, including environmental aspects, will be maintained in working condition.

Buildings will be locked or otherwise secured to prevent inadvertent access once the Mine Site, Tote Road and Milne Port are evacuated by the majority of the personnel, except as required by the onsite staff for site maintenance and security. Non-essential machinery, equipment and systems will be left in a no-load condition or removed from site. Live electrical systems will be fenced, locked, or otherwise secured against inadvertent entry or contact, and appropriate signs will be placed to warn of potential hazards.

7.1.5 Hazardous Materials & Waste Management Sites

During or prior to Temporary Closure Care and Maintenance, an inventory of all hydrocarbon products, chemicals, explosives and hazardous wastes/materials (e.g., used oils, ammonium nitrate and greases) will be updated and the materials stored in a secure and environmentally sound manner.

All storage facilities that contain any such materials will be secured and monitored. Inert waste will be disposed of in the landfill site at the Mine Site or other approved repositories.

During Temporary Closure Care and Maintenance, the non-hazardous waste management facilities at the Project will continue as in normal operations on an as-required basis. If waste management facilities are no longer required, landfills will be covered with 1.5 m of overburden.

If the Temporary Closure Care and Maintenance phase lasts longer than one (1) year, all hazardous materials and wastes will be removed from Project sites via sealift and disposed of at a licensed hazardous waste disposal facility in Southern Canada (Section 7.2.5).

7.1.6 Docks and Airstrip

During Temporary Closure Care and Maintenance activities, the airstrip, dock infrastructure and equipment will be left in place. All non-essential airstrip and dock machinery, equipment and systems will be left in a no-load condition. Live electrical systems will be fenced, locked, or otherwise secured against inadvertent entry or contact, and appropriate signs will be placed to warn of potential hazards.

7.1.7 Control of Effluents

The water management requirements at the Mine Site and Milne Port during Temporary Closure Care and Maintenance will include:

- Domestic sewage treatment
- Surface/discharge waters, as per applicable regulatory requirements

The drainage system established during operations will be retained and surface water will continue to collect in existing settlement ponds and, where required by the Water Licence, waters will be treated prior to discharge to the receiving environment.

The waste rock stockpile will be monitored during operations (Section 9). Current investigations identify that most of the waste rock will not be prone to metal leaching or acid drainage; however, if ongoing work characterization studies show that the minor portion waste rock that is potentially acid generating (PAG) could cause unacceptable impact to runoff and seepage, the waste rock stockpile construction strategy will be modified accordingly. If treatment is required, water will be batch treated with lime dosing for Acid Rock Drainage (ARD) affected water or a treatment plant such as a High Density Sludge (HDS) treatment plant may be provided.

The Life-of-Mine Waste Rock Management Plan (BAF-PH1-830-P16-0031) provides treatment options in the event that waste rock run-off requires treatment. The Fresh Water Supply, Sewage, and Wastewater Management Plan (BAF-PH1-830-P16-0010) provide the design criteria and operations and maintenance requirements for the collection and treatment of the site's wastewater.

7.1.8 Stabilization of Stockpiles

Ore and waste rock stockpiles will be visually assessed for stability at the start of the Temporary Closure Care and Maintenance period and stabilized if required. The stockpiles will be periodically inspected.

7.1.9 Site Inspection Program

The general site areas at the Mine Site, Milne Port and Tote Road will be periodically inspected by onsite security personnel. Visual inspections of the Mine Site and Milne Port will be carried out to verify the physical stability of quarries/borrow pits, waste rock stockpiles and pit walls. Section 9 identifies the environmental management and monitoring plans that will be implemented during any potential Temporary Closure Care and Maintenance period.

7.1.10 Notification of Temporary Closure

Employees, local communities, and the public will be notified in advance of any scheduled short term temporary closure activities.

7.2 Short-Term Temporary Closure Monitoring, Maintenance, and Reporting

During the Temporary Closure Care and Maintenance period, all terms and conditions of Type 'A' Water Licence 2AM-MYR-1325 will remain in force. "Care and Maintenance" monitoring program will include routine inspection, monitoring and reporting as required by Type' A' Water Licence Amendment No.1 2AM-MYR-1325 and its associated management plans. As the facilities are not operational, key monitoring requirements are established within the following management plans:

- Environmental Protection Plan (BAF-PH1-830-P16-0008)
- Surface Water, Aquatic Ecosystems, Fish and Fish Habitat Management Plan (BAF-PH1-830-P16-0026)
- Terrestrial Environmental Management and Monitoring Plan (BAF-PH1-830-P16-0027)
- Fresh Water, Sewage and Wastewater Management Plan (BAF-PH1-830-P16-0010)
- Air Quality and Noise Abatement Management Plan (BAF-PH1-830-P16-0002)
- Emergency Response Plan (BAF-PH1-830-P16-0007)
- Spill Contingency Plan (BAF-PH1-830-P16-0036)
- Explosives Management Plan (BAF-PH1-830-P16-0009)
- Waste Management Plan (BAF-PH1-830-P16-0028)

- Hazardous Materials and Hazardous Waste Management Plan (BAF-PH1-830-P16-0011)
- Life-of-Mine Waste Rock Management Plan (BAF-PH1-830-P16-0031)
- Aquatic Effects Monitoring Plan (BAF-PH1-830-P16-0039)

Throughout a Temporary Closure Care and Maintenance period, Baffinland would continue to report on its activities on an annual basis to the NIRB (as per Project Certificate No. 005), the NWB (as per Type A Water Licence 2AM-MYR-1325 Amendment No. 1) and the Land Owners (as per Commercial Lease Q13C301). If a Care and Maintenance monitoring schedule is required differing from Operations, it will be established in compliance with the applicable management plans, in consultation with applicable regulators.

During any care and maintenance period, regulatory compliance monitoring will continue to abide by all applicable project authorizations. Environmental Monitoring Programs may be modified and/or suspended, in consultation with applicable regulators and land owners, until recommencement of Operations. Long-Term Mine Closure and Suspension of Activities

Baffinland may extend the mine closure over a longer timeframe than one (1) year should economic conditions deteriorate while the facility is in Temporary Closure Care & Maintenance. In the event the Project ceases operation for a period of greater than (1) year with the intent of resuming activities in the future, Long-Term Temporary Mine Closure activities will occur. Long-term Temporary Mine Closure activities will ensure the Project sites are maintained in a secure condition, and all facilities and equipment are de-energized and winterized. Hazardous waste and explosives would be removed from the site. Personnel necessary, including environmental personnel, to maintain site security and project monitoring requirements would remain on site.

A detailed “Long Term Care and Maintenance Plan” would be submitted to the NWB and the Land Owner at least 60 days prior to entering the Long-term Mine Closure period. Site personnel will conduct general inspections periodically and may decrease that frequency if the site inspections indicate that the site infrastructure is stable. A record of these inspections will be maintained. The names of contact persons will be provided to the pertinent regulators and government agencies such as CIRNAC and Landlord for their information, and to facilitate their access to the site, if and when necessary. The Project could reopen when the circumstances requiring the Long-term Temporary Closure change (e.g., when economic or other conditions that caused the temporary cessation of operations is no longer of concern).

The following sub-sections describe the detailed activities that would be undertaken to secure the Project components in the event of Long-Term Temporary Mine Closure.

Table 5.1 provides an overview of the actions taken for each component of the Project for a Long-term Temporary Closure scenario. Once these measures have been implemented, the labour force on site is reduced to the minimum required to ensure security of the site and ongoing monitoring requirements. It is expected the following activities will be carried out within approximately six (6) months of the initiation of Long-term Temporary Closure based on the level of effort required.

7.2.1 Health and Safety of Workers and the Public During Long-term Temporary Closure

Health and safety of workers and the Public will be ensured during Long-term Temporary Closure. Infrastructures will be kept secure by routine maintenance and inspections to eliminate any hazard to the public health and safety or material erosion to the terrestrial or aquatic receiving environment at concentrations that are harmful.

Access to buildings and infrastructures will be restricted to authorized personnel only (Section 7.2.2). Safety will be reinforced by an inspection program (Section 7.2.9).

Employees on site will have been trained for site-specific health and safety. Baffinland commits to abide by the NWT/Nunavut *Mines Safety Act* and Regulations, and the *Explosives Use Act*.

It will be ensured that emergency procedures will be applicable and that all equipment necessary for these procedures will be accessible and kept in good working condition.

7.2.2 Restriction of Access and Site Security

During Long-term Temporary Closure, the Mine Site and Milne Port will be maintained in a secure condition. Access to the buildings, structures and storage compounds will be locked and/or fenced/gated. Potentially unsafe areas will be posted with appropriate signage. Unused machinery and equipment will be removed, where practical.

The explosives contractor will manage explosives in accordance with applicable regulatory requirements by NRCan and the Mines Safety Act. On commencement of Long-term Temporary Closure, explosives will be either removed from the Project or/and detonated in a controlled and safe fashion by experienced and licensed personnel at appropriate locations away from sensitive receptors.

During Long-term Temporary Closure, reclamation activities such as re-grading will continue as per the progressive reclamation plan (Section 6). Erosion and discharge streams will be controlled as part of regular maintenance activities. Additionally, care will be taken that lines and pipes do not freeze and break.

7.2.3 Security of Open Pit

Following notice of Long-term Temporary Closure the pit walls of the open pit will be inspected by a qualified engineer to assess the physical stability. Pit water will be monitored during the course of the operation for any indication of contamination at levels that exceed MDMER or may adversely affect the receiving environment. During Long-term Temporary Closure the decision to continue with dewatering of the open pit will be evaluated based on the planned duration of closure, and forecasts for market conditions at the time.

It is anticipated that the final configuration of the open pit will take an estimated 85 to 150 years to passively fill with water from natural sources such as direct precipitation and surface runoff (KP 2008). Therefore, it is anticipated that the open pit will not completely flood during Long-term Temporary Closure and drainage from the open pit is not considered to be a discharge issue.

Other Long-term Temporary Closure activities to close out the open pit include the following as per NWT/Nunavut *Mines Safety Act* Regulations:

- Barricading access ramps into the open pit.
- Placing of fencing and "Danger"/"Open Hole" signage as necessary.
- Baffinland will engage communities and land users to help assess if additional access restrictions are required. This feedback will focus on effective language for signage, and identification of the priority locations for barriers to deter land users and wildlife.

7.2.4 Security of Mechanical, Hydraulic, and Electrical Systems

All buildings will be locked and/or otherwise secured to prevent inadvertent access once the Project is evacuated by the majority of the personnel, except as required by the onsite staff for site maintenance and security. All non-essential machinery, equipment and systems will be left in a no-load condition. Live electrical systems will be fenced, locked, or otherwise secured against inadvertent entry or contact, and appropriate signs will be placed to warn of potential hazards.

7.2.5 Hazardous Materials and Waste Management Sites

Inert waste will first be disposed of in the landfill site at the Mine Site or other approved repositories. During operations the landfills will be covered with an interim soil cover layer to reduce infiltration and promote permafrost advancement within the waste. As such, contaminated runoff or seepage from the landfill sites are not anticipated during Long-term Temporary Closure. The required thickness of the soil cover to completely encapsulate waste in permafrost will be informed by thermistor measurements at the site.

During or prior to the Long-term Temporary Closure an inventory of all hydrocarbon products, chemicals, explosives and hazardous wastes (e.g., used oils, ammonium nitrate and greases) will be updated and all hazardous materials and wastes will be shipped south to the appropriate hazardous waste disposal facility via sealift. All storage facilities that contained any such materials will be secured and monitored. Inert waste will be disposed of in the landfill site at the Mine Site or other approved repositories.

7.2.6 Stabilization of Stockpiles

At the onset of Long-term Temporary Closure the waste rock stockpile may undergo minor re-contouring and the physical and chemical stability of the waste rock stockpile will be assessed. Following this investigation and according to the stockpile geometry at the time of Long-term Temporary Closure, aspects related to erosion, runoff control, slopes, benches, and discharges will be addressed.

Ore stockpiles are expected to be depleted prior to Long-term Temporary Closure. In the event the ore stockpiles remain during Long-term Temporary Closure, they will be monitored.

7.2.7 Docks and Airstrip

During Long-term Temporary Closure activities, airstrip the ore dock, ore dock office, and the ship loader will be left in place. All non-essential machinery, equipment and systems will be left in a no-load condition. Live electrical systems will be fenced, locked, or otherwise secured against inadvertent entry or contact, and appropriate signs will be placed to warn of potential hazards. The dock office will be secured to prevent inadvertent access. Infrastructure will be kept secure by routine maintenance and inspections to eliminate any hazard to the public health and safety or material erosion to the terrestrial or aquatic receiving environment at concentrations that are harmful. The names of contact persons will be provided to the pertinent regulators and government agencies such as AANDC for their information, and to facilitate their access to the site, if and when necessary.

7.2.8 Control of Effluents

Mine Site and Milne Port water management will be required during Long-term Temporary Closure, including:

- Domestic sewage treatment
- Surface/discharge waters, as per applicable regulatory requirements

Surface water will be collected in settlement ponds and those for the ore stockpiles and waste rock stockpile will be tested for MDMER requirements. The waste rock stockpile will be monitored during operations. Based on current investigations it is anticipated that most of the waste rock will not be prone to metal leaching or acid drainage. However, if ongoing work characterization studies show that the minor portion waste rock that is potentially acid generating (PAG) could cause unacceptable impact to runoff and seepage, the waste rock stockpile construction strategy will be modified accordingly. If treatment is required, water will be batch treated with lime dosing for Acid Rock Drainage (ARD) affected water or in a treatment plant such as a High-Density Sludge (HDS) treatment.

The Life-of-Mine Waste Rock Management Plan (BAF-PH1-830-P16-0031) provides treatment options in the event that waste rock run-off requires treatment. The Fresh Water Supply, Sewage, and Wastewater Management Plan (BAF-PH1-830-P16-0010) provide the design criteria and operations and maintenance requirements for the collection and treatment of the site's wastewater.

7.2.9 Site Inspection Program

The Project areas at the Mine Site, Milne Port and Tote Road will be periodically inspected by onsite security personnel. Visual inspections of the Mine Site and Milne Port will be carried out to verify the physical stability of quarries/borrow pits, docks, and port facilities, waste rock stockpiles and pit walls. The environmental management and monitoring requirements for the Long-term Temporary Closure Care and Management period are identified in Section 7.3.

7.3 Long-Term Temporary Closure Monitoring, Maintenance, and Reporting

During Long-term Temporary Closure, all terms and conditions of Type 'A' Water Licence Amendment No. 1 2AM-MYR-1325 would remain in force unless an amendment to this Licence is requested by Baffinland as part of the "Long-Term Care and Maintenance Plan". The application for a licence amendment would identify the changes proposed for the facilities required to be shutdown, the location of new discharges (if any), updates to any management plans and/or the AEMP (if required), and an indication of sites to be permanently rehabilitated. A monitoring schedule, if differing from Operations, will be established as part of the "Long-Term Care and Maintenance Plan" in compliance with the AEMP and other applicable Management Plans in consultation with applicable regulators.

Routine inspection, monitoring and reporting as required by the Type' A' Water Licence 2AM-MYR-1325 Amendment No. 1 and its associated management plans remain applicable. As the facilities are not operational, key monitoring requirements are established within the following management plans:

- Environmental Protection Plan (BAF-PH1-830-P16-0008)
- Surface Water, Aquatic Ecosystems, Fish and Fish Habitat Management Plan (BAF-PH1-830-P16-0026)
- Terrestrial Environmental Management and Monitoring Plan (BAF-PH1-830-P16-0027)
- Fresh Water, Sewage and Wastewater Management Plan (BAF-PH1-830-P16-0010)
- Air Quality and Noise Abatement Management Plan (BAF-PH1-830-P16-0002)
- Emergency Response Plan (BAF-PH1-830-P16-0007)
- Spill Contingency Plan (BAF-PH1-830-P16-0036)
- Explosives Management Plan (BAF-PH1-830-P16-0009)
- Waste Management Plan (BAF-PH1-830-P16-0028)
- Hazardous Materials and Hazardous Waste Management Plan (BAF-PH1-830-P16-0011)
- Life-of-Mine Waste Rock Management Plan (BAF-PH1-830-P16-0031)
- Aquatic Effects Monitoring Plan (BAF-PH1-830-P16-0039)

Baffinland will continue to report on its activities throughout the Long-term Temporary Closure period on an annual basis to the NIRB (as per Project Certificate No.005, Amendment No. 1), the NWB (as per Type A Water Licence 2AM-MYR-1325 Amendment No. 1) and the Land Owners (as per Commercial Lease Q13C301).

Although regulatory compliance monitoring will continue to abide by all applicable project authorizations. Environmental Monitoring Programs outlined in the Project Certificate will likely be suspended in consultation with applicable regulators and landowners, until Operations recommence.

8 INTEGRATED SCHEDULE OF ACTIVITIES

Based on current estimates of the level of effort required for closure activities, the primary Final Closure phase is expected to be three (3) years, with the flooding of the open pit continuing after the primary closure phase is completed. Following the Final Closure Phase a minimum of fifteen (15) years of post-closure safety and environmental monitoring and treatment, as and if required, will be conducted. A fifteen (15) year post-closure phase is estimated to be required based on the existing closure design and impacts assessment determinations described in the FEIS and addendums. This estimate is expected to be validated by the operations monitoring program results observed, and their comparison against residual effects predictions and environmental significance determinations. Where concerns in project tracking are identified, specific reclamation research programs may be developed to address uncertainties.

Upon initiation of Final Closure activities, a Short Term Temporary Care and Maintenance phase would be implemented consistent with Section 7.1, as required, to facilitate final closure planning and logistics. It is expected this phase to last no longer than one (1) year for a planned closure scenario. As consistent with the activities outlined in Section 7.1, the Short Term Temporary Care and Maintenance period prior to Final Closure activities would focus on maintaining a state of readiness of project components. Although activities would be consistent, the primary difference in a Short Term Temporary Care and Maintenance period prior to Final Closure is activities would be performed to ensure project components are maintained in a state of readiness to support final closure activities rather maintained in a state of readiness with the intent of resuming operational activities in the future. Table 5.1 presents an overview of the actions to be taken for each major Project component (by Project site) for Short Term Temporary Care and Maintenance as well as Long-Term Temporary Closure and Final Closure. The sub section below outlines the planned activities, including this Short Term Temporary Care and Maintenance period, for Final Closure activities.

It should be noted that Baffinland also recognizes that Short Term Temporary Care and Maintenance and Long-term Temporary Closure could occur during the construction or commissioning phases of the Project. The Project is being implemented in gradual phases and therefore not all components of the approved Project would be in place, or operational, should various economic drivers force the Company in Temporary Closure, Long-term Closure or Final Closure. Table 4.1 presents the current status of components related to the Project at the time of publishing.

8.1 Duration of Closure Activites

The activities to achieve Baffinland's Site Abandonment Goal (Section 2.2.2) are undertaken with the intent of achieving component-specific closure criteria, as outlined in Table 5.1 in as short duration as practicable. For planned closure, once the decision has been made to permanently close the Project and the NWB and Land Owners have approved Baffinland's Final Closure Plan, it is anticipated that the major closure activities, as described in Section 8.2, will be completed between July and October over a period three (3) years. This period is preceded by a one year final closure planning period (Year 0) and proceeded by a fifteen (15) year post-closure monitoring period (Year 4 to 18), that will extend further depending on the timing of pit filling, which could take 80+ years, or as few as 2 if the pit is actively infilled.

In a planned closure scenario, final closure planning (Year 0) is anticipated to require 1 year. The reclamation program will be predominantly an earthworks exercise with a simple demolition contract and therefore a relatively simple engineering scope. This would indicate long durations for planning, design, procurement, and coordination are not required. In addition, based on the information developed and reviewed to date as part of this document, the level of information developed and discussed during the ongoing ASRs, and the expected content and review process for future ICRP revisions and the Final CRP, it is expected reclamation strategies would be developed in sufficient detail that the final closure planning period would be expedited and any required approval processes initiated well in advance. It is therefore reasonable to assume that excessive review, planning and revision of the reclamation scope and methodology would not be required and a year duration for a final closure planning period (Year 0) would be sufficient in a planned closure scenario. For the purpose of the ASR and unplanned closure, a two (2) year final closure planning period is assumed to be required. This is based on the assumption a 3rd Party would need additional time to go through a regulatory approval processes that, in a worst-case scenario, is not reasonably expected to be able to be completed in year or less.

The expectation of an active final closure and reclamation activity period of three (3) years is based on estimated duration and level of effort required for identified active closure activities[8]. Based on the ASR process, all active closure activities have a case-by-case person days associated with them to complete each task or sub-task. The summation of the total person days needed to complete the comprehensive list of active closure tasks expected to be required to meet closure objectives and criterion – including consideration of productivity factors and travel time – demonstrates it can be accommodated in three (3) year period assuming final closure and reclamation work is conducted only during the summer month period (mid-June to mid-September) with a total site-wide available camp space of no more than 100 beds.

The expectation of a fifteen (15) year post-closure monitoring period (Year 4 to 18) is based on findings from the Mary River FEIS that show no significant adverse residual effects are predicted for the VECs (Valued Ecosystem Component) or VSECs (Valued Socio-Economic Component) associated with the Project. The post-closure monitoring period is expected to be 5 (five) years of intensive monitoring, with less frequent monitoring being undertaken over the next ten (10) years as closure conditions reach equilibrium. As shown in the Mary River FEIS, the Project is not expected to compromise the ecosystemic integrity of the Nunavut Settlement Area. In addition, no significant adverse residual effects are

[8] Estimated duration and level of effort required for identified closure activities is described in 'Annual Security Review (ASR)' documentation required under Section 9.2 of the Commercial Lease, No. Q13C301, and under Part C and Schedule C of the NWB Type "A" Water Licence No. 2AMMRY1325.

predicated to occur to VSECs identified within the socio-economic environment, and the Project is expected to have significant positive effects for most of the VSECs as the Project reflects the priorities and policies of the Government of Nunavut as well as the aspirations of local communities, and is expected to enhance the future well-being of the residents and communities of the Nunavut Settlement Area and the rest of Canada. See Appendix H for further discussion on Predicted Residual Effects.

Based on this understanding, Baffinland is currently expecting fifteen (15) years Post Closure monitoring and reporting to be required to confirm the prediction that no significant adverse residual effects have been actualized by the Project. This duration in compliance with Section 12.3 of QIA Commercial Lease No.: Q13C301 and was selected as a reasonable time-frame to demonstrate closure activity effectiveness based on the information currently available. As the project progresses into Operations and ongoing monitoring results are developed (such as the rate of pit infilling), if information indicates that fifteen (15) years of post-closure monitoring is not a sufficient amount of time to determine closure activity effectiveness, or vice-versa, is overly conservative, this duration will be re-evaluated in consultation with the Land-Owner(s) and other stakeholders.

8.2 Summary of Activities during Final Closure by Year

A high level schedule for planned Final Closure (by year) has been developed assuming productive use of resources performed in a logical manner with consideration given to unique challenges of working in the Arctic, such that reclamation can be accomplished in a timely fashion, in accordance with the ICRP and the regulatory framework established by the Inuit, Federal and Territorial governments. This schedule will be reviewed and revised to include additional and more detailed information as the final closure phase is approached. New information, when available, will be provided in subsequent revisions of the ICRP.

The current high level Final Closure schedule (by year) for planned closure includes, is presented in Figure 8.1.

Final Closure Activities	Year -1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Notification of closure to land owners and NWB	*																			
Final closure preparation activities	■	■																		
Prioritization of decommissioning sequence, identification of equipment to remain on site for use during closure activities, and mobilization of contractors	■	■																		
Care and maintenance of site		■																		
Approval of final Closure Plan by NWB and land owners		*																		
Routine inspection and monitoring			■	■	■															
Demobilization of on-site contractor equipment and material for shipment through Milne Port or Steensby Port			■																	
Transportation of excess fuel return from Mary River Mine Site to Milne Port and/or Steensby Port			■																	
Decommissioning and demobilization of Baffinland equipment identified for salvage			■																	
Decontamination and disposal of mobile equipment not suitable for salvage			■																	
Mobilization sealift of third-party contractor to either Milne Port or Steensby Port and demobilization sealift of current site contractors and Baffinland equipment and material to the Port of Valleyfield			■																	
Dismantling of facilities/buildings no longer required for mining and maintenance of trucking and transport equipment fleet			■																	
Decommissioning of open pit, mineral exploration areas, remote sites, and stockpiles				■																
Development of Mine open pit overflow discharge channel				■																
Pit flooding (if active flooding)				■																
Systematic closure of remaining borrow bits and quarry sites (re-grading and contouring				■																
Decommissioning of Mary River Mine Site, Milne Port, and Steensby Port Camps				■	■															
Decommissioning of fuel storage facilities				■																
Waste management				■																
Systematic removal of water crossings (culverts, bridges, abutments of concern) from the Milne Inlet Tote Road, followed by stablization of the road for final closure				■	■															
Decommissioning removal of railway tracks, tracks, and ties; and systematic removal of culverts and bridges; followed by stablization of the Railway bed/service road for final closure				■	■															
Treatment of contaminated soil in landfarms				■	■															
Final site clean-up of Mary River Mine Site, including grading and contouring				■																
Final site clean-up of Milne Port and Steensby Port, including grading and contouring					■															
Application of soil cover to any permanent disposal areas					■															
Demobilization sealift from Milne Port and Steensby Port to Valleyfield of third party equipment and residual reclamation equipment, material and supplies					■															
Remaining bulk fuel demobilization sealift					■															
Completion of all site contouring and drainage work					■															
Construction of the Open Pit spillway					■															
Closure and Post-Closure monitoring and reporting activities			■	■	■	■	■	■	■	■										■
Open Pit Enhanced Flooding			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			
Completion of Waste Rock Cover	■	■	■			■				■										
Site abandonment																				■
Achievement of Final Closure objectives and criteria for all Project components																				*

Figure 8.1 Schedule of Final Closure Activities

Baffinland anticipates that all Project sites will be fully decommissioned and rehabilitated by the end of the third year of Final Closure based on level of effort estimates for direct closure activities. The Post-Closure monitoring and reporting activities to be conducted during this period are discussed in Section 9. Post-closure activities will be extended if closure criteria are not met in this timeframe.

By the end of Year 18, Baffinland expects that the Final Closure objectives and criteria for all project components will be achieved.

Maintenance to engineered structures during closure activities Years 1 to 3 will depend on results from operational monitoring. It is likely that a small level of effort will be required to maintain water and waste management structures until they are permanently closed. Maintenance is not anticipated beyond Year 4, and would be addressed only as needed.

9 POST-CLOSURE SITE ASSESSMENT

This ICRP is considered to be a living document that will be updated regularly with additional detail incorporated from research and the results of monitoring plans as the Project evolves or approaches Final Closure.

The monitoring programs presented in the subsequent sub-sections are conceptual in nature at this stage of the Project life (initial phased operations). As the project advances a more detailed study design for assessing residual environmental impacts following completion of reclamation activities will be developed. This study will primarily consist of the post-closure inspection/monitoring programs described below, which are designed to assess the conditions at the site against the agreed upon closure objectives and criteria, as well as, site visits by the Designated Inuit Organization. Additional activities, such as human health and ecological risk assessments, and.

Final Closure activities could result in substantial changes to the Project sites and therefore Baffinland expects the Final Closure and Reclamation Plan to include updated management plans based upon the knowledge gained through studies during the design, construction and operational phases of the Project, and consideration of the anticipated changes.

The following management plans, which include monitoring and reporting requirements, are expected to be updated to support closure and post-closure activities. As these plans are refined and increasing detail is available for closure designs, contingency procedures and/or corrective action levels will be added. The management plans include, but are not limited to:

- Surface Water and Aquatic Ecosystems Management Plan:
  - Updated to reflect re-contoured and natural drainage features re-established to pre-project condition, to the extent reasonably possible.
  - Consideration that sedimentation ponds will be breached and re-profiled.
  - As infrastructure is removed, amended to account for the site final configuration.
- Fresh Water Supply, Sewage, and Wastewater Management Plan:
  - Updated to reflect sewage and wastewater treatment plants will be decommissioned, dismantled and disposed of.
- Waste Management Plan:
  - Modified to account for disposal of equipment, material and waste resulting from demolition and dismantling of facilities considered.
- Terrestrial Environment Mitigation and Monitoring Plan:
  - Modified to account for closure activities.

- Aquatic Effects Monitoring Plan:
  - As some infrastructure is removed, the AEMP will be amended to account for the site final configuration.
- Shipping and Marine Wildlife Management Plan
  - Modified to account for closure activities
- Air Quality and Noise Abatement Management Plan
  - Modified to account for the decommissioning of facilities

After the closure works, the site will not be considered closed out until assessments of the site conditions show that the closure objectives and criteria (Section 5.1.1) are met. Until those closure objective and criteria are met, monitoring of the site will continue in accordance with the project management plans, as applicable.

Monitoring the NIRB requirements, as required during planned closure, are dealt with in the implementation of current management plans that will be updated regularly throughout the life of the Project and through the monitoring and reporting programs shown below. These management plans will still be applicable during closure and, as necessary, post-closure monitoring. See Table 11.3 for concordance to NIRB Project Certificate requirements.

Based on current environmental effect predictions, post-closure monitoring is expected to be required over a fifteen (15) year period, although this time period may be revised, as necessary, as the monitoring programs are further developed to address additional information obtained over the Project lifecycle. Post-closure monitoring would be completed for a period of five (5) years, with a final monitoring assessment completed ten (10) years following.

Figure 9.1 represents the anticipated closure and post closure monitoring program schedule by closure/post-closure year. After closure activities are completed, the results from each monitoring and reporting program will be used to assess if prediction of no significant environmental or social effects are actualized.

	Year 0	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*	*Year 6*	*Year 7*	*Year 8*	*Year 18*
Short-Term Temporary Care and Maintenance Program	SW									
Geotechnical/ Engineering Monitoring	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW
Aquatic Monitoring and Reporting Program	SW	SW	SW	SW	MS	MS	MS	MS	MS	MS
Environmental Site Assessment	SW			SW						
Terrestrial Environment Monitoring and Reporting	SW	SW	SW	SW		SW		SW		
Marine Environment Monitoring and Reporting	MP	MP	MP	MP						
Safety Compliance Inspection[1]	SW	SW	SW	SW	SW	SW	SW	TR, MS	TR, MS	TR, MS
Socio-economic Reporting	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW
Air Quality Monitoring Program	SW	SW	SW	SW	SW					
	C&M[2]	**Final Closure (3 yrs)**			**Post Closure (15 years)**					

NOTES:

SW = Site Wide, MP =Milne Port; TR =Tote Road; MS =Mine Site (including Open Pit and Waste Rock Stockpile)

1. Frequency will be established at the discretion of the Chief Inspector of Mines in consultation with Baffinland

2. Care and Maintenance Phase, up to one (1) year

3. Post Closure activities are expected to last fifteen (15) years but will be extended if closure criteria are not met in that timeframe

Figure 9.1 Anticipated Closure and Post Closure Monitoring & Reporting Program Schedule for Major Mine Areas

The following subsections provide outlines of monitoring programs proposed for closure and/or post-closure.

9.1 SHORT-TERM TEMPORARY CARE AND MAINTENANCE PROGRAM

As described in Section 8, the anticipated Short-Term Temporary Care and Maintenance program includes routine inspection, monitoring and reporting as required by Type 'A' Water Licence Amendment No. 1 2AM-MYR-1325 and its associated management plans. Please refer to Section 7 for more information. The Short-Term Temporary Care and Maintenance period is expected to last no longer than one (1) year for a planned closure scenario. The goal of the Short-Term Temporary Care and Maintenance period is to maintain required project facilities as necessary to support the upcoming active closure activities. As further definition of the Short-Term Temporary Care and Maintenance program is developed, it will be provided in future ICRP revisions and/or incorporated into the Closure and Post Closure Monitoring Plan submitted as part of the Final Closure and Reclamation Plan. If a Care and Maintenance monitoring schedule is required differing from Operations, it will be established in compliance with the AEMP and other appropriate management plans in consultation with applicable regulators and landowners.

Baffinland will continue to report on its activities in this Temporary Care and Maintenance period on an annual basis to the NIRB (as per Project Certificate No. 005 and its Amendment), AANDC Land Lease 47H/16-1-2, the NWB (as per Type A Water Licence 2AM-MYR-1325), and the Land Owners (as per Commercial Lease Q13C301). Through a Care and Maintenance monitoring program, regulatory compliance monitoring will continue to abide by all applicable project authorizations and adaptive management similar to that of Year 1 of Final Closure.

9.2 LONG-TERM MAINTENANCE

During care and maintenance and closure, facilities that are not yet decommissioned will need to be maintained until closure conditions are stabilized. All facilities are expected to be stabilized prior to demobilization of heavy equipment in Year 3. At this time, the only infrastructure that will require continued maintenance is the pit flooding equipment, which is anticipated to be completed between year 8 and year 15. The Open Pit spillway, which will be constructed during closure activities, will be designed and constructed to minimize maintenance requirements post-closure. The geotechnical monitoring (below) will identify the need for maintenance activities on all remaining engineered structures.

Other facilities such as the ore dock and sections of the Tote Road may be left in place following negotiations with QIA and would be left as is. Closure activities for these remaining structures will seek to limit residual liability in these areas, as agreed upon with QIA. Any other facility or structure left in place, such as the airstrip and open pit spillway, would only be left if there were no long-term maintenance required, or as agreed upon with QIA.

9.3 Regulatory Reporting

Given the uncertain regulatory framework that will exist at the planned end of mining (2040), Baffinland has conservatively assumed that all existing regulatory and permitting reporting requirements from the operations phase will continue until the end of closure activities (Year 3). In post-closure, reporting associated with the monitoring programs discussed below is assumed to capture data collection and interpretation requirements for regulatory and permitting purposes as well as QIA and other public agency interests. In some cases, such as NWB and NIRB annual reports, a small level of additional effort may be required as a preamble to appended post-closure monitoring reports. If additional reporting scope is required by NWB and NIRB post-closure, it will be added to the existing monitoring/reporting to streamline reporting/review efforts when possible.

9.4 Geotechnical Engineering Monitoring

Up until post-closure (following completion of the closure activities), Baffinland will report on all Geotechnical/Engineering Monitoring results on an annual basis to the NIRB (as per Project Certificate No. 005 and its Amendment), AANDC Land Lease 47H/16-1-2, the NWB (as per Type A Water Licence 2AM-MYR-1325) and the Land Owners (as per Commercial Lease Q13C301).

The objective of the geotechnical/engineering monitoring will be to confirm the long-term physical stability of the remaining engineered structures and disturbed areas on site, as indicated by closure objectives and criteria in Table 5.1.

Post-closure site assessment/geotechnical engineering monitoring will comprise both engineering analyses and post-construction performance monitoring of both permanent geotechnical structures and disturbed areas (where no permanent structure or significant landform structure will remain). Table 9.1 presents the proposed requirements for post-closure analyses and monitoring. The year prior to Final Closure Activities (Year 0), Baffinland will commission an inspection of the site and review of the design or as-built information (where available) for each of the permanent site features to confirm the scope of post-closure geotechnical assessments (analyses and monitoring). The scope and duration of monitoring and assessments required will be developed and confirmed based on operational performance results and available construction records. If features are no longer needed during mining, this assessment may be completed earlier in the mine's lifespan. Complete studies will be submitted to QIA for review with planned ICRP updates.

Table 9.1: Proposed Post-Closure Geotechnical Assessment and Monitoring Requirements

Mine Feature	Permanent Structure / Disturbed Area	Engineering consideration	As-built Assessment Completed	Monitoring	Analyses and monitoring
Milne Port					
Ore and Freight Docks	Permanent structure	Stability and erosion	Operations	X	
Port site drainage	Disturbed area	Erosion	Post-closure		X
Abandoned quarry sites	Disturbed area	Stability and erosion	Operations	X	
Tote Road					
Former (removed) water crossings	Disturbed area	Erosion	Post-closure	X	
Remaining water crossing abutments	Permanent structure	Erosion	Post-closure		X
Road	Disturbed area	Erosion	Operations	X	
Cut and fill slopes	Permanent structure	Stability and erosion	Operations	X	
Mine Site					
Site drainage	Disturbed Area	Erosion	Post-closure	X	
Open pit	Permanent structure	Stability and erosion	Post-closure		X
Waste rock pile (s)	Permanent structure	Stability and erosion Permafrost Stability	Post-closure		X
Former stockpiles	Disturbed Area	Erosion	Post-closure	X	
Landfill site	Permanent structure	Erosion	Post-closure		X
Site Wide					
Site wide - other	Structure	Stability and erosion	Prior to mining	X	
			Operations	X	
	Disturbed area	Erosion	Prior to mining	X	
			Operations	X	

Following the completion of closure works for each mine feature/area, a construction record will be prepared. Construction records will include:

- description of the works that were completed;
- description of deviations that were made from the design (where appropriate);

- stamped as-built drawings of the completed structure or landform (final grading);
- confirmation of what closure objectives have been met for this structure;
- laboratory results (where appropriate);
- a photolog; and
- confirmation of performance monitoring requirements.

9.4.1 Geotechnical Engineering Analyses

Geotechnical engineering analyses will be required for all permanent structures (i.e. pit wall slopes, waste rock slopes, permafrost covers, port embankments, etc.). The requirements for analyses are as follows:

- appropriately detailed construction records;
- monitoring records indicate that the structure has been performing well;
- slope stability, erosion protection analyses, or other evaluation of the structure to demonstrate long-term stability;
  - based on as-built records, or
  - based on the closure design where as-built conditions have been confirmed to be consistent with the design;
- thermal analyses of the permafrost cover to demonstrate long term post closure permafrost stability
- meets closure criteria (Table 5.1).

These requirements may be found to have already been met for some structures that were constructed during, or prior to operations, provided the records listed above are available.

9.4.1.1 Slope Stability

Slope stability analyses will be used to confirm the long-term stability of permanent constructed structures on site, except for where analyses are deemed not to be required to confirm long-term stability by a NU engineer. Slope stability analyses may be modelled using industry standard software packages such as Geostudio, RocScience, or Plaxis. Slope stability assessments will include both static and pseudo-static (earthquake loading) conditions, and will provide an indication of the potential for liquefaction.

Open Pit

Slope stability modelling of the open pit will be completed for both the transient flooding conditions as well as for long term flooded conditions. Rock mass quality and strength characteristics will be collected during operations once pit development has begun and will be used to inform the assessment.

Under transient conditions, the pit will likely undergo worst case conditions when hydraulic back pressure on the walls from groundwater inflow is at its strongest. Once the pit has flooded, this backpressure will become counterbalanced with the pit lake water, which should improve the pit stability.

Waste Rock

The waste rock pile will be analyzed in consideration of permafrost aggradation. Monitoring of aggradation through operations will inform the stability assessment to confirm the thickness of the active layer that is to be incorporated in the model for the stability assessment.

Permafrost stability will be also modelled using Geostudio package or other appropriate software to ensure the long term performance. The geothermal model will be established taking into account seasonality, climate change and heat generation within the waste rock.

9.4.1.2 Erosion Protection and Drainage

Drainage features will be assessed for design runoff events. Peak discharges would be modelled using the rational method or by HEC-HMS and/or HEC-RAS for large catchments over 80 ha.

As no dams will remain on site, there is no anticipated requirement for conducting dam safety or evaluation programs. Decommissioning and breaching of dams will occur in accordance with all applicable regulations.

Revetment designs (shoreline protection) would be evaluated in accordance with the recommendations set out in the US Army Corps of Engineers (USACE) Shoreline Protection Manual.

Bridge abutments that are to remain within the Mary River will be assessed for erosion potential. Amongst the methods that could be employed to assess the stability of the riprap erosion protection include the Tractive Force Method.

A Final Grading Plan will be developed to outline reclamation activities and expectations for site conditions post-closure. It will be developed in consultation with local communities and in consideration of planned future land uses and environmental goals (e.g., minimizing wind erosion). The Final Grading Plan will address a variety of topics, and is expected to include information such as:

- Site drainage strategies and construction criteria
- Covering methods for foundations that are left in place
- Quarry reclamation, particularly in areas of permafrost disturbance
- Risk management using soil covers for any areas of impacted soil
- Covering landfills
- Regrading procedures at bermed and/or lined areas (e.g. landfarms)

- Grading of rock cuts and/or infill locations along Tote Road
- Grading options to promote desired wildlife and human travel
- Priority areas for scarifying to promote natural revegetation

The Final Grading Plan will describe the above information and provide the objectives that these activities will target.

9.4.2 Geotechnical Monitoring Inspections

Geotechnical inspections will be carried out at regular intervals following the completion of the closure works. Inspections will review the performance of structures relative to the closure objectives.

Site wide inspections of the condition of all site features are to be carried out the year following completion of closure activities (Year 4), as well as in Years 8 and 18.

The Open Pit should be inspected regularly during filling, and then 5 years following filling. For the purposes of devising a monitoring program, it is assumed that enhanced pit filling will take ten (10) years to complete. The final inspection would be completed in year 18.

As part of these inspections, site conditions are to be compared to the construction records, where available. During monitoring inspections, it is expected special attention will be given to the following areas:

1. Milne Port
   a) Ore and freight docks – integrity of dock embankment and indication of shore erosion.
   b) Port site drainage – indications of excessive erosion.
2. Tote Road
   a) Abandoned quarry sites – site condition and advancement of re-vegetation.
   b) Former water crossing – bank stability and indications of excessive stream bank erosion.
   c) Road – bed erosion and progress of re-vegetation cover.
3. Mine Site
   a) Overall site drainage patterns and indication of erosion channels.
   b) Open pit water level and barriers to access.
   c) Open pit spillway
   d) Integrity of waste rock stockpile slopes (erosion, slumping of slopes).
   e) Landfill site status (indication of bank erosion, depression of cover material)
   f) Waste Rock temperature readings to ensure stability/permafrost aggradation

All geotechnical/engineering inspections and assessments will be carried out by licensed NU engineer.

9.4.3 ADDITIONAL SITE OBSERVATIONS

In addition to the detailed geotechnical/engineering monitoring inspections described above carried out by licensed NU engineer, as part of the Closure and Post-Closure Aquatic Monitoring and Reporting Program (Section 9.5), sampling personnel will be trained to identify and document any suspected cases of physical or geotechnical instability of lands and structures remaining on site (e.g., visible signs of cracking, any indication of seepage, indication erosion that has taken place, natural re-vegetation progress, slope ratios, etc.). Therefore, in the interim years between full geotechnical/engineering monitoring inspections, suspected cases of physical instability will be identified and documented for annual review by licensed NU engineer. If the licensed NU engineer deems it necessary in order to meet established closure criteria, an action plan will be developed and implemented as appropriate to correct the situation and ensure long-term physical stability of the project component or lands in question. The component or lands in question, and similar components or lands, will also then become an area of focus for the subsequent detailed geotechnical/engineering monitoring inspections carried out by licensed NU engineer to confirm acceptable corrective action.

9.5 CLOSURE AND POST-CLOSURE AQUATIC MONITORING AND REPORTING

The Closure and Post-Closure Aquatic Monitoring and Reporting Program focuses on detecting the discharge of potential contaminants from various Project components. During Final Closure, the Aquatic Monitoring and Reporting Program will be maintained as outlined by the AEMP (BAF-PH1-830-P16-0039), the SWAEMP (BAF-PH1-830-P16-0026), and in accordance with Type 'A' Water Licence 2AM-MRY1325. If the monitoring schedule is required to be revised from Operations, it will be established in compliance with the AEMP, SWAEMP, and other applicable management plans in consultation with applicable regulators and landowners. It is expected that any additional water quality/quantity monitoring programs developed to focus on specific areas of the Project site (e.g. tote road, quarries) will be rolled into a single plan for the post-closure phase. This includes Environmental Effects Monitoring required by MDMER (below), as well as the Core Receiving Environment Monitoring Program (CREMP). An important detail of this post-closure monitoring program will be the clear distinction of what closure criteria will apply to which areas, such that an appropriate monitoring schedule is developed. For example, MDMER requirements will apply at the Open Pit and Waste Rock Stockpile, and in addition Water Licence effluent criteria, CCME PAL and/or risk-based criteria informed by baseline and operational water quality data will be considered for these and other areas of the site. Refinement of these criteria to numerical values, will occur in cooperation with QIA. In these other areas, post closure monitoring schedules will be informed by the large amount of performance monitoring results acquired throughout operations to allow a refined focus on the specific parameters/locations of concern. Existing water quality monitoring locations are presented on Figure 9-1 and Figure 9-2 below. It is expected that this level of monitoring would decrease during care and maintenance and closure activities (Years 0-3) to reflect the end of mining activities and removal of "end of pipe" discharge locations, but would not be discontinued until an appropriate duration of post-reclamation monitoring has been at each area. In some areas, geotechnical inspection and monitoring will continue after water quality monitoring in order to identify unexpected erosion and sedimentation issues. If concerns are observed, water quality monitoring may be required. Monitoring at the Mine Site (i.e. Waste Rock Stockpile and Open Pit), which represent the largest environmental risk, will continue until Year 18.

As currently described in Section 5.2.1, the Open Pit will be filled by natural infilling and active pumping from local water sources (enhanced pit filling). Where possible, Baffinland would like to avoid unnecessary stresses to the nearby aquatic environment that may be associated with water extraction, while also avoiding a closure scenario that requires long-term active care. To achieve this, Baffinland has tentatively assumed a flooding period of 10 years would be achieved. Closure planning for this element will focus on refining estimates for active pumping from the likely water sources in combination with updated estimates for natural infilling based on new information regarding pit geometry, bulk rock hydraulic conductivity and site hydrological processes. In addition to water quality monitoring which will occur periodically throughout flooding, an additional 3 year monitoring period has been assumed to confirm closure criteria are met and the spillway is functioning as per design intent.

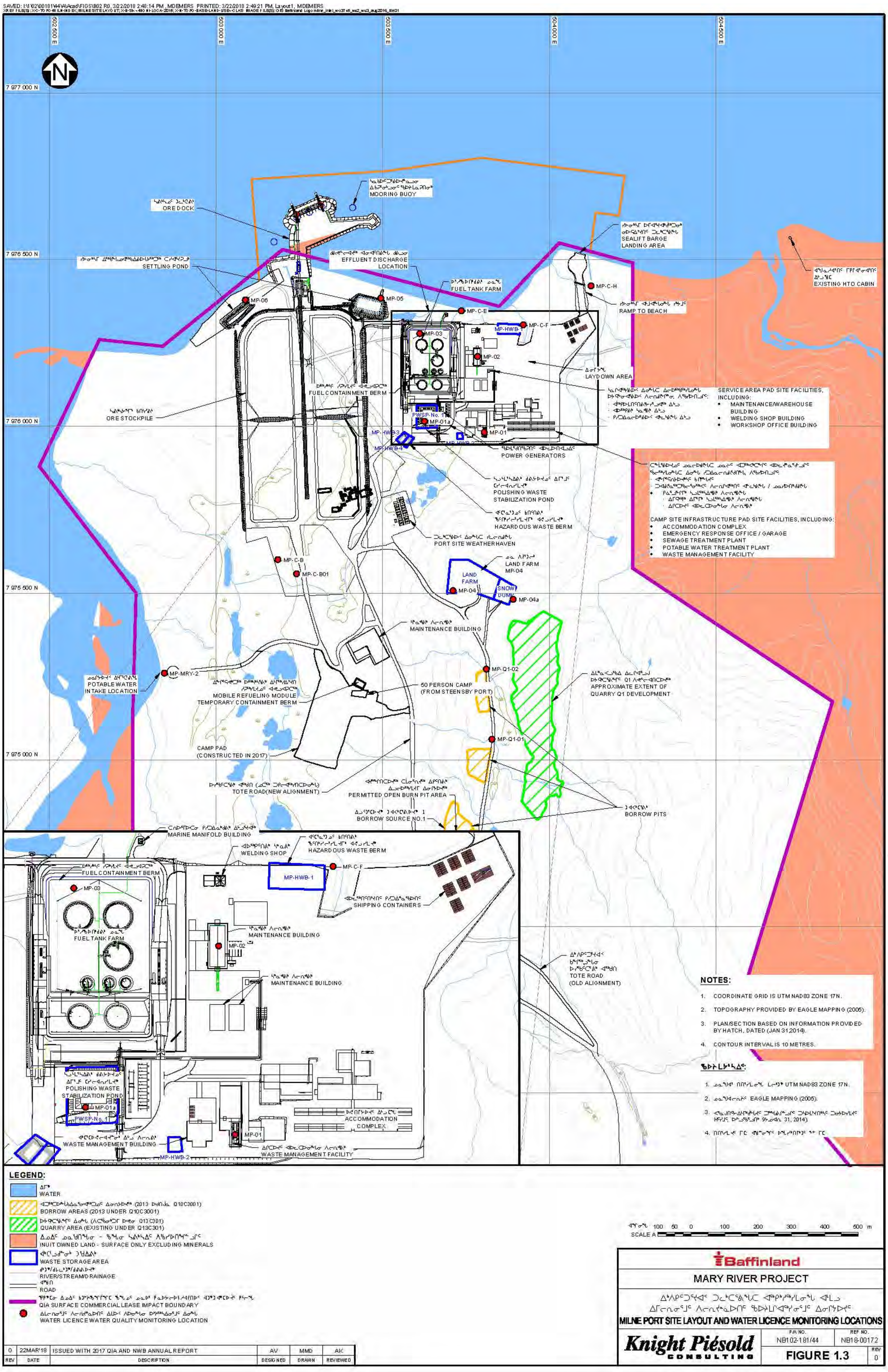

Figure 9.2 Milne Port Site Plan

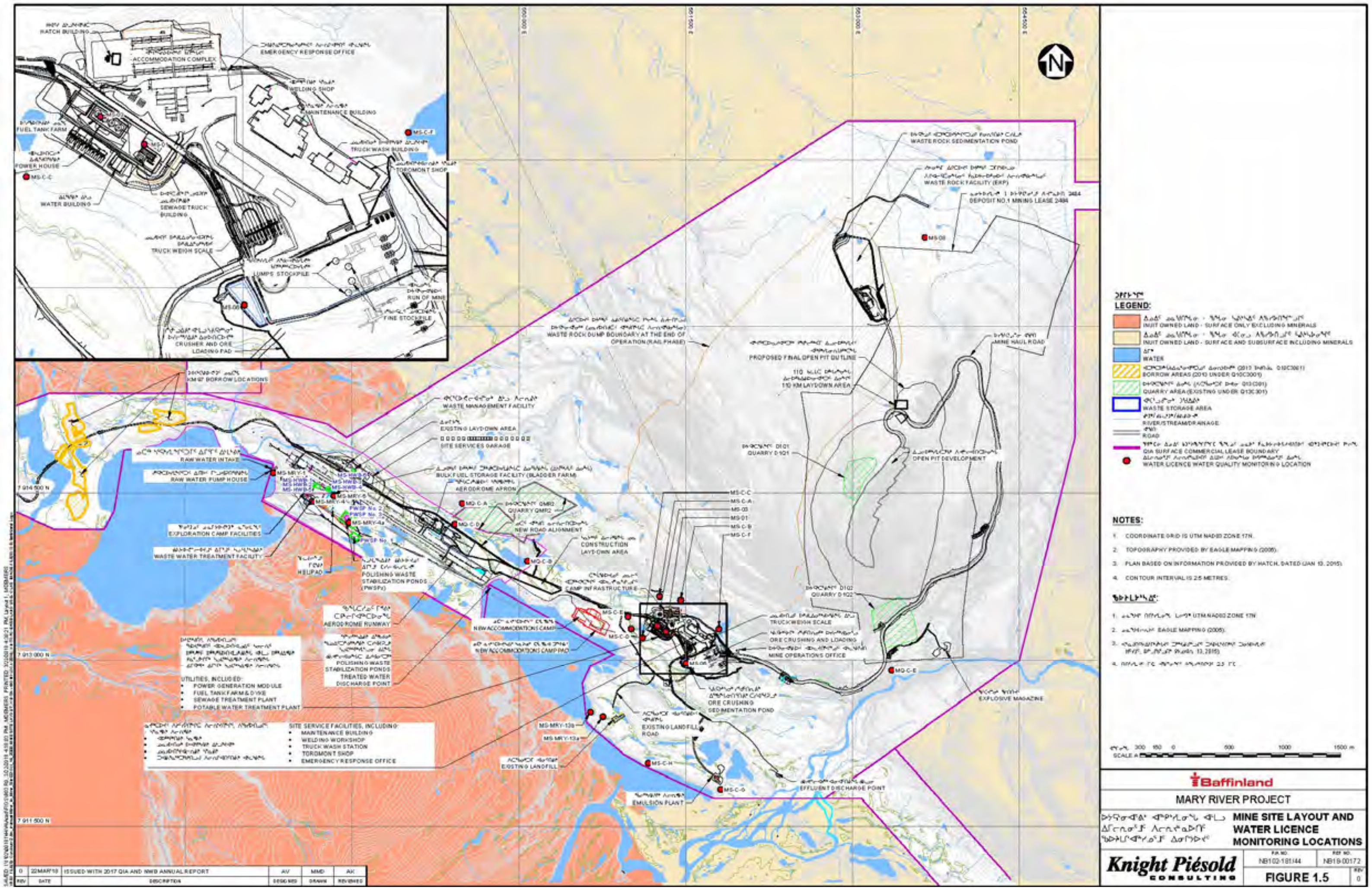

Figure 9.3 **Mary River Mine Site Plan**

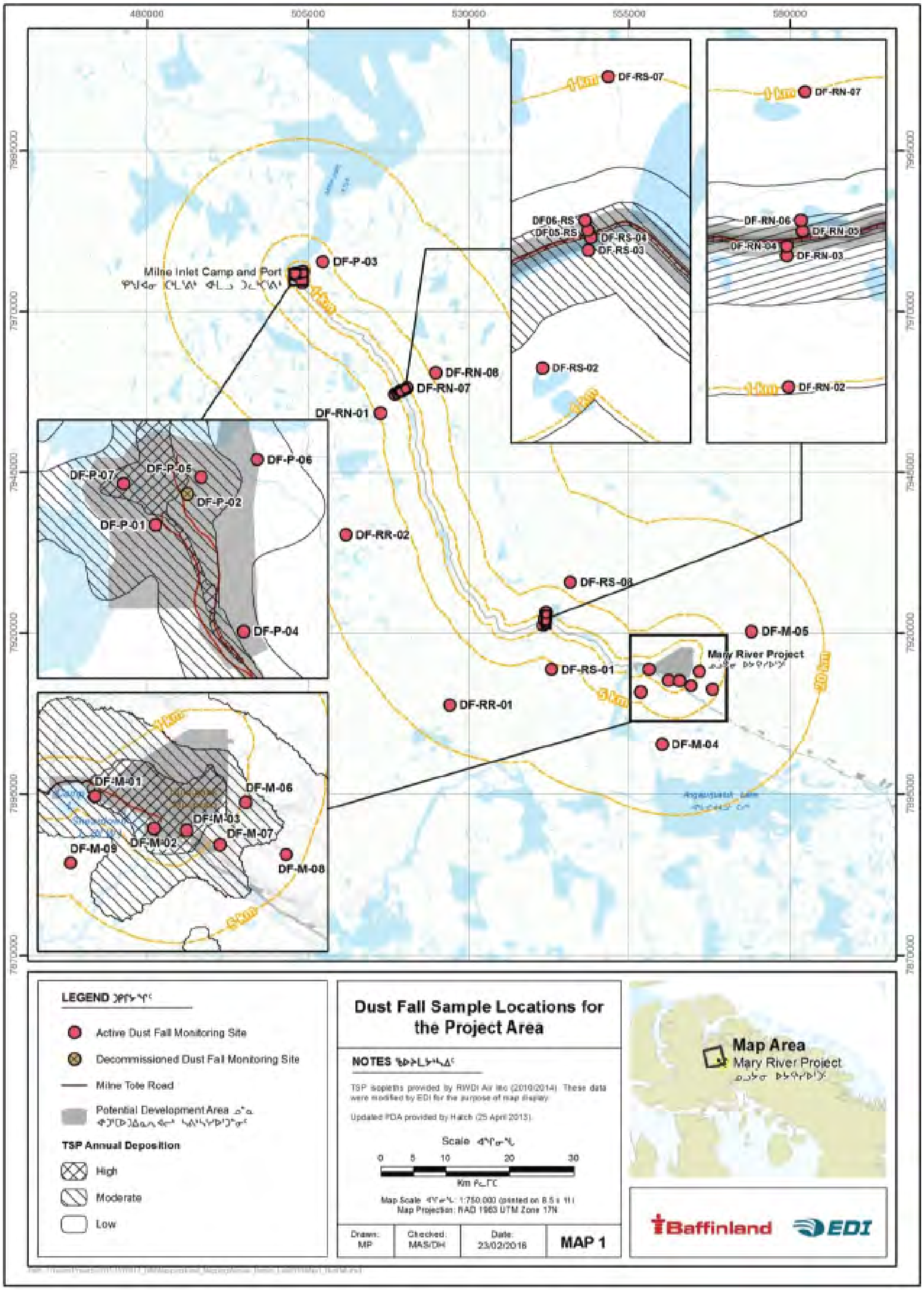

Figure 9.4 Dust Fall Sample Locations for the Project Area

It is expected that sampling of the revised, approved locations will take place up to three (3) time per year, during open water season. It is during these annual sampling events, that sampling personnel will identify and document any suspected cases of physical or geotechnical instability of lands and structures remaining on site as described in Section 9.4.

Aquatic monitoring at Post-Closure will be conducted in Years 4-6 at water crossings along Tote Road to verify the closure criteria are met in these watercourses.

Baffinland will report on its Closure and Post-Closure Aquatic Monitoring and Reporting Program on an annual basis to the NIRB (as per Project Certificate No. 005 and its Amendment), the NWB (as per Type 'A' Water Licence 2AM-MYR-1325), AANDC Land Lease 47H/16-1-2, and the Land Owners (as per Commercial Lease Q13C301).

9.5.1 Environmental Effects Monitoring Program (EEM)

Mandated by the Metal and Diamond Mining Effluent Regulations, Schedule 5, the EEM Program focuses on determining if the discharge of mine contact water to the receiving environment will result in adverse environmental effects on the receiving streams and water bodies. This program will be carried out throughout mining, and as the locations of the mine contact water will not change after Final Closure (i.e., open pit water discharge, and, waste rock stockpile runoff discharge), it is expected the EEM component of the AEMP will remain relatively unchanged until Baffinland has achieved the "Recognized Closed Mine" status under Section 4 of the MDMER. Procedures for EEM monitoring are detailed in the existing AEMP including sampling locations, number of samples for each location, frequency of sampling and methods of interpretation.

Baffinland expects to conduct the EEM Program annually during Final Closure activities (Year 0 to 2) as required by the MDMER. This timeline would satisfy MDMER in order to achieve "Recognized Closed Mine" status, with the exception of the Open Pit. A modified EEM program would likely be designed through discussions with regulators to satisfy the delayed discharge via the Open Pit spillway, which built on the completed work at the Waste Rock Stockpile that can commence as soon as mining reaches 10% designed production capacity. Years 16-18 have been allocated conservatively to complete remaining EEM requirements for mine effluent at site.

Baffinland will report on any new EEM Program results on an annual basis to the NIRB (as per Project Certificate No. 005 and its Amendment), AANDC Land Lease 47H/16-1-2, the NWB (as per Type 'A' Water Licence 2AM-MYR-1325) and the Land Owners (as per Commercial Lease Q13C301).

9.5.2 Core Receiving Environment Monitoring Program (CREMP)

The CREMP focuses on follow-up monitoring to validate predictions to aquatic valued ecosystem components (VECs) and key indicators. As a component study of the AEMP, the CREMP evaluates potential mine-related influences on water quality, sediment quality, and/or biota (including phytoplankton, benthic invertebrates and/or fish) within aquatic environments near the Mine Site. Water and sediment quality monitoring programs, incorporating benchmarks derived from the Canadian Water Quality Guidelines for Protection of Freshwater Aquatic Life (CWQG-PAL), established by the Canadian Council of Ministers of the Environment (CCME), and baseline data, are performed on receiving aquatic environments near the Mine Site, including the Camp Lake, Sheardown Lake, Mary Lake Systems as well as Reference Lake 3 and various reference tributaries.

Baffinland expects to conduct the CREMP during care and maintenance (Year 0), as well as annually during Final Closure activities (Year 1 to 3) to assess whether component-specific closure criteria are met. Post Closure monitoring would then be conducted the first three years following completion of Final Closure activities (Years 4 to 6) and the Years 7, 8 and 18 at the Mine Site to confirm closure objectives are met

Baffinland will report on any new CREMP results on an annual basis to the NIRB (as per Project Certificate No. 005 and its Amendment).

9.5.3 Lake Sedimentation Monitoring Program

A Lake Sedimentation Monitoring Program is also performed annually under the AEMP and monitors dust and sediment deposition rates in Sheardown Lake NW to evaluate potential mine-related influences on biota (e.g. fish larvae hatching success). Annual monitoring reports for the Lake Sedimentation Monitoring Program further discuss the methods used and annual monitoring results and are provided as appendices to the Qikiqtani Inuit Association (QIA) and Nunavut Water Board (NWB) Annual Reports, required under Baffinland's Type A Water Licence and Commercial Lease with the QIA.

Baffinland expects to conduct the Lake Sedimentation Monitoring Program annually during Final Closure activities (Year 1 to 3) to assess whether component-specific closure criteria are met.

9.6 Environmental Site Assessment

An Environmental Site Assessment will be conducted at the onset of closure for areas that are expected to be contaminated with hydrocarbons or chemicals. Soil materials found to exceed the appropriate cleanup criteria for hydrocarbons (based on CCME contaminated sites guidelines or site-specific risk-based criteria) will be remediated onsite in the landfarm units, removed offsite to a licensed waste management facility, or the risk will be managed using site controls (e.g. covers).

The objective of the Environmental Site Assessments will be to determine areas of focus for final closure activities and to demonstrate conformance with CCME contaminated sites guidelines or site-specific risk-based criteria at the Mine Site, Milne Port, Tote Road and Steensby Port.

If not already done so, in the year prior to Final Closure activities (Year 0), Baffinland will commission a confirmatory sampling program at project sites to help determine adequacy of Final Closure activities' ability to meet closure criteria. Based on results, closure activities will be modified accordingly to ensure closure objectives are met. The year following completion of closure activities (Year 4), a second Environmental Site Assessment of project sites will be conducted to confirm CCME contaminated sites guidelines or site-specific risk-based criteria have been met. If results indicate CCME contaminated sites guidelines or site-specific risk-based criteria have not been met, additional closure activities will be performed as necessary to ensure closure objectives are achieved.

If there is reason to suspect an area of soil has been contaminated by chemicals other than hydrocarbons (such as explosives), samples will be collected, and the soil will be tested. If the applicable regulatory requirements are exceeded, an appropriate method of disposal will be sought in consultation with the appropriate authorities.

Baffinland will report on any new Environmental Site Assessment and/or Human Health and Ecological Risk Assessment (HHERA) results on an annual basis to the NIRB (as per Project Certificate No. 005 and its Amendment), AANDC Land Lease 47H/16-1-2, the NWB (as per Type 'A' Water Licence 2AM-MYR-1325) and the Land Owners (as per Commercial Lease Q13C301).

9.7 Terrestrial Environment Monitoring and Reporting

The Terrestrial Environment Monitoring and Reporting program will occur during temporary care and maintenance (Year 0), and during closure activities (Years 1-3). Terrestrial environment monitoring during closure includes vegetation monitoring (exotic invasive vegetation) and caribou movement monitoring. Other monitoring programs such as vegetation health, migratory bird, and caribou habitat monitoring will continue during active closure as well, but may be discontinued during post closure, based on monitoring results to date.

The objective of the Terrestrial Environment Monitoring and Reporting program will shift focuses slightly from the operational project phase to determine if Project areas encourage the desired re-growth of vegetation and wildlife movement upon completion of Final Closure activities. Given the long operational period, effects monitoring programs will diminish quickly in scope post-closure. As noted in Section 2.4, Baffinland intends to establish a Mine Closure Working Group and Baffinland expect this Mine Closure Working Group to help drive desired wildlife movement and passive re-vegetation considerations upon completion of Final Closure activities.

Baffinland expects to resume the Terrestrial Environment Monitoring and Reporting program the second year following completion of closure activities (Year 5) incorporating lesson learned from Operations. This schedule was determined to allow for a one (1) year wildlife/vegetation activity normalization period between active Final Closure activities and Post-Closure monitoring activities to help ensure an accurate representation of abandonment conditions. A follow up monitoring program is planned in Year 7.

The Terrestrial Environment Monitoring and Reporting program is expected to be a focused program that's main objective will be develop evidence of use or occupation of key indicator species in the avian and terrestrial environment for the Project area (visual sighting of species, bones, antlers, tracks, and trails, etc.). It is expected to be conducted by a team of two (2) experts for no more than two (2) weeks accompanied by an associated Bear Monitor. Baffinland will evaluate the re-vegetation of rehabilitated areas and conduct an invasive species assessment. Results of the Terrestrial Environment Monitoring and Reporting period in Year 5 are anticipated to be confirmed using a similar, second period two (2) years after the first, in Year 7.

The Mary River Project FEIS assessed there to be negligible adverse residual effects post-closure to fauna and flora. Post-closure, the loss of vegetation will be reversed with natural re-vegetation and the residual effects on fauna species will gradually lessen with time as the project areas are naturally re-vegetated. The risk of invasive plant species colonizing the area is expected to be negligible, however, it will be monitored post-closure.

Baffinland will report on any new Terrestrial Environment Monitoring and Reporting g program results on an annual basis to the NIRB (as per Project Certificate No. 005 and its Amendment), AANDC Land Lease 47H/16-1-2, the NWB (as per Type 'A' Water Licence 2AM-MYR-1325) and the Land Owners (as per Commercial Lease Q13C301).

9.8 Marine Environment Monitoring and Reporting

Discharges to the marine environment will be captured under the Closure and Post-Closure Aquatic Monitoring and Reporting Program (Section 9.5).

The MEWG will be functioning during the life of the Project to continually evaluate if there are any residual effects from Project activities on the marine environment at the Port. Based on current information that suggest effects on marine mammals is related to ship interaction, it is anticipated that there will be no significant residual effects at closure on the marine environment when ship interaction is removed. As long as shipping activity is occurring during closure, marine monitoring and reporting in place during operation will continue, as outlined in the Shipping and Marine Wildlife Management Plan and Marine Environmental Effects Monitoring Plan at the time of closure. If operational monitoring indicates that the prediction of no significant residual effects at closure on the marine environment may be inaccurate, additional Post-Closure Marine Monitoring will be evaluated in the light of this new information.

9.9 Safety Compliance Inspection

The objective of the Safety Compliance Inspection will be to determine if project components are closed and reclaimed in compliance with the Northwest Territories (NT) and Nunavut (NU) *Mine Health and Safety Act* and Regulations, and the *Explosives Use Act* and Regulations. The Safety Compliance Inspection will be conducted by an Engineer/Inspector of Mines under the direction of the Chief Inspector of Mines working on behalf of the Workers' Safety and Compensation Commission (WSCC) of the Northwest Territories and Nunavut. Inspection frequency and scope will be established at the discretion of the Chief Inspector of Mines in consultation with Baffinland.

Baffinland will report on any Safety Compliance Inspection results on an annual basis to the NIRB (as per Project Certificate No. 005 and its Amendment), AANDC Land Lease 47H/16-1-2, the NWB (as per Type 'A' Water Licence 2AM-MYR-1325 and its Amendment) and the Land Owners (as per Commercial Lease Q13C301).

9.10 Socio-economic Reporting

As per condition 149 of the Project Certificate No. 005, Baffinland published a Closure Scenario Report in September 2014 and submitted it to the Nunavut Impact Review Board (NIRB). The report examines the potential socio-economic and cultural impacts closure may have on Inuit employees and analysis of the risk of temporary and permanent mine closure.

Socio-economic and monitoring during closure will be governed by the following legislative drivers and agreements:

- The *Nunavut Labour Standards Act*
- Human Resources Skills and Development Canada's (HRSDC) Employment Insurance Regulations
- The Nunavut Agreement on Labour Market Development
- Canada-Nunavut Labour Market Agreement
- Inuit Impact and Benefit Agreement between the Qikiqtani Inuit Association and Baffinland

In the event of permanent layoffs due to closure, under the Canada-Nunavut Agreement on Labour Market Development, Baffinland will engage with the Government of Nunavut to establish a Labour Market Partnership with the aim to develop and implement strategies for dealing with labour force adjustments. Under the Partnership Program a Joint Labour Adjustment Committee would be established to assist affected employees, a primary step being conducting a Needs Assessment to determine what labour adjustment issues have been addressed and determine appropriate programming required (e.g., job-search assistant, resume preparation, vocational counseling). Baffinland will also draw the on the expertise of the Mining Industry Human Resources Council (MiHR) who has developed a Mining Workforce Transition Kit that may address the specific needs of employees and their communities.

Socio-economic reporting, as required by the Project Certificate and in accordance with articles of the Inuit Impacts and Benefits Agreement, will be reported on in the Annual Report to the Nunavut Impact Review Board and the Implementation Report for the IIBA for the life of the project.

9.11 Air Quality Monitoring and Reporting

During reclamation activities (e.g., construction/regrading), air quality monitoring and reporting will be consistent with operations, occurring across the entire site, as outlined in the Air Quality and Noise Abatement Management Plan. Air quality data will be collected via active TSP, SO_2, NO_2 sampling and passive sampling for dustfall, including metal deposition. As no one area of the mine will close substantially within the 3-year closure construction period, site-wide post-closure ambient air quality monitoring will be executed following closure. As all the major impacts are removed, only 1 year of post-closure monitoring is planned to confirm ambient levels of TSP, $PM_{2.5}$, SO_2 and NO_2 are within the closure criteria (NU standards).

Baffinland expects to continue this monitoring during the first year of post closure activities (Year 4). TSP and $PM_{2.5}$ were selected as particulate matter poses health concerns due to their ability to be inhaled and accumulate in the respiratory system. Small particulate matter (e.g., $PM_{2.5}$) also has the ability to behave in the atmosphere like a gas and due to is small particle size, can disperse over greater distances than larger sized particulates before deposition.

Emissions of nitrogen oxides and sulphur oxides (i.e., NO_x and SO_x) are generated by fuel combustion in both stationary and mobile equipment. It should be noted there are negligible residual effects expected during post-closure as the primary sources of dust will no longer be in operation. During post-closure, stationary and mobile equipment will no longer be in use, with few exceptions such as truck traffic during monitoring programs. Accordingly, NO_x and SO_x emissions are expected to be negligible. However, to demonstrate that ambient conditions are below the criteria stated in the Environmental Guideline for Ambient Air Quality, Department of Environment, Government of Nunavut, October 2011 (200 $\mu g/m^3$ 24 hr average for nitrogen dioxide and 150 $\mu g/m^3$ 24 hr average for sulphur dioxide), a post-closure monitoring program consisting of up to five (5) sample locations using BAM-1020 or similar with a remote data logger for a period of not more than one (1) month during summer months is expected. Monitoring will be focused on locations identified through operational experience as having particulate emissions higher than other areas.

As indicated respectively by project component in Table 5.1, if Air Quality Monitoring program results demonstrate Mean TSP concentrations less than the risk-based criteria developed in consideration of the NU Ambient Air Quality Standard are met, the project component will be considered to have met the associated closure objectives. Dust deposition has been identified as a potential concern for the health of vegetation and wildlife, however, no residual effects of the Project on caribou health are anticipated due to metal exposure from dustfall. Most dustfall will be associated with the Mine Site and the primary metals are relatively innocuous to caribou (FEIS, Volume 6, Section 5.2.4). The potential effects of metals on plants either from aerial deposition or uptake from soils are highly dependent on site-specific conditions and the plant species themselves. Thresholds have not been developed for dust effects on plants, and the literature acknowledges a lack of data of effects of atmospheric emissions and its effects on Arctic vegetation, leading to uncertainty in effects predictions. In an effort to further address this uncertainty, Baffinland is undertaking additional reclamation research on natural re-vegetation to better understand reclamation options. A dustfall monitoring program is being conducted to confirm project related activities will have a not significant effect on vegetation.

10 FINANCIAL SECURITY

Closure and reclamation costs for the Mary River Project are determined under the Annual Security Review (ASR) process conducted in accordance with Schedule C of the Type "A" Water Licence Amendment No. 1 2AM-MRY1325 and Commercial Lease No. Q13C301. Under the ASR process, Baffinland, the respective landowners (QIA & the Crown), the NWB, and other interested parties confer to determine the estimated closure and reclamation costs for an upcoming year on an annual basis. This approach allows for Baffinland to post financial security in incremental adjustments prior to the commencement of work. Publicly available ASR document submissions for a respective year, describing in detail, annual estimated closure and reclamation costs, can be downloaded from the NWB FTP site at: ftp.nwb-oen.ca, with Username: "public", and the Password: "registry", without the quotes.

10.1 Preliminary Mine Closure and Reclamation Plan Costs

Prior to commencement of the ASR process, which is the current overriding process to determine Project closure and reclamation costs, Baffinland's estimated closure and reclamation costs were established and outlined in the Preliminary Mine Closure and Reclamation Plan (Rev D, H337697-0000-07-126-0014) which was submitted as part of the Mary River Project FEIS (FEIS Appendix 10G). Estimated costs and assumptions were made based on project design and costs available at the time of development using the Mining RECLAIM spreadsheet provided by Aboriginal Affairs and Northern Development Canada (AANDC). Details used to develop the Preliminary Mine Closure and Reclamation Plan (PCRP) Closure and Reclamation Cost Estimate are available within PCRP, Appendix B and C, and are summarized in the Section 10.1.2 for information purposes.

10.1.1 Addendum to PCRP Closure and Reclamation Cost Estimate

An addendum to the PCRP Closure and Reclamation Cost Estimate has been developed to support the Type 'A' Water License 2AM-MRY1325 amendment process for 2015. This addendum has been made using current and updated estimated closure and reclamation costs, established through the ASR process, for Milne Port and the Tote Road aggregated with estimated closure and reclamation costs for Mary River Mine Site, the Railway and Steensby Port that were presented in Baffinland's original submission of the PCRP in February 2012. The purpose of this addendum is to incorporate consideration of Baffinland's ERP to support the Type "A" Water License 2AM-MRY1325 amendment process. Details of the results of this process can be found in the following document: *Final Environmental Impact Statement (FEIS) Closure and Reclamation – Financial Security Estimate Addendum, H349001-0000-07-220-0001.*

Baffinland notes that the *Final Environmental Impact Statement (FEIS) Closure and Reclamation – Financial Security Estimate Addendum, H349001-0000-07-220-0001* does not override the ASR process and the ASR is still the governing process to determine reclamation financial security.

10.1.2 Summary of PCRP Closure and Reclamation Cost Estimate

The PCRP Closure and Reclamation Cost Estimate was developed using the Mining RECLAIM spreadsheet (ver 6) provided by Aboriginal Affairs and Northern Development Canada (AANDC) (formerly Department of Indian Affairs and Northern Development). The Mining RECLAIM spreadsheet model identifies several reclamation components:

- Open pit
- Waste Rock pile
- Buildings and Equipment
- Chemicals
- Water
- Mobilization
- Post Closure
- Ongoing water monitoring

Several reclamation strategies (“Objectives”) were listed for each component, and broken down into lists of actions that were priced separately. A unit cost spreadsheet provided a range of prices for actions which was completed where possible with the most accurate available or Project-specific costs at the time of estimate. To best estimate the total reclamation cost, some actions were modified or adapted to the strategies defined in the PCRP. The financial cost obtained was based on the information available at the time of publishing. Several assumptions and estimations have been made and are described in Appendix D of the PCRP. To make up for uncertainties, the highest prices of the range provided by the MINING RECLAIM unit costs spreadsheet were systematically chosen.

It should be noted this estimate of the financial cost of final closure and reclamation measures required for the fully developed Project as described in the original Mary River Project FEIS. It addresses Project-related activity areas and infrastructure related to the original the Project proposed in the FEIS including mobilization and post-closure monitoring. This estimate was intended to represent Baffinland’s estimated closure and reclamation security for the Project, based on the information available at the time, at a planned closure scenario occurring at end of mine life.

10.1.2.1 Final Mine Closure Cost

MINING RECLAIM calculated the grand total capital costs required for the Project closure and reclamation. The cost was split into land and water liability. Additionally, the cost associated to Inuit Owned Land (IOL) and federal owned (Crown Land) was differentiated from north to south and therefore Milne Port, Tote Road, Mine Site, and the first 25 km of the Railway were attributed to IOL. The remaining section of the Railway and Steensby Port are located on federally owned land and were attributed to Crown Land. Costs relating to the infrastructure, equipment and remediation actions on these sites were attributed to the corresponding category. Less tangible components, such as chemicals and soil management, water management and post-closure monitoring and maintenance were attributed on a basis of two thirds (2/3) to IOL and one third (1/3) to Crown Land. This was based on two of the main sites (Milne Port, Mine Site) being in IOL and one site (Steensby Port) located in Crown Land.

The Ultimate Project closure and reclamation cost, at the time of estimate, was $518,711,208. The break down between land and water liability and IOL/Crown Land is presented in Table 10.1.

Table 10.1: Total Cost and Breakdown for Mary River Project Closure and Reclamation

	Total Cost	Percentage	Land Liability	Water Liability
Inuit Owned Land	$411,234,800	79.2	$405,430,454	$6,106,421
Federal Owned Land	$107,476,408	20.7	$105,391,574	$2,160,637
Total	$518,711,208	100	$510,822,029	$8,267,058

10.2 Total Financial Security Posted

Table 10.2: Summary of Security Amounts Posted Under the Commercial Lease and Water Licence for the Period 2013-2018

	2013	2014	2015	2016	2017	2018
Inuit Owned Land and/or Water	$26,200,000	$39,793,000	$47,517,500	$48,845,50	$51,384,000 $64,642,000*	$83,709,271
Crown Land and/or Water	$9,800,000	$166,000	$166,000	$1,210,000	$1,298,555	$1,298,555
Total	$36,000,000	$39,959,000	$47,683,500	$50,055,500	$52,682,555 $65,940,500*	$85,007,826

*This additional security was posted to reflect a mid-year Addendum to the 2017 Workplan that affected the security requirements under the BIMC-QIA Commercial Lease but not under the Water Licence.

11 CONCORDANCE TABLES

Table 11.1 has been prepared to demonstrate conformity of the ICRP with the MVLWB/AANDC, Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories, November 2013. The concordance table and ICRP have been structured to be consistent with the 'template' provided in pages 31 to 42 of the Guidelines.

Table 11.1: Conformity Assessment of the CIRNAC Guidelines to the ICRP

CIRNAC Guideline	ICRP Section
1.0 Plain Language Summary i. Plain language summary of CRP, with key aspects of current plan, major uncertainties and how they will be addressed, and differences from previous plans	Section 1
2.0 Introduction i. Purpose and scope of the closure and reclamation plan as it relates to Boards' requirements, previous versions of CRP, expectation of stakeholders. Approval dates of previous CRPs	Section 2.1
ii. General project description, description of proponents, spatial and temporal extent of project	Section 2.1
iii. Status of plan (e.g. interim CRP, final CRP, etc.)	Section 2.3.1
iv. Goal of the closure and reclamation plan.	Section 2.2
v. Identify closure and reclamation planning team. Describe, list or show important internal/external organizational relationships and specific responsibilities that facilitate/manage closure and reclamation	Section 2.3
vi. Outline approach to engagement, how they have or will integrate local community values into the CRP, strategies for engaging communities in CRP development and implementation	Section 2.4
vii. Identify relevant regulatory authority and existing/required permits, authorizations, agreements related	Section 2.5
viii. Conformance table showing where CRP satisfies applicable licences/permits. List of additional standards/guidelines to be followed	Section 11
3.0 Project Environment i. Overview of pre-disturbance atmospheric environment (e.g. climate, temperature, precipitation, air quality), including maps, tables, figures	Section 3.1
ii. Overview of pre-disturbance physical (terrestrial) environment (e.g. physiography, geology, permafrost, geological hazards, hydrogeology), including maps, tables, figures	Section 3.2
iii. Overview of pre-disturbance chemical environment (e.g. soil/sediment chemistry, surface water/groundwater quality, ARD and metal leaching potential), including maps, tables, figures	Section 3.2
iv. Overview of pre-disturbance biological environment (e.g. vegetation, aquatic life, terrestrial wildlife, avifauna, overall ecosystem), including maps, tables, figures	Section 3.3.3
4.0 Project Information i. Site location, regional and local context of affected areas, access points and methods of access, including maps and photos	Section 4.1
ii. History of ore discovery, exploration, previous development and operations, ownership changes, summary of application, permitting, and licencing process to date	Section 4.2

CIRNAC Guideline	ICRP Section
iii. Description of site geology, mining resource, extraction methods and rational for footprint and specific target areas, including maps, figures, tables	Section 4.3
iv. Project summary, including life of mine plan through closure and reclamation and various options proposed from EA	Section 4.4
v. List of all project components	Table 4.1
5.0 Permanent Closure and Reclamation i. Definition of permanent closure and reclamation	Section 5.1
ii. Indicate components that may require passive long-term care and expected timelines for relinquishment	Section 5.1.1
iii. Description of project components, including details (e.g. dimensions, footprint, relative locations on map), lifespan and current status, with supporting maps, figures, photos.	Section 5.2 (Sections 5.2.X.1)
iv. Description of pre-development, existing, and projected final site conditions using maps, photos, figures as appropriate. Illustrate relevant water bodies, topographic modifications, and vegetation changes. Identify important/unique environmental conditions with bearing on closure.	Section 5.2 (Sections 5.2.X.2)
v. List of closure objectives and criteria for each component, with any uncertainties noted with reference to the associated reclamation research plan	Table 5.1
vi. Alternatives analysis of various closure options with clear demonstration of pros and cons, risk scenarios and unique/novel closure situations for the specific component.	Section 5.2 (Sections 5.2.X.4)
vii. Selection of preferred closure activity with rationale for selection/rejection of others	Section 5.2 (Sections 5.2.X.4)
viii. Description of engineering work (e.g. demolition, construction) necessary for selected closure activity, with supporting information for proposed work to prove proposed technology or engineering will be successful	Section 5.2 (Sections 5.2.X.5)
ix. Assessment of potential negative residual effects remaining after completion of reclamation. Provide results of risk assessments and discuss how any predicted residual effects compare to stakeholders' preferences and or to company's commitments made during EA.	Appendix G
x. Identify uncertainties associated with the risks of various closure options and how to select the best closure activity, how to best implement a selected closure activity, how to define closure criteria, how Traditional Knowledge will inform closure planning and more. Include how each uncertainty will be addressed (reclamation research, engineering study plan, etc.).	Section 5.2 (Sections 5.2.X.7)
xi. Description of what post closure monitoring will occur (e.g. fugitive dust, stream flow, wildlife and aquatic life movement etc.) and why, including sampling locations, frequencies, duration, maintenance activities, methods of reporting	Section 5.2 (Sections 5.2.X.8), Section 9
xii. List of possible contingencies should closure activity not be successful in meeting closure criteria and objectives, with identification of preferred contingency with rationale	Section 5.2 (Sections 5.2.X.9)
6.0 Progressive Reclamation i. Definition of progressive reclamation	Section 6.1
ii. Opportunities for progressive reclamation during life of the project, including location, aerial extent of work, description of planned reclamation activities and any planned/required monitoring	Section 6.2

CIRNAC Guideline	ICRP Section
iii. Summary and location of completed progressive reclamation activities, including a list of reports detailing any reclamation that has occurred, and any lessons learned that will inform closure planning	Section 6.3
7.0 Temporary Closure i. Closure goal and closure objective of temporary closure	Section 7.1 and 0
ii. Selected temporary closure activities for each project component (must include minimum activities identified by MVLWB guidelines)	Section 7.1 and 0
iii. Monitoring activities during temporary closure	Section 7.2 and 7.3
iv. Contingencies for unforeseen events/conditions during temporary closure if response different from normal operations, including effects on any monitoring activities and plans to address any effects	Section 5.2 (Sections 5.2.X.9)
v. Temporary closure schedule, including anticipated timing/sequence of events, description of temporary closure activities for each component, duration and approximate end date of closure period	Section 7.1 and 0
8.0 Integrated Schedule of Activities i. Component-specific schedule depicting operations, closure dates, and expected start and end times for selected closure activities, including progressive reclamation, initiation and completion of research, timeframes for meeting closure criteria and monitoring and reporting phases	Section 8
ii. Description of schedule uncertainties	Section 8
9.0 Post-Closure Site Assessment i. Description/study design of post-closure impact assessment	Section 9, See also Appendix G
10.0 Financial Security i. Estimates of total liability of permanent closure (including post-closure monitoring programs and activities)	Section ▯
ii. Cost breakdown for each project component	Section 10.1.1 and ASR documentation
iii. Match estimate with timing of closure and reclamation activities	Section 10.1.1 and ASR documentation
11.0 References i. List of documents/reports that support characterization of baseline environmental data, geochemical analyses and predicted ML/ARD potential, and relevant engineering work related to support the CRP	Section 13
Appendix A – Glossary of Terms and Definitions i. Plain language explanation of discipline specific technical terms and key closure and reclamation planning terms	Section 12.1
Appendix B – List of Acronyms, Abbreviations, Units, and Symbols	Section 12.2
Appendix C – Record of Engagement i. Table outlining all completed engagement specific to closure, including issues identified by engaged parties and how company has addressed them	Appendix E
Appendix D – Lessons Learned from Other Projects i. Summary table of relevant on-site closure issues/concerns dealt with at other projects, the completed activity, lessons learned and application to managing project closure and reclamation	Appendix F
Appendix E – Reclamation Research Plans i. Reclamation research plans required to address uncertainties. Plans should describe the	Appendix D

CIRNAC Guideline	ICRP Section
uncertainty, research/study objective, overview of tasks, linkages to other research/studies, project research schedule, costs and references.	

Table 11.2 has been prepared to characterize the content of the ICRP and updated with reference to this ICRP. The concordance table is consistent with the principles of the Qikiqtani Inuit Association (QIA) Abandonment and Reclamation Policy for Inuit Owned Lands ('the Policy') and structured in accordance with Appendix C of the QIA Security Policy (v3).

Table 11.2: QIA Abandonmenta and Reclamation Policy for Inuit Owned Lands Concordance Table

Item	QIA Abandonment and Reclamation Policy for Inuit Owned Lands (v3)	Baffinland Response
1	Have **all** reports and plans including addendums and responses been submitted?	Yes
2	Are the submitted reports and plans executable standalone documents with adequate rational and detail?	Yes
3	Do all reports and plans contain appropriate referencing (document name, author, section, and page number) to **all** supporting information?	Yes
4	Do the reports and plans demonstrate a firm understanding, of QIA's *Guiding Principles on Reclamation* and provide rationale on how these principles have been satisfied?	Yes
5	Has IQ and consultation with Community Land and Resources Committee(s) been applied? Has the Tenant provided detailed community consultation records?	Closure and reclamation issues discussed at hearings related to the Project Certificate. Commitment to Mine Closure Working Group in the future to incorporate community input and IQ.
6	Are **all** the components that are considered in the abandonment and reclamation plan listed?	Yes
7	Does each component of the Project have an abandonment and reclamation objectives and criteria?	Yes
8	Has an A&R plan been provided with a financial security estimate?	Yes. Financial security estimate is conducted in accordance to Section 9.2 of Commercial Lease, No. Q13C301

Item	QIA Abandonment and Reclamation Policy for Inuit Owned Lands (v3)	Baffinland Response
9	Have Table 1, 2, 3 and 4 of Appendix B been used in completing the financial security estimate?	Yes – was adapted to suit project specific requirements.
10	Has evidence been provided to support the Policy assumptions for all reports and plans?	Yes

Table 11.3 has been prepared to show all the Project Certificate No. 005 commitments outlined in Appendix A of the Project Certificate that apply to this ICRP. Where the Project Certificate Terms and Conditions have requirements for Construction, Operations, Temporary Closure/Care and Maintenance, Closure and Post Closure Monitoring the requirements are dealt with by a current Management Plan that will be updated regularly throughout the life of the Project. These Management Plans will still be applicable during Closure and, as necessary, Post Closure Monitoring, however an initial post closure monitoring program has been outlined in this document to tie residual effects and proposed Post Closure Monitoring.

Table 11.3: NIRB Project Certificate Term and Conditions Concordance Table

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
2	Meteorology and Climate – Climate Change Validation and Studies	To provide feedback on the impacts that climate change might be having on the Project.	The Proponent shall provide the results of any new or revised assessments and studies done to validate and update climate change impact predictions for the Project and the effects of the Project on climate change in the Local Study Area and Regional Study Area as defined in the Proponent's Final Environmental Impact Statement.	1 – Climate Change	None planned at this time however any research conducted during Closure and Post-Closure Phases will be provided during Annual Reporting.	Both	Section 9.11
3	Meteorology and Climate – Green House Gas Emissions	To confirm that the Proponent is exploring and implementing concrete steps to reduce greenhouse gases.	The Proponent shall provide interested parties with evidence of continued initiatives undertaken to reduce greenhouse gas emissions.	1 – Climate Change	Air Quality Monitoring Program. Results of Closure Phase Air Quality Monitoring Program and any other initiatives taken to reduce greenhouse gas emissions during Closure and Post-Closure Phases will be provided during Annual Reporting.	Both	Section 9.11
4	Climate Change – Consultation on Climate	To promote public awareness and engagement of affected groups.	The Proponent shall endeavor to include the participation of Inuit from affected communities and other communities in Nunavut when undertaking climate-change related studies and research.	1 – Climate Change	Air Quality Monitoring Program Mine Closure Working Group	Both	Section 9.11 Section 2.4
5	Meteorology and Climate – Weather Monitoring Data	To provide families of employees with up to date information.	The Proponent shall endeavour to explore and implement reasonable measures to ensure that weather-related information for the various Project sites is readily accessible to the public on a continual basis throughout the life of the Project.	2 – Air Quality	Air Quality Monitoring Program. Results of Closure Phase Air Quality Monitoring Program will be provided during Annual Reporting	Both	Section 9.11

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
6	Meteorology and Climate – Emissions	To provide feedback on the Project's emissions.	The Proponent shall provide the results of any emissions calculations conducted to determine the level of sulphur dioxide (SO_2) emissions, nitrogen oxide (NOX) emissions and greenhouse gases generated by the Project using fuel consumption or other relevant criteria as a basis.	2 – Air Quality	Air Quality Monitoring Program	Both	Section 9.11
11	Air Quality – Incineration Management Plan	To mitigate impacts to air quality from incineration activities.	The Proponent shall develop and implement an Incineration Management Plan that takes into consideration the recommendations provided in Environment Canada's Technical Document for Batch Waste Incineration (2010).	2 – Air Quality	Waste Management Plan (carried over from Operations) will apply when incinerators in operation	Both	Section 5.2.7
14	Noise and Vibration – Noise and Vibration Monitoring	To mitigate noise and vibration at Project sites, especially living areas.	The Proponent shall conduct noise and vibration monitoring at Project accommodations sites located at the Mary River mine site, Steensby Inlet Port site, and Milne Inlet Port site. Sampling shall be undertaken during the summer and winter months during all phases of Project development.	3 – Noise and Vibration	Considered, however no monitoring proposed during closure and negligible residual effects expected.	Both	N/A
15	Noise and Vibration	To enhance public safety when travelling around the Project area.	Noise and Vibration Monitoring – The Proponent shall collaborate to the extent possible with the Qikiqtani Inuit Association and local Hamlet organizations when undertaking consultation with all affected communities regarding railway, tote road and marine shipping operations. During these consultations, it is recommended that the Proponent provide information including video, audio, and photographic representation as well as any other aids (i.e. models) that may enhance the general public's understanding of railway, tote road and marine shipping	3 – Noise and Vibration	When undertaking consultation with all affected communities, collaboration with the Qikiqtani Inuit Association and local Hamlet organizations performed via Mine Closure Working Group sessions.	Both	Section 2.4

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
			operations, as well as all safety considerations for members of the public who may be travelling around the project area.				
17	Hydrology and Hydrogeology – Effluent Management	To prevent impacts to water bodies from effluent.	The Proponent shall develop and implement effectives measures to ensure that effluent from project-related facilities and/or activities, including sewage treatment plants, ore stockpiles, and mine pit, satisfies all discharge criteria requirement established by the relevant regulatory agencies prior to being discharged into the receiving environment.	8 – Water Quality	Aquatic Monitoring and Reporting Program Environmental Effects Monitoring Program	Both	Section 9.5 Section 9.3.1
18	Hydrology and Hydrogeology – Pit Lake Monitoring	To enhance predictions for mine site closure conditions.	The Proponent shall carry out continued analyses over time to confirm and update, accordingly, the approximate fill time for the mine pit lake identified in the FEIS.	8 – Water Quality 9 – Surface water and sediment quality	None. ICRP will be reviewed annually and updated regularly throughout the life of the Project to confirm and/or update, accordingly the approximate fill time for the mine pit lake identified in the FEIS.	IOL	Section 2.3.1.3
19	Hydrology and Hydrogeology – Water Infrastructure Monitoring	To mitigate impacts to natural water flow.	The Proponent shall ensure that it develops and implements adequate monitoring and maintenance procedures to ensure that the culverts and other conduits that may be prone to blockage do not significantly hinder or alter the natural flow of water from areas associated with the proposed mine. In addition, the Proponent shall monitor, document and report the withdrawal rates for water removed and utilized for all domestic and industrial purposes.	8 – Water Quality 9 – Surface water and sediment quality	Will be addressed in Annual Report.	Both	N/A

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
20	Groundwater/Surface Waters – Explosives	To ensure that the effects associated with the manufacturing, storage, transportation and use of explosives do not negatively impact the areas surrounding the Project.	The Proponent shall monitor the effects of explosives residue and related by-products from project-related blasting activities as well as develop and implement effective preventative and/or mitigation measures, including treatment, if necessary, to ensure that the effects associated with the manufacturing, storage, transportation and use of explosives do not negatively impact the Project and surrounding areas.	8 – Water Quality 9 – Surface water and sediment quality	None. Negligible once closure activities have ceased	N/A	N/A
24	Groundwater/Surface Waters – Effluent Management	To mitigate impacts to groundwater and surface waters from effluent	The Proponent shall monitor as required the relevant parameters of the effluent generated from Project activities and facilities and shall carry out treatment if necessary to ensure that discharge conditions are met at all times.	8 – Water Quality	Aquatic Monitoring and Reporting Program	Both	Section 9.5
27	Landforms, Geology and Geomorphology – Natural Aesthetics	To mitigate impacts to natural aesthetics.	The Proponent shall include within its public consultation report information related to the sentiments expressed by affected communities about the impacts that changes to the topography and landscape have had on the aesthetic value of the Project area.	4 – Landforms, soil and permafrost	Geotechnical/Engineering Monitoring	Both	Section 9.2
28	Landforms, Geology and Geomorphology – Permafrost	To ensure that permafrost integrity is maintained.	The Proponent shall monitor the effects of the Project on the permafrost along the railway and all other Project affected areas and must implement effective preventative measures to ensure that the integrity of the permafrost is maintained.	4 – Landforms, soil and permafrost	Geotechnical/Engineering Monitoring	Both	Section 9.2
30	Landforms, Geology and Geomorphology – Quarries	To provide oversight on quarry design and management.	The Proponent shall develop site-specific quarry operation and management plans in advance of the development of any potential quarry site or borrow pit.	4 – Landforms, soil and permafrost	Geotechnical/Engineering Monitoring	Both	Section 9.2

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
32	Vegetation – Construction and Operations	To prevent introduction of invasive species.	The Proponent shall ensure that equipment and supplies brought to the Project sites are clean and free of soils that could contain plant seeds not naturally occurring in the area. Vehicle tires and treads in particular must be inspected prior to initial use in Project areas.	5 – Vegetation	Terrestrial Environment Monitoring and Reporting	Both	Section 9.5
33	Vegetation – Monitoring	To facilitate monitoring.	The Proponent shall include relevant Monitoring and Management Plans within its Environmental Management System, Terrestrial Environment Management and Monitoring Plan (TEMMP).	5 – Vegetation	Terrestrial Environment Monitoring and Reporting	Both	Section 9.5
37	Vegetation – Monitoring	To prevent establishment of invasive species.	The Proponent shall incorporate protocols for monitoring for the potential introduction of invasive vegetation species (e.g. surveys of plant populations in previously disturbed areas) into its Terrestrial Environment and Monitoring Plan. Any introductions of non-indigenous plant species must be promptly reported to the Government of Nunavut Department of Environment.	5 – Vegetation	Terrestrial Environment Monitoring and Reporting	Both	Section 9.5
38	Vegetation – Adaptive Management	To mitigate impacts to vegetation abundance, diversity and health.	The Proponent shall review, on an annual basis, all monitoring information and the vegetation mitigation and management plans developed under its Environmental Management System, Terrestrial Environment and Monitoring Plan (TEMMP) and adjust such plans as may be required to effectively prevent or reduce the potential for significant adverse project effects on vegetation abundance, diversity and health.	5 – Vegetation	Terrestrial Environment Monitoring and Reporting	Both	Section 9.5

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
39	Vegetation – Reclamation and Revegetation	To prevent erosion and promote progressive revegetation of disturbed areas.	The Proponent shall develop a progressive revegetation program for disturbed areas that are no longer required for operations, such program to incorporate measures for the use of test plots, reseeding and replanting of native plants as necessary. It is further recommended that this program be directly associated with the management plans for erosion control established for the Project.	5 – Vegetation	Terrestrial Environment Monitoring and Reporting	Both	Section 6 Section 9.5
40	Vegetation – Reclamation and Revegetation	To prevent erosion and promote progressive revegetation of disturbed areas.	The Proponent shall include revegetation strategies in its Site Reclamation Plan that support progressive reclamation and that promote natural revegetation and recovery of disturbed areas compatible with the surrounding natural environment.	5 – Vegetation	Terrestrial Environment Monitoring and Reporting	Both	Section 6 Section 9.5
41	Freshwater Aquatic Environment – Setbacks	To mitigate impacts of runoff into freshwater aquatic habitat.	Unless otherwise approved by regulatory authorities, the Proponent shall maintain a minimum 100-metre naturally-vegetated buffer between the high-water mark of any fish-bearing water bodies and any permanent quarries with potential for acid rock drainage or metal leaching.	4 – Landforms, soil and permafrost 5 – Vegetation	Geotechnical/Engineering Monitoring	Both	Section 9.2
42	Freshwater Aquatic Environment – Setbacks	To mitigate impacts of runoff into freshwater aquatic habitat.	The Proponent shall maintain minimum a 30-metre naturally-vegetated buffer between the mining operation and adjacent water bodies.	4 – Landforms, soil and permafrost 5 – Vegetation	Geotechnical/Engineering Monitoring	Both	Section 9.2
44	Freshwater Aquatic Environment – Explosives	To mitigate impacts of explosives on freshwater aquatic habitat.	The Proponent shall meet or exceed the guidelines set by Fisheries and Oceans Canada for blasting thresholds and implement practical and effective measures to ensure that residue and by-products of blasting do not negatively affect fish and fish habitat.	8 – Water Quality	Aquatic Monitoring and Reporting Program Environmental Effects Monitoring Program	Both	Section 9.5 Section 9.3.1

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
45	Freshwater Aquatic Environment – General	To mitigate impacts to freshwater aquatic habitat.	The Proponent shall adhere to the No-Net-Loss principle at all phases of the project to prevent or mitigate direct or indirect fish and fish habitat losses.	10 – freshwater fish, fish habitat, and other aquatic organisms	Aquatic Monitoring and Reporting Program Environmental Effects Monitoring Program	Both	Section 9.5 Section9.3.1
46	Freshwater Aquatic Environment – Drainage	To mitigate impacts to freshwater aquatic habitat.	The Proponent shall ensure that runoff from fuel storage and maintenance facility areas, sewage and wastewater other facilities responsible for generating liquid effluent and runoff meet discharge requirements.	8 – Water Quality	Aquatic Monitoring and Reporting Program Environmental Effects Monitoring Program	Both	Section 9.5 Section 9.3.1
49	Terrestrial Wildlife and Wildlife Habitat – Terrestrial Environment Working Group	The TEWG will provide direction and guidance to the Proponent regarding: adding to baseline information during construction and before project operations commence; monitoring and reporting regarding effects occurring during operations; and providing advice regarding changes that may be required to make sure the management of negative impacts is effective and that lasting damage is prevented.	The Proponent shall establish a Terrestrial Environment Working Group (“TEWG”) which will act as an advisory group in connection with mitigation measures for the protection of the terrestrial environment and in connection with its Environmental Effects Monitoring Program, as it pertains to the terrestrial environment. Members may consider the draft terms of reference for the TEWG filed in the Final Hearing, but they are not bound by them. The role of the TEWG is not intended to either duplicate or to affect the exercise of regulatory authority by appropriate government agencies and departments.	7 – Terrestrial wildlife and habitat	Terrestrial Environment Monitoring and Reporting	Both	Section 9.5

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
50	Terrestrial Wildlife and Habitat – General	To ensure appropriate and responsive adaptive management.	The Proponent shall continue to develop and implement Project-specific monitoring for the terrestrial environment, and will demonstrate appropriate refinements to design, incorporation of analytical methods and elaboration of methodologies. The monitoring plan shall contain clear thresholds to allow for the assessment of long-term trends and cumulative effects where project interactions are identified. Coordination and cooperation will be required where data collection, analysis and interpretation, or responsibility for mitigation and management requires the efforts of multiple parties (e.g., government, Qikiqtani Inuit Association, communities).	7 – Terrestrial wildlife and habitat	Terrestrial Environment Monitoring and Reporting	Both	Section 9.5
51	Terrestrial Wildlife and Habitat – General	To promote coordination of monitoring efforts.	The Proponent, either directly or as part of the TEWG, shall consider and, where appropriate, cooperate with relevant regional and/or community-based monitoring initiatives that raise issues or produce information pertinent to mitigating project-induced impacts. The Proponent shall give special consideration for supporting regional studies of population health and harvest programs for North Baffin caribou which help address areas of uncertainty for Project impact predictions.	7 – Terrestrial wildlife and habitat	Terrestrial Environment Monitoring and Reporting	Both	Section 9.5
55	Terrestrial Wildlife and Habitat – Reporting	To mitigate potential impacts to wolves.	The Proponent shall develop an adaptive management plan applicable to wolves and wolf habitat in collaboration with the Government of Nunavut-Department of Environment (GN-DOE) to ensure	7 – Terrestrial wildlife and habitat	Terrestrial Environment Monitoring and Reporting	Both	Section 9.5

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
			compliance with the *Nunavut Wildlife Act.* Consideration must be given to the following: a. Monitoring for active wolf dens within a 10 km radius from the mine site, under the direction and prior approval of the GN DOE, and reporting the results through NIRB's Annual Reports on terrestrial wildlife in the Potential Development Area (PDA); b. Estimating the available (glacio-fluvial materials) esker habitat within the Regional Study Area/PDA and identifying such habitat as ecologically sensitive; c. Developing "wolf indices" for presence/abundance of wolves (by conducting studies) to set a baseline pre-construction baseline; and d. Ensuring that wolf monitoring is capable of determining the relative abundance and distribution of wolves in the Project Development				
56	Terrestrial Wildlife and Habitat – Reporting		The Proponent shall develop a strategy for the recovery of terrestrial wildlife habitat in a progressive manner that is consistent with the *Nunavut Wildlife Act.* Overall, this will require the integration of a decision-making process and the identification of mitigation responses to cumulative impacts on caribou survival, breeding propensity, and population dynamics.	7 – Terrestrial wildlife and habitat	Terrestrial Environment Monitoring and Reporting	Both	Section 9.5
57	Terrestrial Wildlife and Habitat – Aircraft Disturbances	To mitigate and monitor for impacts to wildlife.	The Proponent shall report annually regarding its terrestrial environment monitoring efforts, with inclusion of the	7 – Terrestrial wildlife and habitat	Terrestrial Environment Monitoring and Reporting Reporting requirements	Both	Section 9.5

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
			following information: a. Description of all updates to terrestrial ecosystem baseline data; b. A description of the involvement of Inuit in the monitoring program; c. An explanation of the annual results relative to the scale of the natural variability of Valued Ecosystem Components in the region, as described in the baseline report; d. A detailed presentation and analysis of the distribution relative to mine structures and activities for caribou and other terrestrial mammals observed during the surveys and incidental sightings; e. Results of the annual monitoring program, including field methodologies and statistical approaches used to support conclusions drawn; f. A summary of the chronology and level of mine activities (such as vehicle frequency and type); g. An assessment and presentation of annual environmental conditions including timing of snowmelt, green-up, as well as standard weather summaries; and h. A discussion of any proposed changes to the monitoring survey methodologies, statistical approaches or proposed adaptive management stemming from the results of the monitoring program.		will be addressed in Annual Report.		
58	Terrestrial Wildlife and Habitat – Explosives	To mitigate and monitor for impacts to wildlife.	Within its annual report to the NIRB, the Proponent shall incorporate a review section which includes: a. An examination for trends in the	7 – Terrestrial wildlife and habitat	Terrestrial Environment Monitoring and Reporting. Reporting requirements will be	Both	Section 9.5

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
			measured natural variability of Valued Ecosystem Components in the region relative to the baseline reporting; b. A detailed analysis of wildlife responses to operations with emphasis on calving and post-calving caribou behavior and displacements (if any), and caribou responses to and crossing of the railway, the Milne Inlet Tote Road and associated access roads/trails; c. A description of the extent of dust fall based on measured levels of dust fall (fugitive and finer particles such as TSP) on lichens and blueberries, and ash content of caribou fecal pellets; d. A demonstration and description of how the monitoring results, including the railway, road traffic, air traffic and dust fall contribute to cumulative effects of the project; e. Any proposed changes to the monitoring survey methodologies, statistical approaches or proposed adaptive management stemming from the results of the monitoring program; f. Any updates to information regarding caribou migration trails. Maps of caribou migration trails, primarily obtained through any new collar and snow tracking data, shall be updated (at least annually) in consultation with the Qikiqtani Inuit Association and affected communities, and shall be circulated as new information becomes available.		addressed in Annual Report.		

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
59	Terrestrial Wildlife and Habitat – Operations (General)	To mitigate aircraft disturbance to wildlife and Inuit harvesting.	The Proponent shall ensure that aircraft maintain, whenever possible (except for specified operational purposes such as drill moves, take offs and landings), and subject to pilot discretion regarding aircraft and human safety, a cruising altitude of at least 610 metres during point to point travel when in areas likely to have migratory birds, and 1,000 metres vertical and 1,500 metres horizontal distance from observed concentrations of migratory birds (or as otherwise prescribed by the Terrestrial Environment Working Group) and use flight corridors to avoid areas of significant wildlife importance. The Proponent, in collaboration with the Terrestrial Environment Working Group shall develop a program or specific measures to ensure that employees and subcontractors providing aircraft services to the Project are respectful of wildlife and Inuit harvesting that may occur in and around project areas.	6 – Birds	Terrestrial Environment Monitoring and Reporting	Both	Section 9.5
61	Terrestrial Wildlife and Habitat – Public Engagement	To mitigate Project impacts to wildlife.	Whenever practical and not causing a human safety issue, a stop work policy shall be implemented when wildlife in the area may be endangered by the work being carried out. An operational definition of 'endangered' shall be provided by the Terrestrial Environment Working Group.	6 – Birds 7 – Terrestrial wildlife and habitat	Terrestrial Environment Monitoring and Reporting	Both	Section 9.5
62	Terrestrial Wildlife and Habitat – Waste Management	To prevent increased harvesting pressure on wildlife.	The Proponent shall prohibit project employees from transporting firearms to site and from operating firearms in project areas for the purpose of wildlife harvesting.	None.	None.	N/A	N/A

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
63	Birds – Awareness	To keep communities up to date with Project operations.	The Proponent shall liaise with local Hunters and Trappers Organizations in advance of carrying out terrestrial wildlife surveys. At a minimum, The Proponent shall also meet annually in person with Hunters and Trappers Organizations to discuss wildlife monitoring and mitigation plans and address community concerns regarding wildlife interactions. The Proponent may be required to facilitate these meetings through payment of honoraria and meeting costs.	6 – Birds 7 – Terrestrial wildlife and habitat	Terrestrial Environment Monitoring and Reporting	Both	Section 9.5
64	Birds – Species at Risk	To prevent human-carnivore interactions.	The Proponent shall ensure that its Environment Protection Plan incorporates waste management provisions to prevent carnivores from being attracted to the Project site(s). Consideration must be given to the following measures: a. Installation of an incinerator beside the kitchen that will help to keep the food waste management process simple and will minimize the opportunity for human error (i.e. storage of garbage outside, hauling in a truck (odours remain in truck), hauling some distance to a landfill site, incomplete combustion at landfill, fencing of landfill, etc.); and b. Installation of solid carnivore-proof skirting on all kitchen and accommodation buildings (i.e., heavy-duty steel mesh that would drop down from the edge of the buildings/trailers and buried about a half meter into the ground to prevent animals from digging under the skirting).	6 – Birds 7 – Terrestrial wildlife and habitat	Geotechnical/Engineering Monitoring	Both	Section 9.5

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
65	Birds – Species at Risk	To prevent disturbance to birds and bird habitat.	The Proponent shall ensure all employees working at project sites receive awareness training regarding the importance of avoiding known nests and nesting areas and large concentrations of foraging and moulting birds.	6 – Birds	Terrestrial Environment Monitoring and Reporting	Both	Section 9.5
66	Birds – Project Infrastructure	To prevent impacts to sensitive bird species.	If Species at Risk or their nests and eggs are encountered during Project activities or monitoring programs, the primary mitigation measure must be avoidance. The Proponent shall establish clear zones of avoidance on the basis of the species-specific nest setback distances outlined in the Terrestrial Environment Management and Monitoring Plan.	6 – Birds	Terrestrial Environment Monitoring and Reporting	Both	Section 9.5
67	Birds – Construction/Clearing Activities	To prevent impacts to sensitive bird species.	The Proponent shall ensure that the mitigation and monitoring strategies developed for Species at Risk are updated as necessary to maintain consistency with any applicable status reports, recovery strategies, action plans and management plans that may become available during the duration of the Project.	6 – Birds	Terrestrial Environment Monitoring and Reporting	Both	Section 9.5
68	Birds – Construction/Clearing Activities	To prevent potential injuries to birds.	The Proponent shall ensure flashing red, red strobe or white strobe lights and guy-wire deterrents are used on communications towers established for the Project. Consideration should also be given to reducing lighting when possible in areas where it may serve as an attractant to birds or other wildlife.	6 – Birds	Geotechnical/Engineering Monitoring Terrestrial Environment Monitoring and Reporting	Both	Section 9.2 Section 9.5
69	Birds – Flight Altitude Requirements	To prevent nesting by birds in active Project areas.	Prior to bird migrations and commencement of nesting, the Proponent shall identify and install nesting deterrents (e.g. flagging) to discourage birds from	6 – Birds	Terrestrial Environment Monitoring and Reporting	Both	Section 9.5

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
			nesting in areas likely to be disturbed by construction/clearing activities taking place during the nesting season.				
70	Birds – Flight Altitude Requirements	To prevent impacts to birds and nesting areas.	The Proponent shall protect any nests found (or indicated nests) with a buffer zone determined by the setback distances outlined in its Terrestrial Environment Mitigation and Monitoring Plan, until the young have fledged. If it is determined that observance of these setbacks is not feasible, the Proponent will develop nest-specific guidelines and procedures to ensure bird's nests and their young are protected.	6 – Birds	Geotechnical/Engineering Monitoring Terrestrial Environment Monitoring and Reporting	Both	Section 9.2 Section 9.5
71	Birds – Monitoring	To mitigate aircraft disturbance to birds.	Subject to safety requirements, the Proponent shall require all project related aircraft to maintain a cruising altitude of at least: a. 650 m during point to point travel when in areas likely to have migratory birds b. 1100 m vertical and 1500 m horizontal distance from observed concentrations of migratory birds c. 1100 m over the area identified as a key site for moulting snow geese during the moulting period (July-August), and if maintaining this altitude is not possible, maintain a lateral distance of at least at least 1500 m from the boundary of this site.	6 – Birds	Terrestrial Environment Monitoring and Reporting	Both	Section 9.5
72	Birds – Monitoring	To mitigate aircraft disturbance to birds.	The Proponent shall ensure that pilots are informed of minimum cruising altitude guidelines and that a daily log or record of flight paths and cruising altitudes of aircraft within all Project Areas is maintained and	None.	None.	N/A	N/A

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
			made available for regulatory authorities such as Transport Canada to monitor adherence and to follow up on complaints.				
73	Birds – Monitoring	To develop appropriate mitigation and monitoring of impacts to birds.	The Proponent shall develop detailed and robust mitigation and monitoring plans for migratory birds, reflecting input from relevant agencies, the Qikiqtani Inuit Organization and communities as part of the Terrestrial Environment Working Group and to the extent applicable the Marine Environment Working Group.	6 – Birds	Terrestrial Environment Monitoring and Reporting Mine Closure Working Group	Both	Section 9.5 Section 2.4
74	Birds – Monitoring	To develop appropriate mitigation and monitoring of impacts to birds.	The Proponent shall continue to develop and update relevant monitoring and management plans for migratory birds under the Proponent's Environmental Management System, Terrestrial Environment Mitigation and Monitoring Plan prior to construction. The key indicators for follow up monitoring under this plan will include: peregrine falcon, gyrfalcon, common and king eider, red knot, seabird migration and wintering, and songbird and shorebird diversity.	6 – Birds	Terrestrial Environment Monitoring and Reporting	Both	Section 9.5
75	Birds – Monitoring	To assess the extent of terrestrial habitat loss.	The Proponent's monitoring program shall assess and report, on annual basis, the extent of terrestrial habitat loss due to the Project to verify impact predictions and provide updated estimates of the total project footprint.	6 – Birds	Terrestrial Environment Monitoring and Reporting	Both	Section 9.5
76	Marine Environment – Ice Breaking and Shipping	To mitigate potential impacts to the marine environment.	The Proponent shall develop a comprehensive Environmental Effects Monitoring Program to address concerns and identify potential impacts of the Project on the marine environment.	N/A – Related to Marine Monitoring	N/A	Crown (Marine)	N/A

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
77	Marine Environment – Ice Breaking and Shipping	The MEWG will consult with, and provide advice and recommendations to the Proponent in connection with mitigation measures for the protection of the marine environment, monitoring of effects on the marine environment and the consideration of adaptive management plans. The role of the MEWG is not intended to either duplicate or to affect the exercise of regulatory authority by appropriate government agencies and departments.	A Marine Environment Working Group ("MEWG") shall be established to serve as an advisory group in connection with mitigation measures for the protection of the marine environment, and in connection with the Project Environmental Effects Monitoring program, as it pertains to the marine environment. Membership on the MEWG will include the Proponent, Environment Canada, Fisheries and Oceans Canada, Parks Canada, the Government of Nunavut, the Qikiqtani Inuit Association, the Mittimatalik Hunters and Trappers Organization, and other agencies or interested parties as determined to be appropriate by these key members. Makivik Corporation shall also be entitled to membership on the MEWG at its election. The MEWG members may consider the draft terms of reference	N/A – Related to Marine Monitoring	N/A	Crown (Marine)	N/A
78	Marine Environment – Ice Breaking and Shipping	To obtain accurate and current ice information.	The Proponent shall update the baseline information for landfast ice using a long-term dataset (28 years), and with information on inter-annual variation. The analysis for pack and landfast ice shall be updated annually using annual sea ice data (floe size, cover, concentration) and synthesized and reported in the most appropriate management plan.	N/A – Related to Marine Monitoring	N/A	Crown (Marine)	N/A

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
79	Marine Environment – Shoreline Effects and Sediment Redistribution	To assist in the development of nautical charts for Canadian waters.	The Proponent shall provide the Canadian Hydrographic Services with bathymetric data and other relevant information collected in support of Project shipping where possible, to assist in the development of nautical charts for Canadian waters.	N/A – Related to Marine Monitoring	N/A	Crown (Marine)	N/A
87	Marine Environment – Ballast Water	To prevent invasive species introductions resulting from Project shipping.	The Proponent shall develop a detailed monitoring program at a number of sites over the long term to evaluate changes to marine habitat and organisms and to monitor for non-native introductions resulting from Project-related shipping. This program needs to be able to detect changes that may have biological consequences and should be initiated several years prior to any ballast water discharge into Steensby Inlet and Milne Inlet to collect sufficient baseline data and should continue over the life of the Project.	N/A – Related to Marine Monitoring	N/A	Crown (Marine)	N/A
89	Marine Environment – Ballast Water	To prevent impacts to marine water quality resulting from ballast water exchange.	The Proponent shall develop and implement an effective ballast water management program that may include the treatment and monitoring of ballast water discharges in a manner consistent with applicable regulations and/or exceed those regulations if they are determined to be ineffective for providing the desired and predicted results. The ballast water management program shall include, without limitation, a provision that requires ship owners to test their ballast water to confirm that it meets the salinity requirements of the applicable regulations prior to discharge at the Milne Port, and a	N/A – Related to Marine Monitoring	N/A	Crown (Marine)	N/A

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
			requirement noting that the Proponent, in choosing shipping contractors will, whenever feasible, give preference to contractors that use ballast water treatment in addition to ballast water exchange.				
92	Marine Environment – Spill Prevention	To ensure adequate spill response capacity.	The Proponent shall ensure that it maintains the necessary equipment and trained personnel to respond to all sizes of potential spills associated with the Project in a self sufficient manner.	N/A – Related to Marine Monitoring	N/A	Crown (Marine)	N/A
103	Marine Environment – Traffic Log and Shipping Information	To monitor effectiveness of mitigation of shipping impacts to marine wildlife.	The Proponent shall report annually to the NIRB regarding project-related ship track and sea ice information, including: a. A record of all ship tracks taken along both shipping routes covering the entire shipping season; b. When employing ice-breaking, an overlay of ship tracks onto ice imagery to determine whether ships are effectively avoiding shore leads and polynyas; c. A comparison of recorded ship tracks to the expected nominal shipping route, and probable (if any) extent of year-round shipping during periods of ice cover and open-water; d. An assessment of the level of adherence to the nominal shipping route and the spatial extent of the shipping zone of influence; and e. When employing ice-breaking, marine bird and mammal species and number of individuals attracted to ship tracks in ice.	N/A – Related to Marine Monitoring	N/A	Crown (Marine)	N/A

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
106	Marine Environment – Shipboard Observers	To ensure that interactions with marine mammals and Project shipping activities are effectively monitored.	The Proponent shall ensure that shipboard observers are employed during seasons where shipping occurs and provided with the means to effectively carry out assigned duties. The role of shipboard observers in shipping operations should be taken into consideration during the design of any ore carriers purpose-built for the Project, with climate controlled stations and shipboard lighting incorporated to permit visual sightings by shipboard observers during all seasons and conditions. Any shipboard lighting incorporated should be in accordance with the *Canada Shipping Act, 2001's Collision Regulations*, and should not interfere with safe navigation of the vessel.	N/A – Related to Marine Monitoring	N/A	Crown (Marine)	N/A
113	Marine Environment – Arctic Char	To prevent impacts to marine fish in Steensby Inlet and Milne Inlet	The Proponent shall conduct monitoring of marine fish and fish habitat, which includes but is not limited to, monitoring for Arctic Char stock size and health condition in Steensby Inlet and Milne Inlet, as recommended by the Marine Environment Working Group.	N/A – Related to Marine Monitoring	N/A	Crown (Marine)	N/A
114	Marine Environment – Arctic Char	To prevent impacts to marine fish in Steensby Inlet and Milne Inlet.	In the event of the development of a commercial fishery in the Steensby Inlet area or Milne Inlet-Eclipse Sound areas, the Proponent, in conjunction with the Marine Environment Working Group, shall update its monitoring program for marine fish and fish habitat to ensure that the ability to identify Arctic Char stock(s) potentially affected by Project activities and monitor for changes in stock size and structure of affected stocks and fish health (condition,	N/A – Related to Marine Monitoring	N/A	Crown (Marine)	N/A

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
			taste) is maintained to address any additional monitoring issues identified by the MEWG relating to the commercial fishery.				
120	Marine Environment – Marine Mammal Interactions	To prevent impacts to marine mammals associated with Project shipping.	The Proponent shall ensure that, subject to vessel and human safety considerations, all project shipping adhere to the following mitigation procedures while in the vicinity of marine mammals: a. Wildlife will be given right of way; b. Ships will when possible, maintain a straight course and constant speed, avoiding erratic behavior; and c. When marine mammals appear to be trapped or disturbed by vessel movements, the vessel will implement appropriate measures to mitigate disturbance, including stoppage of movement until wildlife have moved away from the immediate area.	N/A – Related to Marine Monitoring	N/A	Crown (Marine)	N/A
121	Marine Environment – Marine Mammal Interactions	To prevent impacts to marine mammals and seabird colonies associated with Project shipping.	The Proponent shall immediately report any accidental contact by project vessels with marine mammals or seabird colonies to Fisheries and Oceans Canada and Environment Canada respectively, by notifying the appropriate regional office of the: a. Date, time and location of the incident; b. Species of marine mammal or seabird involved; c. Circumstances of the incident; d. Weather and sea conditions at the time; e. Observed state of the marine mammal or sea bird colony after the incident; and, f. Direction of travel of the marine mammal	N/A – Related to Marine Monitoring	N/A	Crown (Marine)	N/A

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
			after the incident, to the extent that it can be determined				
122	Marine Environment – Marine Mammal Interactions	To prevent impacts to marine mammals and seabird colonies associated with Project shipping.	The Proponent shall summarize and report annually to the NIRB regarding accidental contact by project vessels with marine mammals or seabird colonies through the applicable monitoring report.	N/A – Related to Marine Monitoring	N/A	Crown (Marine)	N/A
123	Marine Environment – Marine Mammal Interactions	To prevent impacts to marine mammals and seabird colonies associated with Project shipping.	The Proponent shall provide sufficient marine mammal observer coverage on project vessels to ensure that collisions with marine mammals and seabird colonies are observed and reported through the life of the Project. The marine wildlife observer protocol shall include, but not be limited to, protocols for marine mammals, seabirds, and environmental conditions and immediate reporting of significant observations to the ship masters of other vessels along the shipping route, as part of the adaptive management program to address any items that require immediate action.	N/A – Related to Marine Monitoring	N/A	Crown (Marine)	N/A
124	Marine Environment – Marine Mammal Interactions	To prevent impacts to marine mammals and marine fish populations from increased harvesting pressures in Project areas.	The Proponent shall prohibit project employees from recreational boating, fishing, and harvesting of marine wildlife in project areas, including Steensby Inlet and Milne Inlet. The Proponent is not directed to interfere with harvesting by the public in or near project areas, however, enforcement of a general prohibition on harvesting in project areas by project employees during periods of active employment (i.e. while on site and between work shifts) is required.	N/A – Related to Marine Monitoring	N/A	Crown (Marine)	N/A

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
125	Marine Environment – Public Engagement	To assess acceptability of acoustic deterrent devices for the general public.	Prior to use of acoustic deterrent devices, the Proponent shall carry out consultations with communities along the shipping routes and nearest to Steensby Inlet and Milne Inlet ports to assess the acceptability of these devices. Feedback received from community consultations shall be incorporated into the appropriate mitigation plan.	N/A – Related to Marine Monitoring	N/A	Crown (Marine)	N/A
125 a	Marine Environment – Public Engagement	To ensure public acceptability of project vessel anchor sites and reduce potential conflicts between project marine shipping and local harvesting.	The Proponent shall consult with potentially-affected communities and groups, particularly Hunters' and Trappers' Organizations regarding the identification of project vessel anchor sites and potential areas of temporary refuge for project vessels along the shipping routes within the Nunavut Settlement Area. Feedback received from community consultations shall be incorporated into the most appropriate mitigation or management plans.	N/A – Related to Marine Monitoring	N/A	Crown (Marine)	N/A
127	Marine Environment – Public Engagement	To promote public awareness and engagement with Project shipping activities.	The Proponent shall ensure that communities and groups in Nunavik are kept informed of project shipping activities and are provided with opportunity to participate in the continued development and refinement of shipping related monitoring and mitigation plans.	N/A – Related to Marine Monitoring	N/A	Crown (Marine)	N/A
128	Marine Environment – Public Engagement	To ensure habitat compensation is acceptable to local communities.	The Proponent shall consult with local communities as fish habitat off-setting options are being considered and demonstrate its incorporation of input received into the design of the Fish Habitat Off-Setting Plan required to offset the Harmful Alteration, Disruption or	N/A – Related to Marine Monitoring	N/A	Crown (Marine)	N/A

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
			Destruction of Fish and Fish Habitat (HADD).				
129	Population Demographics – Qikiqtaaluk Socio-Economic Monitoring Committee	Description of the general monitoring framework to be developed in consultation with the Qikiqtaaluk Socio-Economic Monitoring Committee.	The Proponent is strongly encouraged to engage in the work of the Qikiqtaaluk Socio-Economic Monitoring Committee along with other agencies and affected communities, and it should endeavor to identify areas of mutual interest and priorities for inclusion into a collaborative monitoring framework that includes socio-economic priorities related to the Project, communities, and the North Baffin region as a whole.	N/A – Related to Population demographics	Will be addressed by the Socio-Economic Monitoring Committee	Both	Section 9.10
130	Population Demographics – Project-specific monitoring	Recognizing that some Project-specific socio-economic monitoring initiatives may be best addressed in smaller more focused working groups, this is encouraged where possible.	The Proponent should consider establishing and coordinating with smaller socio-economic working groups to meet Project specific monitoring requirements throughout the life of the Project.	N/A – Related to Population demographics	Will be addressed by the Socio-Economic Monitoring Committee	Both	Section 9.10
131	Population Demographics – Monitoring demographic changes	To monitor demographic changes affecting the North Baffin communities and the territory as a whole in order to understand changes and to evaluate the Proponent's predictions as related to population demographics.	The Qikiqtaaluk Socio-Economic Monitoring Committee is encouraged to engage in the monitoring of demographic changes including the movement of people into and out of the North Baffin communities and the territory as a whole. This information may be used in conjunction with monitoring data obtained by the Proponent from recent hires and/or out-going employees in order to assess the potential effect the Project has on migration.	N/A – Related to Population demographics	Will be addressed by the Socio-Economic Monitoring Committee	Both	Section 9.10

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
132	Population Demographics – Training programs	To develop training programs in ways which contribute to limiting the potential for migration to occur as North Baffin residents seek training and employment opportunities in the larger centre of Iqaluit.	The Proponent is encouraged to partner with other agencies such as Hamlet organizations in the North Baffin region, the Municipal Training Organization, and the Government of Nunavut in order to adapt pre-existing, or to develop new programs which encourage Inuit to continue living in their home communities while seeking ongoing and progressive training and development. Programs may include driver training programs offered within Hamlets, providing upgraded equipment to communities for use in municipal works, providing incentives for small businesses to remain operating out of their community of origin, or supplementing existing recreational facilities and programming in North Baffin communities.	N/A – Related to Education and Training	Will be addressed by the Socio-Economic Monitoring Committee	Both	Section 9.10
133	Population Demographics – Monitoring demographic changes	Training programs may be developed with the goal of limiting the potential for migration to occur as North Baffin residents may choose to seek employment and therefore move from smaller North Baffin communities to the larger centre of Iqaluit.	The Proponent is encouraged to work with the Qikiqtaaluk Socio-Economic Monitoring Committee and in collaboration with the Government of Nunavut's Department of Health and Social Services, the Nunavut Housing Corporation and other relevant stakeholders, design and implement a voluntary survey to be completed by its employees on an annual basis in order to identify changes of address, housing status (i.e. public/social, privately owned/rented, government, etc.), and migration intentions while respecting confidentiality of all persons involved. The survey should be designed in collaboration with the Government of Nunavut's Department of	N/A – Related to Population demographics	Will be addressed by the Socio-Economic Monitoring Committee	Both	Section 9.10

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
			Health and Social Services, the Nunavut Housing Corporation and other relevant stakeholders. Non-confidential results of the survey are to be reported to the Government of Nunavut and the NIRB.				
134	Population Demographics – Employee origin	Project-specific information regarding employee origin is important to comparing predictions of labour availability and employment opportunities with actual levels of employment from various demographic segments over different geographic areas.	The Proponent shall include with its annual reporting to the NIRB a summation of employee origin information as follows: a. The number of Inuit and non-Inuit employees hired from each of the North Baffin communities, specifying the number from each; b. The number of Inuit and non-Inuit employees hired from each of the Kitikmeot and Kivalliq regions, specifying the number from each; c. The number of Inuit and non-Inuit employees hired from a southern location or other province/territory outside of Nunavut, specifying the locations and the number from each; and d. The number of non-Canadian foreign employees hired, specifying the locations and number from each foreign point of hire.	N/A – Related to Population demographics	Included in Annual Report to NIRB and the Annual IIBA Implementation Report	Both	Section 9.10
145	Livelihood and Employment – Barriers to employment for women	To monitor and understand the existence of barriers to employment for women specifically relating to childcare availability and costs.	The Proponent is encouraged to work with the Government of Nunavut and the Qikiqtaaluk Socio-Economic Monitoring Committee to monitor the barriers to employment for women, specifically with respect to childcare availability and costs.	N/A – Related to Livelihood and Employment	Will be addressed by the Socio-Economic Monitoring Committee and the Closure Working Group closer to mine Closure	Both	Section 9.10
146	Livelihood and Employment – Availability of	To lessen the barriers to employment as relating to the	The Government of Nunavut and the Qikiqtani Inuit Association are strongly encouraged to investigate the possibility	N/A – Related to Livelihood and Employment	Will be addressed by the Socio-Economic Monitoring Committee	Both	Section 9.10

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	childcare for Project employees	availability of childcare.	for Project revenue streams to support initiatives or programs which offset or subsidize childcare for Project employees.		and the Closure Working Group closer to mine Closure		
147	Livelihood and Employment – Affordability of housing	To lessen the barriers to maintaining employment as relating to the availability and costs of housing.	The Proponent is encouraged to work with the Government of Nunavut and the Nunavut Housing Corporation to investigate options and incentives which might enable and provide incentive for employees living in social housing to maintain employment as well as to negotiate for and obtain manageable rental rates.	N/A – Related to Livelihood and Employment	Will be addressed by the Socio-Economic Monitoring Committee and the Closure Working Group closer to mine Closure	Crown	Section 9.10
152	Economic Development and Self-Reliance, and Contracting and Business Opportunities – IIBA contract requirements	To improve ability of small businesses to access Project contract and sub-contract opportunities.	The Qikiqtani Inuit Association is encouraged to provide the Board and the Qikiqtaaluk Socio-Economic Monitoring Committee with information regarding the effectiveness of any provisions within the Inuit Impact and Benefit Agreement which may require that larger contracts be broken down into smaller size in order that they are reasonably managed by smaller businesses in the North Baffin region, while respecting any confidential or privileged information.	N/A – Related to Economic Development and Self-Reliance	Included in Annual IIBA Implementation Report to QIA. Will be addressed by the Socio-Economic Monitoring Committee and the Closure Working Group closer to mine Closure.	Both	Section 9.10
153	Human Health and Well-Being – Employee and family health and well-being	To provide adequate medical services on site, including those that contribute to the mental health and well-being of all employees.	The Proponent is encouraged to employ a mental health professional to provide counseling to Inuit and non-Inuit employees in order to positively contribute toward employee health and well-being.	N/A – Related to Human health and well-being	Included in Annual IIBA Implementation Report to QIA. Will be addressed by the Closure Working Group closer to mine Closure	Crown	Section 9.10
154	Human Health and Well-being – Indirect impacts to health and well-being	To understand the indirect impacts of the Project upon health and well-being.	The Proponent shall work with the Government of Nunavut and the Qikiqtaaluk Socio-Economic Monitoring Committee to monitor potential indirect	N/A – Related to Human health and well-being	Will be addressed by the Socio-Economic Monitoring Committee and the Closure Working	Both	Section 9.10

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
			effects of the Project, including indicators such as the prevalence of substance abuse, gambling issues, family violence, marital problems, rates of sexually transmitted infections and other communicable diseases, rates of teenage pregnancy, high school completion rates, and others as deemed appropriate.		Group closer to mine Closure		
156	Human Health and Well-Being – Support initiatives	To assist with fostering well-being within point-of-hire communities.	The Proponent is encouraged to assist with the provision and/or support of recreation programs and opportunities within the potentially affected communities in order to mitigate potential impacts of employees' absences from home and community life.	N/A – Related to Human health and well-being	Will be addressed by the Socio-Economic Monitoring Committee and the Closure Working Group closer to mine Closure	Both	Section 9.10
157	Human Health and Well-Being – Counseling and treatment programs	To make available, necessary treatment and counseling services for employee and family well-being.	The Proponent should consider providing counseling and access to treatment programs for substance and gambling addictions as well as which address domestic, parenting, and marital issues that affect employees and/or their families.	N/A – Related to Human health and well-being	Included in Annual IIBA Implementation Report to QIA. Will be addressed by the Socio-Economic Monitoring Committee and the Closure Working Group closer to mine Closure	Both	Section 9.10
158	Community Infrastructure and Public Services – Impacts to health services	To monitor indirect Project impacts to health and social services provided by the Government of Nunavut.	The Proponent is encouraged to work with the Government of Nunavut and other parties as deemed relevant in order to develop a Human Health Working Group which addresses and establishes monitoring functions relating to pressures upon existing services and costs to the health and social services provided by the Government of Nunavut as such may be impacted by Project-related in-migration of employees, to both the North Baffin region in general, and to the City of Iqaluit in particular.	N/A – Related to Community Infrastructure and public service	Will be addressed by the Socio-Economic Monitoring Committee and the Closure Working Group closer to mine Closure	Crown	Section 9.10

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
159	Community Infrastructure and Public Services – Impacts to infrastructure	To monitor Project-related impacts to infrastructure within the Local Study Area communities.	The Proponent is encouraged to work with the Government of Nunavut to develop an effects monitoring program that captures increased Project-related pressures to community infrastructure in the Local Study Area communities, and to airport infrastructure in all point-of-hire communities and in Iqaluit.	N/A – Related to Community Infrastructure and public service	Will be addressed by the Socio-Economic Monitoring Committee and the Closure Working Group closer to mine Closure	Crown	Section 9.10
160	Community Infrastructure and Public Services – Distribution of benefits	To ensure the distribution of benefits is done in a way that off-sets Project-related impacts to infrastructure or services.	The Government of Nunavut and the Qikiqtani Inuit Association are encouraged to cooperate to ensure in a broad sense, that Project benefits	N/A – Related to Community Infrastructure and public service	Will be addressed by the Socio-Economic Monitoring Committee and the Closure Working Group closer to mine Closure	Both	Section 9.10
161	Community Infrastructure and Public Services – Policing	To ensure the territorial government and its policing service are adequately prepared to handle any Project-related increases to the need for service and associated impacts.	The Government of Nunavut should be prepared for any potential increased need for policing, and ensure that the Royal Canadian Mounted Police is prepared to handle ongoing Project-related demographic changes and subsequent crime prevention that may be needed as a result of the development, operation, and closure of the Project.	N/A – Related to Community Infrastructure and public service	Will be addressed by the Socio-Economic Monitoring Committee and the Closure Working Group closer to mine Closure	Crown	Section 9.10
162	Culture, Resources and Land Use – Public consultation	To ensure the ongoing and consistent involvement of Elders and community members in developing and revising monitoring and mitigation plans.	The Proponent should make all reasonable efforts to engage Elders and community members of the North Baffin communities in order to have community level input into its monitoring programs and mitigative measures, to ensure that these programs and measures have been informed by traditional activities, cultural resources,	N/A – Related to Cultural resources and Land use	Will be addressed by the Community Working Group and the Closure Working Group closer to mine Closure	Both	Section 9.10

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
			and land use as such may be implicated or impacted by ongoing Project activities.				
163	Culture, Resources and Land Use – Public consultation	To involve communities in the development and evolution of management and monitoring plans.	The Proponent shall continue to engage and consult with the communities of the North Baffin region in order to ensure that Nunavummiut are kept informed about the Project activities, and more importantly, in order that the Proponent's management and monitoring plans continue to evolve in an informed manner.	N/A – Related to Cultural resources and Land use	Will be addressed by the Community Working Group and the Socio-Economic Monitoring Committee and the Closure Working Group loser to mine Closure	Both	Section 9.10
164	Socio-Economic Impacts – Shipping notification	In order to inform members of North Baffin communities of planned Project shipping transits such that community members' planned travel routing may be adjusted to avoid interaction with Project ships and/or ship tracks.	The Proponent is required to provide notification to communities regarding scheduled ship transits throughout the regional study area including Eclipse Sound and Milne Inlet, real-time data regarding ships in transit and any changes to the proposed shipping schedule to the MEWG and agencies within Pond Inlet on a weekly basis during open water shipping, and to the RSA communities on a monthly basis.	N/A – Related to Cultural resources and Land use	Part of already established Marine safety protocols on site and though IIBA Implementation.	Both	Section 9.10
165	Socio-Economic Impacts – Emergency shelters	In order to provide for human safety precautions in the event of adverse weather or other emergency situations along segments of linear transportation infrastructure.	The Proponent is strongly encouraged to provide buildings along the rail line and Milne Inlet Tote Road for emergency shelter purposes, and shall make these available for all employees and any land users travelling through the Project area. In the event that these buildings cannot, for safety or other reasons be open to the public, the Proponent is encouraged to set up another form of emergency shelters (e.g. seacans outfitted for survival purposes) every 1 kilometre along the rail line and Milne Inlet Tote Road. These	N/A	Part of already established Marine safety protocols on site. Will be addressed by the Community Working Group	Both	Section 9.10

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
			shelters must be placed along Tote Road and rail routing prior to operation of either piece of infrastructure, and must be maintained for the duration of project activities, including the closure phase.				
166	Socio-Economic Impacts – Public Consultation	To ensure members of the public are able to access shipping information on an as-required basis in order to inform potential users of the scheduled Project activities which could require deviations to land users' schedules or routing.	The Proponent should ensure through its consultation efforts and public awareness campaigns that the public have access to shipping operations personnel for transits into and out of both Steensby Inlet port and Milne Inlet port either via telephone or internet contact, in order that any questions regarding ice conditions or ship movements that could assist ice users in preparing for travel may be answered by Project staff in a timely fashion.		Part of already established Marine safety protocols on site	Both	Section 9.10
168	Governance and Leadership – Monitoring program	Outline variables that are relevant to the Project and which should be adopted by the QSEMC's monitoring program.	The specific socioeconomic variables as set out in Section 8 of the Board's Report, including data regarding population movement into and out of the North Baffin Communities and Nunavut as a whole, barriers to employment for women, project harvesting interactions and food security, and indirect Project effects such as substance abuse, gambling, rates of domestic violence, and education rates that are relevant to the Project, be included in the monitoring program adopted by the Qikiqtani Socio-Economic Monitoring Committee.	N/A – Related to Governance and leadership	Will be addressed by the Socio-Economic Monitoring Committee closer to mine Closure	Both	Section 9.10
169	Governance and Leadership – Monitoring economic effects	To maintain transparency inform communities in relation to economic	The Proponent provide an annual monitoring summary to the NIRB on the monitoring data related to the regional and cumulative economic effects (positive and	N/A – Related to Governance and leadership	Will be addressed by the Socio-Economic Monitoring Committee closer to mine Closure	Both	Section 9.10

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
		benefits associated with the Project.	negative) associated with the Project and any proposed mitigation measures being considered necessary to mitigate the negative effects identified.				
175	Accidents and Malfunctions – Ship track markers in ice cover	To ensure that measures taken to mark the shipping track(s) during periods of ice cover are effective in advising ice-based travelers, and that, where necessary, revisions to this practice can be made to ensure public safety.	The Proponent shall, in coordination and consultation with the Qikiqtani Inuit Association and the Hunters and Trappers Organizations of the North Baffin communities and Coral Harbour, provide updates to its Shipping and Marine Mammals Management Plan to include adaptive management measures it proposes to take should the placement of reflective markers along the ship track in winter months not prove to be a feasible method of marking the track to ensure the safety of ice-based travelers.	N/A – Related to Marine Monitoring	Part of already established Marine safety protocols on site	Crown (Marine)	N/A
177	Accidents and Malfunctions – Foreign flagged vessels	To ensure foreign flagged ships operating in Canadian waters are held to the same standard as domestic ships with regard to emergency response planning.	The Proponent shall enroll any foreign flagged vessels commissioned for Project-related shipping within Canadian waters into the relevant foreign program equivalent to Transport Canada's Marine Safety Delegated Statutory Inspection Program.	N/A – Related to Marine Monitoring	Part of already established Marine safety protocols on site	Crown (Marine)	N/A
180	Transboundary Effects – Makivik Corporation involvement in the Marine Environment Working Group	To enable Makivik Corporation and Nunavik communities near shipping lanes to remain informed and involved in those shipping activities which could affect the marine environment and marine mammals.	The Marine Environment Working Group established for this Project shall invite a representative from Makivik Corporation to be a member of the Group	N/A – Related to Marine Monitoring	Will be addressed in Annual Report. And in Marine Environmental Working Group	Crown (Marine)	N/A

Ref #	Category	Objective	Project Condition/Type A Water Licence Condition	Related VEC	Associated Closure/Post-Closure Monitoring Program	IOL/ Crown land	ICRP Ref
181	Transboundary Effects – Marine Environment Working Group reporting	To enable Makivik Corporation and Nunavik communities near shipping lanes to remain informed and involved in those shipping activities which could affect the marine environment and marine mammals.	Regardless of whether Makivik Corporation participates as a member of the Marine Environment Working Group, the Marine Environment Working Group will provide Makivik Corporation with regular updates regarding the activities of the Marine Environment Working Group throughout the Project life cycle.	N/A – Related to Marine Monitoring	Will be addressed in Annual Report. And in Marine Environmental Working Group	Crown (Marine)	N/A
182	Transboundary Effects – Reporting to Marine Environment Working Group (MEWG)	To enable Makivik Corporation and Nunavik communities near shipping lanes to remain informed and involved in those shipping activities which could affect the marine environment and marine mammals.	Baffinland shall make available to Makivik Corporation any ship route deviation reports provided to the NIRB in accordance with the terms and conditions set out in Section 4.12.4 of the Final Hearing Report.	N/A – Related to Marine Monitoring	Will be addressed in Annual Report. And in Marine Environmental Working Group	Crown (Marine)	N/A

Table 11.4 has been prepared to show concordance with Part J, Number 2 of the Type 'A' Water Licence, 2AM-MRY1325.

Table 11.4: Type 'A' Water Licence 2AM-MRY1325 Amendment No.1, Part J, Item 2

TYPE 'A' WATER LICENCE 2AM-MRY1325, Schedule J	ICRP Section
a. Detailed description, including maps and other visual representations, of the preconstruction conditions for each site, accompanied by a detailed description of the proposed final landscape, with emphasis on the reclamation of surface drainage over the restored area	3 & 5.2
b. A description of how progressive reclamation will be employed and monitored throughout the life of the mine, plus reclamation scheduling and coordination of activities with the overall sequence of the project; details of reclamation scheduling and procedures for coordinating reclamation activities within the overall mining sequence and materials balance	6
c. Implications of any updated water balance and water quality model prediction results and any adaptive management measures that may be required	5.2.1.9, 5.2.2.9, & Appendix D
d. An evaluation of closure and reclamation measures for each mine component, including the goals, objectives, closure criteria and the rationale for selection of the preferred measures	Table 5.1
e. A comprehensive assessment of materials suitability, including geochemical and physical characterization and a schedule of availability for reclamation needs. Particular attention shall be given to cover materials, including maps showing sources and stockpile locations of all reclamation construction materials	5.2.8.5.1
f. An assessment and description of any required post-closure treatment for pit water that is not acceptable for discharge, taking into consideration further studies completed and updated modeling information	5.2.1
g. Contingency measures for all reclamation components including action thresholds that are linked to the monitoring programs	5.1.1
h. Monitoring programs to assess reclamation performance and environmental conditions including monitoring locations for surface water and Ground Water, parameters	9
i. Monitoring schedules and overall timeframes	9
j. QA/QC procedures for managing the demolition landfill and other waste disposal areas	5.2.7
k. A list of non-salvageable materials and disposal locations	5.2.4, 5.2.5, & 5.2.7
l. Rock storage facility closure design plans and sections including the types of material placed and volumes	5.2.2

TYPE 'A' WATER LICENCE 2AM-MRY1325, Schedule J	ICRP Section
m. Protocol for the disposal of any contaminated soil;	Section 9.4
n. An assessment of the Long-term physical stability of all remaining project components;	Table 5.1
o. A revised closure and reclamation cost estimate; and	10.1
p. A detailed implementation schedule for completion of reclamation work	Table 5.1

12 GLOSSARY OF TERMS, ACRONYMS, OR ABBREVIATIONS

12.1 Glossary of Terms

Term	Meaning
Abandonment	The permanent dismantlement of a facility so it is permanently incapable of its intended use. This includes the removal of associated equipment and structures.
Acid-Base Accounting (ABA)	Acid-Base Accounting (ABA) is a screening procedure whereby the acid-neutralizing potential and acid-generating potential of rock samples are determined.
Acid generating (AG)	Production of acidity irrespective of its effect on the adjacent pore water or whether the material is net acid producing or neutralizing.
Acid rock drainage (ARD)	Acidic drainage stemming from open pit, underground mining operations, waste-rock or tailings facilities that contains free sulphuric acid and dissolved metals sulphate salts, resulting from the oxidation of contained sulphide minerals or additives to the process. The acid dissolves minerals in the rocks, further changing the quality of the drainage water.
Acid Potential (AP)	Maximum potential acid generation from a sample. The calculation of AP (or MPA) is an integral part of acid/base accounting.
Acidity	Measure of the capacity of a solution to neutralize a strong base.
Active layer	The layer of ground above the permafrost which thaws and freezes annually.
Alkalinity	Measure of the capacity of a solution to neutralize a strong acid.
Backfill	Material excavated from a site and reused for filling the surface or underground void created by mining. Reinsertion of materials in extracted part(s) of the ore body. Materials used for backfilling can be waste-rock or overburden. In most cases backfill is used to refill mined-out areas in order to: ▪ Assure ground stability. ▪ Prevent or reduce underground and surface subsidence. ▪ Provide roof support so that further parts of the ore body can be extracted and to increase safety. ▪ Provide an alternative to surface disposal. And ▪ Improve ventilation.
Background	An area near the site under evaluation not influenced by chemicals released from the site, or other impacts created by onsite activity.
Baseline	A surveyed condition and reference used for future surveys.
Benign	Having little or no detrimental effect.
Berm	A mound or wall, usually of earth, used to retain substances or to prevent substances from entering an area.

Term	Meaning
Best Management Practices	Any program, technology, process, operating method, measure, or device that controls, prevents, removes, or reduces pollution and impact on the environment.
Biodiversity	The variety of plants and animals that live in a specific area.
Bioremediation	The use of microorganisms or vegetation to reduce contaminant levels in soil or water.
Borrow Pit	A source of fill or embanking material.
Care and Maintenance	A term to describe the status of a mine when it undergoes a temporary closure.
Closure	When a mine ceases operations without the intent to resume mining activities in the future.
Closure Criteria	Detail to set precise measures of when the objective has been satisfied.
Closure Goal	The guiding statement that provides the vision and purpose of reclamation. Attainment of the closure goal happens all closure objectives have been satisfied. By its nature, the closure goal is a broad, high-level statement and not directly measurable.
Closure Principles	A fundamental basis for the selection of closure objectives.
Closure Objectives	Statements that describe what the selected closure activities are aiming to achieve; they are guided by the closure principles.
Comminution	Size reduction of an ore by crushing and/or grinding to such a particle size that the product is a mixture of relatively clean particles of mineral and gangue. In order to produce a relatively pure concentrate, it is necessary to grind the ore fine enough to liberate the desired minerals.
Contaminant	Any physical, chemical, biological or radiological substance in the air, soil or water that has an adverse effect. Any chemical substance with a concentration that exceeds background levels or which is not naturally occurring in the environment.
Contouring	The process of shaping the land surface to fit the form of the surrounding land.
Cumulative Effects	The combined environmental impacts that accumulate over time and space as a result of a series of similar or related actions or activities.
Crushing	Comminution process that reduces the particle size of run-of-mine ore to such a level that grinding can be carried out. This is accomplished by compression of ore against rigid surfaces, or by impact against surfaces in rigidly constrained motion path.
Cryoconcentration	Concentration of solutes due to exclusion by ice.
Decommissioning	Process by which a mining operation is shut down i.e.: permanently closing a site. Removing equipment, buildings and structures. Rehabilitation and plans for future maintenance of affected land and water are also included.
Dewatering	Process of removing water from an underground mine or open pit, or from the surrounding rock or non-lithified area. The term is also commonly used for the reduction of water content in concentrates, tailings and treatment sludges.

Term	Meaning
Disposal	The relocation, containment, treatment or processing of unwanted materials or materials that are not reusable. This may involve the removal of contaminants or their conversion to less harmful forms.
Drainage	Manner in which the waters of an area exist and move, including surface streams and groundwater pathways. A collective term for all concentrated and diffuse water flow.
Drainage Chemistry	Concentrations of dissolved components in drainage, including element concentrations, chemical species and other aqueous chemical parameters.
Effluent	Treated or untreated liquid waste material that is discharged into the environment from a structure such as a settling pond or a treatment plant.
End Land Use	The allowable use of disturbed land following reclamation. Municipal zoning and/or approval may be required for specific land uses.
Environment	Interrelated physical, chemical, biological, social, spiritual and cultural components that affect the growth and development of living organisms.
Erosion	The wearing away of rock, soil or other surface material by water, rain, waves, wind or ice, the process may be accelerated by human activities.
Evaporation	Physical process by which a liquid is changed into a gas.
Existing Operation	An installation in operation or, in accordance with legislation existing before the date on which this Directive is brought into effect, an installation authorized or in the view of the competent authority the subject of a full request for authorization, provided that that installation is put into operation no later than one year after the date on which this Directive is brought into effect.
Frost Heave	Annual ground displacements and differential ground pressures due to the freezing of water within soils.
Geochemistry	Science of the chemistry of geological materials and the interaction between geological materials with the environment.
Geology	Study of the earth, its history and the changes that have occurred or are occurring, and the rocks and non-lithified materials of which it is composed and their mode of formation and transformation.
Grade	Dimensionless proportion of any constituent in an ore, expressed often as a percentage, grams per tonne (g/t) or parts per million (ppm).
Ground Thermal Regime	Temperature conditions below the ground surface. A condition of heat losses and gains from geothermal sources and the atmosphere.
Groundwater	All subsurface water that occurs beneath the water table in rocks and geologic formations that are fully saturated. Distinct from surface water.
Humidity Cell Test	Kinetic test procedure used primarily to measure rates of acid generation and neutralization in sulphide-bearing rock.
Hydrogeology	Science of the groundwater circuit (interrelationship of geologic materials and processes with water).
Hydrology	The science that deals with water, its properties, distribution and circulation over the Earth's surface.

Term	Meaning
Inert Waste	Material having insignificant leachability and pollution content which will not require laboratory analysis.
Infiltration	Entry of water into a porous substance.
Inukshuk	A stone representation of a person, used as a milestone or directional marker by the Inuit of the Canadian Arctic.
In Situ Treatment	A method of managing or treating contaminated soils, sludges and waters “in place” in a manner that does not require the contaminated material to be physically removed or excavated from where it originated.
Landfill	An engineered waste management facility at which waste is disposed by placing it on or in land in a manner that minimizes adverse human health and environmental effects.
Leachate	Solution obtained by leaching e.g. water that has percolated through soil containing soluble substances and that contains certain amounts of these substances in solution.
Leaching	Passage of a solvent through porous or crushed material in order to extract components from the liquid phase. For example, gold can be extracted by heap leaching of a porous ore, or pulverized tailings. Other methods are tank leaching of ore, concentrates or tailings and in-situ leaching.
Lithology	Composition of rocks, including physical and chemical characteristics such as colour, mineralogical composition, hardness and grain size.
Migration	The movement of chemicals, bacteria, and gases in flowing water or vapour.
Mineral Resource	Concentration or occurrence of natural, solid, inorganic or fossilized organic material in or on the Earth’s crust in such form and quantity and of such a grade or quality that it has reasonable prospects for economic extraction. The location, quantity, grade, geological characteristics and continuity of a Mineral Resource are known, estimated or interpreted from specific geological evidence and knowledge.
Mining	Methods and techniques to extract ore from the ground, including support facilities (e.g. stockpiles, workshops, transport, ventilation) and supporting activities in the mine itself or in the vicinity.
Mining Operation	Any extraction of ore from which mineral substances are taken, where the corporate intent is to make an operating profit or build continuously toward a profitable enterprise.
Mitigation	The process of rectifying an impact by repairing, rehabilitating or restoring the affected environment, or the process of compensating for the impact by replacing or providing substitute resources or environments.

Term	Meaning
Monitoring	Observing the change in geophysical, hydrogeological or geochemical measurements over time. Process intended to assess or to determine the actual value and the variations of an emission or another parameter, based on procedures of systematic, periodic or spot surveillance, inspection, sampling and measurement or another assessment methods intended to provide information about emitted quantities and/or trends for emitted pollutants.

Term	Meaning
Naturally Re-vegetate or Natural Re-vegetation	For the purposes of the Mary River Project natural re-vegetation will include scarification and covering with overburden as required and allowing the surrounding natural vegetation to encroach and be re-established on the disturbed area.
Neutralization	Raising the pH of acidic solutions or lowering the pH of alkaline solutions to near-neutral pH (about pH 7) values through a reaction in which the hydrogen ion of an acid and the hydroxyl ion of a base combine to form water.
Neutralization Potential (NP)	General term for a sample's or a material's capacity to neutralize acidity.
Objectives	Objectives describe what the reclamation activities are aiming to achieve. The goal of mine closure is to achieve the Long-term objectives that are selected for the site.
Open Pit Mining	Mining operation takes place on the surface. Mining operation and environment are in contact over an extended area.
Operator	Any natural or legal person that is responsible for the control, operation, and maintenance of the mine, mineral processing plant, tailings dam and/or related facilities including the after-closure phases.
Ore	Mineral or variety of accumulated minerals of sufficient value as to quality and quantity that it/they may be mined at a profit. Most ores are mixtures of extractable minerals and extraneous rocky material.
Orebody (mineral deposit)	Naturally occurring geological structure consisting of an accumulation of a desired mineral and waste-rock, from which the mineral can be extracted, at a profit, or with a reasonable expectation thereof.
Overburden	Layer of natural grown soil or massive rock on top of an orebody. In case of open pit mining operations it has to be removed prior to extraction of the ore
P	Phosphate
Passive Treatment	Treatment technologies that can function with little or no maintenance over long periods of time.
Permafrost	Ground that remains at or below zero degrees Celsius for a minimum of two consecutive years.
Permafrost Aggradation	A naturally or artificially caused increase in the thickness and/or area extent of permafrost.
Permeability	The ease with which gases, liquids, or plant roots penetrate or pass through soil or a layer of soil. The rate of permeability depends upon the composition of the soil.

Term	Meaning
Phreatic Surface	The term phreatic is used in Earth sciences to refer to matters relating to ground water below the water table (the word originates from the Greek phrear, phreat- meaning “well” or “spring”). The term ‘phreatic surface’ indicates the location where the pore water pressure is under atmospheric conditions (i.e. the pressure head is zero). This surface normally coincides with the water table.
Potentially Acid Generating (PAG)	Rock or overburden material that has the potential to produce acidity irrespective of its effect on the adjacent pore water or whether the material is net acid producing or neutralizing.

Term	Meaning
Progressive Reclamation	Actions that can be taken during mining operations before permanent closure, to take advantage of cost and operating efficiencies by using the resources available from mine operations to reduce the overall reclamation costs incurred. It enhances environmental protection and shortens the timeframe for achieving the reclamation objectives and goals.
Primary Crushing	Process of reducing ore into smaller fragments to prepare it for further processing and/or so that it can be transported to the processing plant. In underground mines, the primary crusher is often located underground, or at the entrance to the processing plant.
Quarry	Whole area under the control of an operator carrying out any activity involved in the prospecting, extraction, treatment and storage of minerals, including common related infrastructures and waste management activities, being not a mine. It is distinguished from a mine because it is usually open at the top and front, and used for the extraction of building stone, such as slate, limestone, gravel and sand.
Reclamation	The process of returning a disturbed site to its natural state or one for other productive uses that prevents or minimizes any adverse effects on the environment or threats to human health and safety.
Rehabilitation	Activities to ensure that the land will be returned to a form and productivity in conformity with a prior land use plan, including a stable ecological state that does not contribute substantially to environmental deterioration and is consistent with surrounding aesthetic values.
Remediation	The removal, reduction, or neutralization of substances, wastes or hazardous material from a site in order to prevent or minimize any adverse effects on the environment and public safety now or in the future.
Restoration	The renewing, repairing, cleaning-up, remediation or other management of soil, groundwater or sediment so that its functions and qualities are comparable to those of its original, unaltered state.
Re-vegetation	Replacing original ground cover following a disturbance to the land.
Risk Assessment	Reviewing risk analysis and options for a given site, component or condition. Risk assessments consider factors such as risk acceptability, public perception of risk, socio-economic impacts, benefits, and technical feasibility. It forms the basis for risk management.
Run-of-mine (ROM)	Run of mine. Unprocessed conveyed material (ore) from the mining operation.
Runoff	Part of precipitation and snowmelt that does not infiltrate but moves as overland flow and drains off the land into bodies of water.
Scarification	Seedbed preparation to make a site more amenable to plant growth.
Screening	Separating material into size fractions.
Security Deposit	Funds held by the Crown or designated owner of the land that can be used in the case of abandonment of an undertaking to reclaim the site, or carry out any ongoing measures that may remain to be taken after the abandonment of the undertaking.

Term	Meaning
Sediment	Solid material, both mineral and organic, that has been moved by air, water, gravity, or ice and has come to rest on the earth's surface either above or below sea level.
Seismic	Relating to an earthquake or to other tremors of the Earth, such as those caused by large explosions.
Solubility	Quantity of solute that dissolves in a given volume and type of solvent, at given temperature and pressure, to form a saturated solution. The degree to which compounds are soluble depends on their ability, and that of the other dissolved species, to form ions and aqueous complexes in particular drainage chemistry.
Sump	An underground catch basin in a mine where water accumulates before being pumped to the surface.
Supernatant	The clear liquid that floats about the sediment or precipitate.
Surface Water	Natural water bodies such as river, streams, brooks, ponds and lakes, as well as artificial watercourses, such as irrigation, industrial and navigational canals, in direct contact with the atmosphere.
Sustainable Development	Industrial development that does not detract from the potential of the natural environment to ensure benefits for future generations.
Tailings	Material rejected from a mill after most of the recoverable valuable minerals have been extracted.
Taliks	Unfrozen zones that can exist within, below, or above permafrost layers. They are usually located below deep water bodies.
Temporary Closure	When a mine ceases operations with the intent to resume mining activities in the future. Temporary closures can last for a period of weeks, or for several years, based on economical, environmental, political, or social factors.
Thermokarst	A landscape characterized by shallow pits and depressions caused by selective thawing of ground ice, or permafrost.
Topsoil	Natural huminous layer on top of the orebody, which has to be stripped prior to start-up of ore extraction.
Traditional Knowledge	A cumulative, collective body of knowledge, experience, and values built up by a group of people through generations of living in close contact with nature. It builds upon the historic experiences of a people and adapts to social, economic, environmental, spiritual and political change.
Ultramafic	Igneous rock composed chiefly of mafic minerals, e.g. monomineralic rocks composed of hypersthenes, augite, or olivine.
Waste-rock, Discard, or Spoil Material	All rock materials, except ore and tailings that are produced as a result of mining operations.
Watershed	A region or area bordered by ridges of higher ground that drains into a particular watercourse or body of water.
Water Table	The level below where the ground is saturated with water.

Term	Meaning
Weathering	Processes by which particles, rocks and minerals are altered on exposure to surface temperature and pressure, and atmospheric agents such as air, water and biological activity.

12.2 Acronyms and Abbreviations

The following are acronyms or abbreviations that may be used in this document:

Abbreviation	Description
General	
A&R	Abandonment and Reclamation
ARD	Acid Rock Drainage
Baffinland	Baffinland Iron Mines Corporation
CCME	Canadian Council of Ministers of the Environment
DEIS	Draft Environmental Impact Statement
EA	Environmental Assessment
EHS	Environmental Health and Safety
EIS	Environmental Impact Statement
EMMP	Environmental Mitigation and Monitoring Plans
ERP	Proposed Early Revenue Phase
ESA	Environmental Site Assessment
FEIS	Final Environmental Impact Statement
FOL	Federal Owned Lands
Ga	Giga-annum (billion years)
HADD	Harmful Alteration, Disruption, or Destruction
HTA/HTO	Hamlets, Hunters, and Trappers Association/Organization
HTO	Hunters and Trappers Organization
ICRP	Interim Closure and Reclamation Plan
IIBA	Inuit Impact and Benefits Agreement
IOL	Inuit Owned Lands
IQ	Inuit Qaujimajatuqangit (Inuit knowledge, or traditional knowledge)
KI	Key Indicator
LAC	Land Advisory Committee
LSA	Local Study Area
MASL	Metres above Sea Level
Mary River	Nuluujaak
MDAG	Mineral Development Advisory Group
MERA	Mineral and Energy Resource Assessment
ML	Metal Leaching
MOU	Memorandum of Understanding
Mtpa	Million Tonne-Per-Annum
NLCA	Nunavut Land Claims Agreement
NSA	Nunavut Settlement Area
NWT	Northwest Territories
PAG	Potential Acid Generating

Abbreviation	Description
PCRP	Preliminary Closure and Reclamation Plan
PDA	Potential Development Area
PDW	Pre-Development Works
PLA	Production Lease Area
PPR	Personal Property Registry
RA(s)	Responsible Authority(ies)
RMO	Resource Management Officer
RSA	Regional Study Area
TC-NWPP	Transport Canada Navigable Waters Protection Program
the Project	Mary River Project
TK	Traditional Knowledge
VC	Valued Component
VEC	Valued Ecosystem Component
VSEC	Valued Socio-Economic Component
Federal and Territorial Acts	
AWPPA	Arctic Waters Pollution Prevention Act
BCANU	Business Corporations Act (Nunavut)
CEAA	Canadian Environmental Assessment Act
CEPA	Canadian Environmental Protection Act, 1999
CLA	Commissioner's Land Act
CNPA	Canada National Parks Act
CWA	Canada Wildlife Act
EG&GANU	Engineers, Geologists and Geophysicists Act (Nunavut)
EMAANU	Emergency Medical Aid Act (Nunavut)
EPANU	Environmental Protection Act (Nunavut)
EUANU	Explosives Use Act (Nunavut)
EXA	Explosives Act
FA	Fisheries Act
FPANU	Fire Prevention Act (Nunavut)
LSANU	Labour Standards Act (Nunavut)
MBCA	Migratory Birds Convention Act, 1994
MH&SANU	Mine Health and Safety Act (Nunavut)
NW&NSRTA	Nunavut Waters and Nunavut Surface Rights Tribunal Act
PHANU	Public Health Act (Nunavut)
TDGA	Transportation of Dangerous Goods Act, 1992
TDGANU	Transportation of Dangerous Goods Act (Nunavut)
TLA	Territorial Lands Act
TPANU	Territorial Parks Act (Nunavut)
WANU	Wildlife Act (Nunavut)
WCANU	Workers' Compensation Act (Nunavut)
Federal and Territorial Regulations	
AWPPR	Arctic Waters Pollution Prevention Regulations
CFAEAP&R	Regulations Respecting the Coordination by Federal Authorities of Environmental Assessment Procedures and Requirements
CLR	Commissioner's Land Regulations
CMR	Canada Mining Regulations

Abbreviation	Description
CRFR	AECB Cost Recovery Fees Regulations, 1996
CSLR	Comprehensive Study List Regulations
CSLRNU	Comprehensive Study List Regulations (Nunavut)
CSRNU	Camp Sanitation Regulations (Nunavut)
ELR	Exclusion List Regulations
EURNU	Explosives Use Regulations (Nunavut)
EXR	Explosives Regulations
FPRNU	Fire Prevention Regulations (Nunavut)
ILR	Inclusion List Regulations
LLR	Law List Regulations
MBSR	Migratory Bird Sanctuary Regulations
MH&SRNU	Mine Health and Safety Regulations (Nunavut)
MDMER	Metal and Diamond Mining Effluent Regulations
NA&PSR	Nunavut Archaeological and Palaeontological Sites Regulations
NBRLUP	North Baffin Regional Land Use Plan
NPWR	National Parks Wildlife Regulations
NWTFR	Northwest Territories Fishery Regulations
NWTWR	Northwest Territories Waters Regulations
PCSRNU	Propane Cylinder Storage Regulations (Nunavut)
SCP&RRNU	Spill Contingency Planning and Reporting Regulations (Nunavut)
TDGR	Transportation of Dangerous Goods Regulations
TDGRNU	Transportation of Dangerous Goods Regulations (Nunavut)
TDR	Territorial Dredging Regulations
TLR	Territorial Lands Regulations
TLUR	Territorial Land Use Regulations
TPRNU	Territorial Parks Regulations (Nunavut)
TQR	Territorial Quarrying Regulations
WAR	Wildlife Area Regulations
WCRNU	Workers' Compensation Regulations (Nunavut)
WSRNU	Wildlife Sanctuaries Regulations (Nunavut)
Federal Government Departments and Agencies	
AANDC	Aboriginal Affairs and Northern Development Canada
CTA	Canadian Transportation Agency
DFO	Fisheries and Oceans Canada
DOJ	Department of Justice Canada
EC	Environment Canada
CIRNAC	Crown Indigenous Relations and Northern Affairs Canada, formerly Indian and Northern Affairs Canada and prior to that Aboriginal Affairs and Northern Development Canada
NRCan	Natural Resources Canada
PCH	Parks Canada Agency (Canadian Heritage)
TC	Transport Canada
Territorial Government Departments and Agencies	
CGSNU	Department of Community and Government Services
CLEYNU	Department of Culture, Language, Elders and Youth
DOJNU	Department of Justice

Abbreviation	Description
DOENU	Department of Environment
ED&TNU	Economic Development & Transportation
GN	Government of Nunavut
H&SSNU	Department of Health and Social Services
WSCC	Workers Safety and Compensation Commission of the Northwest Territories and Nunavut
Institutions Of Public Government	
CLARC	Community Land and Resource Committee
CLO	Community Liaison Officer
IPGs	Institutions of Public Government
MVLWB	Mackenzie Valley Land and Water Board
NIRB	Nunavut Impact Review Board
NPC	Nunavut Planning Commission
NSRT	Nunavut Surface Rights Tribunal
NWB	Nunavut Water Board
NWMB	Nunavut Wildlife Management Board
Inuit Organizations	
DIO	Designated Inuit Organizations
MHTO	Mittimatalik Hunters and Trappers Organization
NTI	Nunavut Tunngavik Incorporated
QIA	Qikiqtani Inuit Association
RIA	Regional Inuit Association
RWO	Regional Wildlife Organization

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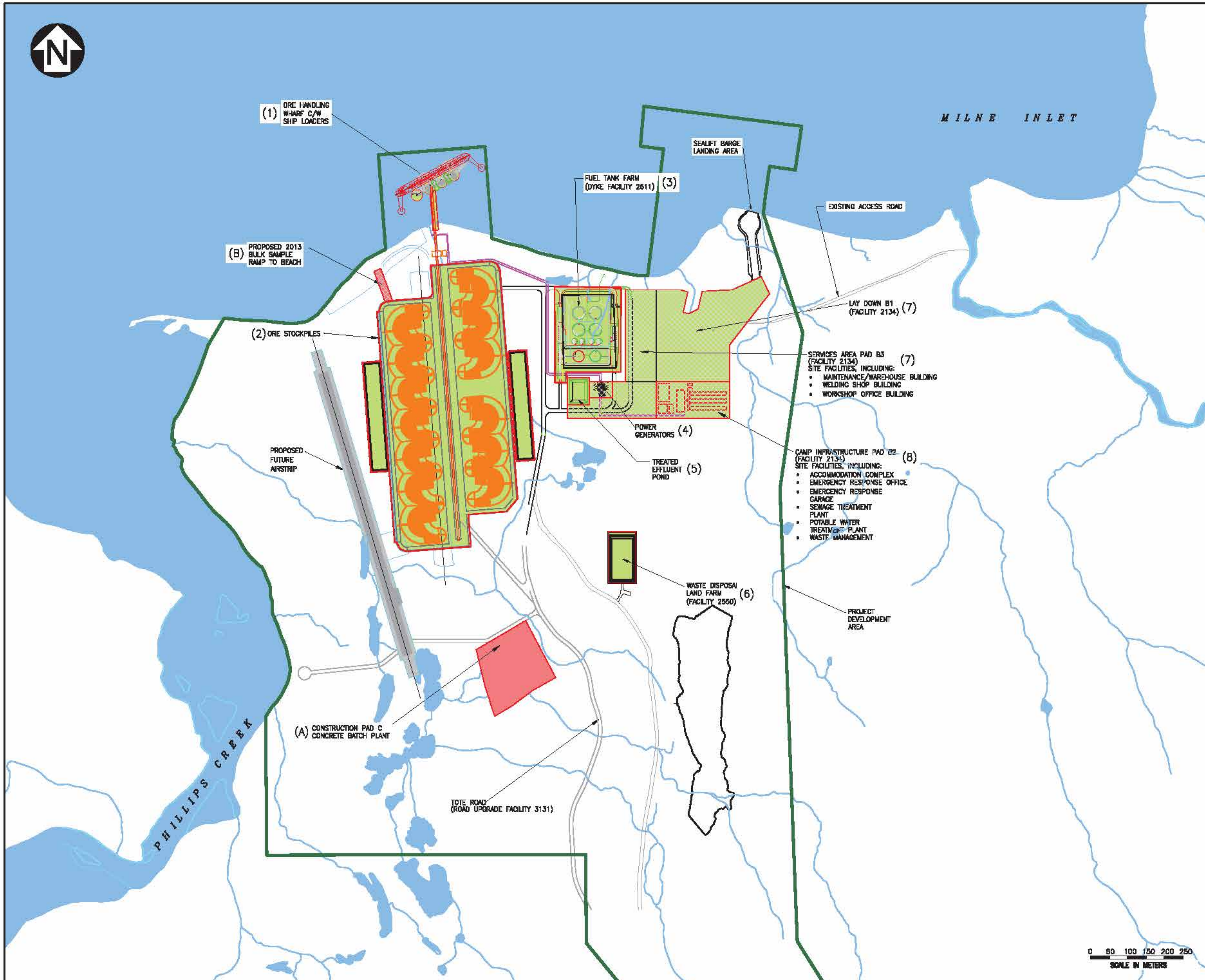
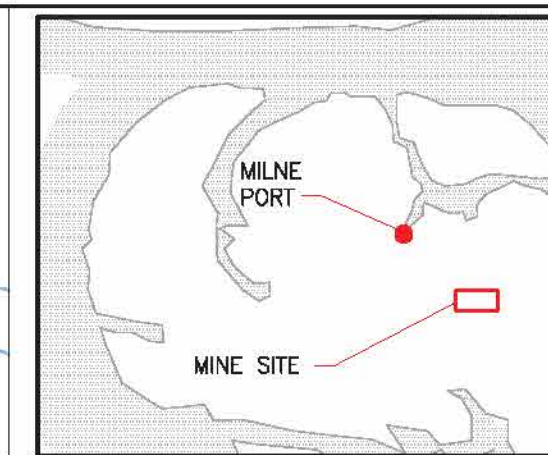
Appendix A Preliminary Mine Closure and Reclamation Plan Drawings





RECLAMATION AREA - AFTER CONSTRUCTION

AREA ID	m^2
A	31,597
B	1,835
TOTAL	33,432

RECLAMATION AREA - AFTER OPERATION

AREA ID	m^2
1	4600
2	267,770
3	42,630
4	2,780
5	4,450
6	10,500
7	116,730
8	20,000
TOTAL	451,460

LEGEND:

( ) RECLAMATION AREA ID

RECLAMATION AREA - AFTER CONSTRUCTION

RECLAMATION AREA - AFTER OPERATION

BAFFINALND IRON MINES CORPORATION

MARY RIVER PROJECT

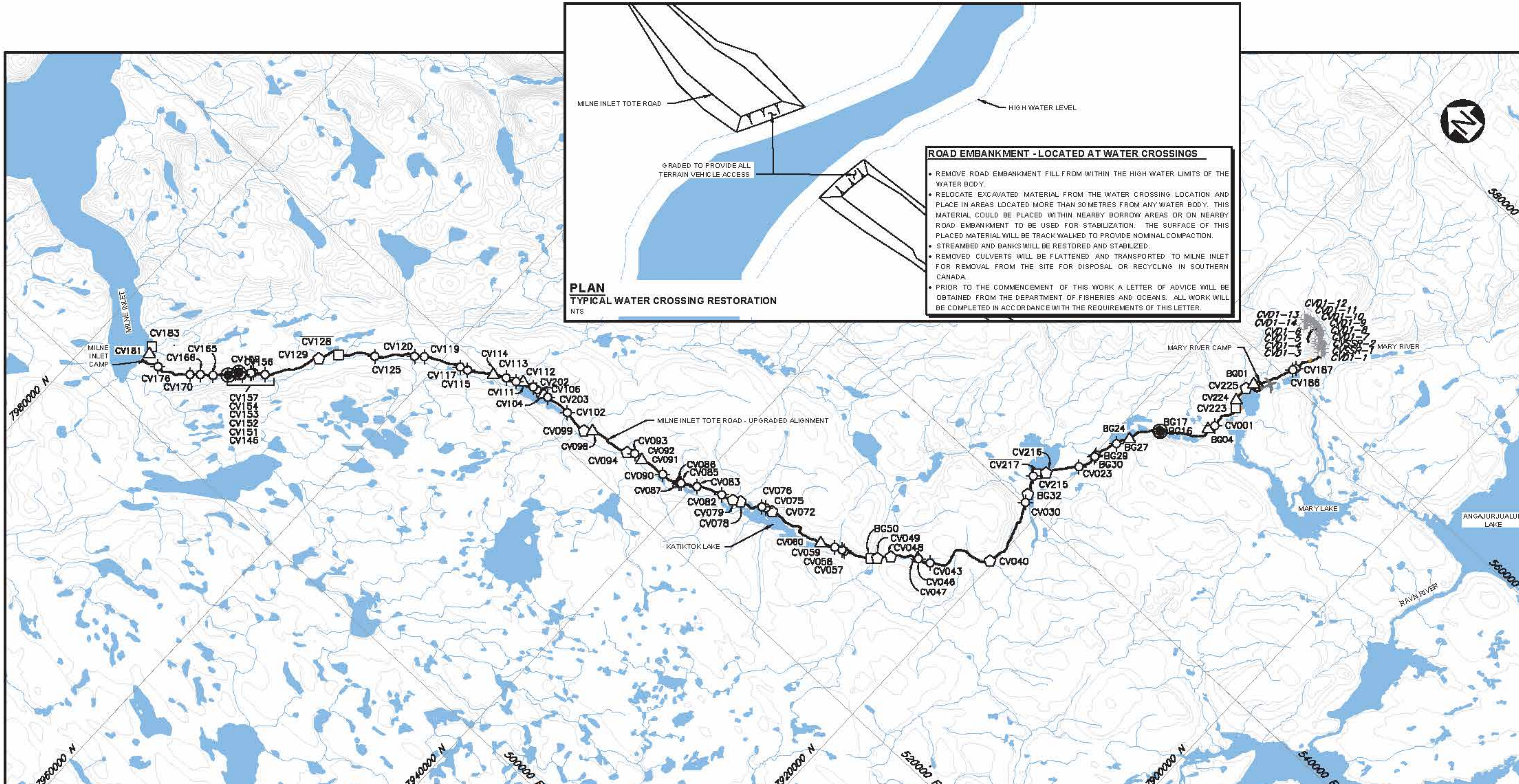
AREAS OF RECLAMATION - MILNE PORT LAYOUT

Baffinland

REF NO. BL_ARP_CAD_001

FIGURE NO. E349000-2000-07-014-0001

REV 0



ROAD EMBANKMENT - LOCATED AT WATER CROSSINGS

- REMOVE ROAD EMBANKMENT FILL FROM WITHIN THE HIGH WATER LIMITS OF THE WATER BODY.
- RELOCATE EXCAVATED MATERIAL FROM THE WATER CROSSING LOCATION AND PLACE IN AREAS LOCATED MORE THAN 30 METRES FROM ANY WATER BODY. THIS MATERIAL COULD BE PLACED WITHIN NEARBY BORROW AREAS OR ON NEARBY ROAD EMBANKMENT TO BE USED FOR STABILIZATION. THE SURFACE OF THIS PLACED MATERIAL WILL BE TRACK WALKED TO PROVIDE NOMINAL COMPACTION.
- STREAMBED AND BANKS WILL BE RESTORED AND STABILIZED.
- REMOVED CULVERTS WILL BE FLATTENED AND TRANSPORTED TO MILNE INLET FOR REMOVAL FROM THE SITE FOR DISPOSAL OR RECYCLING IN SOUTHERN CANADA.
- PRIOR TO THE COMMENCEMENT OF THIS WORK A LETTER OF ADVICE WILL BE OBTAINED FROM THE DEPARTMENT OF FISHERIES AND OCEANS. ALL WORK WILL BE COMPLETED IN ACCORDANCE WITH THE REQUIREMENTS OF THIS LETTER.

LEGEND:

- WATER
- MILNE INLET TOTE ROAD - UPDATED ALIGNMENT
- AIRSTRIP
- EXPLORATION CAMP LOCATION
- CULVERT LOCATION
- EXTRA SMALL CROSSING
- SMALL CROSSING
- MEDIUM CROSSING
- LARGE CROSSING
- EXTRA LARGE CROSSING

NOTES:

1. COORDINATE GRID IS UTM (NAD83) ZONE 17.
2. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA, DEPARTMENT OF NATURAL RESOURCES, (2004). ALL RIGHTS RESERVED.
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL VARIES.
4. MILNE INLET TOTE ROAD ALIGNMENT SURVEY PROVIDED BY GENIVAR (SURVEY COMPLETED IN JULY 2008).
5. NOT FOR CONSTRUCTION.

SCALE A 3 1.5 0 5 10 15 km

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

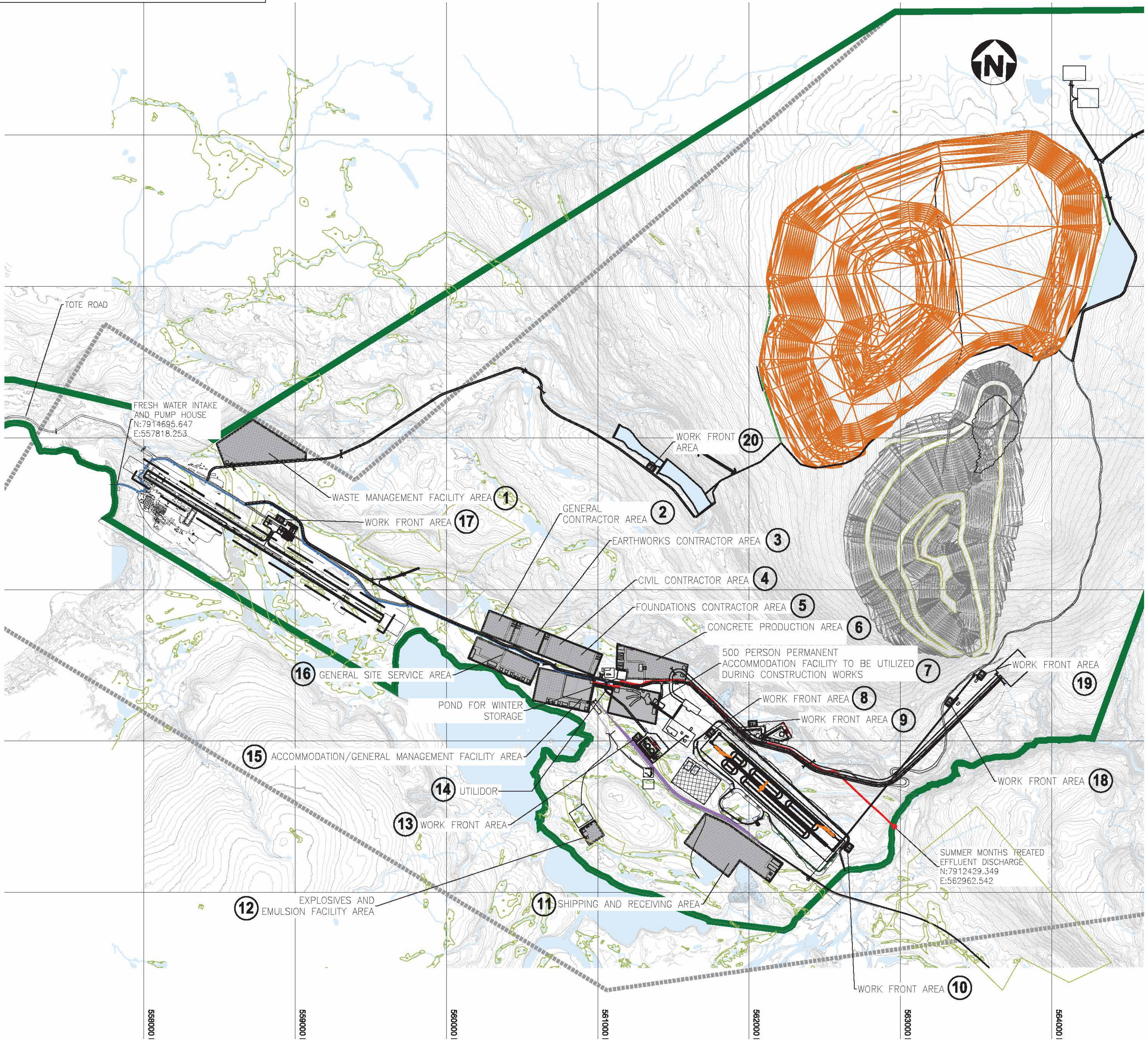
MILNE INLET TOTE ROAD
WATER CROSSING RESTORATION

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-181/29	1

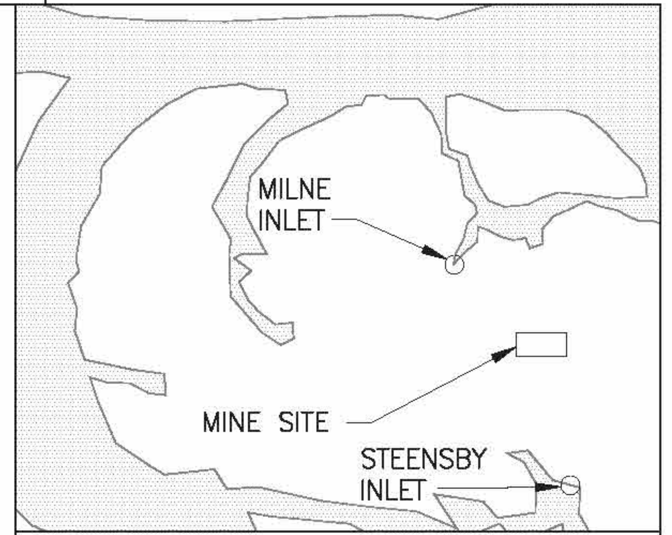
FIGURE 8.10 REV 0

DWG. NO. H337697-4210-07-012-0001



RECLAMATION AREA - AFTER CONSTRUCTION

AREA	m²
1	102,610
2	30,000
3	30,000
4	30,000
5	30,000
6	71,540
7	63,380
8	1,860
9	1,860
10	1,860
11	133,540
12	132,30
13	1,860
14	2,800
15	81,160
16	66,400
17	1,860
18	1,860
19	1,860
20	1,860
TOTAL	**669,540**



KEYPLAN

LEGENDS:

- RECLAMATION AREA AFTER CONSTRUCTION
- WATER
- WETLAND
- CONSTRUCTION WORKS LAYDOWN AREA
- RIVER/STREAM/DRAINAGE
- RAILWAY ALIGNMENT
- TREATED EFFLUENT PIPELINE
- FRESHWATER PIPELINE
- ACCESS ROAD
- POTENTIAL DEVELOPMENT AREA
- BAFFINLAND'S COMMERCIAL LEASE ON INUIT OWNED LAND

NOTES:

1. TOPOGRAPHY PROVIDED BY EAGLE MAPPING (2005).
2. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 17 AND IS IN METRES.
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL IS 10 METRES.
4. MINE SITE AS-CONSTRUCTED INFORMATION PROVIDED BY GENIVAR.
5. PROPOSED PERMANENT WORKS LAYOUT SHOWN FOR REFERENCE PURPOSES ONLY. DO NOT USE FOR CONSTRUCTION.

SCALE 300 150 0 500 1000 1500 mm

SCALE 1:15,000

DRAWING NO.	DRAWING TITLE

REFERENCE DRAWINGS

NO.	DESCRIPTION	BY	CHK'D	APP'D	DATE
A	ISSUED FOR INFORMATION				

REVISIONS

REV.	ISSUE FOR	AUTH. BY	DATE
A	ENVIRONMENTAL PERMITTING		

ISSUE AUTHORIZATION

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DESIGNED BY A. GRZEGORCZYK DATE	DRAWN BY M. LU DATE
CHECKED BY T. HO DATE	DISCIP. ENGR. J. BINNS DATE
PROJ. DES. COORD. DATE	PROJ. ENGR. DATE
PROJ. MGR. DATE	

Baffinland Iron Mines Corporation

MARY RIVER PROJECT

PRELIMINARY MINE CLOSURE AND RECLAMATION PLAN MINE SITE CONSTRUCTION PHASE

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OR AS NOTED	H337697-4210-07-012-0001	A

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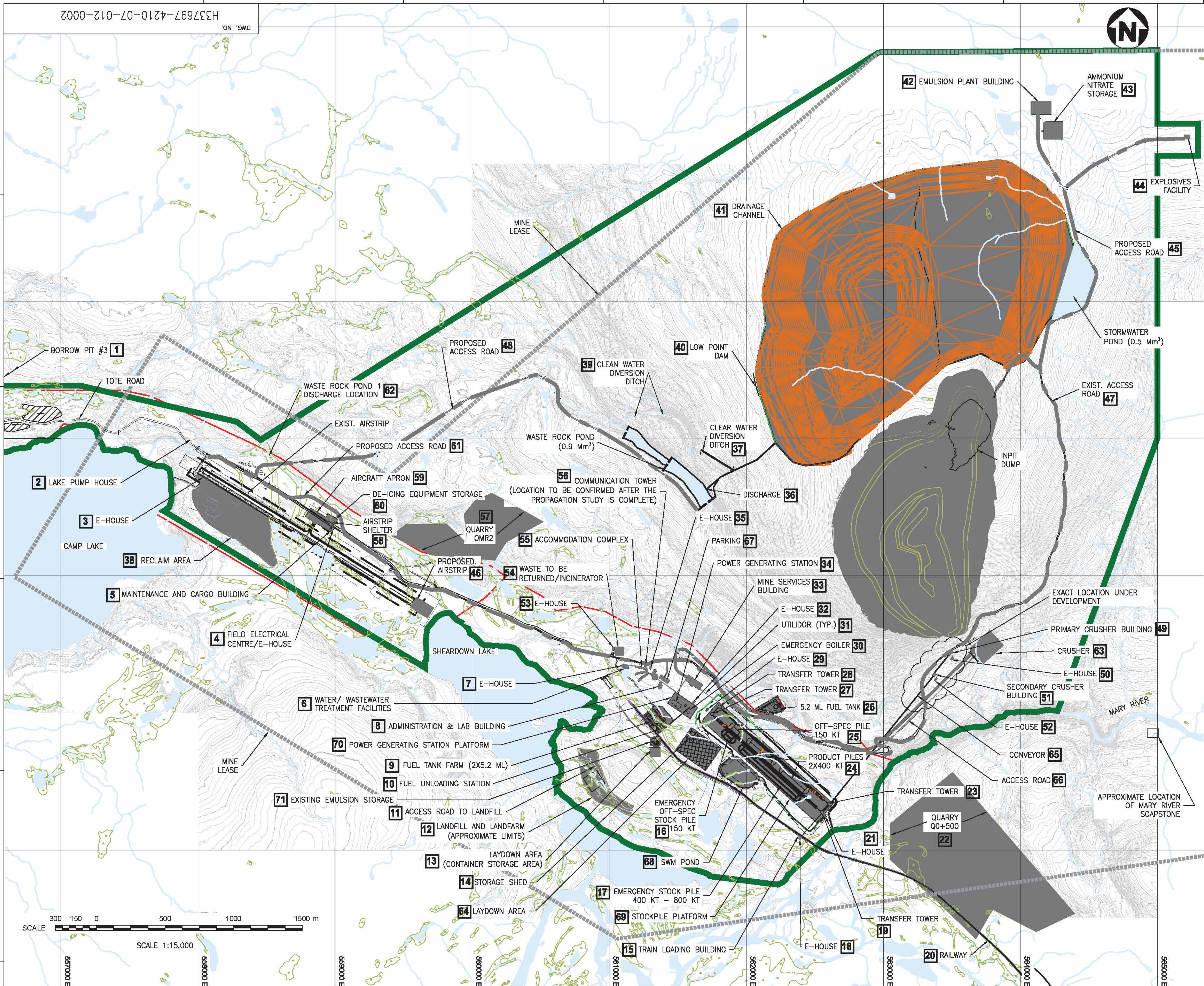
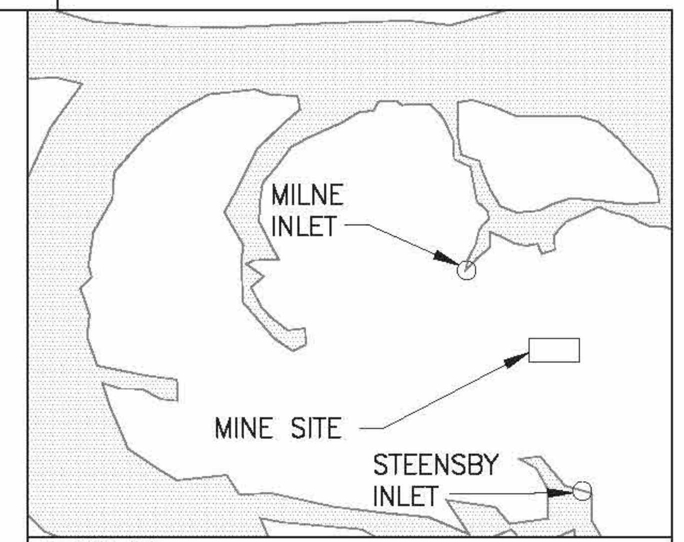


RECLAMATION AREA - AFTER OPERATION

AREA	m²
1	38,850
2	20
3	290
4	40
5	230
6	870
7	290
8	940
9	24,190
10	600
11	4,900
12	76,300
13	4,420
14	4,320
15	370
16	5,760
17	31,450
18	140
19	200
20	26,750
21	140
22	817,690
23	200
24	28,000
25	5,760
26	16,340
27	200
28	200
29	290
30	380
31	2,000
32	290
33	5,750
34	2,550
35	250
36	700
37	800
38	175,780
39	2,400
40	3,300
41	5,080,000
42	14,260
43	17,380
44	1,020
45	27,900
46	13,500
47	56,800
48	34,560
49	500
50	290
51	350
52	290
53	290
54	870
55	5,740
56	220
57	260,310
58	510
59	14,620
60	890
61	41,500
62	500



KEYPLAN

LEGENDS:

- RECLAMATION AREA AFTER OPERATION
- WATER
- EXISTING BORROW AREA
- TEMPORARY LAYDOWN AREA
- ACCESS ROAD
- RIVER/STREAM/DRAINAGE
- POTENTIAL DEVELOPMENT AREA
- BAFFINLAND'S COMMERCIAL LEASE ON INUIT OWNED LAND
- COMMUNICATION TOWER

NOTES:

1. TOPOGRAPHY PROVIDED BY TERRAPOINT CANADA INC.
2. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 17 AND IS IN METRES.
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL IS 2 METRES.
4. MINE SITE INFRASTRUCTURE IS BASED ON EIS AND AMEC DRAWINGS ADDITIONAL DETAILS PROVIDED IN DRAWINGS : A1-164512-6120-121-0100 A1-165926-6000-121-GAD-0100 A1-159952-6020-121-0200
5. MATERIAL HANDLING AND PROCESSING LAYOUT WAS REVISED BASED ON AKER KVAERNER DRAWING DWG-2000-M-0003, REV C.
6. MINE SITE AS-CONSTRUCTED INFORMATION PROVIDED BY GENIVAR, SURVEYED AS OF JAN. 2009.

AREA	m²
63	30,000
64	48,500
65	3,460
66	58,300
67	3,400
68	43,600
69	133,670
70	16,800
71	6,570
TOTAL	7,200,570

DRAWING NO.	DRAWING TITLE

REFERENCE DRAWINGS

NO.	DESCRIPTION	BY	CHK'D	APP'D	DATE
A	ISSUED FOR INFORMATION				

REVISIONS

REV.	ISSUE FOR	AUTH. BY	DATE
A	ENVIRONMENTAL PERMITTING		

ISSUE AUTHORIZATION

HATCH

Baffinland Iron Mines Corporation

DESIGNED BY A. GREGORCZYK DATE	DRAWN BY M. LU DATE
CHECKED BY T. HO DATE	DISCIP. ENGR. J. BINNS DATE
PROJ. DES. COORD. DATE	PROJ. ENGR. DATE
PROJ. MGR. DATE	

MARY RIVER PROJECT

PRELIMINARY MINE CLOSURE AND RECLAMATION PLAN MINE SITE FINAL CLOSURE PHASE

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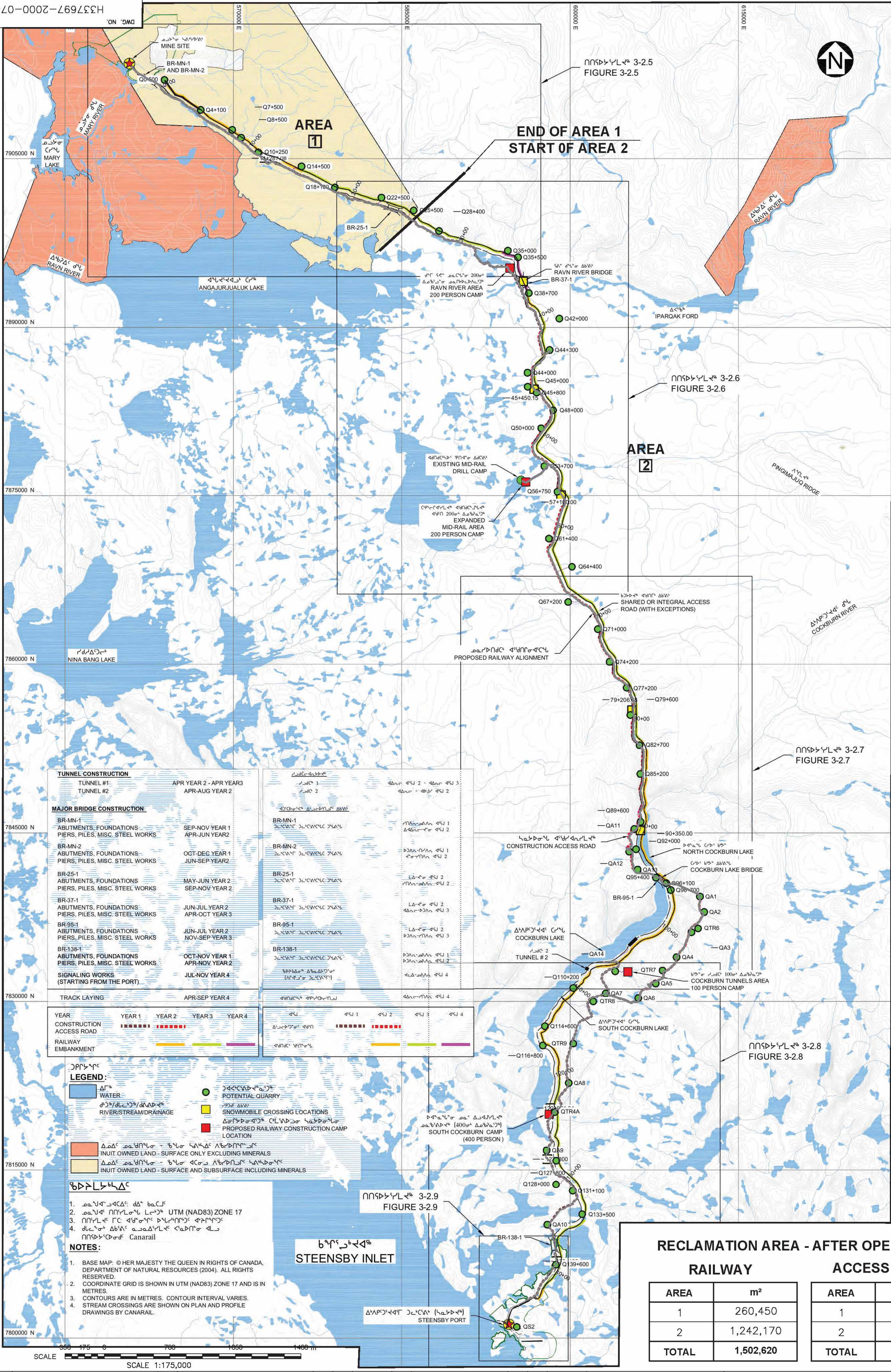

TUNNEL CONSTRUCTION	
TUNNEL #1	APR YEAR 2 - APR YEAR3
TUNNEL #2	APR-AUG YEAR 2
MAJOR BRIDGE CONSTRUCTION	
BR-MN-1	
ABUTMENTS, FOUNDATIONS	SEP-NOV YEAR 1
PIERS, PILES, MISC. STEEL WORKS	APR-JUN YEAR2
BR-MN-2	
ABUTMENTS, FOUNDATIONS	OCT-DEC YEAR 1
PIERS, PILES, MISC. STEEL WORKS	JUN-SEP YEAR2
BR-25-1	
ABUTMENTS, FOUNDATIONS	MAY-JUN YEAR 2
PIERS, PILES, MISC. STEEL WORKS	SEP-NOV YEAR 2
BR-37-1	
ABUTMENTS, FOUNDATIONS	JUN-JUL YEAR 2
PIERS, PILES, MISC. STEEL WORKS	APR-OCT YEAR 3
BR-95-1	
ABUTMENTS, FOUNDATIONS	JUN-JUL YEAR 2
PIERS, PILES, MISC. STEEL WORKS	NOV-SEP YEAR 3
BR-138-1	
ABUTMENTS, FOUNDATIONS	OCT-NOV YEAR 1
PIERS, PILES, MISC. STEEL WORKS	APR-NOV YEAR 2
SIGNALING WORKS (STARTING FROM THE PORT)	JUL-NOV YEAR 4
TRACK LAYING	APR-SEP YEAR 4

YEAR	YEAR 1	YEAR 2	YEAR 3	YEAR 4
CONSTRUCTION ACCESS ROAD				
RAILWAY EMBANKMENT				

LEGEND:

- WATER
- RIVER/STREAM/DRAINAGE
- POTENTIAL QUARRY
- SNOWMOBILE CROSSING LOCATIONS
- PROPOSED RAILWAY CONSTRUCTION CAMP LOCATION
- INUIT OWNED LAND - SURFACE ONLY EXCLUDING MINERALS
- INUIT OWNED LAND - SURFACE AND SUBSURFACE INCLUDING MINERALS

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA, DEPARTMENT OF NATURAL RESOURCES (2004). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 17 AND IS IN METRES.
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL VARIES.
4. STREAM CROSSINGS ARE SHOWN ON PLAN AND PROFILE DRAWINGS BY CANARAIL.

RECLAMATION AREA - AFTER OPERATION

RAILWAY

AREA	m²
1	260,450
2	1,242,170
TOTAL	1,502,620

ACCESS ROAD

AREA	m²
1	269,440
2	1,247,730
TOTAL	1,517,170

DRAWING NO.	DRAWING TITLE	DESCRIPTION	CHK'D	APP'D	DATE	REV.	ISSUE FOR	AUTH. BY	DATE
		A ISSUED FOR INFORMATION							
REFERENCE DRAWINGS		REVISIONS					ISSUE AUTHORIZATION		

HATCH

Baffinland Iron Mines Corporation

DESIGNED BY — DRAWN BY M.L.
CHECKED BY — DISCIP. ENGR.
PROJ. DES. COORD. — PROJ. ENGR.
PROJ. MGR.

MARY RIVER PROJECT

PRELIMINARY MINE CLOSURE AND RECLAMATION PLAN RAILWAY ALIGNMENT

SCALE: AS NOTED

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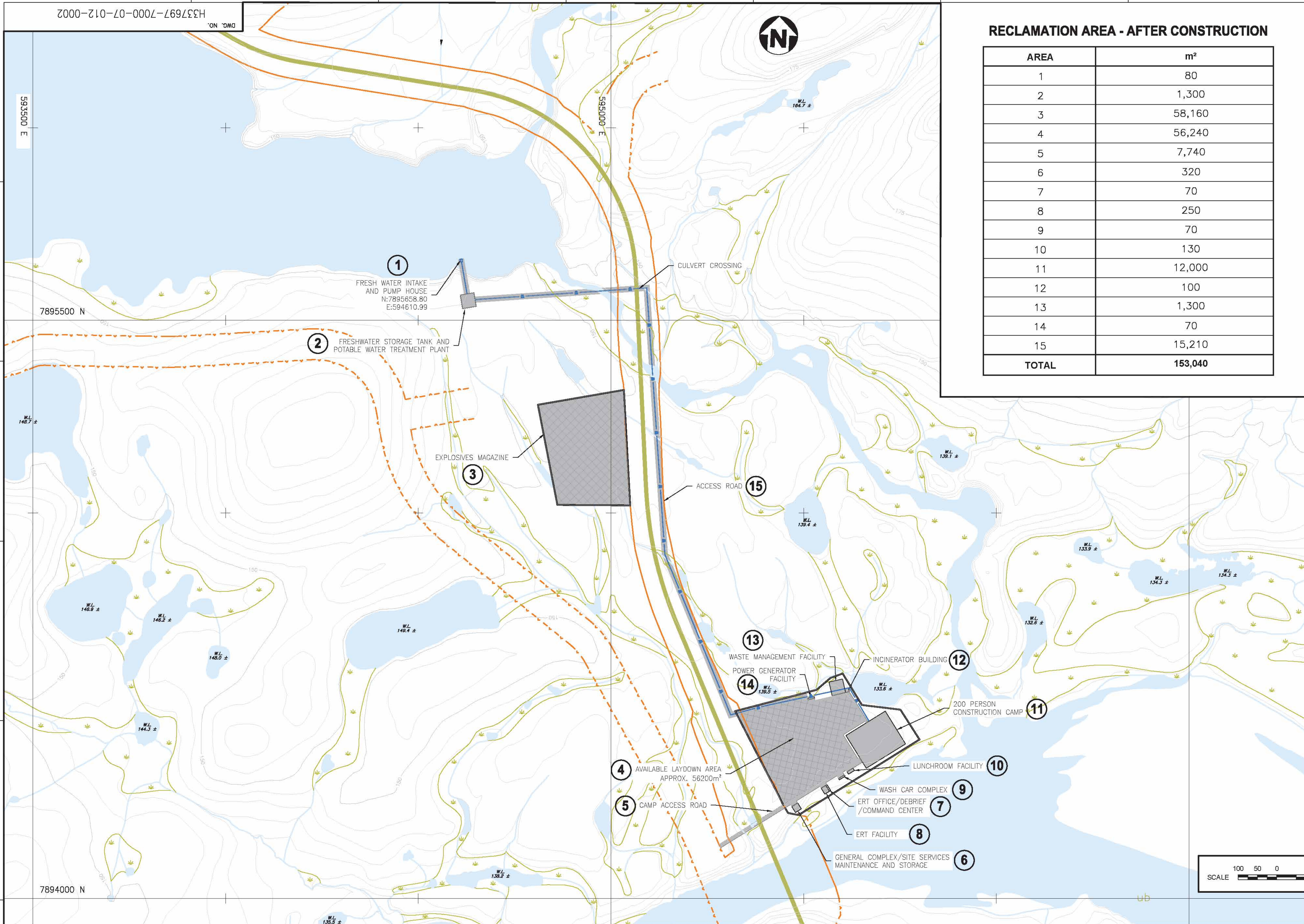
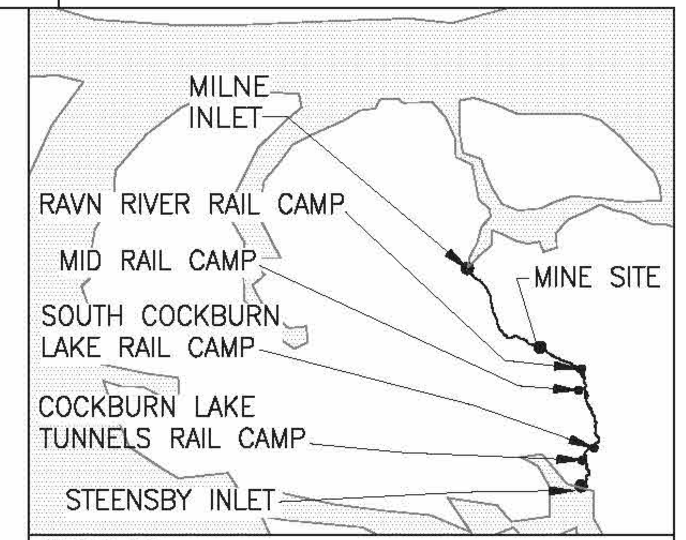


SCALE 1:5,000

RECLAMATION AREA - AFTER CONSTRUCTION

AREA	m²
1	80
2	1,300
3	58,160
4	56,240
5	7,740
6	320
7	70
8	250
9	70
10	130
11	12,000
12	100
13	1,300
14	70
15	15,210
TOTAL	**153,040**



KEYPLAN

LEGENDS:

- RECLAMATION AREA AFTER CONSTRUCTION
- WATER
- WETLAND
- PRE-DEVELOPMENT LAYDOWN AREA
- RIVER/STREAM/DRAINAGE
- FUTURE RAILWAY ALIGNMENT

NOTE(S):

1. TOPOGRAPHY PROVIDED BY EAGLE MAPPING (2005).
2. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 17 AND IS IN METERS.
3. CONTOURS ARE IN METERS. CONTOUR INTERVAL IS 10 METERS.

DRAWING NO.	DRAWING TITLE

REFERENCE DRAWINGS

NO.	DESCRIPTION	BY	CHK'D	APP'D	DATE
A	ISSUED FOR INFORMATION				

REVISIONS

REV.	ISSUE FOR	AUTH. BY	DATE
A	ENVIRONMENTAL PERMITTING		

ISSUE AUTHORIZATION

HATCH

DESIGNED BY A. GRZEGORCZYK — DATE
DRAWN BY D. FUNG — DATE
CHECKED BY T. HO — DATE
DISCIP. ENGR. J. BINNS — DATE
PROJ. DES. COORD. — DATE
PROJ. ENGR. — DATE
PROJ. MGR. — DATE

Baffinland Iron Mines Corporation

MARY RIVER PROJECT

PRELIMINARY MINE CLOSURE
AND RECLAMATION PLAN
RAVN RIVER RAIL CAMP

SCALE: OR AS NOTED
DWG. NO. H337697-7000-07-012-0002
REV. A

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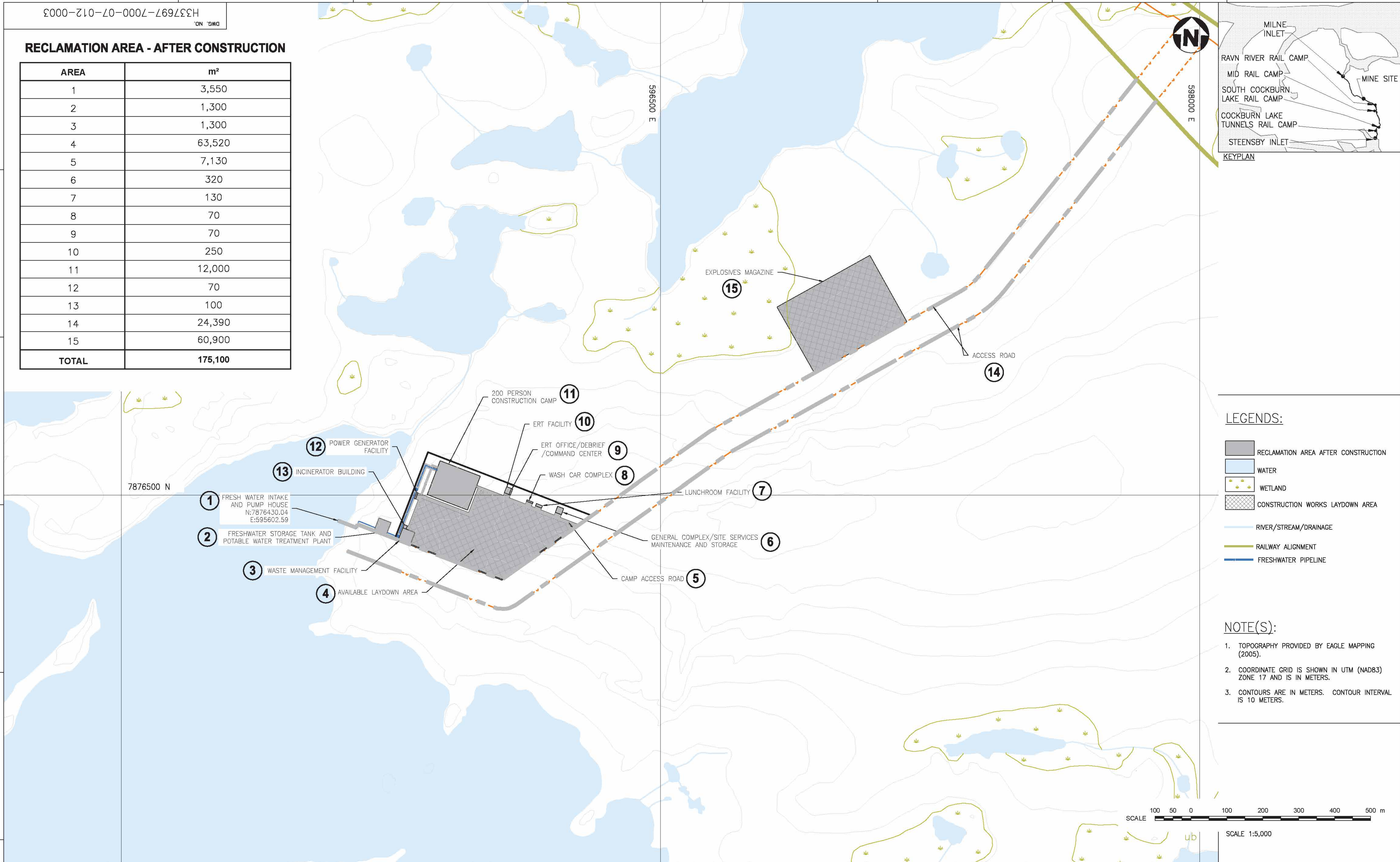
DWG. NO. H337697-7000-07-012-0003

RECLAMATION AREA - AFTER CONSTRUCTION

AREA	m²
1	3,550
2	1,300
3	1,300
4	63,520
5	7,130
6	320
7	130
8	70
9	70
10	250
11	12,000
12	70
13	100
14	24,390
15	60,900
TOTAL	**175,100**



LEGENDS:

- RECLAMATION AREA AFTER CONSTRUCTION
- WATER
- WETLAND
- CONSTRUCTION WORKS LAYDOWN AREA
- RIVER/STREAM/DRAINAGE
- RAILWAY ALIGNMENT
- FRESHWATER PIPELINE

NOTE(S):

1. TOPOGRAPHY PROVIDED BY EAGLE MAPPING (2005).
2. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 17 AND IS IN METERS.
3. CONTOURS ARE IN METERS. CONTOUR INTERVAL IS 10 METERS.

SCALE 1:5,000

DRAWING NO.	DRAWING TITLE

REFERENCE DRAWINGS

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A	ISSUED FOR INFORMATION				

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REV.	ISSUE FOR	AUTH. BY	DATE
A	ENVIRONMENTAL PERMITTING		

ISSUE AUTHORIZATION

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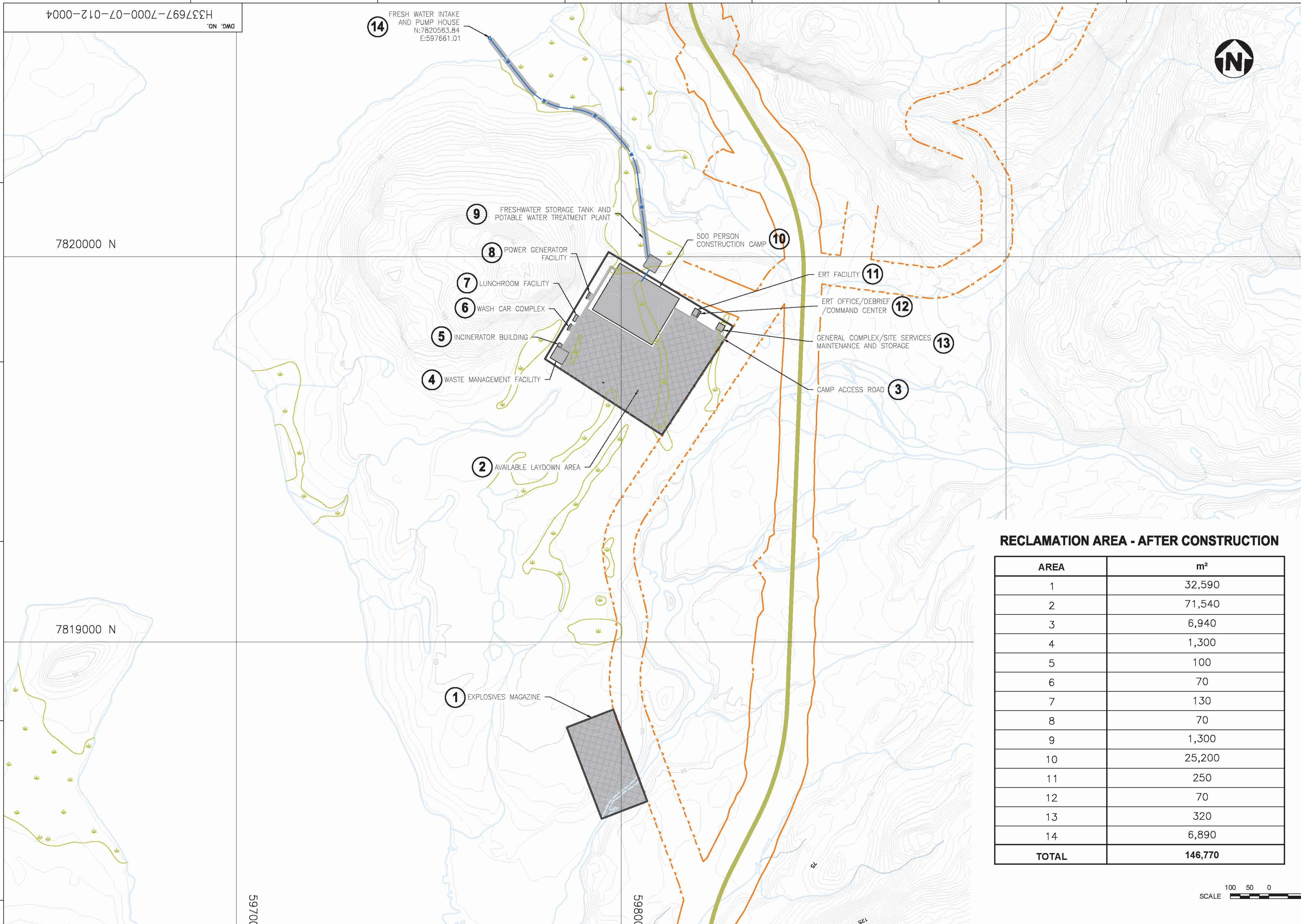
DESIGNED BY A. GRZEGORCZYK DATE	DRAWN BY Y. HUANG DATE
CHECKED BY T. HO DATE	DISCIP. ENGR. J. BINNS DATE
PROJ. DES. COORD. DATE	PROJ. ENGR. DATE
PROJ. MGR. DATE	

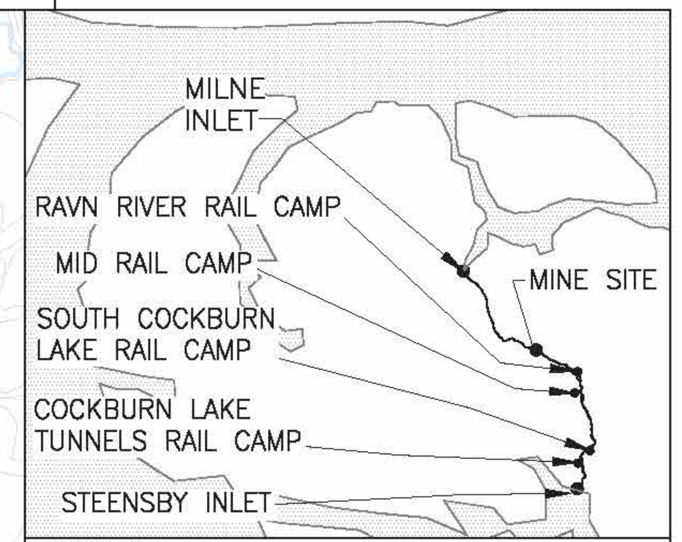
Baffinland Iron Mines Corporation

MARY RIVER PROJECT

PRELIMINARY MINE CLOSURE AND RECLAMATION PLAN MID RAIL CAMP

SCALE: OR AS NOTED | DWG. NO. H337697-7000-07-012-0003 | REV. A





KEYPLAN

RECLAMATION AREA - AFTER CONSTRUCTION

AREA	m²
1	32,590
2	71,540
3	6,940
4	1,300
5	100
6	70
7	130
8	70
9	1,300
10	25,200
11	250
12	70
13	320
14	6,890
TOTAL	**146,770**

LEGENDS:

- RECLAMATION AREA AFTER CONSTRUCTION
- WATER
- WETLAND
- CONSTRUCTION WORKS LAYDOWN AREA
- RIVER/STREAM/DRAINAGE
- RAILWAY ALIGNMENT
- FRESHWATER PIPELINE

NOTE(S):

1. TOPOGRAPHY PROVIDED BY EAGLE MAPPING (2005).
2. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 17 AND IS IN METERS.
3. CONTOURS ARE IN METERS. CONTOUR INTERVAL IS 10 METERS.

SCALE 100 50 0 100 200 300 400 500 m

SCALE 1:5,000

DRAWING NO.	DRAWING TITLE

REFERENCE DRAWINGS

NO.	DESCRIPTION	BY	CHK'D	APP'D	DATE
A	ISSUED FOR INFORMATION				

REVISIONS

REV.	ISSUE FOR	AUTH. BY	DATE
A	ENVIRONMENTAL PERMITTING		

ISSUE AUTHORIZATION

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DATE	DATE
CHECKED BY T. HO	DISCIP. ENGR. J. BINNS
DATE	DATE
PROJ. DES. COORD.	PROJ. ENGR.
DATE	DATE
PROJ. MGR.	
DATE	

Baffinland Iron Mines Corporation

MARY RIVER PROJECT

PRELIMINARY MINE CLOSURE AND RECLAMATION PLAN SOUTH COCKBURN LAKE RAIL CAMP

SCALE	DWG. NO.	REV.
OR AS NOTED	H337697-7000-07-012-0004	A

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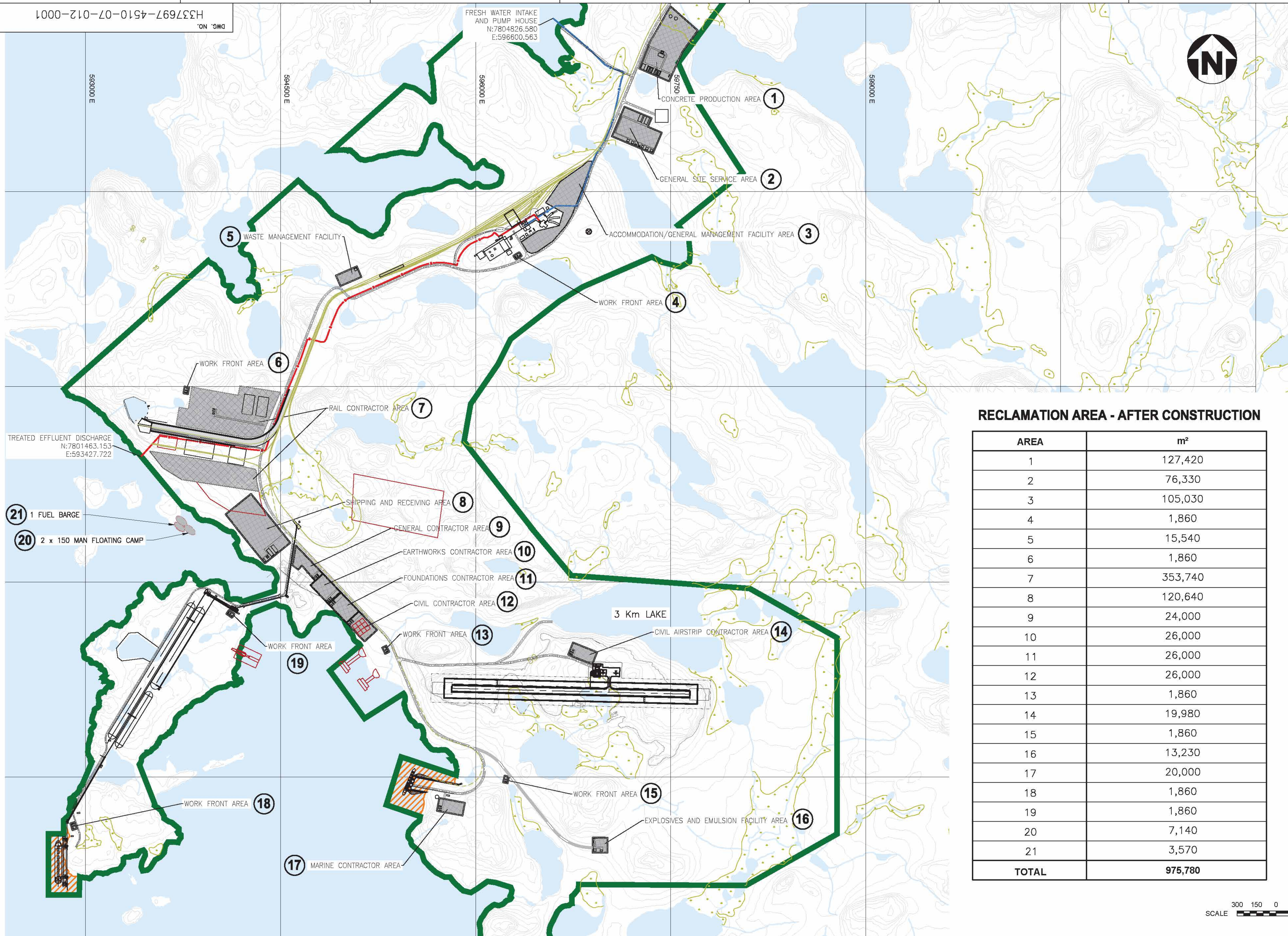

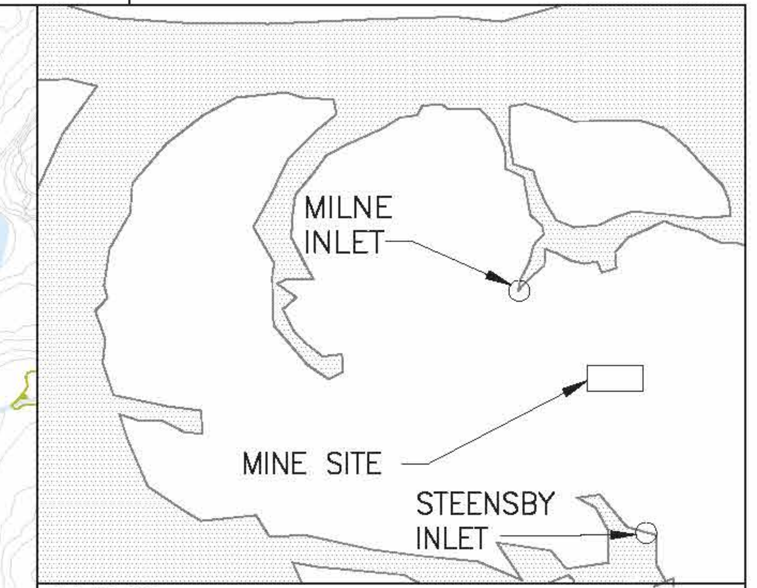

KEYPLAN

RECLAMATION AREA - AFTER CONSTRUCTION

AREA	m²
1	127,420
2	76,330
3	105,030
4	1,860
5	15,540
6	1,860
7	353,740
8	120,640
9	24,000
10	26,000
11	26,000
12	26,000
13	1,860
14	19,980
15	1,860
16	13,230
17	20,000
18	1,860
19	1,860
20	7,140
21	3,570
TOTAL	**975,780**

LEGENDS:

- RECLAMATION AREA AFTER CONSTRUCTION
- WATER
- WETLAND
- CONSTRUCTION WORKS LAYDOWN AREAS
- FORESHORE AREA
- RIVER/STREAM/DRAINAGE
- POTENTIAL DEVELOPMENT AREA
- FUTURE RAILWAY ALIGNMENT
- ACCESS ROAD
- TREATED EFFLUENT PIPELINE
- FRESHWATER PIPELINE

NOTE(S):

1. TOPOGRAPHY PROVIDED BY EAGLE MAPPING (2005).
2. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 17 AND IS IN METRES.
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL IS 5 METRES.
4. AS-CONSTRUCTED INFORMATION PROVIDED BY GENIVAR IN 2008.
5. PROPOSED PERMANENT WORKS LAYOUT SHOWN FOR REFERENCE PURPOSES ONLY. DO NOT USE FOR CONSTRUCTION.

SCALE 300 150 0 500 1000 1500 m

SCALE 1:15,000

DWG. NO. H337697-4510-07-012-0001

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A	ISSUED FOR INFORMATION				

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A	ENVIRONMENTAL PERMITTING		

ISSUE AUTHORIZATION

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CHECKED BY T. HO DATE	DISCIP. ENGR. J. BINNS DATE
PROJ. DES. COORD. DATE	PROJ. ENGR. DATE
PROJ. MGR. DATE	

Baffinland Iron Mines Corporation

MARY RIVER PROJECT

PRELIMINARY MINE CLOSURE AND RECLAMATION PLAN STEENSBY PORT CONSTRUCTION PHASE

SCALE	DWG. NO.	REV.
OR AS NOTED	H337697-4510-07-012-0001	A

Oct 28, 2011, 4:39pm Login name: fun51283 Layout: STEENSBY INLET
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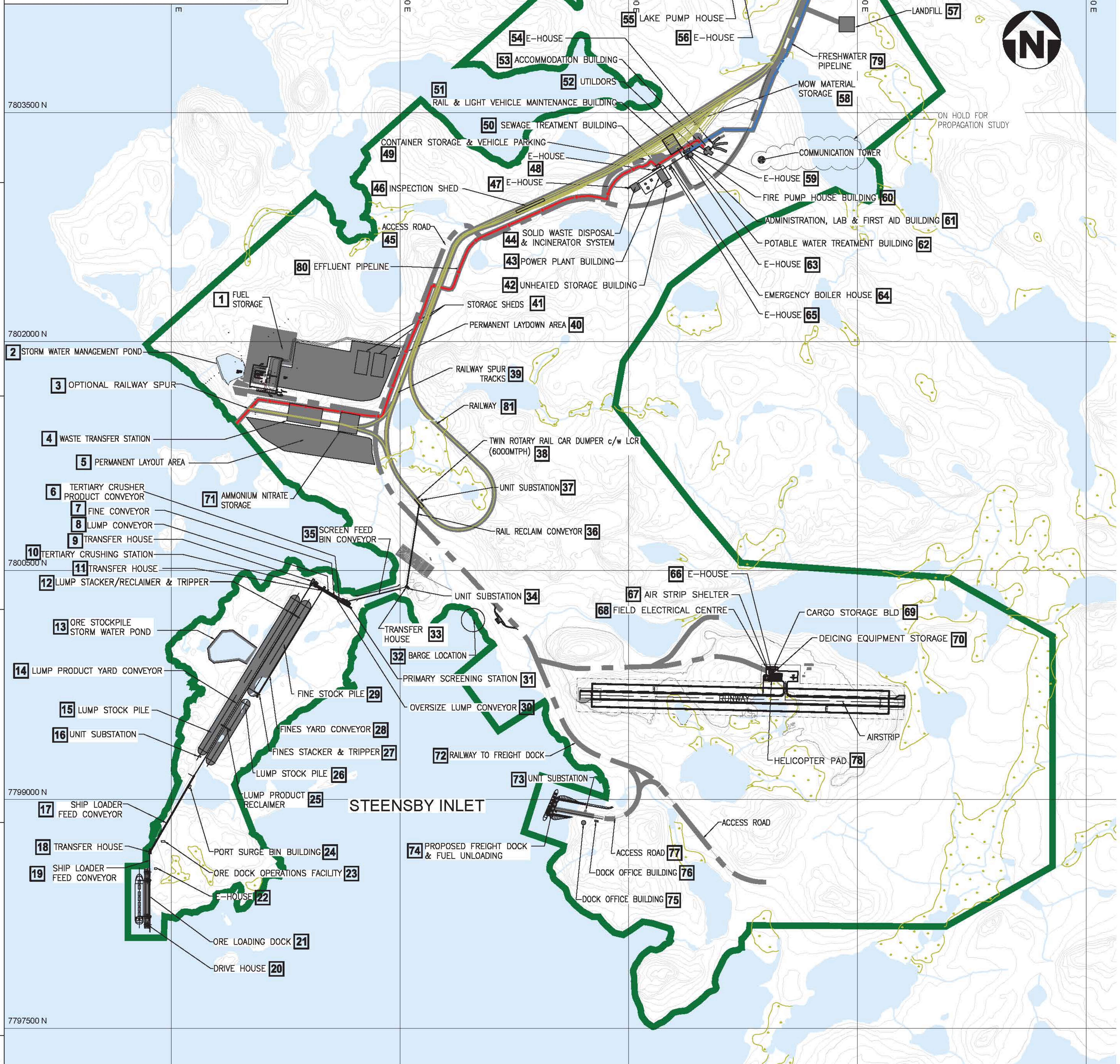
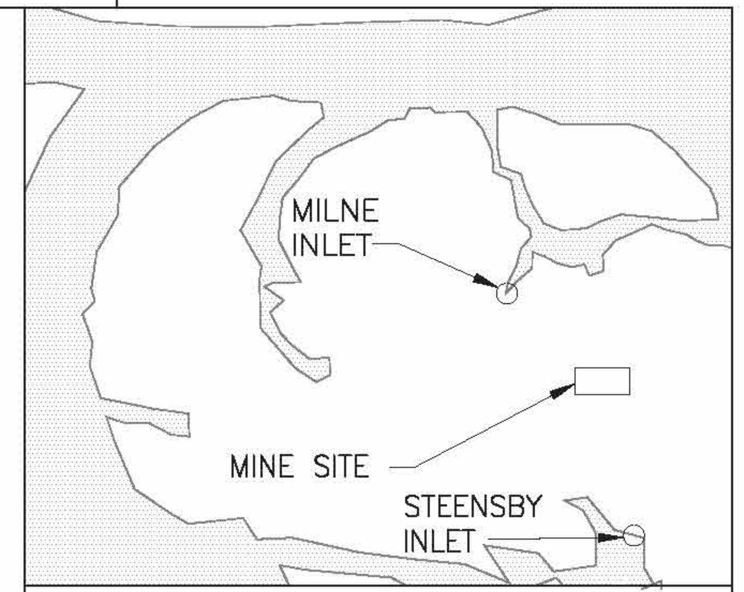
DWG. NO. H337697-4510-07-012-0002



RECLAMATION AREA - AFTER OPERATION

AREA	m²	AREA	m²
1	100,430	42	1,080
2	25,320	43	3,740
3	8,100	44	2,500
4	26,010	45	89,100
5	130,440	46	3,500
6	430	47	130
7	300	48	60
8	420	49	5,300
9	490	50	480
10	580	51	8,880
11	350	52	2,080
12	360	53	5,260
13	49,330	54	140
14	3,150	55	40
15	74,220	56	40
16	140	57	10,000
17	1,200	58	2,670
18	410	59	140
19	1,110	60	290
20	750	61	900
21	15,440	62	290
22	140	63	140
23	220	64	130
24	220	65	140
25	360	66	40
26	29,670	67	230
27	220	68	360
28	1,250	69	540
29	52,050	70	520
30	460	71	15,630
31	1,800	72	29,030
32	24,000	73	220
33	240	74	2,200
34	100	75	610
35	22,500	76	220
36	830	77	7,650
37	100	78	1,430
38	1,280	79	6,260
39	16,000	80	24,420
40	198,780	81	114,380
41	24,510	**TOTAL**	**1,154,480**



KEYPLAN

LEGENDS:

- RECLAIMED AREA AFTER OPERATION
- WATER
- WETLAND
- CONSTRUCTION WORKS LAYDOWN AREAS
- FORESHORE AREA
- RIVER/STREAM/DRAINAGE
- POTENTIAL DEVELOPMENT AREA
- FUTURE RAILWAY ALIGNMENT
- ACCESS ROAD
- TREATED EFFLUENT PIPELINE
- FRESHWATER PIPELINE

NOTE(S):

1. TOPOGRAPHY PROVIDED BY EAGLE MAPPING (2005).
2. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 17 AND IS IN METRES.
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5. PROPOSED PERMANENT WORKS LAYOUT SHOWN FOR REFERENCE PURPOSES ONLY. DO NOT USE FOR CONSTRUCTION.

SCALE 300 150 0 500 1000 1500 m

SCALE 1:15,000

DRAWING NO.	DRAWING TITLE

REFERENCE DRAWINGS

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A	ISSUEDE FOR INFORMATION	DF	AG	TH	11/09/11

REVISIONS

REV.	ISSUE FOR	AUTH.	BY	DATE
B	ENVIRONMENTAL PERMITTING	SP	TH	07/02/12
A	ENVIRONMENTAL PERMITTING	SP	TH	11/09/11

ISSUE AUTHORIZATION

HATCH

DESIGNED BY A. GRZEGORCZYK DATE
DRAWN BY D. FUNG DATE
CHECKED BY T. HO DATE
DISCIP. ENGR. J. BINNS DATE
PROJ. DES. COORD. DATE
PROJ. ENGR. DATE
PROJ. MGR. DATE

Baffinland Iron Mines Corporation

MARY RIVER PROJECT

PRELIMINARY MINE CLOSURE AND RECLAMATION PLAN STEENSBY PORT FINAL CLOSURE PHASE

SCALE AS NOTED | DWG. NO. H337697-4510-07-012-0002 | REV. B

Appendix B Mine Closure and Reclamation Planning Guidelines, Regulations and Lease Requirements

The following tables provide cross-referencing to where responses to key Mine Closure and Reclamation Planning guidelines, regulations or lease requirements can be found in this document. The referenced section of this ICRP provides an outline, at a conceptual level, of how the proponent plans to address the particular requirement.

Table B-1: Territorial Lands Act

Territorial Land Use Regulations (TLUR 2010)		
Key Mine Closure and Reclamation Plan Guidelines	**TLUR Section**	***ICRP* (Section)**
All closure work shall be carried out in accordance with permit requirements as stated in the *Territorial Land Use Regulations.*	s. 8 through 10, 31	2.5
"Subject to the terms and conditions of his permit or the express written authority of an inspector, every permittee shall replace all materials removed by him in the course of excavating, other than rock trenching, and shall level and compact the area of excavation."	s. 12	Table 5.1
"Restore the channel and bed of the stream to their original alignment and cross-section."	s. 13.(1 b)	Table 5.1
"Subject to the terms and conditions of his permit, every permittee shall, after completion of a land use operation, restore the permit area as nearly as possible to the same condition as it was prior to commencement of the land use operation."	s. 18	Table 5.1
Remove all buildings equipment, machinery, and storage equipment/containers and materials onsite.	s. 19.(1)	5.2.4
A final plan will be issued to the "engineer" within 60 days following completion of the land use operation or expiration of the permit.	s. 33	2.3.1.4
All plan drawings shall be: • Drawn to scale that clearly illustrates all mine features. • Shows the scale on the drawing. and • Provide geographic co-ordinates.	s.35	Appendix A
"In order to ensure that a permittee compiles with the terms and conditions of his permit with these Regulations, the engineer may include in the permit a condition that the permittee deposit with the Minister a security deposit not exceeding $100,000."	s. 36	?

Table B-2: Nunavut Impact Review Board

Guidelines for the Preparation of an Environmental Impact Statement for Baffinland Iron Mines Corporation's Mary River Project (2009)	
Key Mine Closure and Reclamation Plan Guidelines	***ICRP* (Section)**
"To ensure that issues associated with the effective closure and reclamation of all Project Components is considered at the earliest possible stage in the mine development process, thereby influencing mine design to take into account environmental issues related to mine closure and reclamation."	All
"To establish major targets for reclamation of lands potentially affected by the Project."	Table 5.1
"Description of reclamation methods, time frames and schedules, including proposed notice periods to employees and public."	5
"Description of temporary closure measures and a discussion of at what point a temporary closure should be considered permanent for the purposes of requiring implementation."	0
"Discussion of research programs to address challenges to reclamation, given the local conditions."	Appendix D
"Considerations for the Projection of public health and safety."	7.1.1, & 7.2.1
"Description of closure and post - closure monitoring of environmental components."	9
"Discussion of the need for long - term monitoring and maintenance by establishing physical and chemical stability."	9
"Discussion on reduction or elimination of environmental effects once the mine ceases operation."	Table 5.1 & 9
"Discussion regarding re-establish conditions that permit the land to return to similar pre-mining land use."	Table 5.1 & 5.1.1
"Consideration for ML/ARD potential of rocks, in association with related waste rock management strategies."	5.2.1.9 & 5.2.2.7
"Any considerations for the restoration of the natural aesthetics of the Project."	Table 5.1

Table B-3: AANDC (CIRNAC) Guidelines

Mine Site Reclamation Guidelines for the Northwest Territories (2007)	
Key Mine Closure and Reclamation Plan Guidelines	***ICRP* Report Section**
Develop and implement preventive and control strategies to effectively minimize the potential for ARD and ML to occur.	5.2.2
Where ARD and ML are occurring as a result of mine activities, mitigate and minimize impacts to the environment.	5.2.1.9 & 5.2.2.9
Re-establish the pre-mining ground cover, which may involve encouraging self-sustainable indigenous vegetation growth.	5
Remediate any sources of contamination that may have been created during the development and operation of the mine site in order to protect humans, wildlife, and environmental health.	Table 5.1
Ensure physical stability of residual earth structures for environmental, human, and wildlife safety.	Table 5.1

Mine Site Reclamation Guidelines for the Northwest Territories (2007)	
Key Mine Closure and Reclamation Plan Guidelines	***ICRP* Report Section**
Open Pit: • Minimize access to protect human and wildlife safety. • Implement water management strategies to minimize and control migration and discharge of contaminated drainage, and if required, collect and treat contaminated water. • Stabilize slopes to minimize erosion and slumping.	5.2.1
Waste Rock: • Minimize erosion, thaw settlement, slope failure, collapse or the release of contaminants or sediments.	5.2.2
Buildings and infrastructure, equipment: • Return area to its original state or to a condition compatible with the end land-use targets.	5.2.4
Restore natural drainage patterns where surface infrastructure has been removed.	Table 5.1
Landfills: • Control erosion and effects to the ground thermal regime.	5.2.7
Water Management Systems: • Dismantle and remove/dispose of as much of the system as possible and restore natural or established new drainage patterns. • Stabilize and protect from erosion and failure for the long term.	Table 5.1 & 5.2.8

Table B-4: AANDC (CIRNAC) Policies

Mine Site Reclamation Policy for Nunavut (2002) and Mine Site Reclamation Policy for the Northwest Territories (2002)	
Key Mine Closure and Reclamation Plan Guidelines	***ICRP* Report Section**
Areas should be returned to viable and self sustaining areas where practical.	5.1.1
Use best management principles such as progressive reclamation and reduce the environmental risk.	6
Communication and consultation shall be undertaken with all applicable parties.	2.3.1.3 & 2.4
Closure impacts for all mine components.	Table 5.1
Closure costs estimates should be undertaken by a third party using a recognized methodology such as RECLAIM. Closure cost estimates should include contingency factors.	10
Inclusion of a progressive reclamation plan.	6
Removal/stabilization of all structures.	5.2.4 & 5.2.5
Reclaim and stabilize waste rock stockpiles remaining on site.	5.2.2
Reclaim the disturbed surface areas to acceptable standards.	Table 5.1
Water quality at closure shall meet or exceed the accepted standards.	Table 5.1

<table>
<tr><th colspan="2">Mine Site Reclamation Policy for Nunavut (2002) and Mine Site Reclamation Policy for the Northwest Territories (2002)</th></tr>
<tr><th>Key Mine Closure and Reclamation Plan Guidelines</th><th>ICRP Report Section</th></tr>
<tr><td>Temporary Closure measures shall be included in the Preliminary Closure Plan and cost estimate.</td><td>7</td></tr>
<tr><td>Inclusion of a post - closure monitoring program.</td><td>9</td></tr>
<tr><td>Detailed closure and decommissioning of the following:
• Buildings and other structures.
• Roads.
• Airstrips.
• Waste rock stockpiles.
• Ore stockpiles
• Quarries.
• Open pit.
• Petroleum and chemical storage areas and facilities.
• Pipelines.
• Power corridors.
• Sewage and waste disposal areas and Mine drainage.</td><td>5.2</td></tr>
<tr><td>Re-vegetation of the site where practical.</td><td>5</td></tr>
<tr><td>Meet or exceed applicable water standards.</td><td>Table 5.1</td></tr>
<tr><td>Recycle materials where practical.</td><td>5.2.7</td></tr>
<tr><td>Closure cost estimate to be calculated for the total financial security for final closure.</td><td>10</td></tr>
<tr><td>Utilization of a recognized methodology for calculating the closure costs (i.e. RECLAIM model).</td><td>10</td></tr>
<tr><td>Establish financial security to be provided to the Minister of Aboriginal Affairs and Northern Development Canada (previously Indian Affairs and Northern Development).</td><td>10</td></tr>
</table>

Table B-5: AANDC (CIRNAC) Guideline

Mine Reclamation in the Northwest Territories and Yukon (1992)	
Key Mine Closure and Reclamation Plan Guidelines	***ICRP* Report Section**
Preliminary Closure Plan objectives are to: • Protect the public health and safety. • Prevent and/or reduce the environmental deterioration. • Return all disturbed areas to the original state or an accepted level of reclamation.	N/A
Ensure post-closure physical and chemical stability.	5.1.1
Development of a monitoring program to assess the effectiveness of the restoration to be undertaken between the Proponent and Indian and Northern Affairs Canada.	9
Reclaimed areas should be returned to previous land use and aesthetics, to the extent possible.	Table 5.1
Include temporary closure and indefinite (long term) Preliminary Closure Plans.	0
Mine features should be closed in accordance with the guidelines provided in Tables 5.2 through Table 5.8 (Robertson and Kirsten 1992).	5
Inclusion of a fully developed closure cost estimate.	10
Re-vegetation where practical. Local arctic species and distributions should be considered.	5.2

Table B-6: Northwest Territories Water Board Guidelines

Guidelines for Abandonment and Restoration Planning for Mines in the Northwest Territories (1990)	
Key Mine Closure and Reclamation Plan Guidelines	***ICRP* Plan Report Section**
Evaluation of ML/ARD potential for open pit, waste rock stockpiles and disturbed areas.	5.2.1 & 5.2.2 (ongoing process)
Cover design for waste rock stockpiles, if required. Stockpiles should be designed and contoured to ensure stability.	5.2.2
Re-vegetation of disturbed areas, where practical.	5.2
Open pit closure preferably backfilling or flooding.	5.2.1
Stability of open pit should be investigated.	5.2.1
Quarries should be backfilled and contoured to match the surrounding topography.	5.2.3
Removal of fuel and chemical storage tanks and associated piping and plumbing if applicable.	5.2.7
Fuel contaminated soils should be remediated.	5.2.7 & 9.4
Chemical storage facilities should be removed from site.	7.1.5 & 7.2.5
Soils surrounding chemical facilities should be tested for contamination and where present be removed from site.	9.4
Culverts should be removed from site.	5.2.8
Airstrips should be left intact, unless deemed unsafe.	5.2.6

Guidelines for Abandonment and Restoration Planning for Mines in the Northwest Territories (1990)	
Key Mine Closure and Reclamation Plan Guidelines	***ICRP* Plan Report Section**
Natural drainage should be restored to the site. Roads that do not impede the natural drainage may remain intact.	5.2.6 & 5.2.8
Solid wastes should be dealt with in responsible manner.	5.2.7
Hazardous wastes are to be disposed at an approved facility.	5.2.7
Buildings and structures should be removed from the site.	5.2.4
Concrete foundations may be left in a safe condition.	5.2.4
The Preliminary Closure Plan should include a planned shutdown/temporary closure scenario.	7.1
The Preliminary Closure Plan should include a long term shutdown/Long-term Closure scenario.	0
The Preliminary Closure Plan should include a final abandonment/final closure scenario.	5
It is encouraged that site closure include phased plan development (progressive closure).	6
A monitoring program should be devised to measure the effectiveness of the site closure.	9
Financial security is required for the closure phase.	10

Appendix C Site Photos of Current Site Condition (2017)

Mary River Mine Site

(Aerial photos of existing site conditions, 2017)

Milne Port

Tote Road

Steensby Camp

Mid-Rail Camp

Appendix D Reclamation Research Plans

The following is an overview of the reclamation research plans that are proposed to reduce uncertainties associated with closure planning. Progress updates for these research programs will be provided in standalone reports that will be included within each following ICRP submission. In addition to the individual research program objectives, a summary of planned research tasks and timelines and findings from completed work to date are is included in this Appendix.

Research plans described below have been identified by BIM and/or stakeholders as key topics of uncertainty and/or risk with respect to closure. Research tasks may focus on confirming and/or refining initial predictions for residual effects, improving understanding on what achievable levels of reclamation success are to inform closure criteria, and developing site-specific closure techniques or other efforts needed to address notable gaps in advancing the ICRP to a final closure design.

Additional research plans may be included in future ICRPs as appropriate. New plans will be considered by BIM and project stakeholders as the project advances and uncertainties relating to closure arise. A primary role of the Mine Closure Working Group (MCWG) will be to evaluate the efficacy of any implemented reclamation research, where reclamation research has provided valuable information to update closure planning, and where deficiencies or unknowns exist that could be addressed by future reclamation plans. Baffinland implements a robust collection of monitoring programs, which include reporting components for stakeholder review and the opportunity to present questions/concerns related to closure. In particular, the NIRB Annual Monitoring Report is developed to assess the accuracy of predictions contained in the Project's environmental impact statements. This submission allows for comment by Project stakeholders and is followed closely by Baffinland's closure planning staff to identify environmental changes during mining that could impact the adequacy of the existing ICRP. Tracking and understanding of project impacts/effects is a focus of the MEWG and the TEWG, who will communicate findings/discussions with the MCWG. These regulatory reporting requirements and working groups provide a mechanism for identifying key uncertainties for closure and assessing the need for new research topics. Recommendations from the MEWG, TEWG and the various regulatory stakeholders will be assessed by the MCWG, which will provide final recommendations on the reclamation research programs.

D.1 Reclamation Research Program - Open Pit Runoff Water Quality

Background

At the end of mining, the open pit will gradually fill with water from precipitation; time is estimated at 85 to 150 years, depending on annual precipitation, evaporation and other factors (Knight Piésold, 2008). Baffinland has since committed to reducing this time period using alternatives for enhanced flooding of the open pit(addressed under the "Open Pit Flooding Timeline" research program).

AMEC (2012c) developed water quality estimates for pit water for the final year of mining (Year 21), which were utilized as input in the water quality mass loading model under the assumption that, once the pit has filled, in each subsequent (post-closure) year all precipitation into the open pit will accumulate and that excess water will discharge via a spillway during the open water period according to the natural hydrograph.

The mass loading modelling indicated that Level I magnitude effects to water quality will occur under low flow conditions, with a calculated HQ between 1 and 10 for mercury, selenium and silver. It is noted that an HQ >10 was calculated for mercury within the F0 tributary, upstream of fish presence or habitat; however, since the assessment of water and sediment quality is based on fish as the receptor, the effects assessment considers the resultant water quality at fish habitat within the Mary River, where all parameters have an HQ value less than 10.

Based on pit water quality for Year 21 of mining, it is possible the water will have a pH of around 4.2, which is outside of the pH range of the MDMER (6.0 to 9.0) however the mass loading modelling carried out is based on conservative assumptions and Baffinland is continuing to study the geochemistry of waste rock and ore to further refine predictions and management plans.

Uncertainty

Due to the early stage of project development and the fact only conceptual geochemical modelling (mass loadings assessment) has been completed to date, there is uncertainty with respect to the Open Pit water quality predictions.

Inflows to the open pit include: direct precipitation, runoff, groundwater inflow, and any enhanced flooding flows. Outflows include evaporation/sublimation, groundwater seepage discharge, and overflow discharge (once fully flooded). Chemistry of water in the open pit will be influenced by both the chemistry of the inflows, as well as the pit walls, residues from the mining process (blasting, etc.), and seasonal or temporary stratification of the water column into waters of differing chemistry and temperature (such as a chemocline or thermocline) that may be affected by bathymetry, climactic conditions, quality and temperature of inflows, wind, influence of permafrost, ice over (formation) and ice off (melting).

Research/Study Objective

This research plan aims to:

- improve predictions for water quality within the open pit during flooding operations and to inform decision making with respect to enhanced flooding alternatives, and
- to improve long-term water quality predictions for open pit (pit lake) effluent flows with respect to meeting applicable closure objectives and criteria in Post-Closure, and to assess the effectiveness of water treatment options in modifying Open Pit runoff water quality, if necessary.

Overview of Tasks and Project Research Schedule

The following are an overview of the anticipated tasks required to obtain the study objectives; the objectives are general in nature and not explicitly linked to the tasks below. An indication on status of each task is provided and when warranted, anticipated commencement and/or conclusion dates.

Task 1 – Pit Lake Miromixis

Deep pit lakes are often subject to a stratification of the water column into waters of differing chemistry typically due to strong density gradients within the water due to salinity or temperature. While permeant stratification of the pit lake can result in the long-term storage of salts within the pit, a seasonal turnover of the lake could result in poor water quality conditions at certain times of the year.

Based on the predicted water quality within the lake and data collected from the site weather station, an assessment will be carried out to evaluate if the pit lake will likely be meromictic or if it will become seasonally stratified. In support to this evaluation, a focused review of scientific literature relating to meromictic pit lakes in cold regions should be carried out. Further, analyses of the temperature gradients, wind conditions, precipitation, groundwater inflows, and other conditions will be carried out as site conditions allow (i.e. presence of an open pit) to evaluate the likelihood of the pit lake becoming stratified and subsequently becoming mixed.

Task 2 – Water Monitoring and Comparison against Water Quality Predictions

The quality and flow of key inflows to the open pit should be monitored (or otherwise estimated) and compared against water quality predictions.

It is, however, not advised that runoff from the pit walls is used as an analogue for future water quality in the open pit. The chemistry of the pit wall runoff will differ from the longer-term pit wall runoff with respect to the proportions of various rock types that comprise the pit walls, the degree of weathering of those faces, and that samples will likely be impacted by other (potentially significantly larger) open pit inflows.

Should the measured chemistry or flow of any of the key pit inflows deviate significantly from predicted values over a 5-year basis, the water quality prediction model will be updated in light of the results of water quality modelling, and updates to the mine plan or geochemical analyses.

Task 3 – Update Water Quality Predictions

As per above (Task 2), the predictive water quality model will be updated not later than 5 years prior to the planned cessation of mining operations. In addition to evaluating the long-term water quality of the flooded open pit (pit lake), the effects of mine flooding rates will be considered with regards to the short-term water quality of the pit lake (at initial discharge).

Task 4 – Water Treatment Options Analysis

Water treatment alternatives will be considered if it is found that the predicted water quality in the Pit Lake (at initial discharge, or long term) is not anticipated to meet effluent water quality.

Table D-1: Overview of Tasks for Reclamation Research - Open Pit Runoff Water Quality

Task	Reference Document	Status Anticipated Start and/or End Date
• Establish initial water quality predictions and review relevant baseline conditions	FEIS Volume 7, Section 3.4	Completed (2013)
• Conduct literature review and analyze long term predicted conditions to assess if permanent meromictic conditions are anticipated. o Should long term meromictic conditions be anticipated, this characteristic should be incorporated into the open pit predictive water quality model. o Should it be possible to create long term permanent meromictic conditions in the open pit, designs should be developed so that these measures could be incorporated into the ICRP if justified.	N/A	2019-2020
• Monitor water quality within the open pit, runoff to the open pit, groundwater surrounding the open pit, and other inflows to the open pit. Water quality data should be compared against the assumptions made in the initial water quality predictions. o The water quality predictive model should be assessed for updating on the basis of findings every 5-years, in the event that unexpected water quality conditions are encountered o Follow up investigation of unknown sources of contaminants may be required.	N/A	Onset of open pit dewatering activities to Life of Project

Task	Reference Document	Status Anticipated Start and/or End Date
• Results and collected data are to be presented in the research program progress reports.		
• Not less than 5 years prior to the end of operations, the water quality predictive model will be updated and predicted water quality should be compared against the criteria set out in Table 5.1. o Modelling will include an assessment of the influence of filling time on open pit water chemistry. (*Reclamation Research Program: Open Pit Flooding Timeline*) o Should additional humidity cell data become available, the results of these analyses will be incorporated into the geochemical aspects of the water quality model.	N/A	Five years prior to Life of Project (duration 1 year)
• If required, suitable contingencies should be identified and assessed for addressing long term water quality.	N/A	One year prior to Life of Project (duration 1 year)

Findings of Research Completed

Research into meromictic pit lakes has not yet been completed. This work is scheduled to start in 2019.

Open Pit Water Quality Research Results

No results have been provided yet as the mine has not advanced into the open pit stage. Ore has, to date, been extracted from the hillslope, rather than the future open pit.

Linkages to Other Research/Studies

This research will be linked to the research being completed regarding pit flooding timelines. Findings of waste rock stockpile runoff water quality reclamation research will be considered. Updates on open pit prediction of runoff water quality will be provided in future updates of the ICRP.

Costs

TBD

References

AMEC. 2012a. Interim Waste Rock Stockpile Seepage Quality Model Report, Mary River Project. January 2012.

AMEC. 2012b. Interim Open Pit Water Quality Model Technical Memorandum, Mary River Project. January 2012.

AMEC 2012c. Interim Mine Rock ML/ARD Report, Mary River Project, January 2012.

Baffinland Iron Mines Corporation. 2012. Mary River Project – Final Environmental Impact Statement. February 2012.

Baffinland Iron Mines Corporation. 2013. Mary River Project – Addendum to the Final Environmental Impact Statement. June 2013.

Baffinland Iron Mines Corporation. 2018. 2017 Qikiqtani Inuit Association (QIA) and Nunavut Water Board (NWB) Annual Report. March 31, 2018

Knight Piésold Ltd. 2007. Mine Site Infrastructure, Pit Overburden & Waste Dumps - 2006 Site Investigation Summary Report. Ref. No. NB102-00181/3-2, Rev. 0. North Bay: Knight Piésold Ltd. February 28, 2007.

Knight Piésold Ltd. 2008. Mine Site Infrastructure, Pit Overburden & Waste Dumps - 2007 Site Investigations and Foundation Recommendations Summary Report. Ref. No. NB102-00181/8-2, Rev. 1. North Bay: Knight Piésold Ltd. February 20, 2008.

Knight Piésold Ltd., 2010. Mine Site Infrastructure, Pit Overburden and Waste Dumps - 2008 Site Investigations Summary Report. Knight Piésold Ref. No. NB102-00181/24-1, Rev. 0, May 4, 2010.

Knight Piésold Ltd. 2015. 2014 Water and Sediment CREMP Monitoring Report. Ref. No. NB102 00181/34-6, Rev. A, dated February 24, 2015.

D.2 Reclamation Research Program - Open Pit Flooding Timeline

Background

The mining plan and the ongoing waste rock characterization plan will inform the prediction modeling of the mine pit water quality at the end of mine life (addressed under the "Open Pit Runoff Water Quality" research program). The results of the Open Pit Runoff Water Quality research program will be summarized in the annual NIRB and NWB reports which will subsequently be reviewed and discussed by the Mine Closure Working Group.

Based on passive inflows alone (seepage into the pit, direct precipitation, and surface runoff), it is anticipated that the open pit will take an estimated 85 to 150 years to passively fill (Knight Piésold, 2008). The flooding of the open pit could be accelerated by pumping water from a nearby water source (i.e. accelerated flooding). At a conceptual level, four potential water sources have been identified: Sheardown Lake, Camp Lake, Mary Lake, and Mary River. It was estimated that withdrawal from these sources could reduce the flooding time to as little as 2 years (based on a total withdrawal of 10% of the annual volume, although this would require very specific and ideal conditions to achieve. Section 5.2.1.4 of this document presents some preliminary assumptions and calculations regarding the enhanced pit infilling alternative.

Uncertainty

With respect to natural flooding, the rate of groundwater inflow is the primary source of uncertainty with respect to open pit flooding time prediction.

With respect to the enhanced flooding schemes, the primary source of uncertainties are:

- the maximum rate of water taking from the water sources; and
- the practical limit of pumping water from those sources to the open pit (feasibility and financial viability).

Research/Study Objective

The goal of this program is to better assess the timelines for Open Pit flooding for both natural flooding and the enhanced pit infilling alternative and develop a flooding program that will meet closure objectives and criteria in Post-Closure within an appropriate timeline relative to the proposed monitoring.

Overview of Tasks and Project Research Schedule

The key tasks of the study are as follows:

- Updating the accuracy of the open pit flooding timeline under passive conditions.
- Assessing the potential water sources for enhanced pit infilled in greater detail, and increase the accuracy of the enhanced pit infilling timelines.

- Enhancing the understanding of the impacts of the pit flooding time on the overall closure plan and monitoring timeline.

Task 1 - Pit Flooding Timeline Predictions (passive conditions)

To better understand the rate of natural flooding of the open pit, pit dewatering flows (monthly volumes) will be recorded throughout operations to provide an estimate of the overall net inflows to the open pit, including all inflows (groundwater inflow, direct precipitation, and runoff) and outflows (evaporation and seepage).

It was estimated in 2009 that natural flooding would take between 85 and 150 years. Using the open pit dewatering flows as a basis of calibration, this estimate can be refined at a later time.

To complete this task, pumping records and data from the site weather station will be recorded during operations. The pit flooding model will then be updated with acquired site data.

Task 2 - Assessment of potential water sources / enhanced flooding

Assisted pit filling is governed by two parameters – technical limitations that drive pumping costs, and water source locations/drawdown limits. Costs are driven by materials and equipment required for the operation (e.g., heat-traced piping, pumps, generators, and fuel requirements) as well as the construction and maintenance of the necessary roads and berms. Pumping water to the pit is uphill and therefore significant elevation head will provide technical challenges to any pumping design. Water source drawdown limits are designed to ensure that the volume of water extracted from a given source has minimal impact on the aquatic ecosystem. Key factors to consider when calculating maximum acceptable drawdown of a lake include issues such as the potential disturbance of spawning habitat, as well as the residency time of the water body.

In order to better understand alternatives for enhanced pit filling, the following steps are planned:

- A desktop review of regional hydrological and potential spawning habitat data will be conducted to support the development of a waterbody-specific assessments for the maximum allowable water taking rate;
- a feasibility level engineering assessment will be carried out for pumping water from each of the potential water sources to confirm the feasibility of each alternative; and
- the estimated flooding times will be updated for each enhanced flooding scenario.

Task 3 – Enhancing the understanding of the impacts of the pit flooding time on the overall closure plan and monitoring timeline.

Following the completion of Tasks 1 & 2, the integrated schedule of closure activities would be reviewed in light of the updated natural and enhanced flooding scenarios and summarized for discussion with the Mine Closure Working Group. The flooding timeline would also impact post-closure monitoring durations at the Open Pit and down gradient areas.

Table D-2: Overview of Tasks for Reclamation Research - Open Pit Runoff Water Quality

Task		**Reference Document**	**Status Anticipated Start and/or End Date**
	Establish initial flooding time estimates.	KP 2008	Completed
Task 1	Monitor mine dewatering flow rates.		Ongoing (2013-Life of Project)
	Use mine dewatering flow rates to update mine flooding model to estimate passive (natural) flooding time.		5-years following onset of mine dewatering.
Task 2	Assess regional hydrology flows and retention times in each potential water source.		Should be completed during first 5 years of dewatering. Duration of task: 1 year
	Evaluate maximum allowable water taking with respect to protection of aquatic life.		
	Prefeasibility assessment of practicability of pumping from each water source.		
	Estimated flooding times from each water source to be updated using mine flooding model.		
Task 3	Review the impacts of enhanced open pit flooding on the mine closure activities and monitoring with Mine Closure Working Group.		Task to commence following completion of Task 2. Duration of task: 6 months

Findings of Research Completed

Initial predictions for filling times (natural and enhanced) have been previously estimated, as described in Section 5.2.1.4. Additional research that is to be carried out will be reported here.

Pit Flooding Timeline Predictions (passive conditions)

As no significant dewatering has taken place in the open pit to date, no update of the flooding model has been completed to date.

Open pit dewatering flows will be recorded once active dewatering (pumping) starts.

Results to Date

TBD

Linkages to Other Research/Studies

This research will be linked to the research being conducted on open pit water quality.

Costs

TBD

References

Knight Piésold Ltd. 2008. Mine Site Infrastructure, Pit Overburden & Waste Dumps - 2007 Site Investigations and Foundation Recommendations Summary Report. Ref. No. NB102-00181/8-2, Rev. 1. North Bay: Knight Piésold Ltd. February 20, 2008.

D.3 Reclamation Research Program - Waste Rock Stockpile Seepage/Runoff Water Quality

Background

Metal leaching and acid rock drainage (ML/ARD) characterization studies in support of the Life-of-Mine pit waste rock are provided in the report entitled "Mine Rock ML/ARD Characterization Report Deposit 1, Mary River Project", March 2014 as appended to the Life-of-Mine Waste Rock Management Plan.

The waste rock was subdivided based on broad geo-structural categories about the iron ore zone, mainly by hanging wall and footwall zones. A total of 776 waste rock samples were selected as representing the waste rock categories and broad spatial coverage of non-ore mine rock in the vicinity of the Life-of-Mine open pit development. All 776 waste rock samples were analyzed for modified Sobek acid base accounting (ABA), NAG pH and elemental content. Subsets of drillcore samples were also analyzed for downhole variability, NAG leachate, short-term metal leaching, whole rock elemental content, detailed mineralogical analysis, and long-term kinetic testing.

Results of ABA testing determined that waste rock is generally characterized as having low neutralization potentials (NP) and low acid potentials (AP). Data suggests that the waste rock is dominated by non-carbonate sources of NP (e.g. silicates) with lesser NP derived from carbonate sources. Sulphide was the primary form of sulphur. Approximately 85% of waste rock samples had neutralization potential ratios (NPR) greater than 2 and are classified as non-potentially acid generating (Non-PAG) and are unlikely to generate acidic drainage. Approximately 10% of the samples had NPR values of less than 1, and 5% of the samples were classified as having uncertain acid generating potential (1<NPR<2). Extrapolating these results to the project waste rock model, indicates that approximately 11% of the Life-of-Mine in-pit waste rock is expected to have NPR <2 and is considered potentially acid generating (PAG). Proximity to ore appears to correlate to increased PAG quantities (defined as NPR <2) with the hanging wall schist (HWS) and footwall schist (FWS) zones identified with the greatest proportion of PAG of the major waste units.

Analysis of a set of samples proximal to the proposed five-year pit indicates a lower sulphur and sulphide content is likely to be encountered in the shallower HWS and FWS rock of early development than at depth during later production. This lower sulphide content is expected to result in a lower percentage of PAG rock being encountered during early operations than would be predicted by extrapolating the overall (including deeper) HWS and FWS waste rock data to near surface.

For planning, 10% PAG rock plus allowances for expansion due to field screening limitations and dilution has been assumed.

Ten waste rock samples were run in humidity cells for 53 weeks in 2008 and 2009. A further 17 waste rock samples were initiated in humidity cell tests in May 2011 for between 109 and 120 weeks of reported data. Nine of these samples were standard humidity cells and eight were NP depleted humidity cells designed to assess drainage quality in the absence of carbonate NP. The pH of most cells was in the range of 5.5 to 7 throughout testing. Of the 17 cells in operation since 2011, three cells exhibited slowly declining pH throughout testing reaching a minimum measured weakly acidic pH between 4.5 and 5 after approximately two (2) years of operation (under laboratory conditions). Metal release rates from humidity cells were generally low. Kinetic testing results and cold climate conditions at site suggest the lag time to acid on-set in PAG rock with potentially increased metal release rates would be on the order of five years or longer.

Waste characterization, volume estimation, and monitoring of the Waste Rock ML/ARD is ongoing. The design of the waste rock facility will be updated periodically as necessary throughout the LOM.

The deposition strategy for the water rock area is to promote permafrost aggradation. Studies of waste rock in permafrost demonstrate that permafrost forms an effective long-term barrier to water and oxygen, thereby preventing significant oxidation of sulphidic waste rock located below the surficial active zone. The surficial “active” zone, which will be subject to seasonal freeze-thaw.

For this reason, the PAG, Non-PAG, and Overburden are handled as three separate streams and are placed in zones within the Waste Rock Facility. PAG material will effectively encapsulated in non-PAG material.

The “active” zone is not anticipated to extend into the PAG material through 50 m non-PAG shell in the long-term (within 200 years) under the influence of climate change (Intergovernmental Panel on Climate Change, 2007). Therefore, over the long term, seepage water quality which is influenced by contact water that flows through the active layer in the waste rock stockpile will not be affected. Following closure, generation of ML/ARD is not anticipated.

Seepage and drainage is anticipated to discharge from the active layer and from portions of the waste rock pile that have not yet aggraded of permafrost.

Uncertainty

Due to the early stage of project development and only conceptual modelling done to date, there is uncertainty in the final composition of the waste rock stockpile. In particular, the composition may vary with respect to the proportion of waste rock by lithology, geochemistry, and the associated seepage/drainage conditions. Climactic conditions may also heavily impact the volume and quality of seepage, as thermal conditions within the pile can affect the rate of chemical release and reactions, permafrost develop creating low permeability conditions in an otherwise free draining media, and wetting-up time may impact the period of time for precipitation to report as seepage.

As more information becomes available, the conceptual modelling completed as part of the FEIS will be updated.

Research/ Study Objective

This research plan is designed to improve understanding of the expected performance of the waste rock stockpile closure concept in an effort to confidently characterize predicted waste rock effluent discharge quality and assess if waste rock stockpile seepage water quality can be expected to meet closure objectives and criteria (MDMER, CCME PAL) in Post-Closure.

Specific objectives include:

- Determination of quantity of waste rock stockpile seepage that can be expected post-closure.
- Determination of quality of waste rock stockpile seepage that can be expected post-closure.
- Greater understanding of the thermal evolution of the waste rock stockpile and permafrost development to determine impact on geochemical reactions and, therefore, seepage water quality.

Overview of Tasks and Project Research Schedule

The following are an overview of the anticipated tasks required to obtain the study objectives; the objectives are general in nature and not explicitly linked to the tasks below. An indication on status of each task is provided and when warranted, anticipated commencement and/or conclusion dates.

Task 1 – Monitor Drainage from Waste Rock Stockpiles and Additional Humidity Cell Testing

Water quality should be monitored at selected locations around the waste rock stockpile. Where seepage can be reliably associated with a particular area of the waste rock stockpile, careful records should be kept of the schedule, volumes, and lithology of waste rock that is deposited in that area.

Waste rock samples should be collected regularly from each type of lithology of waste rock. A small number of representative samples should be set up as humidity cells and run continuously.

Tasks 2 and 3 – Field Test Pad Construction and Monitoring

In the absence of completed areas at the Waste Rock Stockpile representative of closure conditions, field Test pads should be constructed of known materials to support various assessments, most notably including estimating leachate volume. The volume of seepage will be affected by wetting up time and permafrost aggradation. Waste rock piles in many climates may take years to decades to accumulate sufficient water (wetting up) to have precipitation report as seepage. While it may not be practical to establish Test pads greater than 50 m high to simulate the design conditions, test pads should be significantly larger than the maximum depth of the active layer.

Tasks 3 – Geochemical Modelling

With regards to modelling, the test pads would serve as controlled scenarios, from which the behaviour of the wastes can be extrapolated to the overall Waste Rock Stockpile. As a first step, the test pads would be studied for basic hydrogeologic function, with an aim to resolve the effects of wetting-up time and advancement of permafrost (also Research Program: Waste Rock Thermal Modelling). Subsequently, seepage from the test pads could be investigated with respect to chemistry, making allowances for composition of the test pads (lithology, grain size, etc.), thermal conditions, and hydrogeologic function.

The functionality of the test pads should be modelled based on the available climactic conditions (based on site weather data), mine production data, and geochemical assays and humidity cells. The model will then be calibrated using the leachate from the test pads, and subsequently then expanded to encompass the monitored locations of the waste rock stockpile. Water quality predictions will then be compared against the criteria set out in Table 5.1.1.

Should additional studies be required, recommendations for these studies would be included within the Reclamation Research Progress Reports.

Table D-3: Overview of Tasks for Reclamation Research - Waste Rock Stockpile Water Quality

Task	Reference Document	Status Anticipated Start and/or End Date
• Monitor drainage water quality from waste rock stockpile. Conduct focused review of seepage quality monitoring results to predicted leachate values. o Set up additional humidity cells for each type of waste rock lithology.	N/A	Life of Project (as necessary)
• Confirm the feasibility of developing field test pads or equivalent area for instrumentation in a completed section of the Waste Rock Stockpile. o Development of study design for field test pads (some including application of cover material) at the site using selected waste rock material generated during early mine development. o Construct, operate and monitor test piles (if feasible) to inform the project about projected drainage quality and water quality modeling assumptions under site-specific cold climate conditions	Phase 1 Waste Rock Management Plan (BAF-PH1-830-P16-0029)	Designed/constructed in 2019. Monitored from 2019-Life of Project
• Modelling, interpretation and documentation of monitoring results (initially calibrating to field test pad data, and then extrapolating to the waste rock stockpile) to assess confidence if waste rock stockpile runoff water quality can be reasonably expected to meet closure objectives and criteria (MDMER, CCME PAL) in Post-Closure	N/A	Scheduled for 2024, then updated every 10 years

Findings of Research Completed

Seepage from the Waste Rock Stockpile has been monitored as part of regular site operation. As reported by Golder in the Interim Waste Rock Management Plan (March 2018), in the summer of 2017, seepage conditions from the Waste Rock Stockpile pond were found to be more acidic than was anticipated. A water treatment facility has been installed in the interim to address short term issues with respect to water quality.

The cause of the acidic conditions is under investigation and should be resolved as part of this research program in conjunction with the Waste Rock Thermal Modelling research program. These ongoing efforts informing the updated Interim Waste Rock Management Plan will also identify if an area of the existing Waste Rock Stockpile can be instrumented, or seperate field trial pads should be constructed.

Linkages to Other Research/Studies

Predicted leaching rates for various waste rock lithologies will be shared between this study and of the Open Pit Runoff Water Quality research program.

Findings of natural re-vegetation reclamation research will be considered related to colonization of cover material.

Regular updates on waste rock characterization and prediction of runoff water quality will be provided in future updates of the Life-of-Mine Waste Rock Management Plan (BAF-PH1-830-P16-0031) and ICRP.

Costs

TBD

References

Baffinland Iron Mines Corporation. 2012. Mary River Project – Final Environmental Impact Statement. February 2012.

Baffinland Iron Mines Corporation. 2013. Mary River Project – Addendum to the Final Environmental Impact Statement. June 2013.

Baffinland Iron Mines Corporation. 2014. Phase 1 Waste Rock Management Plan BAF-PH1-830-P16-0029, Rev 0. April 2014.

Baffinland Iron Mines Corporation. 2015. 2014 Qikiqtani Inuit Association (QIA) and Nunavut Water Board (NWB) Annual Report. March 31, 2015

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Knight Piésold Ltd. 2008. Mine Site Infrastructure, Pit Overburden & Waste Dumps - 2007 Site Investigations and Foundation Recommendations Summary Report. Ref. No. NB102-00181/8-2, Rev. 1. North Bay: Knight Piésold Ltd. February 20, 2008.

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Knight Piésold Ltd. 2015. 2014 Water and Sediment CREMP Monitoring Report. Ref. No. NB102 00181/34-6, Rev. A, dated February 24, 2015.

D.4 Reclamation Research Program - Waste Rock Thermal Modelling

Background

Thermal analyses of the waste rock stockpile to predict the long-term distribution of permafrost within the dump will be required. The heat transfer processes can be simulated with available computer models; however, none of the models can confirm that permafrost will develop within the dump without more reliable input data regarding the method of placing the waste rock and the resulting properties of the waste rock in the dump. In addition, it will be important to compare the thermal analyses against existing case histories including the Nanisivik mine.

Uncertainty

It is unclear at what rate the waste rock stockpile will experience permafrost aggradation during operations and closure, and/or what the eventual active layer thickness will be.

In addition, a better understanding of the exothermic nature of the acid generating materials currently in the PAG pile is required to predict aggradation.

Research/Study Objective

Thermal monitoring and evaluation is required as part of the current LOM Waste Rock Management Plan and to support the prediction of aggradation rates and estimation of the active layer thickness.

The objective of the thermal modelling program is to monitor ground temperatures and confirm the aggradation of permafrost within the waste rock stockpile and active layer thickness in order to update long-term ground temperature predictions.

Overview of Tasks and Project Research Schedule

Task 1 – Thermistor Data Collection

Data from temperature sensors installed to monitor the ground temperatures will be collected on a regular basis and used to ensure that frozen conditions are maintained below the waste rock stockpile.

Task 2 – Thermal Model Development

Based on the results of the geochemical sampling program and the thermal instrumentation program a thermal model for the pile will be developed. If substantial heat generation from oxidation is expected based on geochemical results, the thermal model may incorporate heat generation from sulphide oxidation in the pile to model the impact of heat generation on the pile freeze-back process. Climate change will also be included to account for warming temperatures after closure.

Table D-4: Overview of Tasks for Reclamation Research - Waste Rock Stockpile Thermal Modelling

Task	Reference Document	Status Anticipated Start and/or End Date
Task 1 – Thermistor Data Collection	N/A	Life of Project (as necessary)
Task 2 – Thermal Model Update	N/A	Following at least 5 years of data collection.

Findings of Research Completed

No tasks have been completed at this time, however installation of thermistors is scheduled for fall 2018 and winter 2019. Data from these installations will be used to update the Waste Rock Management Plans, but will also begin to address uncertainty regarding the closure strategy.

Linkages to Other Research/Studies

The thickness of the active layer will be considered in the development of the Waste Rock water quality predictions.

Costs

TBD

References

TBD

D.5 Reclamation Research Program - Natural Re-Vegetation

Background

A review of baseline data collection results applicable to re-vegetation during reclamation was conducted based on the findings of the vegetation baseline studies associated with FEIS development (FEIS Appendix 6C – Vegetation Baseline Report). Findings indicated approximately 20 plots were established on the old road surface or adjacent to it, in sites disturbed in the past. These sites were surveyed to contribute to the knowledge of natural succession and the plant species that can become re-established without intervention. Observations from baseline work applicable to reclamation include:

- Natural re vegetation in this general environment is slow, but not as slow as expected. Based on observations on an old silver mine near the Doris North Project in the Kitikmeot Region, researchers expected little re-vegetation in the Mary River study area thirty years after use, but were surprised to find that considerable re-vegetation had occurred along the old tote road, particularly in damp areas. The difference is that much of the area traversed by the tote road is on sandy soils, whereas the Roberts Bay Silver Mine is located mostly on fractured gravels (Burt, 2003).
- Colonization of dry areas along the old roads, paths, and campsite areas is occurring slowly, so slowly as to be almost immeasurable in the time since the disturbance.
- Plant communities around the old mining camp near Sheardown Lake have been slightly affected by the addition of nutrients, and are, as expected, richer than normal, with more lush growth and more species of grasses and forbs.
- This colonization (around the old camp) may be on the wane, due to depletion of nutrients and lack of enrichment in the ensuing years.
- There are plenty of local species that can be utilized for reclamation; it is neither necessary nor advisable to obtain plant stocks for reclamation from elsewhere. Use local/regional plant stocks and seed sources for any active revegetation being done on the Mary River Project.

Uncertainty

Due to limited research conducted to date for mines in the Canadian Arctic, there is uncertainty in the rates of natural re-vegetation at disturbed areas Post-Closure. This research will focus on development of methods to promote accelerated recovery of a sustainable vegetation cover that also benefits the desired land use for the Project sites over these long expected timelines. These sites include gravel roads, gravel pads, waste rock stockpile, and other priority areas identified during closure planning.

It should be noted that vegetation is naturally sparse or nonexistent (e.g., waste rock stockpile footprint) over much of the Project Area, and therefore the potential for natural re-vegetation of disturbed Project areas is uncertain. Re-vegetation by reseeding or replanting is not currently being considered by the

Project based on the current site conditions and the potential for success in areas not historically vegetated.

Research/Study Objective

The goal of this program is to identify methods to successfully promote natural re-vegetation in an effort to achieve a sustainable vegetation cover that meets the desired aesthetic conditions for the Project site post-closure in the shortest duration possible. Specific objectives may include:

- To assess which locally available substrates are most effective for plant establishment and growth.
- To assess which groups and individual native plant species may be able to establish and survive on a variety of substrates.
- To investigate the duration groups and individual native plant species are able to establish and survive on a variety of substrates.
- To assess the potential for native plant species to egress from site of introduction to adjacent areas.

Overview of Tasks and Project Research Schedule

Because it is too early to establish experimental reclamation plots within the Project footprint, Baffinland will, in 2019, conduct a detailed desktop study of reclamation efforts, successes and lessons learned in Arctic Canada. This will focus applicable objectives noted above, as well as the overall utility of reclamation practices establishing native vegetation in a reasonable time frame during progressive reclamation and post-closure. The review will include work completed at other Arctic sites, including mine, municipality, and contaminated site (e.g., DEW line site) reclamation and remediation.

The following are an overview of the anticipated tasks required to obtain the study objectives; the objectives are general in nature and not explicitly linked to the tasks below. An indication on status of each task is provided and when warranted, anticipated commencement and/or conclusion dates.

Table D-5: Overview of Tasks for Reclamation Research - Natural Re-Vegetation

Task	Reference Document	Status Anticipated Start and/or End Date
• Review of baseline data collection results applicable to re-vegetation during reclamation	FEIS Appendix 6C – Vegetation Baseline Report	Completed in 2016
• Literature review of re-vegetation at disturbed areas in northern climates	N/A	Scheduled for 2019
• Establishment of representative test plots for Project candidate sites for re-vegetation: gravel roads, gravel pads, waste rock, stockpiles, and waste dumps	N/A	Scheduled for 2019
• Soil sampling and vegetation assessment	N/A	Scheduled for 2019-2024

Task	Reference Document	Status Anticipated Start and/or End Date
• Interpretation and documentation of monitoring results assess confidence in developing re-vegetation procedure (Reclamation Research Summary Report issued)	N/A	Scheduled for 2025
• Identify any additional research that may be required and long-term monitoring	N/A	Scheduled for 2025
• Continued monitoring and analysis of re-vegetation research plots (if necessary)	N/A	2025-Life of Project (as necessary)
• Determine monitoring results applicability to closure and reclamation strategies and criteria	N/A	Scheduled for 2026

Findings of Research Completed

No research has been completed to date.

Linkages to Other Research/Studies

Findings of natural re-vegetation reclamation research will be considered related to colonization of cover material for waste rock stockpile. Updates on natural re-vegetation reclamation research will be provided in future updates of the ICRP.

Costs

TBD

References

Baffinland Iron Mines Corporation. 2012. Mary River Project – Final Environmental Impact Statement. February 2012.

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Appendix E Record of Engagement

As the Project advances, Baffinland is committed to engagement with stakeholders regarding closure and reclamation issues. These issues include, but are not limited to:

- Appropriate closure and reclamation strategies and criteria based on desired end use of Project areas.
- Additional or modified reclamation research activities (Appendix D).
- Requirements to address identified uncertainties and determine the appropriateness of existing action levels (Appendix D and Appendix G).
- Whether there will be any interest in maintaining the bulk fuel storage facilities and/or sealift landing areas for use by the local community assuming responsibility for the operation and maintenance of the facilities would be transferred to the local interested party.
- Transfer of responsibility of the Tote Road water crossings to the local community and if the Tote Road will be left completely intact assuming road operation and maintenance responsibility would then be transferred to another party.
- Transfer of responsibility of airstrip (including airstrip lighting) to the local community assuming the airstrip is left intact and operation and maintenance responsibility would then be transferred to another party.
- Whether there will be any interest in transfer of salvageable materials and buildings for local community use assuming responsibility would be transferred to another party.

Baffinland anticipates to rely on the Mine Closure Working Group (Section 2.4) in order to best facilitate stakeholder engagement related to the Mary River Project and incorporate considerations for post-closure land use of the Project site. A mandate or Terms of Reference for the Mine Closure Working Group will be developed in consultation with the QIA prior to the initial first meeting of the Mine Closure Working Group. Baffinland expects an early priority for the Mine Closure Working Group will be to determine additional or modified reclamation research activities applicable to the Project to help address identified uncertainties and determine the appropriateness of existing action levels.

Baffinland is currently in the process of integrating 'StakeTracker' software into project monitoring and reporting initiatives which will facilitate a comprehensive coverage assessment of stakeholder engagement matters related specifically to closure and reclamation issues historically and moving forward over the life of the Project. Table E-3 provides a summary of comments received to date, together with associated responses and cross-references.

Table E-3: Record of Engagement

Stakeholder Comment	Project Team Comment	Relevant Section from IRCP
This is not really concerning Baffinland, but refers to caribou. The infrastructure from the Nanisivik Mine was left behind. We tried to get the mine to clean it up but they didn't. There were fuel and diesel spills left behind. No one has cleaned it up. Seals have bad livers now because of what they were eating. Pond Inlet will need to worry about fuel and fuel clean up. The marine mammals can be affected because of this; we've seen the impacts in Arctic Bay from this. Just beware of all these promises the company makes.	The comment is noted. Baffinland is required to post securities for reclamation and closure through the water licensing process. Ongoing monitoring programs, environmental effects assessment, and the development of this interim closure plan will all safeguard against future environmental effects.	2.4; Appendix G
When they dig down the whole mountain what are we going to call it?	No response at this time.	n/a
Fuel drums were used in the early stage of exploration. Later on, they were using containers. The drums of fuel that were used are stockpiled at the dump now, corroding away. When I was a young man, these were used as fuel drums. It that going to be the same practice for you guys? Are you going to leave the drums there when you switch to containers?	Baffinland is required to post securities for reclamation efforts, as a condition of operating the Mary River Project through the water licensing process. The current practice is to remove the drums by backhauling empty drums, as well as any other waste that cannot be incinerated.	2.4; 5.1; 5.2
Three topics. I myself want the environment protected. Although the job opportunities are important, I also want the environment protected. While they are exploring, once they have done their exploration, we know they won't be making any money and they have to clean up the area. They have to close it and try to put it back the way it was before. Will they go back to Baffinland, or will they be surplus and given to QIA? If that were to happen, if they make money they would probably stay there. If they are going to drill deep down, what will they use to close them up (the drillholes)?	Baffinland is required to post securities for reclamation efforts, as a condition of operating the Mary River Project through the water licensing process. Baffinland will decide if camp and equipment will be sold to the community or brought to another project.	2.4; 5.1; 5.2

Stakeholder Comment	Project Team Comment	Relevant Section from IRCP
You mention that the mine is going to operate for 100 years, can things start being cleaned up at the mine right now?	While the life of the mine could last 100 years, Baffinland is committed to progressive reclamation measures where appropriate.	5.1.3; 6.3

Appendix F Lessons Learned from Other Projects

Mine and port decommissioning, closure, and rehabilitation have been conducted at sites in the Canadian North for several decades. This time period has allowed the planning, permitting, closure, and post-closure performance to be evaluated. These include: Colomac Mine, Giant Mine, Diavik Mine, Ekati Mine, Faro Mine, Nanisivik Mine/Port. As part of its reclamation researched initiatives, Baffinland is committed to establishing the primary lessons learned from these examples and others, to help evaluate options related to, but not limited to: re-vegetation strategies; post closure property control and land use; stakeholder relationships and commitments; residual waste material management; post-closure maintenance (if required); water management (before, during, and after closure), and managing socio-economic impacts. A summary of lessons learned from these projects will be completed using a topic specific approach and findings will be incorporated into future versions of the ICRP.

Appendix G Residual Effects

G.1 Predicted Residual Effects

Residual effects refer to the remaining environmental effects identified for the Project, post-mitigation, at the expected closure period of the Project. As the Project is in the early stages of operations and no major changes to the initial mine plan have occurred, the predicted residual impacts from the Mary River Project FEIS are considered to be accurate. Based on the information presented in the Mary River Project FEIS, the Mary River Project as planned will have no significant adverse residual effects for the VECs identified within the biophysical environment. The Project is not expected to compromise the ecosystematic integrity of the Nunavut Settlement Area. In addition, no significant adverse residual effects are predicated to occur to VSECs identified within the socio-economic environment, and the Project is expected to have significant positive effects for most of the VSECs. This position is supported by comprehensive site-specific studies (baseline and modeling studies), IQ, extensive public consultation, and expert opinions.

An overview of the assessment methodology used to develop this residual effect position, as detailed in Volume 2 of the Mary River Project FEIS, is provided in Section G.2. A summary of the non-significant residual impacts identified for each VEC and VSEC as part of the Mary River Project FEIS is provided in Section G.3. Section G.5 includes the associated closure and post closure monitoring programs proposed to be implemented to appropriately monitor residual effects.

Further detail of the Project residual effects is presented in Volume 4 through 8 of the Mary River Project FEIS.

G.2 Residual Effects Assessment Methodology

G.2.1 Determining Significance of Residual Effects

Residual project effects refer to the environmental effects identified for the Project, post-mitigation. The significance of residual environmental effects was determined from the following criteria (NIRB 2009):

- Direction or nature of an effect (i.e., positive/beneficial versus negative/adverse).
- Magnitude and complexity of an effect.
- Extent of the effect, including such as the geographical area that will be affected, the size of the affected human populations, and/or the size of the affected wildlife populations and habitat.
- Frequency and duration of an effect.
- Reversibility or irreversibility of an effect.
- Probability of occurrence of the effect.
- Confidence in the effect prediction.
- Context of the effect.

These criteria were adopted for this assessment, as specified in the Guidelines and because the criteria have precedence of use for other environmental assessments in the Canadian Arctic (NIRB 2007, 2009; Lawrence Environmental 2000, 2004; Wolfden Resources Inc. 2006; De Beers Canada Inc. 2004). In addition to the above attributes, NIRB (2009) directed Baffinland to consider additional qualifiers in its significance evaluation. Definitions and assessment criteria for each are identified in Table G-1, which lists the complete set of attributes (criteria and qualifiers), provides a definition and rationale as well as a summary of their relevance or context to the Mary River Project, and describes how the attribute was incorporated into the assessment.

Table G-1: Attributes Used to Evaluate Significance of Residual Effects

Attribute	Definition and Rationale	Role in Significance Determination[2]
Direction and Nature[1]	The ultimate long-term trend of an environmental effect - positive, neutral, or negative.	**Qualifier** Only negative effects are assessed for significance
Magnitude [1]	The amount or degree of change in a measurable parameter or variable relative to existing conditions (the exposed population)[3]. This attribute can also consider complexity - the number of interactions (Project phases and activities) contributing to a specific effect.	**Primary Criterion** High magnitude = high significance **Secondary Criterion** If magnitude and geographic extent are related, the higher the potential significance
Extent[1]	The geographic area over which the interaction will occur.	**Secondary Criterion** The larger the zone of influence, the higher the potential significance
Frequency[1]	The number of times during a project or a project phase that an interaction or environmental effect can be expected to occur.	**Secondary Criterion** Greater the frequency of occurrence, the higher the potential significance
Timing	The Project Phase within which the environmental effect will occur.	**Qualifier** Provides context
Duration[1]	The period over which the environmental effect will occur.	**Secondary Criterion** The longer the duration of an interaction the higher the potential significance
Reversibility[1]	The likelihood that a VEC/VSEC or Indicator will recover from an environmental effect, including consideration of active management techniques.	**Primary Criterion** The greater the potential to reverse an effect, the lower its potential significance

Attribute	Definition and Rationale	Role in Significance Determination[2]
	Reversibility is considered for biological VECs at the population level. Therefore, although an effect like mortality is irreversible, the effect at the population level might be reversible.	
Probability[1]	The likelihood that an interaction and a consequent effect will, in fact occur.	**Qualifier** (considered only for potentially significant effects) The higher the probability of occurrence, the greater the significance
Certainty[1]	The level of confidence in the knowledge or analysis that supports the prediction, in particular with respect to limitations in overall understanding of the ecosystem, and limitations in the ability to foresee future events or conditions.	**Qualifier** (considered only for potentially significant effects) The lower the certainty of occurrence, the more conservative the approach to prediction of significance
Ecological/Socio-economic context/value[1]	The general characteristics of the area in which the Project is located, as indicated by existing levels of human activity and associated types of disturbance. Interpreted to mean the basis for assigning "value" to the particular VEC.	**Qualifier** VECs/ VSECs and Indicators have been identified as "valued"
Environmental Sensitivity[1]	Environmental sensitivity of the area likely to be potentially affected. Refers to areas of heightened sensitivity that will be identified where applicable in relation to the Project (i.e., areas sensitive to spills; caribou calving areas).	**Qualifier** The Magnitude of an effect within an area of environmental sensitivity will be greater; therefore environmental sensitivity is considered in the discussion and rating of the Magnitude attribute.
Historical, cultural, archaeological significance[1]	To be considered within the geographic area to be potentially affected	**Qualifier** (Extent - above) Historic, cultural and archaeological significance is evaluated within the archaeology effects assessment (Volume 4)
Human and wildlife populations, and the size of the affected wildlife populations and related habitat[1]	The size of the potentially affected human populations; and the size of the potentially affected wildlife populations and related habitat.	**Qualifier** (Extent - above)

Attribute	Definition and Rationale	Role in Significance Determination[2]
The extent of the effects of the project on other regional human populations and wildlife populations, including the extent of the effects on Inuit harvesting activities[1]	The Project might have the potential to affect other human and wildlife population, if there are residual effects to marine wildlife or socio-economic benefits that extend outside Nunavut.	**Qualifier** Consider within the Transboundary Effects Assessment (FEIS Volume 9, Section 4)
The potential for cumulative adverse effects given past, present and future relevant events[1]	The Project might have the potential for cumulative effects where residual effects from the Project are expected to occur.	**Qualifier** Consider in the Cumulative Effects Assessment (FEIS Volume 9, Section 1)
Ecosystem function and integrity[1]	Ecosystem function and integrity is important to identified VECs and humans.	**Qualifier** Outcome of the significance determination
The effect on the capacity of resources to meet present and future needs (sustainability) [1]	The sustainability of this Project, and any major industrial project, is an important element to assess.	**Qualifier** Outcome of the significance determination
Value[1]	The value attached to the affected VEC or VSEC by those who identified them. An environmental or socio-economic component was identified as "valued" and was addressed in the EIS if it was found to have a high value to communities.	**Qualifier** Addressed as part of Issues Scoping where the "value" of each component is considered. The value attached to a VEC or VSEC is more or less equivalent to "Sensitivity" described above.

NOTES:

1. Specifically required by NIRB guidelines.
2. Criterion – directly contributes to the determination of significance. Primary criteria are given greater weight than secondary criteria. Qualifier – acts as a modifier to be considered when assigning values/rankings to assessment criteria.
3. In the majority of cases there is either a poor or no estimate available of the total population. However for the purpose of undertaking an environmental assessment, an effects prediction can be made by making reasonable assumptions. The most common approach is to take an area that is less than the full range of a population and, often on the basis of density estimates (or by using habitat as an indicator), a conservative prediction is possible, i.e. If the effect is calculated for a portion of the population and it results in a magnitude of effect that is beneath a defined threshold, then it is reasonable to predict the effect on the entire population, even in the absence of a total population estimate. This approach is not greatly different from that used by resource managers that have the mandate to manage wildlife populations, who are challenged to develop harvest quotas, even where they do not have an accurate or complete population estimate available to support these decisions.

Volumes 4 through 8 of the Mary River Project FEIS present the effects predictions for individual resource-specific component themes presented in each volume. Volume 9 of the Mary River Project FEIS presents the cumulative environmental effects assessment.

G.2.2 Rating Criteria of Residual Biophysical Impacts

For the categories for criteria and qualifiers applied directly to the determination of significance for residual biophysical effects, with due consideration to the NIRB requirements cited above, see Table G-2.

Table G-2: Ratings for Evaluating Residual Biophysical Effects

Criteria	Classification	
Magnitude (Specific to the VEC and the impact)	Level I	An effect on the exposed indicator/VEC that results in a change that is not distinguishable from natural variation and is within regulated values
	Level II	An effect that results in some exceedance of regulated values and/or results in a change that is measurable but allows recovery within one to two generations
	Level III	An effect predicted to exceed regulated values and/or results in a reduced population size or other long-lasting effect on the subject of assessment
Extent The physical extent of the effect, relative to study area boundaries	Level I	Confined to the LSA
	Level II	Beyond the LSA and within the RSA
	Level III	Beyond the RSA
Frequency How often the effect occurs	Level I	Infrequent
	Level II	Intermittent
	Level III	Frequent or continuous
Duration The length of time over which a Project effect will occur	Level I	Short term (effect lasts up to four years)
	Level II	Medium term (up to 25 years, for the life of the Project)
	Level III	Long term (beyond the life of the Project) or permanent
Reversibility The likelihood of the VEC to recover from the effect	Level I	Fully reversible
	Level II	Reversible with cost/effort
	Level III	Irreversible
Qualifiers		
Certainty Limitations in the overall understanding of the ecosystem and ability to predict future conditions	High	Baseline data are comprehensive; predictions are based on quantitative data; effect relationship is well understood
	Medium	Intermediate degree of confidence between high and low
	Low	Baseline data are limited; predictions are based on qualitative data; effect relationship is not well understood
Probability The likelihood that the predicted impact/residual effect will occur	Unlikely	Less than 20% likelihood of occurrence
	Moderate	Between 20 and 60% likelihood of occurrence
	Likely	Over 60% likelihood of occurrence

Each of the five criteria contributes to the determination of significance. Criteria are categorized in three levels (Levels I, II, and III), where Level I is indicative of a negligible or limited potential to contribute to an overall significant environmental effect, and Level III is indicative of a high potential. Level II represents the intermediate condition.

G.2.3 Rating Criteria for Residual Socio-Economic Impacts

Similar criteria were applied to the socio-economic effects assessment with some modification and additional criteria in consideration of the nature, complexity, and multiple perspectives associated with socio-economic issues. For the attributes (criteria and qualifiers) identified as the determinants of significance of socio-economic effects, see Table G-3.

Table G-3: Rating Criteria for Evaluating Residual Socio-Economic Impacts

Criteria	Classification
Direction	Positive
	Variable
	Negative
Geographic Extent	Description of the area and communities most affected
Social Extent	Demographic groups or social units identified as most affected
Magnitude Intensity of the effect	Low
	Moderate
	High
Frequency How often the effect occurs	Infrequent
	Intermittent
	Continuous
Duration Length of time over which a Project effect will occur	Short term (less than four years)
	Medium term (up to 25 years, life of the Project)
	Long term (beyond the life of the Project)
Reversibility Likelihood of recovery from effect	Reversible
	Partly reversible with cost/effort
	Irreversible

G.2.4 Overall Evaluation of Significance

NIRB (2009) stated that impact significance is based on comparing the predicted state of the environment with and without the Project, and expressing a judgment as to the importance of the changes identified. NIRB directed that the EIS shall present the residual effects assessment of the Project so that the reader can clearly understand the real consequences of the Project, the degree of mitigation of effects, and which effects cannot be mitigated.

NIRB also directed Baffinland to consider the dynamic change of ecosystems and their components in determining significance.

The overall significance of an effect is derived from the experience and professional judgment of the environmental practitioners who prepared the assessment, considering the rankings of the contributing attributes of significance. While substantially based on professional judgment, the following are general rules of thumb applied in determining significance:

- If the magnitude of the effect is low, then the predicted effect is "not significant," recognizing that magnitude includes consideration of sensitive species, habitats or populations. If effects on measurable components such as air or water quality meet applicable performance criteria, standards or guidelines, then the magnitude of the effect is negligible to moderate, and therefore the prediction will be for an effect that is "not significant."
- If the geographic extent of the effect is confined to the PDA or LSA, then the predicted effect is likely to be "not significant."
- If the extent of a negative socio-economic effect is limited to individuals who also receive a corresponding positive benefit, then the predicted effect is likely to be "not significant."
- If the effect has a moderate to high reversibility, the predicted effect is likely to be "not significant."
- If the duration of the effect is short term (e.g., construction period only) then the effect prediction is also likely to be "not significant."
- NIRB (2009) also directed Baffinland to communicate with potentially affected communities and organizations to solicit input on the values placed on VECs and VSECs as well as significance of impacts:
- *The Proponent shall describe how it will ascertain that significance that different parties assigned to each impact, and how it will proceed if different parties ascribe varying significance to VECs, VSECs or the associated impacts. If it is impossible to attain a consensus on the significance of certain impacts, the Proponent shall present the range of viewpoints expressed and shall present and justify its preference, if any. Finally, the Proponent shall describe the significance it ascribes to each effect, and justify how the significance of the effect was determined, taking into consideration and avoiding duplication of, the information provided above. (NIRB 2009)*
- Finally, in its Pre-Hearing Conference Report, NIRB (2011) directed Baffinland to reconsider the significance of potential Project impacts where parties raised concerns with the significance determinations presented within the Draft Environmental Impact Statement (DEIS).
- To this end, Baffinland has attempted to assemble, synthesize and present feedback from the following sources:
- Records of public meetings from 2006 through the first part of 2011.
- Records from Inuit knowledge studies held to date (individual interviews and workshops).
- Kajjuqtikkut - A five-day workshop held in Arctic Bay March 10-14, 2008, attended by members of the five Inuit Knowledge Study working groups. The key themes of transportation (marine and rail), caribou, marine mammals, and socio-economic issues were discussed and minutes recorded.
- A five-day workshop jointly held by Baffinland and the QIA at Mary River the week of September 12-18, 2010, with community representatives selected by the QIA. The workshop focused on community perspectives on the significance of predicted impacts on caribou, marine mammals and land use.

- Feedback of concerns raised with the significance determinations presented in the DEIS.
- Baffinland has integrated a summary of the significance determination within each of the individual effects assessments in Mary River Project FEIS Volume 4 through Volume 8 while Volume 9 presents the cumulative environmental effects assessment. The approach in this EIS was to present the evidence clearly and in the manner requested in the Guidelines (NIRB 2009).

G.3 Residual Effects Predicted at Planned Closure

Using the methodology presented in Section G.2, the predicted residual impacts were assessed and the associated consequences were evaluated for each impact to a VEC or VSEC. Although no significant adverse residual effects were predicted for the Project at planned closure, this section provides a summary of all predicted residual impacts that were expected to exist during closure and beyond the closure of the Project site for both VECs and VSECs.

Residual impact criteria (e.g., direction, magnitude, reversibility, etc.) noted in the following sub-sections are defined in Section G.2. Complete details including the environment consequence calculations, residual impact criteria classification, probability of occurrence and level of confidence all VECs and VSECs are presented in Volume 4 through 8 of the Mary River Project FEIS. The EIS was updated to account for the Early Revenue Phase.

G.3.1 Atmospheric Environment

Air Quality

Residual effects air quality effects are those that remain when all mitigation options have been incorporated into the Project design and operation. The criteria identified in Table G-4 were used to rate the effects on air quality of these residual effects from project activities. These criteria are consistent with but differ slightly from the assessment criteria defined in Section G.2, having been modified to account for the nature of air quality effects. The overall rating as presented in Table G-5 is a professional judgment based on consideration of the magnitude in relation to indicator thresholds, the geographic extent, the duration, the frequency, the reversibility of the effects, and the certainty and probability of the occurrence.

Table G-4: Residual Effect Rating Criteria Used for the Air Quality Assessment

Criteria	Rating Term	Definition
Magnitude	Level I	The expected emission, ambient concentration, or deposition is less than the background value; is less than 10 % of the indicator threshold; or the associated change is less than 5 %
	Level II	The expected emission, ambient concentration, or deposition is more than the background value; is less than the indicator threshold; or the associated change is greater than 10 %
	Level III	The expected emission, ambient concentration or deposition is predicted to exceed the indicator threshold
	Level I	The expected measurable changes are confined to the LSA

Table G-4: Residual Effect Rating Criteria Used for the Air Quality Assessment

Criteria	Rating Term	Definition
Geographic Extent	Level II	The expected measurable changes extend beyond the LSA
Duration	Level I	The predicted effect persists briefly - no longer than several hours or several days per year
	Level II	The predicted effect persists for the duration of the project phase
	Level III	The predicted effect persists beyond the duration of the Project
Frequency	Level I	Predicted effects occur only a few hours a year due to variable exposures from meteorological variability
	Level II	Predicted effects occur during clearly defined seasons
	Level III	The predicted effect occurs continuously and/or is associated with annual averaging periods
Reversibility	Level I	The predicted effect is reversible after the activity ceases
	Level II	The predicted effect is reversible with cost/effort when the activity ceases
	Level III	The effect cannot be reversed
Qualifiers		
Certainty	High	Baseline data are comprehensive; predictions are based on quantitative data; effect relationship is well understood
	Medium	Intermediate degree of confidence between high and low
	Low	Baseline data are limited; predictions are based on qualitative data; effect relationship is not well understood
Probability	Unlikely	Less than 20 % likelihood of occurrence
	Moderate	Between 20 and 60 % likelihood of occurrence
	Likely	Over 60 % likelihood of occurrence

Table G-5: Effects Assessment Summary for Air Quality

Potential Effect			Evaluation Criteria				
Project Activity	**Direction and Nature of Interaction**	**Mitigation Measure(s)**	**Magnitude**	**Duration**	**Frequency**	**Extent**	**Reversibility**
Construction and Closure Phases	Negative: increased concentrations of CACs	Best practices to minimize air emissions	Level III for: TSP, metals, TSP deposition, PM_{10}, and $PM_{2.5}$	Level III for TSP Deposition Level II for all other parameters	Level III	Level I	Level III for TSP deposition Level I for all other parameters
			Level II for all other CACs and PAI	Level II	Level III	Level I	Level I
Post Closure Phase	Negative: increased concentrations of CACs	Best practices to minimize air emissions	Level I for: TSP, metals, TSP deposition, PM_{10}, and $PM_{2.5}$	Level III for TSP Deposition Level II for all other parameters	Level II	Level I	Level III for TSP deposition Level I for all other parameters

Table G-5: Effects Assessment Summary for Air Quality

Potential Effect			Evaluation Criteria				
Project Activity	**Direction and Nature of Interaction**	**Mitigation Measure(s)**	**Magnitude**	**Duration**	**Frequency**	**Extent**	**Reversibility**
			Level I for all other CACs and PAI	Level II	Level II	Level I	Level I

NOTE(S):

1. CACs = CRITERIA AIR CONTAMINANTS [TSP, PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO].

The project residual effects to air quality can thus be summarized as: the ambient concentrations of the air quality parameters are at a Level I or II for all phases of the Project. Concentrations in excess of the thresholds are predicted to generally be confined to the LSA, and the effects are fully reversible. The residual air quality effects are predicted to be not significant.

For the Post-Closure phase, it is expected the primary sources of dust emissions will be eliminated (with the exception of monitoring site visits) and therefore the closure criteria for Air Quality related to dust deposition (e.g., Mean TSP concentrations less than 60 µg/m^3 annual and 120 µg/m^3 24 hr average or site-specific risk-based criteria) are expected to be met.

Noise and Vibration

Impacts from the significant noise and vibration producing activities such as on-site demolition activity, on-site equipment operation and air traffic are not expected to occur beyond the closure phase. During active closure of project facilities, including the Mine Site and ports, and transportation links such as roadways and the railway, may generate substantial amounts of noise that can affect human receptors and other VECs such as wildlife. However, the duration of these events is expected to be short-term, the frequency of effect is occasional and the effect is reversible. Based on this, the effect is anticipated to be not significant.

G.3.2 Terrestrial Environment

Landforms, Soils and Permafrost

Geotechnical investigations have been conducted across the PDA. Investigations and assessment has found construction and mining activities have the potential to create potential changes to sensitive landforms but the residual effect is not predicted to be significant. The residual effects related to sensitive landforms are assessed as:

- The magnitude of the effects is a change will not be distinguishable from natural variation and will be within regulated values (Level 1).
- The extent of the effects will be confined to the PDA (Level 1).

- The frequency of how often the effect occurs will be negligible as the mitigative measures will ensure that no effects occur (negligible).
- The duration is the length of time over which a Project effect will occur which will be negligible as there is negligible frequency (negligible).
- The reversibility is the likelihood of the sensitive landforms to recover from the effect will be negligible as there is negligible frequency and duration (negligible).
- While soils will be disturbed and there will be residual effects, soils are important as a matrix for vegetation and wildlife habitat which are assessed later in this subsection.
- As changes are expected to be limited to within the PDA, the potential residual effect to permafrost is predicted to be not significant.

Vegetation

The assessment of the Project's effect on vegetation is based on three measurable parameters: vegetation abundance and diversity; culturally valued vegetation; and vegetation health. For the purpose of quantifying the effects of the Project at planned closure, three assumptions are made to simplify the assessment:

- New disturbance within the footprint of the Project will remove all vegetation within the entire PDA for the life of the Project.
- All land is terrestrial habitat and, therefore, is potentially vegetated; though much of the RSA is considered barren or sparsely vegetated.
- Regeneration of the disturbed area is a slow process and will not occur until beyond the life of the project.

Loss of vegetation within the PDA is a residual effect — it is not expected that disturbed areas will become re-vegetated until after closure of the mine. Some of the mine footprint may never return to baseline conditions. This includes blueberries which are considered culturally valued vegetation. However, since effects are expected to be limited to the PDA, any changes to vegetation abundance and diversity (including culturally valued vegetation) occurring outside of the PDA due to dust, NO_2 emission or N deposition are expected to occur at a small magnitude and extent. Consequently, there is high confidence that project related activities will have a not significant effect on vegetation abundance/diversity and culturally-valued vegetation at the scale of the RSA.

Regarding vegetation health, during project construction, operation, and closure activities, it is predicted that annual dust deposition could occur outside of the PDA beyond the 55 g TSP/m²/a threshold level, which may have an effect on the health of vegetation communities. It is estimated that those effects would be limited to a small portion of vegetated areas in the RSA (<0.01 %), and small proportion of each vegetation class (<0.01 %) relative to their individual availability in the RSA. The effects would be reversible when the dust-producing activities cease after project closure. When the air emissions and nitrogen deposition cease at project closure, the effects of nitrogen additions to the ecosystems will persist. This can result in long-term effects on plant community composition and individual species resilience. The prediction is that those effects will be limited to only small proportions (<0.1 %) of the more sensitive vegetation classes within the RSA. Metals contained in dust will likely accumulate to some degree in soils beyond the PDAs, although the affected area is expected to be relatively small in comparison to the RSA. Plant responses to metals in soil are extremely varied and dependant on the species in question, but are primarily determined by soil pH. Since soil and substrate pH were found to be in a neutral range of 6 to 7.5 (based on baseline results) within the Project study area, bioavailability of metals is expected to be maintained at low levels, thereby minimizing or preventing potential phyto toxic effects. The prediction is that any effects will be small in extent and could be minimized by several monitoring and mitigation measures. Based on this there is moderate confidence that project related activities will have a not significant effect on plant heath within the Regional Study Area.

It is noted the prediction confidence is moderate for the effects on vegetation health. Thresholds have not been developed for dust effects on plants, and the literature acknowledges a lack of data of effects of atmospheric emissions and its effects on Arctic vegetation. The effects levels are an estimate based solely on available literature, much of which is based on research, and little in Arctic communities. The potential effects of metals on plants either from aerial deposition or uptake from soils are highly dependent on site-specific conditions and the plant species themselves. Under near neutral pH soil conditions such as those found in baseline soil studies, a significant barrier to metal uptake typically exists that prevents metals from being bioavailable to plants. If metals in soil have limited bioavailability, then the potential for effects on plant health is greatly diminished. In an effort to further address this uncertainty, Baffinland in undertaking additional reclamation research on natural re-vegetation to ensure closure objectives and criteria can be met (Appendix D).

In addition, to confirm project related activities will have a not significant effect on vegetation abundance/diversity at the scale of the RSA, and to assist to further determine expected post closure conditions for vegetation adjacent the limits of the PDA, a vegetation and soil base metal monitoring program has been implemented to detect changes over time in metal concentrations of soil and vegetation (2015 NIRB Annual Report, Section 7.2.1.4 Dustfall Monitoring). The study design aligns with the dust fall monitoring program where reasonable, to include sample sites at varying distances from the PDA to compare metal concentrations in soil and vegetation between near (impacted) and far (control) sites. Based on the dust fall monitoring program, the study design for the vegetation and soil monitoring program considers three Project areas (Milne Port, Tote Road, Mine Site) at varying distances from the PDA (0–100 m; 100–1,000 m; > 1,000 m). Control site locations are those that are greater than 1000 m from the PDA. Distance categories were selected based on data from the dust fall monitoring program that indicates differences in dust fall within 100 m from the PDA and between 100-1.000 m from the PDA (EDI 2015). Beyond 1000 m, dust fall levels were generally below laboratory detection limits. Results from this study will provide further detail on the expected post closure conditions for vegetation adjacent the limits of the PDA. Refer to the 2017 Mary River Project Terrestrial Environment Annual Monitoring Report (EDI 2018), for further information on the vegetation and soil base metal monitoring program.

Migratory Birds and Habitat

Project-related activities could potentially alter bird behavior and cause displacement during during closure activities but activities will be confined to the Project footprint, which is relatively small in relation to the availability of suitable habitat nearby. Densities of bird key indicators (Peregrine Falcon, Snow Goose, Common and King Eider, Red-throated Loon, Thick-billed Murres, Lapland Longspur) are expected to decline within the footprint, and possibly within adjacent zones of influence. However, these changes are expected to be a result of displacement out of the affected areas and not a result of mortalities to the birds or their offspring.

Based on this, the residual effects of Project activities on bird key indicators at planned closure include habitat changes such as localized direct habitat loss and chronic disturbance; however, overall effects are not likely to have serious implications for any species' regional populations. Species abundance and habitat use will almost certainly be altered within the port footprints, and to some extent within a certain zone of influence around them as some individuals are forced out to less-disturbed neighboring areas but because of the vast amount of available suitable habitat nearby, the overall effect of the Project to the key indicators specifically, and to all bird species in general, is expected to be minimal and the effect is anticipated to be not significant.

Terrestrial Wildlife and Habitat

Closure activities have the potential to effect distribution and abundance of wildlife VECs in the RSA through planned closure. The key indicator of the Project's effects on the VEC "Terrestrial Wildlife" is caribou. During construction, operation, and closure of the Mary River Project, monitoring of caribou abundance is important for determining the effectiveness of mitigations and the precision of effect predictions. The current low population of caribou in the RSA makes it difficult to predict effects because there are so few receptors of any potential effects. Consequently, monitoring will be necessary to determine how the effects change as abundance increases. An adaptive wildlife management plan will be the key to reducing any effects of the mine on the terrestrial wildlife. Four measurable parameters were selected to allow prediction of the effects of the Project on caribou. These are: habitat, movement, mortality and health.

HABITAT

Loss of habitat within the PDA (footprint) of the project is a residual effect - Baffinland does not expect that habitat will be reclaimed (re-vegetated) within a generation of caribou or by planned closure. Sensory disturbances that reduce habitat effectiveness within a zone of influence can only be partially mitigated until post-closure. Caribou will find some project activities disturbing. It is uncertain to what degree caribou will adapt to those disturbances. However, over the entire range of the north Baffin Island caribou, habitat effectiveness is predicted to be reduced by 1.72 % during the calving season, 1.67 % during the growing (summer) season, and by 1.83 % during the winter season. This effect will last for the duration of the project's activities or until caribou adapt to the disturbances.

The loss of calving habitat will be entirely from disturbance (i.e. indirect effects of human presence and associated noise) associated with the mine and transportation system, and therefore is reversible at planned closure once these disturbances are removed. Of the calving areas identified from completed studies (collared females), only one calving area was identified within 1 km of the project (near the Southern Railway). Given the broad distribution of calving sites within the RSA, the assumed availability of alternative calving areas, and the minimal competition for calving areas, Baffinland is moderately confident that after mitigation the Project will have a not significant effect on calving caribou. How long the transition back to use of calving habitat close to mine infrastructure post closure is expected to be determined based on terrestrial wildlife monitoring work completed by Baffinland during Operations to further determine or confirm Project effects on caribou and their response to habitat disturbances. In 2015, terrestrial wildlife monitoring work included:

- Height-of-Land (HoL) caribou surveys
- Snow tracking surveys and snow bank height monitoring
- Incidental observations

Results from these ongoing studies will provide further detail on the transition period it would take for caribou to be re-habituated after habitat disturbances and identify any conditions to promote caribou habitat quality. Applicable findings will be incorporated into future revisions of the ICRP. Refer to the 2017 Mary River Project Terrestrial Environment Annual Monitoring Report (EDI 2018), for further information on the terrestrial wildlife monitoring program.

Movement

Alterations to the landscape that will remain post-closure are consistent with the surrounding environment and will be immeasurable features on the landscape given the rough terrain in the RSA. Transportation embankments and building foundations do not exceed the characteristics of the current landscape. The caribou population is expected to rebound and large numbers of migratory caribou, relative to current levels, are expected to return to the area. Trails that were altered because of transportation infrastructure will be re-established as caribou return to and start to move through the region again. The overall residual effect of the project on caribou movement may be that caribou travelling on five of 52 (9.6 %) known trails of may experience a barrier to their movement on those trails. This effect is expected to have a not significant effect on the movement of North Baffin caribou.

Mortality

There are no known features of the project that will remain post-closure that will reduce health to a level of increased mortality for the north Baffin Island caribou herd. There are no expected residual effects of the project on caribou mortality. Mortality, if it occurs, will be limited to individuals within the PDA. The effect of the Project on North Baffin caribou mortality is not significant.

HEALTH

No residual effects of the Project on caribou health are anticipated due to metal exposure from dustfall. Most dustfall will be associated with the Mine Site and the primary metals are relatively innocuous to caribou (FEIS, Volume 6, Section 5.2.4).

G.3.3 Freshwater Environment

Freshwater Quantity

The water component of "Freshwater quantity" refers to surface water (rivers, streams, lakes) and groundwater, however, groundwater quality is generally not considered to be at risk in the Project area because the extensive permafrost layer acts as an impermeable barrier eliminating/limiting potential migration of contaminants into the groundwater located below. Article 20 Inuit Water Rights of the Nunavut Land Claims Agreement (NLCA) formally recognizes the importance of water quantity and flow to the Inuit. Under the NLCA, Inuit require compensation if a project or activity will substantially affect the quantity of water flowing through Inuit-Owned Lands. Therefore, water quantity has been identified as a VEC with respect to hydrology. The water quantity VEC can be defined as the spatial and temporal variability of the volume of water within the RSA that may be subject to alteration by Project activities.

Potential residual effects of the Project on water quantity will be addressed under the following three (3) key issues: withdrawal, diversion, and discharge. Based on these (3) key issues related to freshwater quality, residual effect predictions results in the following:

- The Project will not have significant adverse residual effects on the under-ice water volume of water. All withdrawals meet DFO guidelines for the Regional Study Area.
- Withdrawal will not have significant adverse residual effects on the outflow of water from waterbodies. Magnitude threshold will be exceeded at only one location, 3 km Lake within the Steensby LSA, during June and September; however, the extent of the effect is minor relative to the entire LSA and will occur only while access is being established to ST347 Lake, the permanent water source for the Steensby Port. All withdrawals are within thresholds.
- The Project will not have significant adverse residual effects on water quantity resulting from water diversion. Magnitude threshold will be exceeded in several cases within the Mine Site and Steensby Port LSAs; however in all cases the extent of the effects is minor relative to the applicable LSA. The majority of these diversions do not alter total water quantity; they merely redistribute the water.
- The Project will not have significant adverse residual effects on water quantity resulting from effluent discharge. Magnitude threshold will be exceeded in several cases within the Mine Site LSA; however, in all cases the extent of the effects is minor relative to the applicable LSA. The majority of these discharges do not alter total water quantity; instead, they redistribute during it.

- Based on this, the Project is not predicted to have significant adverse residual effects on Water Quantity resulting from combining the Key Issues of Water Withdrawal, Diversion and Discharge. In all cases the relative extent of the effects is minor as they redistribute rather than alter the total quantity. The Level of Confidence in all Water Quantity significance ratings is either moderate or high, based on an assessment of the quality of available information used to evaluate the residual effects for each watershed.

Water and Sediment Quality

For the same reason "Water Quantity" is important to Inuit values and selected as a VEC, so is "Water and Sediment Quality". Water and sediment quality is an essential component of the aquatic environment with the potential to affect the food chain, fish and fish habitat, and local residents. Project-related effects on sediment quality were primarily assessed qualitatively due to limited data availability, limited information on hydrodynamics, hydraulics, transport and conversion of potential contaminants, and limitations in accurately predicting future effects on sediment quality. In most instances, effects on sediment quality were assessed using surface water quality VEC as a proxy. Residual effects on water quality were considered likely to induce a similar residual effect on sediment quality.

Effects on the surface water and sediment quality VEC were assessed in accordance with the methodology outlined in Section G.2. VEC-specific modifications were made to the general methodology, which are highlighted below to determine residual effects:

- Regional and local study areas were determined
- VECs, Key Indicators and Thresholds were identified
- Project activities that could affect surface water and sediment quality were identified
- Project interactions with, and effects on, the surface water and sediment quality VEC were identified
- Linkage evaluations were performed outlining potential effects related to various phases of the Project (Construction, Operation, and Closure) and Project LSAs (Milne Port, Milne Inlet Tote Road, Mine Site, Railway Alignment, and Steensby Port)
- Mitigation measures were identified to avoid or reduce the potential effects during the various phases of the Project
- Residual effects and their relative significance were identified for the surface water and sediment quality VECs
- Long-term monitoring programs were identified to distinguish Project-related impacts from natural variability, in order to verify impact assessment predictions and to meet compliance/conformance criteria
- Based on this methodology, residual effects of Project infrastructure and activities were assessed with a focus on mine contact water that will be discharged into the freshwater environment at planned

closure and 'other water discharges' that have potential residual impacts that may remain at planned closure

Mine Contact Water Discharges Post-Closure

Project-related emissions of mine contact water may result in impaired surface water and sediment quality in the Mine Site LSA. Management of storm water and process water that has been in contact with the iron ore (mine contact water) is required at the Mine Site. The following sources have been identified for inclusion in the aqueous point source emissions residual effect assessment because they involve mine contact water that will be discharged into the freshwater environment at planned closure:

- Waste Rock Stockpile runoff to Camp Lake and Tributaries
- Pit lake water and waste rock discharges to Mary River in post-closure

The rationale for the residual effects ratings for these two (2) mine contact water discharges is provided below. Given the variability in runoff flows, the ponds were sized to accommodate the two-year extreme event. Discharge is anticipated to be distributed evenly with the natural flows from approximately mid-June until September. Water quality modelling in the Life-of-Mine Waste Rock Management Plan (Appendix 4 and 5, BAF-PH1830-P16-0031) indicates that the waste rock stockpile and open pit area runoff water will not contain concentrations of metals in excess of discharge requirements based upon the MDMER. In addition, ammonia and nitrate in runoff are not expected to cause receiving water impacts or regulatory exceedances. However, in the event that ongoing water quality modelling or field monitoring shows a trend toward exceedance of discharge requirements, then water treatment facilities will be constructed. Details regarding theoretical treatment options are provided in the Life-of-Mine Waste Rock Management Plan (Section 3.6.4, BAF-PH1830-P16-0031) and were considered for both metal and ammonia/nitrate removal. Theoretical treatment options for metals removal included:

- Resins
- Polymer Addition
- Sodium Hydrosulfite Treatment
- Ozonation
- Biofilters-Sulphide Precipitation
- Activated Carbon
- Lime Precipitation

Theoretical treatment options for ammonia/nitrate removal include:

- Biological De-nitrification (for removal of both ammonia and nitrate)
- Ion Exchange

- Electro-Chemical Ion Exchange
- Breakpoint Chlorination of Ammonia
- The main findings of the Life-of-Mine Waste Rock Management Plan suggest that, with sufficient storage and upstream control, any water quality issues that arise can be managed. See Life-of-Mine Waste Rock Management Plan (BAF-PH1830-P16-0031) for further discussion on theoretical treatment options (Section 3.6.4) and water quality modelling results for the waste rock pile and open pit area runoff water (Appendix 4 and 5).
- In addition to upstream controls such as water treatment which are outlined above, other upstream control methods such as diversion ditches (which can reduce water volumes and contact) and settling/buffer ponds are potential options to address water quality issues. If the only challenge with the water quality is TSS concentration, this will often be solved using retention time alone. With a buffer pond that has a sufficiently large retention time it is possible to allow particles to settle while discharging - either by gravity or pumping - in a continuous system.
- The PAG waste rock will be covered with a layer of non-PAG material up to 50 m thick. If water quality issues are observed, modifications to the design, components and thickness of this cover would also bean effective upstream control for limiting infiltration mass loadings from the PAG material.

All mine contact water (including that from the ore stockpiles) in the Milne Port and Steensby Port LSAs is discharged to the ocean; their potential effects are assessed as part of consideration of the Marine Environment (Section G.3.4).

Waste Rock Stockpile Runoff to Camp Lake and Tributaries

The mass balance modelling indicates that several parameters will have Level II magnitude effects to water quality under both mean and low flow conditions at the nearest downstream location inhabited by fish at L0, and in Camp Lake (Hazard Quotient - HQ of >1 and <10). An HQ >10 and <100 was applied for mercury using 90th percentile baseline concentrations. All other parameters are at Level I or lower. Each of the metals showing an HQ >1 (a Level I effect) or HQ >10 (a Level II effect) is identified in the humidity cell testing as having >50 % non-detects, and half the detection limits were assumed for non-detect results. Consequently, the derived source terms for these metals are substantially based on the analytical method detection limits (MDLs). Most of these same parameters (including arsenic, cadmium, chromium, mercury, selenium and silver, as well as other metals that do not trigger a Level I effect) have measured baseline concentrations that are mostly non-detect, and therefore the calculated mean or 90th percentile concentrations are substantially based on MDLs. On this basis, the assignment of a Level II magnitude rating for water and sediment quality effects arising from discharge of stormwater from the west waste rock pond to the Camp Lake tributaries and Camp Lake is considered to be highly conservative. Baffinland is exploring options for re-testing or additional testing to obtain a dataset of more precise measurements for these parameters.

Discharge of mine contact water from the Waste Rock Stockpile into the lower reach of Camp Lake tributary L1 may be required during the Operation, Closure and post-closure phases of the Project and therefore a Level III duration rating was assigned. The frequency of the potential effect will be annual, limited to the period between June and September therefore a Level II frequency rating was assigned. The extent of the potential effect is expected to be limited to the Mine Site freshwater LSA and to reach negligible levels where Camp Lake discharges into Mary Lake therefore a Level I extent rating was assigned. The potential effects are anticipated to be partially reversible therefore a Level II reversibility rating was assigned. See Appendix H for freshwater quality predictions applicable to discharges of mine contact water from the Waste Rock Stockpile into the lower reach of Camp Lake in post-closure and how they relate to water quality standards based on FEIS and its Addendum, Volume 7, Section 3.4.

Based on these ratings, discharge of mine contact water from the Waste Rock Stockpile into the tributary of Camp Lake is not expected to result in an adverse environmental effect on water and sediment quality in the Mine Site LSA.

Pit Lake Water and Waste Rock Discharges to Mary River in Post-Closure

At the end of mining, the open pit will gradually fill with water from precipitation; time is estimated at 85 to 147 years, depending on annual precipitation, evaporation and other factors (Knight Piésold, 2008). During the years that the pit is filling, runoff will continue to discharge to tributary F0 and the Mary River from the Waste Rock Stockpile. AMEC (2012) developed water quality estimates for pit water for the final year of mining (Year 21), which were applied in a water quality model under the assumption that, once the pit has filled, in each subsequent (post-closure) year all precipitation into the open pit will accumulate and spill over the southwest edge facing the Mary River, behaving like a spillway, and that water will be released during the open water period according to the natural hydrograph.

Mass loading modelling carried out indicates that Level I magnitude effects to water quality will occur under low flow conditions, with a calculated HQ between 1 and 10 for mercury, selenium and silver. It is noted that an HQ >10 was calculated for mercury within the F0 tributary, upstream of fish; however, since the assessment of water and sediment quality is based on fish as the receptor, the effects assessment considers the resultant water quality at fish habitat within the Mary River, where all parameters have an HQ value less than 10.

The effects associated with the discharge of pit water and waste rock runoff into the Mary River are permanent and therefore a Level III duration. The waste rock seepage may run off into the Mary River starting in the first year post-closure, whereas the pit water is not expected to discharge to the Mary River until the pit fills, after 80 years or more for natural infilling, and as short as two years if pumping infilling is used. It should be noted, that post-closure monitoring is only scheduled for the first fifteen (15) years after closure activities. In the event reclamation research and operational monitoring indicated that closure criteria related to pit water and waste rock runoff into the Mary River cannot be met in that timeframe, post-closure monitoring programs will be re-evaluated and updated.

The frequency of the potential effect will be annual, limited to the period between June and September when exploration drilling is scheduled and therefore a Level II frequency rating was assigned. The extent of the potential effect is likely to be limited to the Mine Site freshwater LSA therefore a Level I extent rating was assigned. The effects associated with the discharge of pit water and waste rock runoff into the Mary River is partially reversible therefore a Level II reversibility rating was assigned. See Appendix H for freshwater quality predictions applicable to pit lake water and waste rock discharges to Mary River in post-closure and how they relate to water quality standards based on FEIS and its Addendum, Volume 7, Section 3.4.

Based on these ratings, discharge of pit water and stormwater from the Waste Rock Stockpile into the Mary River is not expected to result in an adverse environmental effect on water and sediment quality in the Mine Site LSA. The Level of Confidence is Medium, due to the assumptions made in the mass loading models and the consequently highly conservative nature of the effect prediction.

It is noted Baffinland recognizes there is potential uncertainty with waste rock and open pit discharge predictions. In an effort to address this uncertainty, Baffinland in undertaking additional reclamation research on Waste Rock Stockpile and Open Pit discharges to ensure closure objectives and criteria can be met (Section 5.1.1).

In addition, based on pit water quality for Year 21 of mining, it is possible the water will have a pH of around 4.2, which is outside of the pH range of the MDMER (6.0 to 9.0). If required, adjustment of pH will be carried out periodically through closure using either batch lime treatment or in-line treatment, drawing down the pit lake periodically. The mass loading modelling carried out is based on conservative assumptions and Baffinland is continuing to study the geochemistry of waste rock and ore to further refine predictions and management plans. If reclamation research and operational monitoring of the geochemistry of waste rock indicate pit water quality is reasonably certain to have a pH range outside of the MDMER, then the ICRP will be updated to reflect proposed treatment approach. The most commonly used commercial process for treating metal contaminated mine drainage is lime precipitation where an aqueous solution of $CaCO_3$ precipitates metals as solid hydroxides which are then removed as a sludge. Although several other processes are also possible for metal removal, in this situation the simplicity of the system operation is a key requirement and as such lime treatment is the preferred technique as this is the simplest most reliable operation. See Life-of-Mine Waste Rock Management Plan (Section 3.6.4.1, BAF-PH1830-P16-0031) for further discussion on lime precipitation and proposed treatment options.

Other Water Discharges Post-Closure

In addition to the aqueous point source emissions discharged into the freshwater environment at planned closure, there may be remaining infrastructure and activities that were widespread or had non-point source discharges that have potential residual impacts that may remain at planned closure. The effect of these non-point source emissions were assessed in a qualitative manner on a Project-wide basis rather than assessing residual effects for each individual water body. These activities included: ground preparation and earthworks, site water management, laydown areas, quarries and borrow areas, tunnelling and rock cuts, camps and fuel management, water use and management, and airstrips and airstrip use. Based on this approach, it was found project activities resulting in non-point source discharges may result in changes to surface water and sediment quality in the five freshwater aquatic LSAs, however with appropriate use of mitigation measures, monitoring and adaptive management, this is not anticipated to result in significant adverse residual effects on water (freshwater) or sediment quality. This significant determination is generally based on the effect confined to the LSA, the effect being fully or partially reversible after activity is complete, and the effect is expected occur greater than threshold value(s) only rarely or is expected to occur intermittently or continuously within threshold values. See Appendix H for freshwater quality predictions applicable to other water discharges post-closure and how they relate to water quality standards based on FEIS and its Addendum, Volume 7, Section 3.4.

Freshwater Biota and Habitat

Closure activities have the potential to effect distribution and abundance of freshwater biota and habitat in the RSA. Arctic Char was identified as the key indicator for the "Freshwater Biota and Habitat" VEC. Potential linkages between the Project components/activities and Arctic Char fall into three key issues:

- Key Issue #1: Potential effects on the health and condition of Arctic Char
- Key Issue #2: Potential effects on their habitat
- Key Issue #3: Potential effects on their direct mortality.
- Based on these three (3) key issues, it was determined overall the Project will not have significant adverse residual effects on Arctic Char. The Project will cause residual effects across the five LSAs, but the effects will be confined to these areas or portions of these areas, the magnitude of residual effects is predicted to be Low or Medium, and effects are expected to be reversible. The specific characteristics that were considered related to the three (3) key issues are further descried briefly below. For further detailed discussion on potential effects on distribution and abundance of freshwater biota and habitat in the RSA, please refer to FEIS and Amendment No.1, Volume 7, Section 4.5.

Health and Condition

Potential effects on Arctic Char health and condition relate to changes in water quality, which may occur from the Construction through to the Closure phases in relation to aqueous discharges and due to dust deposition. The water and sediment quality assessment (FEIS and Amendment No.1, Section 3.4.2.3) indicates there will be residual effects due to introduction of dust to surface waters during the Construction, Operation, and Closure phases. The greatest deposition of TSP predicted in the air quality modeling (FEIS Amendment No.1, Figure 5-2.2, Volume 5) is predicted to occur in Catchment MI-02, which does not support Arctic char. Further, the greatest dust deposition would occur in drainages that report to Milne Inlet or the lower reach of Phillips Creek. Available information indicates limited (or possibly no) Arctic char usage of Phillips Creek and unsurveyed streams in the dust deposition area are expected to provide no habitat, or marginal habitat at best. The risk of exposure of Arctic char to dust-related effects on water quality is therefore limited.

In general, for the Milne Port LSA, waterbodies located within the dust deposition zone are largely devoid of Arctic char with the possible exceptions of Phillips Creek, Stream M2-1, the lower reaches of streams M3-3 and M11-1 (all potential habitat), and tributary streams west and east of Phillips Creek that have not been surveyed (FEIS Amendment No.1 Figure 7-4.2). Streams M3-4 through M4-7 draining into the west bank of Phillips Creek and streams M4-8 through M4-10 draining into the east bank of Phillips Creek have not been surveyed but a determination of Arctic char habitat potential was made based on air photo interpretation. Streams M3-4 through M3-6 are ephemeral streams with no potential habitat. The very downstream end of Stream M4-7 is just inside the predicted dust deposition zone. This stream drains several upstream lakes, at least one of which may be deep enough to support Arctic char overwintering. It is probably an intermittent stream, at least near its confluence with Phillips Creek, where it may provide seasonal juvenile rearing habitat. Overall, the stream likely provides only low quality habitat in its lowest reaches and is poorly connected to potential upstream lake habitat. Lake ML-23, the most downstream lake in the M4-7 drainage is outside of the predicted zone of dust deposition and is too shallow to provide overwintering or spawning habitat. Stream M4-8 is a small ephemeral stream and M4-9 and M4-10 are probably intermittent, at least in their lower reaches. Of these latter streams, neither is connected to upstream lakes with fish habitat potential. Both streams are poorly connected to Phillips Creek at their confluences and fish passage would likely be difficult or impossible except during periods of high flow. All of these streams are expected to provide no habitat or marginal habitat at best. Farther upstream, a larger unnamed tributary flows into the west bank of Phillips Creek, approximately 1 km downstream of the impassable falls on Phillips Creek. The lower portion of this stream falls within the predicted dust deposition zone from haul traffic along the Milne Inlet Tote Road. This stream has not been surveyed, as it contains small lakes within its watershed, examination of air photos suggests that it would support marginal habitat at best, due to poor connectivity between upstream habitat and Phillips Creek at all but high flows.

The lower reach of Stream M11-1 was identified as potential Arctic char habitat during the baseline studies, although no fish were captured. As the freight dock footprint will be placed on stream M11-1, the area has been considered to be lost and is not assessed further here.

Introduction of particulate dust to surface waters for the Milne Port LSA is predicted to cause negligible to small (within an order of magnitude of water quality thresholds) increases in TSS and metals associated with the ore dust. The water quality assessment (FEIS and Amendment No.1, Section 3.4.3.3) indicates that increases would occur largely during spring freshet and would therefore occur over a short period. No effects of dust on sediment quality are predicted in FEIS Amendment No.1 Section 3.4.3.3 due to the limited amount of settling predicted. Available information indicates limited (or possibly no) usage of Phillips Creek and streams M2-1, M3-3 and M11-1 by Arctic char, and unsurveyed streams in the dust deposition area are expected to provide no habitat or marginal habitat at best. The risk of exposure of

Arctic char to dust-related effects on water quality is therefore limited. Overall, the residual effects of this pathway have been ranked as low magnitude (Level I), frequent (Level II), confined to the LSA (Level I), of medium term duration (Level II), partially reversible (Level II), and is predicted to be Not Significant.

For the Mine Site LSA, the greatest effects are predicted to occur within small tributaries to Camp and Sheardown lakes in relation to dust deposition and for Camp Lake Tributary 1, due to both dust deposition and discharge from the Waste Rock Stockpile. Water quality effects are also expected in Camp and Sheardown lakes, most notably near tributary mouths. Mary River may also experience exceedances in CCME PAL guidelines during Operation, Closure and Post-Closure due to dust deposition and the discharge of effluents and runoff. The magnitude of residual effects on Arctic Char health and condition will range from Low in Mary River to Medium in tributaries to Camp and Sheardown lakes due to cumulative effects of the Project on water quality. Effects will also vary over time, with the largest effects occurring in the Operation phase during spring freshets, when dust introduction will be greatest, and during periods of effluent discharge. Effects related to runoff from Waste Rock Stockpile and pit water release (after the pit has filled) will extend into the post-Closure period. These range from short-term (due to dust generation during active vehicle movement and infrastructure demolition) to long-term duration (although it is expected the major sources of dust emissions will be eliminated and closure criteria for Air Quality related to dust deposition are expected to be met, some dust sources may still exist post-closure). Effects are expected be confined to the LSA, and will be reversible with the use of reclamation approaches (e.g., natural re-vegetation). See FEIS and Amendment No.1, Section 4.5 for further discussion.

HABITAT

Potential effects on Arctic Char habitat include increased sedimentation rates, loss of habitat to Project footprints in waterbodies, water withdrawals, alterations in water levels and flows due to diversions that may reduce the amount of available habitat, and collectively, reduction of productive capacity in streams and lakes due to all of these effects pathways. Following mitigation, residual effects on Arctic Char habitat are expected to be a small to moderate reduction in the amount and productive capacity of habitat in LSA waterbodies, most notably in smaller tributaries to Camp and Sheardown lakes. Effects will be of moderate or long-term duration, limited to the LSA, and reversible.

MORTALITY

No residual effects on direct mortality of Arctic Char are predicted following mitigation.

G.3.4 Marine Environment

Sea Ice

During the scoping activities, sea ice and Project-related effects to sea ice were identified as being of utmost importance to Inuit as it relates to their culture, as well as to animals that rely on ice. Therefore, sea ice was identified as VEC. A number of pathways were identified through which construction, operation, and closure activities would interact with sea ice. These include:

- Disruption of landfast ice at Steensby Port during construction activities, including on-ice construction activities.
- Treated wastewater discharge during construction and operation of the Project.
- Disruption of landfast ice at Steensby Port and Milne Port due to dust deposition on the ice surface.
- Disruption of pack ice through Hudson Strait and Foxe Basin by icebreaking ore carrier passage.

It is noted given the timing for shipping from Milne Port, the ERP will not involve any components that interact with Sea Ice or Landfast Ice. Consequently there will be no effects on this VEC.

Based on a residual effects assessment, annual icebreaking activity represents the residual effects on sea ice. There is potential for the physical alteration of a maximum cumulative annual total of 136 km^2 of landfast ice within Steensby Inlet. This represents 4.0 % of the landfast ice within the Inlet and less than 0.5 % of landfast ice within Foxe Basin and the RSA. This effect is an unavoidable result of shipping at Steensby Port. Effects on integrity of the landfast sea ice from shipping are predicted to be "not significant" because they will be small in magnitude, confined to within the LSA, long in duration, and fully reversible following Project closure. There is no predicted residual effect to sea ice in post-closure.

Water and Sediment Quality

For the same reasons "Water and Sediment Quantity" in the Freshwater Environment is important, so is "Water and Sediment Quantity" in the Marine Environment and therefore it was identified as VEC. A number of pathways were identified through which closure activities would interact with Water and Sediment Quantity in the marine environment. These include:

Vessel Traffic (Ice-Free Season Only)

Vessel traffic during the closure phase is not anticipated effects to TSS, nutrient, or metal concentrations in the water or sediment due to resuspension of substrates from propeller currents as it is expected that the seafloor will have stabilized by planned closure. In addition, there are no anticipated increases in hydrocarbon concentrations in water or sediments assuming normal vessel operations. It is assumed all ships will comply with the Anti-Fouling Systems Convention and will not introduce tributyl-tin to the environment. Based on this, vessel traffic is expected to have negligible or no effect on water or sediment quality during the Closure Phase of the Project.

Discharge of Ballast Water

The environmental effect of the discharge of ballast water during planned closure includes potential localized temperature threshold exceedances and/or localized reduction in nutrient concentrations in water. However, mitigative measures require the ballast water to be exchanged in nutrient poor areas of the high seas (according to the Ballast Water Control and Management Regulations administered under the Canada Shipping Act), and is expected to be discharged over a large area (e.g., within protected waters). Based on this, the environmental effect of the discharge of ballast water during planned closure will be of low magnitude (Level 1), confined to areas within the LSA (Level 1), infrequent (Level 1) of short duration (Level 1) and fully reversible (Level 1). The environmental effect of the discharge of ballast water on water and sediment quality in Milne Inlet is predicted to be "Not Significant".

WASTEWATER AND SITE WATER DISCHARGE

The environmental effect of the discharge of wastewater and site runoff (oiled site water, and overland runoff) may cause potential increases in BOD and concentrations of TSS, nutrients, metals, and hydrocarbons in the water and nutrients, metals, and hydrocarbons concentrations in the sediment. However, all discharges of wastewater, oiled water, and contact water will be monitored to ensure they meet the respective guidelines prior to discharge. Although not expected, in the event respective guidelines are not met based on monitoring/testing results, the water will be treated prior to discharge similar to current operational practices. Following closure, discharges of wastewater, oiled water and contact water will cease.

Based on this, during closure and post-closure activities, the environmental effects of wastewater and site water discharges to Milne Inlet will be low magnitude (Level 1), confined to within the LSA (Level 1), frequent (Level 2), of short duration (Level 1), and reversible (Level 1). The environmental effect of wastewater and site water discharges to the Marine Environment is predicted to be "Not Significant".

Freshwater Biota And Habitat

Closure activities have the potential to effect distribution and abundance of marine biota and habitat in the RSA. Arctic Char was identified as the key indicator for the "Marine Biota and Habitat" VEC. Arctic char are seasonally abundant in marine coastal waters, and are of value as a cultural, subsistence and commercial resource.Potential linkages between the Project components/activities and Arctic Char fall into two key issues:

MARINE FISH HABITAT

During closure activities, potential effects on marine fish habitat relate to discharge of wastewater and site drainage (Increase TSS, alter sediment composition, alter productive capacity), barge and ship traffic (ice-free season only) (no change in TSS, sediment composition, or productive capacity), noise disturbance due to infrastructure removal and vessel activities (avoidance by fish), and ballast water discharge (water temperature and water-borne nutrient concentration change, decrease in benthic productivity). It is expected that the magnitude of these residual effects will be low (Level I). Project activities leading to residual effects on water quality (short-term water quality guideline exceedances) would be reversible and related effects on marine habitat (e.g., changes due to ballast water) are also expected to be reversible. Based on this, the Project will have no significant adverse residual effects on marine fish habitat.

ARCTIC CHAR HEALTH AND CONDITION

During closure activities potential effects on anadromous Arctic Char health and condition relate to habitat-related effects (including the loss of a negligible amount of habitat contained within infrastructure footprints), possible reduced benthic productivity due to ballast water discharge, and possible avoidance of a small area around the dock sites due to underwater noise. It is expected that these effects will be contained to within the respective LSAs, and would be of small consequence in the context of feeding habitat available within Milne and Steensby Inlets. These effects are expected to be reversible. Project activities are expected to cause no direct mortality (e.g., fishing by employees will not be permitted) or effect the size of anadromous Arctic char populations. Residual effects on water and sediment quality may result in low magnitude effects on char health and condition, but these effects are expected to be confined to within the Milne and Steensby Inlets LSAs. Project activities leading to residual effects on water quantity will be reversible and effects on Arctic char are also expected to be reversible. As such, the residual effects are predicted to be “not significant”.

Marine Mammals

Based on issue scoping during development of the Mary River Project EIS, the following marine mammals were selected as an indicator species: ringed seal, bearded seal, walrus, beluga whale, narwhal, bowhead whale and polar bear. Scoping also indicated that the influences of noise on the behaviour, health, distribution and abundance of marine mammals in the LSA and RSA were of primary concern. The residual effects assessment therefore focuses on the potential effects of noise from various Project activities. Other Project activities such as the discharge of wastewater will interact with some marine mammals, but with mitigation measures in place residual effects are expected to be negligible to very minor. The approach for predicting how many marine mammals might be exposed to noise of sufficient level (and duration) that could elicit a behavioural response or cause hearing impairment is intended to provide guidance on the expected level of effect. Based on this assessment approach, the residual effects were determined as outlined below.

It should be noted there is a low level of certainty with the prediction of disturbance effects of vessels transiting marine waters on indicator species. The Marine Environmental Working Group (MEWG) will be functioning during the life of the Project to continually evaluate if there are any residual effects from Project activities on the marine environment at the Port(s). Based on current information that suggest effects on marine mammals is related to ship interaction, it is anticipated that there will be no significant residual effects at closure on the marine environment when ship interaction is removed. If operational monitoring indicates that the prediction of no significant residual effects at closure on the marine environment may be inaccurate, additional Closure and/or Post-Closure activities will be evaluated in the light of this new information. Baffinland’s Marine Environmental Effects Monitoring Plan (BAF-PH1-830-P16-0046) outlines the approach for monitoring of marine mammals during Operations and results are reported back to the MEWG and reported annually to external stakeholders in via NIRB Annual Report. Monitoring results will provide input into the ongoing residual impact evaluation process as described in Section G.5.

Ringed Seal

The Project is predicted to have no significant residual effects on ringed seals. Habitat change, disturbance, hearing impairment, masking, and mortality effects are predicted to be low magnitude and confined to the LSA.

Bearded Seals

The Project is predicted to have no significant residual effects on bearded seals. Habitat change, disturbance, hearing impairment and masking effects are predicted to be low magnitude and confined to the LSA.

Walrus

The Project is predicted to have no significant residual effects on walruses. Habitat change, disturbance, hearing impairment, and masking effects are predicted to be low magnitude and confined to the LSA. No mortality is expected.

Beluga Whale

The Project is predicted to have no significant residual effects on beluga whales. Habitat change, hearing impairment, and masking are predicted to be low magnitude and confined to the LSA. No mortality is expected. Disturbance effects are predicted to be low to medium magnitude and to occur within the LSA. There is a low level of certainty with the prediction of disturbance effects of ore carriers transiting Hudson Strait during the ice-cover period. There is also uncertainty with masking predictions. A monitoring program and an adaptive management plan will be undertaken to address these uncertainties and ensure that beluga whales do not incur significant effects.

Narwhal

The Project is predicted to have no significant residual effects on narwhals. Habitat change, hearing impairment, and masking are predicted to be low magnitude and confined to the LSA. No mortality is expected. Disturbance effects are predicted to be low to medium magnitude and to occur within the LSA. There is a low level of certainty with the prediction of disturbance effects of vessels transiting Eclipse Sound and Milne Inlet during the open-water period and with ore carriers transiting Hudson Strait during the ice-cover period. There is also uncertainty with masking predictions. A monitoring program and an adaptive management plan will be undertaken to address these uncertainties and ensure that narwhals do not incur significant effects.

Bowhead Whale

The Project is predicted to have no significant residual effects on bowhead whales. Habitat change, hearing impairment, and masking are predicted to be low magnitude and, with perhaps the exception of masking, confined to the LSA. No mortality is expected. Disturbance effects are predicted to be low to medium magnitude and to occur within the LSA. There is a low level of certainty with the prediction of disturbance effects of ore carriers transiting Hudson Strait during the ice-cover period. There is also uncertainty with masking predictions. A monitoring program and an adaptive management plan will be undertaken to address these uncertainties and ensure that bowhead whales do not incur significant effects.

POLAR BEAR

The Project is predicted to have no significant residual effects on polar bears. Habitat change and disturbance effects are predicted to be low magnitude and confined to the LSA. A minimal number of bears may be killed to protect humans but this would be taken out of the quota with compensation provided.

G.3.5 Human Environment

Population and Demographics

The Project will have multiple residual effects on the Population Demographics VSEC for some of the communities in the North Baffin LSA. These will affect individuals, families and communities, and may include positive as well as negative directions. Residual effects arising from in-migration and out-migration are expected to arise; however, these effects are not expected to be sufficient to cause adverse effects on demographic stability of the affected communities. Therefore these residual effects are assessed to be not significant although it is recognized that the dynamic nature of human and community interactions makes it difficult to predict the overall direction (positive or negative) and magnitude of such changes. Mitigation measures implemented by Baffinland aim to enhance the positive residual effects of the Project on this VSEC. Based on the best available understanding of the dynamics involved in these decisions, there is moderate confidence that negative residual effects will have no significant effect on Population Demographics.

Education and Training

The assessment of the Project's residual effects on life skills and on education and skills leads to a conclusion that the Project will have a significant positive effect on education and training. This is attributed to positive residual effects on life skills amongst young adults that are anticipated to arise from the Project through access to industrial work supported by pre-employment preparation and on-the-job training and beneficial residual effects on education and skills across the LSA. It is recognized that there is a potential that individuals may drop out of school or forego further education in order to work at the Project; however, the overall effect of the Project will be to increase the value of education and thereby the "opportunity cost" of dropping out of school.

This Project's residual effects on life skills and on education and skills are expected to be confined to the LSA and should have sustained benefits beyond panned closure. Given the mitigation measures that have been committed to, as described in the Human Resource Management Plan (HRMP, found in the FEIS, Volume 10F-3 December 2010 Rev 0), confidence in this assessment is high.

Livelihood and Employment

The Project is assessed to have no significant adverse residual effects on the Livelihood and Employment VSEC. The Project will have a positive effect on wage employment in the North Baffin by introducing new job opportunities and assisting local residents to access these jobs while building capacity that will last past project closure. The Project will also have a positive effect on the ability of local residents to progress in their jobs and career choices. This effect will arise as a result of the new career paths that will be introduced to the region, from entry-level through step-by-step advancement to higher level jobs. Based on this, and with successful implementation of planned mitigation, it is assessed to have significant beneficial effects on this valued component.

Although no significant adverse residual effects on the Livelihood and Employment are predicted, it is noted stakeholders, including QIA and CIRNAC, have expressed concerns on Project effects on Inuit harvesting. In order to provide further context for this concern to make sure it is addressed appropriately in closure planning, the potential Project interactions with individuals, households, communities, and marine and terrestrial wildlife after completion of planned closure are summarized in Table G-6 below.

Table G-6: Summary of Project Interactions with Inuit Harvesting after Completion of Closure Activities

Socio-Economic Effects

- Inter-community Inuit migration – This may lead to more Inuit becoming interested in hunting in a particular region (and a consequent reduction in hunting in some other region). This is predicted to be a low magnitude effect.
- Improved life skills – Increased well-being associated with improved life skills could lead to a greater interest in rediscovering traditional Inuit values and activities, including perhaps a renewed interest in harvesting. This could lead to more hunting activities.
- Increased household purchasing power – Those who gain income from the Project will have improved access to purchasing the gear, equipment, and supplies needed to support harvest activities of family and friends. They may or may not choose to apply their purchasing power to these ends however. If this does occur to a substantial degree, it is possible that hunting intensity may increase. Whether this leads to a change in harvesting patterns is not known—the baseline does not provide adequate insight into current harvest patterns in terms of the balance between “weekend hunters” and “intensive hunters.”
- Wildlife harvesting by Inuit – Harvesting by Inuit was assessed based on the parameter of harvest quantity per level of effort, meaning the number of harvests by species, or total quantity (i.e., weight) of country food obtained, in relation to an estimated level of effort (amount of time spend hunting). Taking into consideration the results of the assessments on marine wildlife and arctic char the residual effects on harvesting were predicted to be negligible. The residual effects on caribou harvesting were predicted to be not significant because the measurable parameter was predicted to change by less than 1 % in magnitude.

Effects on Caribou

- Sensory effect on wildlife – Effects includes noise and dust emissions that are limited to the zone of influence and are addressed under loss of habitat.
- Caribou habitat – The Project will lead to small reductions in caribou habitat and habitat effectiveness. Assessment conclusion: We are moderately confident that Project related activities will have a “not significant” loss of habitat and a “not significant” reduction in the effectiveness of caribou habitat within the North Baffin caribou range.

• Movement – The overall residual effect of the project on caribou movement may be that caribou travelling on five of 52 (9.6 %) known trails experience a barrier to their movement on those trails. Few caribou currently exist within the RSA, so few caribou will be affected by the mine infrastructure and activity. Assessment conclusion: We are moderately confident that Project related activities will have a “not significant” effect on traditional caribou migration on north Baffin Island. • Mortality – There are no expected residual effects of the project on caribou mortality. Mortality, if it occurs, will be limited to individuals within the PDA. There are no expected indirect effects on the north Baffin Island caribou population as a result of hunter access.
Effects on Marine Mammals • The small area of the dock footprints is a negligible part of nearshore habitat and therefore a “not significant” effect on marine mammal nearshore habitat in is predicted after completion of planned closure. • As stated above, none of the Project interactions were considered to lead to significant impacts on any of the indicators related to harvesting. However, some agencies have asked how multiple “non-significant” residual effects might combine over the course of the Project. The possibility for such aggregations of residual effects is acknowledged, however, given what is known about Inuit land-use and harvesting practices the probability that any such combination would lead to a significant adverse effect on Inuit harvesting is considered to be unlikely. The following points provide a rationale in support of this conclusion: • Households that gain access to better transportation and harvesting equipment directly or indirectly related to Project-derived income may improve their opportunity to harvest. This is important to intergenerational transfer of harvesting values, culture and knowledge to the younger generations. • Contribution of the Project to trends related to “sharing” versus “commercialization” of harvested country food is considered to be complex and multi-directional. Some aspects of the Project may support the development of commercial harvesting activity, while others may serve to strengthen traditional sharing networks. • To illustrate the previous point, the culture of sharing harvested food is difficult to maintain among families that are dependent on social assistance for their sustenance. The ability of members of these households to gain employment may, for some, present the ability to have enough income that groceries, money, hunting equipment, or the proceeds of harvesting can be shared beyond the immediate household. This sharing could serve to maintain and strengthen traditional sharing cultures by enabling a greater portion of the population to participate in sharing relationships. • The Project may contribute to trends in the adoption of technology by harvesters. It will provide some households with the income they need to acquire and support this technology. This could lead to a divergence between those harvesters who have access to the technology and those who do not. However, current income differentials already exist amongst households in the LSA. Those with access to the largely public sector jobs have far more income than households who have no substantial wage income. Introduction of mine jobs may lead to improved wealth distribution in communities. Traditions of sharing equipment in exchange for country food should serve to further reduce the gap between technology “haves” and “have-nots.”

The complexity of factors that are understood to affect trends in Inuit harvesting activities are highly inter-twinned with other factors affecting harvesting in the LSA. The potential for beneficial outcomes is equally or more highly anticipated than the potential for negative effects. Monitoring of specific Key Indicators that relate to Inuit harvesting—such as effects on wildlife habitat and populations and effects on employment—will be carried out as described in the Mary River FEIS. However, given the complex and indirect nature of many of these interactions—along with the concurrent influence of many other trends and interactions unrelated to the Project— these narrowly focused monitoring initiatives are not on their own expected to generate an integrated understanding of how Inuit harvesting may be affected from the combination and accumulation of these individual interactions. Baffinland will participate with Inuit and other agencies to support monitoring initiatives related to changes in Inuit land-use and harvesting, and associated culture and skills, by making available relevant data the Company generates.

Baffinland will also follow the outcome of socio-economic monitoring that is carried out by other agencies and companies. This will include reviewing the annual socio-economic monitoring reports to NIRB from projects such as the Meadowbank mine.

Economic Development and Self-Reliance

The overall direction of the effects of the Project on the Economic Development and Self-Reliance VSEC are assessed, with a high level of confidence, to be positive. Direct and indirect economic expansion associated with the Project will create new opportunities for employment and business across the RSA, and particularly within the LSA. The Project will enhance labour force capacity and may increase Inuit business capacity. The assessment of Project interactions on land and land use dimensions of this VSEC suggest that these effects will be multi-dimensional. No significant adverse effects on the underlying VECs are assessed. The integrated analysis of the combined effects of the Project does not lead to an assessment of adverse effects on harvesting. Considering the Project's interactions with these multiple dimensions related to Economic Development and Self-Reliance, the residual effects of the Project are assessed to be positive and significant.

It is noted at planned closure there will be a reduction of benefits flowing from the Project. Loss of employment will be partially off-set by workers' eligibility for employment insurance payments. At final closure, Project employment will cease and individuals will be eligible for Employment Insurance (EI). During their EI benefits period, former workers may seek work elsewhere, either in the local economy or in the broader job markets.

The effect of job loss on individuals and households will depend on personal circumstances. Those who take advantage of the opportunities to acquire education and improved technical skills should have better prospects for employment than those who do not. Personal money management decisions may also affect the effects of job loss. Maintaining savings, staying up-to-date on rent and utilities obligations, and other good personal finance practices will help to ease the effects of temporary or permanent term layoffs from the Project. The inclusion of money management as a component in the training and Employee and Family Assistance Program (EFAP) program is outlined in the Human Resource Management Plan.

Temporary closure and final closure will also affect local businesses that take on opportunities with the Project or serve the increased consumer demand. This is an inherent risk of business. Businesses that may be most affected will be those that develop specifically to supply the Project. Clearly, when Project demand ceases, these companies will either need to quickly seek out new customers, change their product or close.

Mitigation measures to enhance the capacity of entrepreneurs to make informed decisions related to risk and reward are addressed in the Human Resource Management Plan. In particular, Baffinland will support the QIA's efforts to enhance Inuit business capacity through its contribution to a business capacity and start-up fund.

Human Health and Well-Being

The positive residual effects of the Project on the Human Health and Well-being VSEC are assessed to be significant. Improved income is a major factor in this assessment, as it will improve the well-being of most children whose parents work at the mine. Some negative residual effects are expected to occur in relation to the well-being of some children arising from absence of workers from the community. These effects are not expected to reach levels that would cause significant adverse impacts on the VSEC, however, the Project will have positive and negative residual effects on substance abuse, but these are not assessed to be significant.

Community Infrastructure and Public Services

The assessment of the Project's residual effects on the Community Infrastructure and Public Services VSEC, combined with a consideration of the subjects of note, leads to a conclusion that the Project will have a significant positive impact this valued component. This conclusion is based on an assessment of no significant adverse residual effects on community infrastructure and services arising from competition for skilled workers, and on an assessment of significant labour force capacity development.

Contracting and Business Opportunities

The direction of the effects of the Project on the Contracting and Business Opportunities VSEC are assessed, with a high level of confidence, to be positive. Baffinland, through the IIBA, is committed to work closely with the QIA and will fund an initiative for capacity building that will be administered by the QIA. The company is also committed to an Inuit contracting policy adapted to the capacity of Inuit firms.

The successful implementation of these mitigation measures, and the active participation of individuals in these programs, will largely determine the significance of the Project's residual effects on contracting and business opportunities. In light of the mitigation measures adopted by Baffinland, the residual effects are assessed to be positive and significant.

Cultural Resources

The Project will involve the avoidance, protection and mitigation of archaeological sites in accordance with an Archaeological Mitigation Plan approved by CLEY, and a protection plan to reduce the potential for unintentional destruction of archaeological sites. With the implementation of both the mitigation and protection plans, the Project is expected to have negligible residual effect on the disturbance or removal of archaeological sites, and on the cultural resources VSEC.

Resources and Land-Use

The Project will interact with current land-use activities such as harvesting, travel and camping. Direct adverse residual effects on these activities are acknowledged. With planned mitigation described in the Key Indicator assessments these effects are predicted to be not significant. Concerns that Project effects on these Key Indicators along with other residual effects on relevant VECs and VSECs might combine to lead to adverse effects on Resources and Land-Use and on harvesting livelihoods were raised. The integrated analysis of the combined effects of the Project does not lead to an assessment of adverse effects on harvesting. The interactions are expected to be complex and highly inter-twinned with other factors affecting harvesting in the LSA. The potential for beneficial outcomes is equally or more highly anticipated than the potential for negative effects.

Cultural Well-Being

The Project will affect Inuit culture and its development through interactions with Inuit cultural values. To a large degree, these interactions will be positive. The opportunities for productive livelihoods based on self-reliance and sharing of resources, learning and sharing experience through supervisory and role-model functions and for monitoring the environment are all relevant and supportive of these values. This conclusion that productive employment is aligned with Inuit culture in the contemporary context is something that has also been expressed by Elders during community consultations.

It is acknowledged, however, that culture has many facets. Different perspectives on industrial development and its effects on culture have been heard during community engagement. Some individuals have deep concerns about the effect of ongoing economic development and expansion of the wage economy on Inuit culture. What may be a positive cultural effect for some-access to a job that enables one to provide for family and relatives-may be a negative cultural effect for someone else. For these reasons, Project effects on culture are considered to be diverse in their directions-neither positive nor negative. No significant impact is assessed.

Benefits, Royalty, and Taxation

After completion of planned closure, there will be a reduction of benefits flowing from the Project related to Benefits, Royalties, and Taxation VSEC, however though its contributions made under the IIBA, as well as payments of royalty, rents, and taxes, the Project will have a significant beneficial effect on the Benefits, Royalties, and Taxation VSEC that should last into post closure if managed appropriately. The Project is also expected to reduce social entitlement program expenditures while modestly increasing demands for discretionary social spending.

Government and Leadership

The Project is considered to fit well with the strategic priorities identified for both the RSA and the communities of the North Baffin LSA. Through an effective governance regime in place with the signing of an IIBA and, through partnership with the Q-SEMC, Baffinland will contribute to socio-economic monitoring important to the region's leadership into closure and post-closure. Therefore, the Project is considered to have a positive and significant effect on the Government and Leadership VSEC and no significant negative impact is assessed.

G.4 Current Predicted Residual Impacts

At this time, the residual effect and impact assessment results from the Mary River EIS remain relevant as the Project is in the relatively early stages of operation and development has proceeded largely as proposed. Collection of information and data occurs on an annual basis under Baffinland's environmental monitoring program and is used to assess current site conditions for comparison to initial predictions and assumptions from the Mary River EIS. Results are reported annually to the NIRB and other relevant stakeholders (Section 2.5.2). Overall, based on environmental monitoring program results to date, Baffinland suggests the Project has provided net positive effects to the region. No significant adverse effects have been identified. It is noted however, monitoring programs are in their early stages of implementation and will provide more information after several years of operating and monitoring.

Revisions to existing predictions of residual impact assessments will be completed where significant variances are identified. Identification of significant variances includes the QA/QC; comparisons to the respective benchmark and to reference and/or baseline; and review of the data using various tools such as Exploratory Data Analysis (EDA) and Statistical Data Analysis (SDA), to determine if change is occurring. A change may be detected statistically or qualitatively, relative to benchmarks, baseline values and/or spatial or temporal trends. A change may be statistically significant, but professional judgement will also be applied using the various evaluation tools to detect a change qualitatively. If this analysis does not detect change, then no action is required. If a change is observed, then further evaluation of the data for that/those indicator(s) will be carried out to determine whether the observed change is Project-related. If the evaluation has indicated with some certainty that the measured change is Project-related, a determination of the action level associated with the observed monitoring results through comparisons to indicators or benchmarks will be conducted. As appropriate to the VEC in question, a determination of the action level associated with the observed monitoring results, and the appropriate response will align with:

- Section 5 of the Aquatic Effects Monitoring Plan (BAF-PH1-830-P16-0039)
- Section 5 of the Shipping and Marine Wildlife Management Plan (BAF-PH1-830-P16-0024)
- Appendix B of Terrestrial Environment Mitigation and Monitoring (BAF-PH1-830-P16-0027)

G.5 Ongoing Residual Impact Evaluation

In order to evaluate whether or not residual effect predictions are meeting expectations, Closure and Post-Closure monitoring and reporting will occur. Similar to Operations monitoring, Closure and Post-Closure monitoring will focus on the Project's potential effects on VECs and key indicators, and to apply the monitoring results to assess the Project`s environmental performance relative to the effects predictions.

The evaluation process involves several key steps, as follows:

- Identify the project activities that have the potential to affect a VEC/Key Indicator
- Identify the potential effects as identified in the FEIS or in subsequent environmental effects assessment processes
- Review monitoring results and conclusions to determine which predicted residual effects occurred (and other effects not predicted, if this occurred)
- Determine if the measured residual effect exceeded or differed from the predicted effect
- If the measured residual effect is different than predicted, identify adaptive management measures that can be implemented to eliminate or reduce the severity of the residual effect
- Determining whether or not ongoing monitoring is required, depending on:
  - The intended nature of the monitoring program - short- or long-term
  - Whether or not monitoring objectives have been required
  - Or if unexpected effects have required adaptive management - modifications to mitigation measures and/or monitoring programs

FIGURE G-1 provides a representation of this process ensure residual effect predictions are meeting expectations. TABLE G-7 provides a summary of the potential residual effects, by VEC and VSEC, currently identified for the Project and their associated closure and post closure monitoring programs. A review and re-evaluation of residual effect predictions, which help drive closure approach and criteria is conducted on an annual basis based on the most recent monitoring results and research available. The results of this process, are communicated to key stakeholders in the NIRB Annual Report and QIA/NWB Annual Report and applicable results are incorporated into future revisions of the ICRP. Post Closure Monitoring Programs expected to be executed in Post-Closure are detailed in Section 9.

- Short Term Temporary Care and Maintenance (Section 9.1)
- Geotechnical/Engineering Monitoring (Section 9.2)
- Closure and Post-Closure Aquatic Monitoring and Reporting (Section 9.5)
- Environmental Effects Monitoring (Section 3.1)

- Environmental Site Assessment (Section 9.6)
- Post-Closure Fauna and Flora Monitoring (Section 9.5)
- Marine Environmental Monitoring (Section 9.6)
- Safety Compliance Inspections (Section 9.9)
- Socio-economic Reporting (Section 9.10)
- Air Quality Monitoring (Section 9.11)

The Post Closure Monitoring Programs referenced above are expected to be required based on current residual effect predictions. It is noted that additional detail regarding the study design for evaluating the residual impacts (e.g., scope and duration of performance monitoring programs, inspections, assessments, etc.) will be required in the future to support final approval of closure criteria.

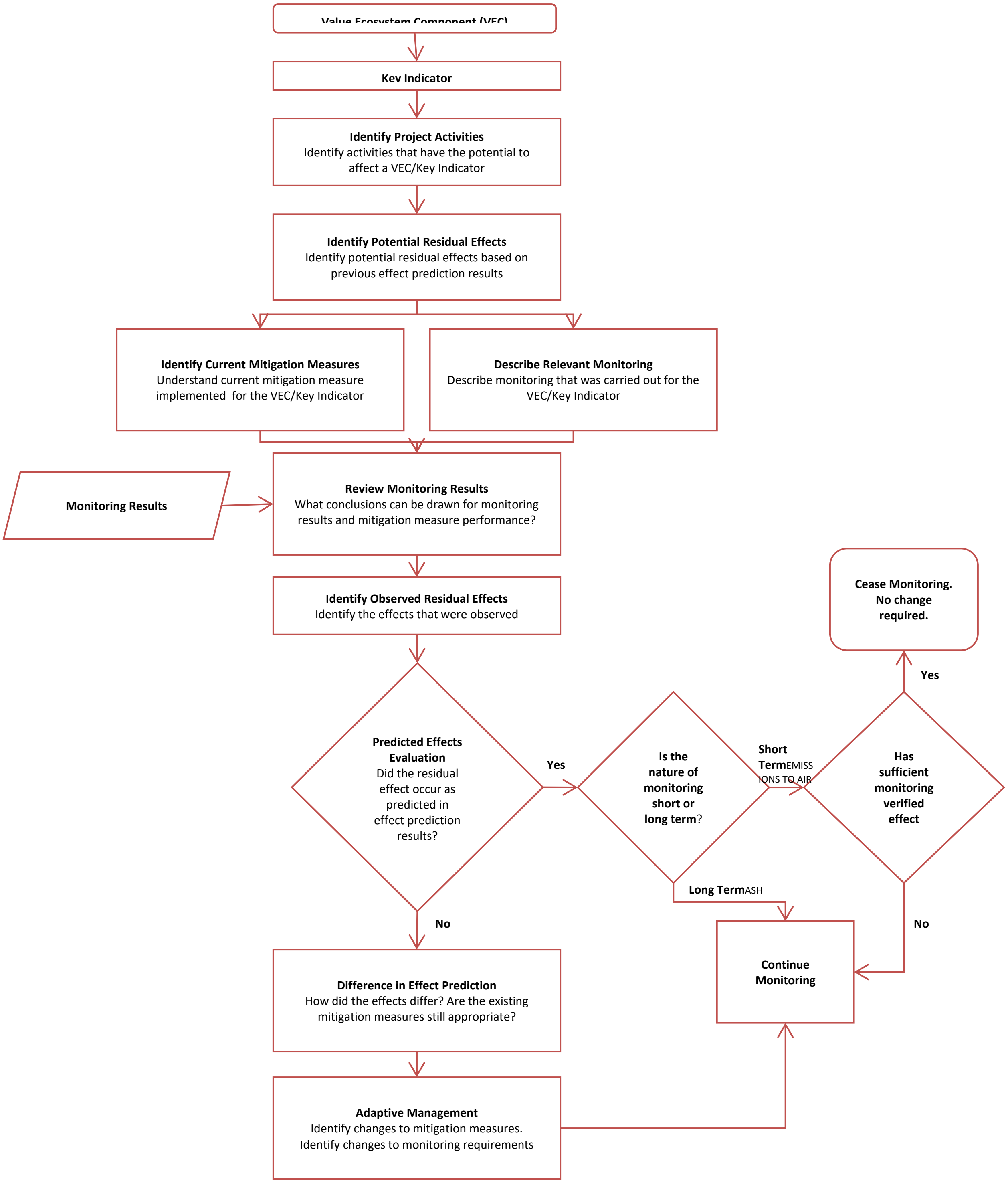

Figure G-1: Approach To Evaluating Effect

Table G.7: FEIS Predicted Residual Impacts and Closure/Post-Closure Monitoring

VEC	Key Indicator	Potential Effect(s)	Mitigation Measures	Residual Effect (s) Predicted to Occur During Active Closure	Monitoring During Active Closure	Residual Effect(s) Remaining Post-Closure	Post-Closure Monitoring	ICRP Section Reference
ATMOSPHERIC ENVIRONMENT								
Climate change	Greenhouse Gases (GHG)	• Increased GHG emissions • Climate change	• Arctic grade diesel fuel • Rail transportation of ore	• Increased GHG emissions	• PC-mandated annual calculation of Project GHG emissions (NIRB Annual Report)	• Minimal GHG emissions generated post-closure (limited to site visits)	• None	• Not applicable; monitoring prescribed by PC and not required to confirm closure objectives met
Air quality	Air quality	• Increased concentrations of total suspended particulate (TSP), sulphur dioxide (SO_2), nitrogen dioxide (NO_2), and carbon monoxide (CO) • Increased deposition of dust, potential acid input (PAI)	• Apply best management practices for limiting air emissions • Use of low sulphur Arctic grade diesel fuel • Limit speed on roads • Ore crushing facilities are enclosed, vented and equipment with dust collection equipment • Apply dust suppressant as required in high traffic areas and stockpiles • Procurement policy on emissions from equipment (incinerator, generators, vehicles) • Waste segregation (incineration) • Where possible, use of granular material for road construction • Regular maintenance of equipment and vehicles	• Increased concentrations of TSP, SO_2, NO_2, CO • Increased deposition of dust and PAI	• TSP monitoring in Year 2 of active closure	• Negligible residual effects expected post-closure	• None	• Section 9.11
Noise and vibration	Noise and vibration levels	• Sensory impact on wildlife	• Procurement policy for noise for equipment and vehicles • Use of mufflers – regular maintenance of engines and equipment	• Sensory impact on wildlife (effect expected to be comparable to the construction phase)	• No monitoring proposed	• Negligible residual effects expected post-closure	• None	• Not applicable
TERRESTRIAL ENVIRONMENT								
Landforms, soil and permafrost	Sensitive landforms	• Soil contamination • Soil structure alteration • Soil destabilization and erosion • Thaw weakening and settlement • Creep settlement	• Sitting of facilities and alignment of roads and railway • Design foundations suitable for site conditions • Design stream crossing structures for extreme flood event • Ensure adequate drainage and prevent pooling of water	• No residual effect (disturbance of sensitive landforms) after mitigation	• Regular visual inspections • Geotechnical Inspection • Environmental site assessment and remediation of hydrocarbon contaminated soils	• Residual effects not expected to occur post-closure; if reclamation objectives have been met	• Post-closure geotechnical inspections at start and end of post-closure monitoring	• Active closure phase monitoring described in Section 9.2 • Post-closure monitoring described in Section 9.2
Vegetation	Vegetation	• Loss of vegetation abundance and diversity	• Limit physical footprint of facilities • Limit areas of access for vehicles • Progressive reclamation / closure	• Loss of vegetation limited to Project Development Areas (PDA)	• Invasive species monitoring (PC Condition 37) • Annual review of the TEMMP (PC Condition 38)	• Negligible adverse residual effects post-closure. Post-closure, the loss of vegetation will be reversed with natural revegetation. The risk of invasive plant species colonizing the area is negligible.	• None	• Closure and reclamation research will describe vegetation research projects, Appendix D

VEC	Key Indicator	Potential Effect(s)	Mitigation Measures	Residual Effect(s) Predicted to Occur During Active Closure	Monitoring During Active Closure	Residual Effect(s) Remaining Post-Closure	Post-Closure Monitoring	ICRP Section Reference
TERRESTRIAL ENVIRONMENT (CONT`D)								
Birds	Bird key indicators identified in the FEIS, including species at risk	• Destruction of nests • Habitat loss • Mortality • Influences on health • Sensory disturbance	• Mitigation measures identified in the Terrestrial Environment Management and Monitoring Plan (TEMMP), including: • Employee awareness / environmental induction program • Minimize footprint of facilities • Conduct nest search prior to start of activities • No hunting policy • Avoidance of areas of large concentrations of foraging or moulting birds • Avoidance of known nests or nesting areas • To the extent possible, enforce closure of a 500 m radius of the nest until fledging occurs • Nest-specific management plans • To the extent possible, develop appropriate aircraft approach and departure flight paths	• Habitat loss • Mortality • Influences on health	• No monitoring proposed during active closure • Baffinland will seek input from a Closure Working Group on actions that may enhance wildlife use of the area post-closure.	• Residual effects on bird species will gradually lessen with time as the project areas are naturally revegetated.	• Post-closure flora and fauna occupancy and use surveys in Years 5 and 7 (the second and fourth years of post-closure)	• Terrestrial Environment Monitoring and Reporting described in Section 9.5
Terrestrial wildlife and habitat	Caribou	• Habitat loss • Restriction of movement • Mortality	• Use of dust suppressant on Tote Road during growing season • Speed limits for trucks and trains which will provide more time for caribou to get off the road or rail, and will increase the chance of a truck being able to stop before a collision with a caribou. • The train is expected to operate 300 days per year, so seasonal stoppages are possible if large groups of migratory caribou return to the area. • Baffinland has a no hunting policy for all personnel while working on site. • Snow management that will grade snow banks along railway and roadway so that caribou are able to easily cross the transportation corridor without being blocked by steep snow banks. • The railway embankment will be constructed of finer fill material at the five identified trails for easier caribou movement across the railway embankment. The finer fill will replicate natural trail conditions. • Physical barriers from trains will be reduced by limiting train traffic to four passes per day.	• Habitat loss • Restriction of movement • Mortality	• Same as above	• Same as above	• Same as above	• Same as above

VEC	Key Indicator	Potential Effect(s)	Mitigation Measures	Residual Effect(s) Predicted to Occur During Active Closure	Monitoring During Active Closure	Residual Effect(s) Remaining Post-Closure	Post-Closure Monitoring	ICRP Section Reference
FRESHWATER AQUATIC ENVIRONMENT								
Water quantity	Water quantity	• Reductions in water quantity due to water withdrawals • Increases in water quantity due to effluent discharges • Redistribution of water flows in the natural environment due to diversions	• Permit required for water withdrawal • Measurement of withdrawal quantities as per Water License • Implement measures to reduce water consumption	• Residual effects predicted to occur during the operation phase will either remain or will be reduced through the removal of diversions and watercourse crossings	• Implementation of Closure and Post Closure Aquatic Monitoring • Stream gauging as identified in the Aquatic Effects Monitoring Plan (AEMP) • The Stream Diversion Monitoring Program, a targeted study of the AEMP, will likely have concluded	• Residual effects predicted to occur during the operation and into the active closure phase will remain static or will be reduced	• Implementation of Closure and Post Closure Aquatic Monitoring	• Closure and Post-closure Aquatic monitoring described in Section 9.5
Surface water and sediment quality	Water and sediment quality	• Changes in water quality due to point-source, non point-source and airborne emissions • Changes in sediment quality due to point-source, non point-source and airborne emissions	• Siting of facilities/quarries at least 30 m from stream or water body • Install range of sediment and erosion control structures • Install diversion/collection channel or containment berms where appropriate • Routine inspection and maintenance • Ice and freshet management • Implementation of BMPs for surface water management • Sewage treatment • Wastewater treatment plant (oily water, truck wash, maintenance facilities, explosives equipment wash water) • Management of potentially acid generating rocks from waste rock pile, ore stockpiles, quarries and mine • Minimize footprint of stream crossing • Compensation plan for HADD • Appropriate design of stream/river crossing structures • Limit barrier to movement with site specific design of rocky ramps at culvert crossing (where required) • Channel enhancement where required • Maintain minimum flow in impacted streams where possible • Monitor low flow stream, fish salvage if necessary • Fish barrier for extremely low flow streams • Application of DFO guideline when using explosives near fish-bearing waterbodies • Prevent discharge of contaminants • Storage of fuel and other hazardous materials in secondary containment • Refuelling on impermeable surfaces and runoff contained • Emergency and Spill Response Plan	• Changes in water quality due to point-source, non point-source and airborne emissions • Changes in sediment quality due to point-source, non point-source and airborne emissions	• Implementation of Closure and Post Closure Aquatic Monitoring • Implementation of any remaining monitoring requirements of the closure phase AEMP	• Residual effects predicted to occur during the operation and into the active closure phase will remain static or will be reduced	• Aquatic and AEMP monitoring until mine achieves "recognized closed mine" status from the Nunavut Water Board • Implementation of Closure and Post Closure Aquatic Monitoring • As a component study of the AEMP, a final Environmental Effects Monitoring (EEM) study will be conducted as prescribed in the Metal and Diamond Mining Effluent Regulations (MDMER), to seek "recognized closed mine" status from Environment Canada under the MDMER, anticipate sampling in year 4 and 6 post closure.	• Closure and Post-closure Aquatic monitoring described in Section 9.5

VEC	Key Indicator	Potential Effect(s)	Mitigation Measures	Residual Effect(s) Predicted to Occur During Active Closure	Monitoring During Active Closure	Residual Effect(s) Remaining Post-Closure	Post-Closure Monitoring	ICRP Section Reference
FRESHWATER AQUATIC ENVIRONMENT (CONT'D)								
Freshwater fish, fish habitat, and other aquatic organisms	Arctic char	• Effects on Arctic char health • Effects on Arctic char movement • Effects on Arctic char habitat quality • Arctic char mortality	• Siting of facilities/quarries at least 30 m from stream or water body • Install range of sediment and erosion control structures • Install diversion/collection channel or containment berms where appropriate • Routine inspection and maintenance • Ice and freshet management • Implementation of BMPs for surface water management • Sewage treatment • Wastewater treatment plant (oily water, truck wash, maintenance facilities, explosives equipment wash water) • Management of potentially acid generating rocks from waste rock pile, ore stockpiles, quarries and mine • Minimize footprint of stream crossing • Compensation plan for HADD • Appropriate design of stream/river crossing structures (culvert, bridges, etc.) • Limit barrier to movement with site specific design of rocky ramps at culvert crossing (where required) • Channel enhancement where required • Maintain minimum flow in impacted streams where possible • Monitor low flow stream, fish salvage if necessary • Fish barrier for extremely low flow streams • Use of explosives in or near streams/water bodies as per DFO Guidelines • Prevent discharge of contaminants • All hazardous materials stored on impermeable surface/secondary containment • Tank farm and large storage tanks placed in secondary containment structures (lined and impermeable) • Smaller tank – double wall ISO-containers • Refuelling on impermeable surfaces and runoff contained • Emergency and Spill Response Plan	• Effects on Arctic char health • Effects on Arctic char movement • Effects on Arctic char habitat quality	• Fisheries monitoring of in-water works during the removal of bridges, culverts and outfalls, as per DFO Fisheries Authorization and Water Licence • Implementation of any remaining monitoring requirements of the closure phase AEMP • Implementation of Closure and Post Closure Aquatic Monitoring	• Residual effects predicted to occur during the operation and into the active closure phase will remain static or will be reduced	• Fish and fish habitat monitoring as outlined in the AEMP until the mine achieves "recognized closed mine" status from the Nunavut Water Board • As a component study of the AEMP, a final Environmental Effects Monitoring (EEM) study will be conducted as prescribed in the Metal and Diamond Mining Effluent Regulations (MDMER), to seek "recognized closed mine" status from Environment Canada under the MDMER. Monitoring in year 4 and 8. • Implementation of Closure and Post Closure Aquatic Monitoring	• Closure and Post-closure Aquatic monitoring described in Section 9.5

VEC	Key Indicator	Potential Effect(s)	Mitigation Measures	Residual Effect(s) Predicted to Occur During Active Closure	Monitoring During Active Closure	Residual Effect(s) Remaining Post-Closure	Post-Closure Monitoring	ICRP Section Reference
MARINE ENVIRONMENT								
Marine water and sediment quality	Marine water and sediment quality	• Changes in water and sediment quality in Steensby and Milne Inlets • Accident and malfunction (e.g. oil spill)	• Site runoff water management as per management plan • Hazardous substances contained within impermeable areas as per Waste Management Plan • Sewage treatment and wastewater treatment plant (oily water, truck wash, maintenance facilities, explosives equipment wash water) • Emergency and Spill Response Plan, Milne Port OPEP and Steensby Port OPEP; SOPEP for all ships • Ship on-board waste management - no discharge at sea	• Changes in water and sediment quality in Steensby and Milne Inlets • Accident and Malfunction	• Implementation of Closure and Post Closure Aquatic Monitoring	• Residual effects predicted to occur during the operation and into the active closure phase will remain static or will be reduced	• Implementation of Closure and Post Closure Aquatic Monitoring	• Closure and Post-closure Aquatic monitoring described in Section 9.5
Marine mammals	Ringed seals Bearded Seals Walruses Beluga whales Narwhals Bowhead Whales	• Disturbance caused by airborne and/or underwater noise from construction, shipping, and aircraft • Hearing impairment and/or damage caused by noise from construction activities • Masking of environmental sounds caused by vessel and construction noise	• Dock structures were designed to minimize the footprints in the marine environment • Schedule dock construction activity during period of low mammal occurrence – April to June (blasting, pile driving, dredging) • Use proven mitigation measures to reduce noise and noise propagation during construction (DFO's guideline overpressure limit, bubble curtain system for blasting) • Discourage marine mammals from the blast area with potential use of acoustic deterrent device • Vessels will maintain a constant course and speed whenever possible - reduce vessel speed in Milne Inlet • Vessels will minimize idling of engines when docked at Milne and Steensby ports • Aircraft will be operated at a minimum altitude of 450 m over marine areas, when weather conditions allow • Aircraft will be prohibited from flying low over marine mammals for sightseeing or photography	• Disturbance caused by noise from construction, shipping, and aircraft overflights • Masking caused by shipping noise	Implementation of Closure and Post Closure Aquatic Monitoring	• Residual effects predicted to occur during the operation and into the active closure phase will remain static or will be reduced	• Implementation of Closure and Post Closure Aquatic Monitoring	• Closure and Post-closure Aquatic monitoring described in Section 9.5
	Polar bears	• Habitat change resulting from icebreaking and/or ice management • Disturbance caused by noise from construction, shipping, and aircraft • Mortality from human-bear interactions	• Primary use of Mary River airstrip during the Operation Phase • Educate workers about bear safety • Work areas kept clean of food scraps, garbage, and toxic materials • Use of bear monitor at camp sites • Use of bear deterrent devices	• Habitat change from icebreaking and/or ice management • Disturbance caused by noise from construction, shipping, and aircraft overflights • Mortality if a bear is killed in defense of human life	• Implementation of Closure and Post Closure Aquatic Monitoring • Baffinland will seek input from a Closure Working Group on actions that may enhance wildlife use of the area post-closure.	• None	• Implementation of Closure and Post Closure Aquatic Monitoring • Post-closure flora and fauna occupancy and use surveys in Years 5 and 7 (the second and fourth years of post-closure)	• Closure and Post-closure Aquatic monitoring described in Section 9.5 • Terrestrial Environment Monitoring and Reporting described in Section 9.5 9.6.

VEC	Key Indicator	Potential Effect(s)	Mitigation Measures	Residual Effect(s) Predicted to Occur During Active Closure	Monitoring During Active Closure	Residual Effect(s) Remaining Post-Closure	Post-Closure Monitoring	ICRP Section Reference
HUMAN ENVIRONMENT								
Population demographics	Demographic stability	• In-migration of a small number of workers from south will have effect on the demographic make-up of communities • Migration of non-Inuit Project employees into the North Baffin LSA • Migration of non-Inuit into North Baffin for indirect jobs • Inter-community Inuit migration • Out-migration from the North Baffin	• Designation of North Baffin communities as "Point of Hire" (Arctic Bay, Clyde River, Hall Beach, Igloolik, and Pond Inlet) • Iqaluit and a southern hub are also designated "Point of Hire" • Free transportation from "Point of Hire" to Mine Site	• In-migration of a small number of workers from south or other Nunavut communities will have effect on the demographic make-up of communities • Inter-community Inuit migration seeking alternate employment	• Baffinland will seek input from the Socio-Economic Working Group on actions that may support monitoring movement • Baffinland will engage with the GN to establish a Labour Market Partnership to develop and implement strategies for dealing with labour force adjustments	• Inter-community Inuit migration seeking alternate employment	• None	• Socio-economic Monitoring and Reporting described in Section 9.10
Education and training	Life skills	• Improved life skills amongst young adults	• Work readiness training • Supportive work environment • Employee and family assistance program • "No drug, no alcohol" policy	• Improved life skills amongst many LSA residents	• Baffinland will engage with the GN to establish a Labour Market Partnership to develop and implement strategies for dealing with labour force adjustments	• Improved life skills amongst LSA employees and families	• None	• Socio-economic Monitoring and Reporting described in Section 9.10
	Education and Skills	• Incentives related to school attendance and success • Opportunities to gain skills	• Minimum age of 18 yrs for Project employment • Career planning • Priority hiring for Inuit • Upgrading opportunities • Summer experience • Career counselling • Training	• Transferable skills for LSA employees • Incentives related to school attendance and success	• Baffinland will engage with the GN to establish a Labour Market Partnership to develop and implement strategies for dealing with labour force adjustments	• Transfer of skills to alternate employment	• None	• Socio-economic Monitoring and Reporting described in Section 9.10
Livelihood and Employment	Wage Employment	• Creation of jobs in the LSA • Employment of LSA residents	• LSA points of hire • Recruitment strategy • Inuit hiring policy • Management commitment	• Ongoing employment of LSA residents for closure roles • Development of banking and money management skills	• Baffinland will engage with the GN to establish a Labour Market Partnership to develop and implement strategies for dealing with labour force adjustments	• Development of money management skills	• None	• Socio-economic Monitoring and Reporting described in Section 9.10
	Job Progression and Career Advancement	• New career paths	• Individual career support • Inuit hiring / promotions policy • Management commitment	• Expanded employment options based on acquired skills and experience • Resume and other employment documents	• Baffinland will engage with the GN to establish a Labour Market Partnership to develop and implement strategies for dealing with labour force adjustments	• Expanded employment options based on acquired skills and experience	• None	• Socio-economic Monitoring and Reporting described in Section 9.10

VEC	Key Indicator	Potential Effect(s)	Mitigation Measures	Residual Effect(s) Predicted to Occur During Active Closure	Monitoring During Active Closure	Residual Effect(s) Remaining Post-Closure	Post-Closure Monitoring	ICRP Section Reference
				to support future employment				
Economic Development and Self-reliance	Land	• Increased pressure on the land • Changes to human engagement in land-based economy	• Lease agreement • VEC-related measures • Resources and Land Use measures (VSEC)	• Increased employment capacity and general well-being	• Baffinland will engage with the GN to establish a Labour Market Partnership to develop and implement strategies for dealing with labour force adjustments	• Transferable employment and life skills • Improved education and training • Increased wealth • Increased capacity to engage in procurement processes/provide services on alternate projects, industries and government contracts	• None	• Socio-economic Monitoring and Reporting described in Section 9.10
	People	• Increased opportunities for youth • Improved education and training • Increased wealth and well-being	• Inuit recruitment strategy • Education and training program • Community support fund • Employee and family assistance program	• Improved ability to achieve strategic community development objectives	• Baffinland will engage with the GN to establish a Labour Market Partnership to develop and implement strategies for dealing with labour force adjustments	• Increased local businesses • Increased capacity to engage in procurement processes/provide services on alternate projects and industries and government contracts	• None	• Socio-economic Monitoring and Reporting described in Section 9.10
	Community Economy	• Increased wealth in community • Rotational absence of residents • Increased local business opportunities	• Money management orientation • Community Fund • Monitoring to support decision-making	• Growth in the economy and related job creation and business expansion	• Baffinland will seek input from the Socio-Economic Working Group on actions that may support monitoring movement • Baffinland will engage with the GN to establish a Labour Market Partnership to develop and implement strategies for dealing with labour force adjustments	• Increased local businesses • Increased capacity to engage in procurement processes/provide services on alternate projects and industries and government contracts	• None	• Socio-economic Monitoring and Reporting described in Section 9.10
	Territorial Economy	• Expanded economic activity (GDP) • Increased diversity of territorial economy	• Direct and indirect investment in the economy • Payment of taxes • Payment of resource royalties	• Positive – increase awareness for LSA employees, focus on health and safety, employee assistance and counselling • Negative - increased ability to afford substances will have effects on substance abuse	• "No drug and alcohol" policy remains in place consistent during active closure in addition to medical checks in relation to new employees on site	• Positive – increase awareness for LSA employees, focus on health and safety • Negative - increased ability to afford substances will have effects on substance abuse	• None	• Socio-economic Monitoring and Reporting described in Section 9.10

VEC	Key Indicator	Potential Effect(s)	Mitigation Measures	Residual Effect(s) Predicted to Occur During Active Closure	Monitoring During Active Closure	Residual Effect(s) Remaining Post-Closure	Post-Closure Monitoring	ICRP Section Reference
Human health and well-being	Substance abuse	• Transport of substances through Project sites • Affordability of substances • Attitudes towards substances and addictions	• "No drug – no alcohol" policy • Measures to prevent transportation through sites • Employee and Family Assistance Program	• Improved well-being of children • Access to Employee and Family Assistance Program	• Baffinland will engage with the GN to establish a Labour Market Partnership to develop and implement strategies for dealing with labour force adjustments	• Increased life skills for parents and young adults of LSA employees	• None	• Socio-economic Monitoring and Reporting described in Section 9.10
	Well-being of children	• Changes in parenting • Increased household income and food security • Overall effects on children	• Orientation and training related to fly-in/fly-out adaptation, health, well-being • Employee and Family Assistance Program • Money management training • Community support fund	• Absence of residents while they are working at Project • Moving off of rotation, families will have to readjust to potential full time living/working arrangements	• Ongoing monitoring of exit interviews and grievance procedure to understand impact of rotation on employees • Baffinland will engage with the GN to establish a Labour Market Partnership to develop and implement strategies for dealing with labour force adjustments	• Moving off of rotation, families will have to readjust to potential full time living/working arrangements	• None	• Socio-economic Monitoring and Reporting described in Section 9.10
	Community social stability	• Absence from community during work rotation	• Orientation and training related to fly-in/fly-out adaptation • Short rotation (two week in / two week out)	• Competition for skilled workers may lead to temporary effects on municipal services. • Long term improvement in labour force capacity	• Baffinland will engage with the GN to establish a Labour Market Partnership to develop and implement strategies for dealing with labour force adjustments	• Competition for skilled workers	• None	• Socio-economic Monitoring and Reporting described in Section 9.10
Community infrastructure and public service	Recruitment and Retention of Hamlet	• Competition for skilled workers • Labour force capacity	• Early start for skills training • Ongoing training • Employment experience	• Expanded market — business services to Project • Expanded market — consumer goods and services • Increased entrepreneurial capacity	• Baffinland will engage with the GN to establish a Labour Market Partnership to develop and implement strategies for dealing with labour force adjustments	• Increased entrepreneurial capacity • Increased ability to participate in procurement processes	• None	• Socio-economic Monitoring and Reporting described in Section 9.10
Contracting and business opportunities	Opportunities For Business	• Expanded market - business services to Project • Expanded market - consumer goods and services • Increased entrepreneurial capacity	• Inuit contracting strategy • Cooperation with QIA to build Inuit capacity • Establish a fund to support and build capacity • Management assistance to Inuit designated firms • Opportunities for local entrepreneurs to work with Project	• Chance of unmitigated archaeological sites subject to accidental or deliberate partial or complete destruction is minimal • Potential for chance finds • Increased traffic at Steensby Inlet could affect archaeological resources	• Ongoing procedures for archeological finds on site	• Potential for chance finds	• None	• Socio-economic Monitoring and Reporting described in Section 9.10

VEC	Key Indicator	Potential Effect(s)	Mitigation Measures	Residual Effect(s) Predicted to Occur During Active Closure	Monitoring During Active Closure	Residual Effect(s) Remaining Post-Closure	Post-Closure Monitoring	ICRP Section Reference
Cultural resources	Archaeological Sites	• Disturbance or removal of archaeological sites • Unauthorized removal of artefacts • Potential loss of regionally significant sites through approved mitigation	• Pre-development archaeological surveys to support avoidance and protections of sites, mitigation by SDR prior to construction, implementation of a chance finds procedure • Training, flagging and exclusion zones, implementation of government-approved mitigation plans, involvement of local people, management plans, implementation of chance finds procedure	• Changes in caribou harvesting • Changes in marine mammal harvesting • Changes in fish harvesting	• Ongoing implementation of Article 13.4 NLCA Inuit Rights of Travel and Access • Ongoing implementation of Hunting and Weapons Policy on site	•	• None	• Socio-economic Monitoring and Reporting described in Section 9.10
Resources and land use	Inuit harvesting of wildlife	• Changes in caribou harvesting • Changes in marine mammal harvesting • Changes in fish harvesting	• Prohibition of harvesting by employees • Measures to mitigate VEC effects (VEC assessments)	• Safe travel around Eclipse Sound and Pond Inlet • Safe travel through Milne Port • Emissions and noise disruption • Sensory disturbance and safety along Milne Inlet Tote Road • Detour around Mine Site • HTO cabin closure • Difficulty and safety relating to railway crossings • Detour around Steensby Port • Restrictions on camping locations around Steensby Port	• Ongoing implementation of Article 13.4 NLCA Inuit Rights of Travel and Access • Ongoing implementation of Hunting and Weapons Policy on site during active closure	• Safety protocols developed as necessary for post closure including detours as necessary	• None	• Socio-economic Monitoring and Reporting described in Section 9.10
Resources and land use	Travel and camps	• Safe travel around Eclipse Sound and Pond Inlet • Safe travel through Milne Port • Emissions and noise disruption • Sensory disturbance and safety along Milne Inlet Tote Road • Detour around Mine Site • HTO cabin closure • Difficulty and safety relating to railway crossings • Detour around Steensby Port	• Road Management Plan • Mine Closure Plan • Safety Plan • IIBA Agreement with QIA • Designated railway crossing locations	• • Ongoing cultural awareness training for all staff and visitors on site • Increased awareness from cross-cultural training	• Ongoing monitoring of exit interviews and grievance procedure	• Increased awareness from cross-cultural training	• None	• Socio-economic Monitoring and Reporting described in Section 9.10

VEC	Key Indicator	Potential Effect(s)	Mitigation Measures	Residual Effect(s) Predicted to Occur During Active Closure	Monitoring During Active Closure	Residual Effect(s) Remaining Post-Closure	Post-Closure Monitoring	ICRP Section Reference
		• Restrictions on camping locations around Steensby Port						
Cultural Well-Being	Cultural Well-Being	• Pijitsirnjiq – serving and providing for… • Pilnimmaksarniq – passing on of knowledge and skills • Avatittinnik Kamattiarniq – environmental stewardship	• Measures to support Inuit culture on site, including Inuktitut language plan • Inuit priority for employment • Inuit involvement in environmental monitoring	• Payments of payroll and corporate taxes to territorial government	• None	• None	• None	• Socio-economic Monitoring and Reporting described in Section 9.10
Benefits, taxes and royalties	Territorial own-source revenues	• Increased taxes and revenues from indirect and induced growth • Payments of payroll and corporate taxes to territorial government	• None	• IIBA agreement with QIA • Development of leadership skills	• Ongoing documentation of any supervisory skills training in place	• Increased leadership and team working skills	• None	• Socio-economic Monitoring and Reporting described in Section 9.10
Governance and leadership	Governance and leadership	• IIBA Agreement with QIA • Development of leadership skills	• Participation in initiatives to identify indicators of relevance to regional monitoring programs, share data generated by activities related to the Project, and discuss the interpretation of this data with others involved in these initiatives • Fit well with the strategic priorities identified for both the RSA	• In-migration of a small number of workers from south or other Nunavut communities will have effect on the demographic make-up of communities • Inter-community Inuit migration seeking alternate employment	• Baffinland will seek input from the Socio-Economic Working Group on actions that may support monitoring movement • Baffinland will engage with the GN to establish a Labour Market Partnership to develop and implement strategies for dealing with labour force adjustments	• Inter-community Inuit migration seeking alternate employment	• None	• Socio-economic Monitoring and Reporting described in Section 9.10

Appendix H FEIS Freshwater Quality Predictions (Based on FEIS and its Addendum, Volume 7, Section 3.4)

Water and Sediment Quality

Effects on the surface water and sediment quality VEC were assessed in accordance with the methodology outlined in FEIS Volume 2, Section 3.0. VEC-specific modifications were made to the general methodology, which are highlighted below.

Assessment Methods and Criteria

The following basic EA steps were undertaken during the assessment:

- Regional and local study areas were determined.
- VECs, Key Indicators and Thresholds were identified.
- Project activities that could affect surface water and sediment quality were identified.
- Project interactions with, and effects on, the surface water and sediment quality VEC were identified.
- Linkage evaluations were performed outlining potential effects related to various phases of the Project (Construction, Operation, and Closure) and Project LSAs (Milne Port, Milne Inlet Tote Road, Mine Site, Railway Alignment, and Steensby Port.
- Mitigation measures were identified to avoid or reduce the potential effects during the various phases of the Project.
- Residual effects and their relative significance were identified for the surface water and sediment quality VECs.
- Long-term monitoring programs were identified to distinguish Project-related impacts from natural variability, in order to verify impact assessment predictions and to meet compliance/conformance criteria.

Key Indicators and Thresholds

For the assessment of potential effects on the surface water and sediment quality VEC a list of key indicators that were considered to be the most relevant and important elements of the VEC was assembled. The key indicators fall into four categories:

1) General Parameters
2) Metals
3) Nutrients
4) Petroleum Hydrocarbons

Thresholds were identified representing a level of change where adverse effects may be expected to occur. In the case of water and sediment quality, it is important to note that the thresholds do not relate to water or sediment quality in itself, but rather to known effects on aquatic receptors that rely on water and sediment to exist.

The thresholds used in this assessment were derived from the following sources, which are relevant in the context of this environmental effects assessment:

- Schedule 4 of the Metal and Diamond Mining Effluent Regulation under the Federal *Fisheries Act*.
- CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life (PAL) (2003).
- Interim Sediment Quality Guidelines (ISQG) and Probable Effects Level (PEL) identified in the CCME Canadian Sediment Quality Guidelines for the Protection of Aquatic Life (2003).

The CCME PAL thresholds are typically the most stringent; hence these values were generally selected for application.

Local waters around the Project sites have not historically been used for drinking, although the Project uses and will use local waters for potable water supply, and it is conceivable that Inuit travelling over the land could also drink any of the local water. Therefore, Health Canada's Canadian Drinking Water Guidelines (2004) have been used for comparison purposes.

To fill gaps for those key indicators that have no thresholds identified in the sources listed above, two secondary sources were adopted:

- BC Ministry of Environment (MOE) Approved and Working Water Quality Guidelines and Alert Levels.
- Criteria Continuous Concentration (Chronic) National Recommended Water Quality Criteria, USEPA (2006).

The relationships between potential surface water and sediment quality effects, key indicators and thresholds are summarized in Table H.1.

Table H.1: Key Indicators and Thresholds for Water and Sediment Quality

Potential Effect	Key Indicator	Thresholds (Magnitude and Extent)			
		MMER[1]	CWQG (PAL)[2]	CDWQG[3]	NWB[4]
Water Quality from Mine Contact Water and Site Runoff	TSS (mg/L)	15	+5		35
	pH (pH unit)	6.0 - 9.5	6.5 - 9.0	6.5 - 8.5[11]	6.0 - 9.5
	Hardness $CaCO_3$ (mg/L)				
	Alkalinity $CaCO_3$ (mg/L)				
	Chloride (mg/L)		640 (Short-term) 120 (Long-term)	250[12]	
	Sulphate SO4 (mg/L)			500[12]	
	Ammonia N (total) (mg/L)		Varies[5]		
	Ammonia N (un-ionized) (mg/L)		0.019		
	Nitrate N (mg/L)		13	10	
	Nitrite N (mg/L)		0.06	3.2	
	Total P (mg/L)		see Table 7-3.4 (FEIS Volume 7)		
	Total Aluminum (mg/L)		0.005 - 0.1[6] (0.94)[7]	0.1	

Potential Effect	Key Indicator	Thresholds (Magnitude and Extent)			
		MMER[1]	CWQG (PAL)[2]	CDWQG[3]	NWB[4]
	Total Antimony (mg/L)			0.006	
	Total Arsenic (mg/L)	0.5	0.005	0.01	
	Total Barium (mg/L)			1	
	Total Beryllium (mg/L)		0.0053[8]		
	Total Boron (mg/L)		29 (Short-term) 1.50 (Long-term)		
	Total Cadmium (mg/L)		0.000029[8]	0.005	
	Total Chromium (mg/L)		0.0047[7]	0.05	
	Trivalent Chromium (mg/L)		0.001		
	Hexavalent Chromium (mg/L)		0.0089		
	Total Cobalt (mg/L)				
	Total Copper (mg/L)	0.3	0.00467[7]	1.0[12]	
	Total Cyanide (mg/L)	1.0	0.005 (as free CN)	0.2	
	Total Iron (mg/L)		1.2[7]	0.3[12]	
	Total Lead (mg/L)	0.2	0.001[9]	0.01	
	Total Manganese (mg/L)			0.05[12]	
	Total Mercury (mg/L)		0.000026	0.001	
	Total Molybdenum (mg/L)		0.073		
	Total Nickel (mg/L)	0.5	0.083[10]		
	Total Selenium (mg/L)		0.001	0.01	
	Total Silver (mg/L)		0.0001		
	Total Thallium (mg/L)		0.0008		
	Total Uranium (mg/L)		0.015	0.02	
	Total Vanadium (mg/L)		0.006[11]		
	Total Zinc (mg/L)	0.5	0.03	5.0	
	1-2 Propylene Glycol		500 (interim)		
Water Quality from Fuel Contact	Benzene (µg/L)		370		
	Toluene (µg/L)		2		
	Ethyl benzene (µg/L)		90		
	Lead (µg/L)		1		
	Oil and Grease (µg/L)		15,000		
Water Quality from Discharge of Sewage	BOD_5 (mg/L)				30
	Fecal Coliform (CFU/100mL)				1,000
Potential Effect	**Key Indicator**	**Thresholds (Magnitude and Extent)**			
		ISQG[14]	**PEL[14]**		
Sediment Quality	Arsenic (mg/kg)	5.9	17		
	Cadmium (mg/kg)	0.6	3.5		
	Chromium (mg/kg)	37.3	90		
	Copper (mg/kg)	35.7	197		
	Lead (mg/kg)	35.0	91.3		
	Mercury (mg/kg)	1.7	4.86		
	Zinc (mg/kg)	123	315		

Potential Effect	Key Indicator	Thresholds (Magnitude and Extent)			
		MMER[1]	CWQG (PAL)[2]	CDWQG[3]	NWB[4]

NOTE(S):

1. MEAN MONTHLY MAXIMUM AVERAGES IN SCHEDULE 4 OF THE METAL AND DIAMOND MINING EFFLUENT REGULATION UNDER THE FEDERAL *FISHERIES ACT*.
2. CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT (CCME) CANADIAN WATER QUALITY GUIDELINES FOR THE PROTECTION OF AQUATIC LIFE (PAL) (2011).
3. HEALTH CANADA GUIDELINES FOR CANADIAN DRINKING WATER QUALITY SUMMARY TABLE (2010).
4. NUNAVUT WATER BOARD WASTEWATER CRITERIA.
5. VARIES WITH TEMPERATURE AND PH.
6. VARIES WITH PH; AT PH <6.5 CRITERION IS 0.005 MG/L; AT PH >6.5 CRITERION IS 0.1 MG/L.
7. SITE SPECIFIC CRITERION DEVELOPED FOR THE MARY RIVER MINE SITE AREA (KNIGHT PIÉSOLD, 2011)
8. VARIES WITH HARDNESS [Cd] = $10^{0.86[\log10(hardness)]-3.2}$ µg/L. BASED ON MEAN HARDNESS IN MARY RIVER OF 84 MG/L, THE CADMIUM CRITERION WOULD BE 0.000029 MG/L.
9. VARIES WITH HARDNESS. [Pb] = $e^{1.273[\ln(\underline{hardness})]-4.705}$ µg/L. BASED ON MEAN HARDNESS IN MARY RIVER OF 84 MG/L, THE LEAD CRITERION WOULD BE 0.00255 MG/L.
10. VARIES WITH HARDNESS. [Ni] = $e^{1.273[\ln(\underline{hardness})]-4.705}$ µg/L. BASED ON MEAN HARDNESS IN MARY RIVER OF 84 MG/L, THE NICKEL CRITERION WOULD BE 0.083 MG/L.
11. BC MOE APPROVED AND WORKING WATER QUALITY GUIDELINES.
12. AESTHETIC OBJECTIVE.
13. PROPOSED GUIDELINE.
14. INTERIM SEDIMENT QUALITY GUIDELINES (ISQG) AND PROBABLE EFFECTS LEVEL (PEL) IDENTIFIED IN THE CCME CANADIAN SEDIMENT QUALITY GUIDELINES FOR THE PROTECTION OF AQUATIC LIFE (2003).

The thresholds identified in Table H.1 were applied in the effects assessment in the following manner:

- MDMER Schedule 4 thresholds were applied as 'end of pipe' criteria for mine contact water discharge.
- CCME PAL (or site-specific water quality objectives) were applied as receiving environment criteria for all sources.
- NWB were applied as 'end of pipe' criteria for wastewater (sewage effluent) discharge.

A number of key parameters are naturally elevated in surface waters around the Mine Site, and as such, site specific water quality objectives (SSWQOs) were developed for the following parameters using CCME (1993) background concentration procedure (Knight Piésold, 2011):

- Aluminum
- Chromium
- Copper
- Iron

The developed SSWQOs are summarized in Table H.1 above. It was not appropriate to develop site specific criteria for Uranium or Selenium as explained in FEIS Appendix 7B-2.

Key Issues and Pathways

Key issues which were assessed for the surface water and sediment quality VEC included:

- Pit water quality from the Mine Site LSA
- Surface runoff from Project roads in the five freshwater LSAs
- Discharges from Project WWTFs from the five freshwater LSAs
- Acid Rock Drainage (ARD) and Metal Leaching (ML) resulting from waste rock piles, ore stockpiles, open pit dewatering, construction fills, embankment of roads and railway, and open quarries in the five freshwater LSAs
- Nutrient input from blasting activities and chemical leaching from rail sleeper coatings in the five freshwater LSAs
- Suspended sediment due to construction of mine facilities, Milne Inlet Tote Road, the railway and associated water crossings
- Runoff at fuel storage facilities, including fuel spills and malfunctions from the five freshwater LSAs
- Effects from waste management activities including storage, handling and landfilling of waste, landfarming of contaminated ice/snow/soil, the management of historically contaminated material, and sewage effluent discharges in the five freshwater LSAs
- Effects from construction and operation of camps in the five freshwater LSAs
- Effects from erosion and sediment transport due to vegetation removal, cuts/fills and other disturbances in the five freshwater LSAs
- Effects from dust deposition in the five freshwater LSAs
- Effects from drilling water withdrawals and returns in the Mine Site LSA

An account of key issues, indicators, and Project locations and phases that were incorporated in the effects assessment is provided in Table H.2.

Table H.2: Key Issues for Water And Sediment Quality

Key Issue	Indicators	Project Location (LSA)	Project Phase
Ground Preparation, Earthworks, Road and Railway construction	pH, TSS, Metals and Nutrients	All	Construction and Closure
Site Water Management	pH, TSS, Metals, Nutrients and Petroleum Hydrocarbons	Milne Inlet Tote Road LSA Mine Site LSA Rail Alignment LSA	Construction, Operation and Closure

Key Issue	Indicators	Project Location (LSA)	Project Phase
Laydown Areas	pH, TSS, and Metals	All	Construction and Closure
Airstrips and Airstrip Use	TSS and Petroleum Hydrocarbons	All	Construction, Operation, Closure
Mine Contact Water - Waste Rock Stockpile	pH, TSS, Metals and Nutrients	Mine Site LSA	Operation, Closure and Post Closure
Mine Contact Water - Open Pit and Run of Mine Stockpile	pH, TSS, Metals and Nutrients	Mine Site LSA	Operation, Closure and Post Closure

Residual Effects Rating Criteria

Residual effects are those effects that persist after mitigation has been applied to potential effects. Each Project-related residual effect was rated using the standard criteria described in FEIS Volume 2.0 and the VEC-specific criteria identified in Table H.3.

Table H.3: Significance Ratings for Evaluating Residual Water and Sediment Quality Effects

Criteria	Classification	
Magnitude	Negligible	Concentrations of indicator(s) predicted to be less than threshold value(s)
	Level I	Concentrations of indicator(s) predicted to be above but within an order of magnitude of threshold value(s) (1 to 10x the threshold)
	Level II	Concentrations of Indicators predicted to be exceed threshold value(s) by an order of magnitude or greater (10 to 100x the threshold)
	Level III	Concentrations of Indicators predicted to be exceed threshold value(s) by more than two orders of magnitude (greater than 100x the threshold)
Extent The physical extent of the effect, relative to study area boundaries	Level I	Confined to the LSA
	Level II	Beyond the LSA and within the RSA
	Level III	Beyond the RSA
Duration The length of time over which a Project effect will occur	Level I	Short term (effect lasts for up to 4 years)
	Level II	Medium term (up to 25 years, for the life of the Project)
	Level III	Long term (beyond the life of the Project) or permanent
Frequency How often the effect occurs	Level I	Infrequent – rarely occurring
	Level II	Intermittent – occasionally occurring
	Level III	Continuous
Reversibility The likelihood of the VEC to recover from the effect	Level I	Fully reversible after activity is complete
	Level II	Partially reversible after activity is complete
	Level III	Non-reversible after activity is complete

Of the five rating criteria used in rating residual effects, magnitude is heavily weighted when determining the significance of the residual effect and is also the criterion that requires the most interpretation. Since the main receptor affected by changes in water quality is aquatic life, magnitude ratings were established based on aquatics-related thresholds, as summarized in Table H.1.

Receiving water quality objectives (WQOs) have been established for the Protection of Freshwater Aquatic Life (CCME PAL). If receiving waters meet the selected Water Quality Objectives (CCME PAL or SSWQOs) with a discharge, this is deemed a Negligible effect to freshwater biota and hence to water and sediment quality. Level I, II and III magnitude effects are related to the relative level of exceedance of any WQOs.

The potential effects associated with discharge of mine contact water into the natural environment are well understood and have led to the enactment of the MDMER under the *Fisheries Act*. The following parameters, identified in Schedule 4 of the MDMER, are regulated by point-of-discharge concentrations:

- Arsenic
- Copper
- Cyanide
- Lead
- Nickel
- Zinc
- TSS
- Radium

These parameters have been regulated due to potential deleterious effects on fish and other biota in the receiving environment. Mine contact waters may be authorized for discharge under the MDMER of the *Fisheries Act*, provided the effluents at the point of discharge meet the MDMER Schedule 4 criteria and pass regular testing for acute lethality and chronic toxicity.

Baseline Characterization

Using the baseline data as a frame of reference, the following methods were applied to aqueous non-point source emissions, aqueous point source emissions and airborne emissions.

Aqueous Non-Point Source Emissions

Infrastructure and activities that were widespread or had non-point source emissions, were assessed in a qualitative manner on a Project-wide basis rather than assessing residual effects for each individual water body. To identify potential sensitivity to the particular indicators and to add context to the rating, general water quality parameters determined for the Sample Group and/or the LSA were considered. The description of the general water quality characteristics for Sample Groups (rivers/streams and lakes) is provided in FEIS, Volume 7, Tables 7-3.5 and 7-3.7.

Given the uncertainty regarding the potential contaminant source, distribution, and location that would be required to complete a quantitative assessment, a qualitative assessment was undertaken applying conservative assumptions. Examples of residual effects associated with aqueous non-point source emissions included increased TSS due to erosion and sediment transport, ML/ARD from various earth materials, nutrient additions from blasting, and petroleum hydrocarbon constituents from accidental spills.

The majority of meltwater and precipitation in the Project area occurs between June and September, the open-water period for streams and rivers. Consequently, erosion and sediment transport, nutrient and metals transport, and petroleum hydrocarbon mobilization are likely to occur in this period, when receiving waterbodies are at their maximum flows and have increased capacity to buffer these inputs.

Where residual effects were considered likely and there was a lack of reliable data available to quantify the contaminant source, a conservative approach was employed by assuming that the concentration of the key indicator(s) for that particular effect would exceed the respective threshold(s) (Table 7-3.8, FEIS, Volume 7), resulting in a Level II magnitude effect. For these cases, it was further assumed that the magnitude could be maintained below a Level III effect (i.e., less than an order of magnitude greater than the threshold) by identifying the occurrence of the effect through environmental monitoring and responding appropriately under an adaptive management framework.

A conservative approach was also applied to assumptions regarding the effectiveness of mitigation measures, in recognition that there may be limitations associated with implementation and effectiveness, given the extreme climatic conditions in the Project area. Following that logic, where qualitative assessment was employed, a magnitude of Level I was only attributed to a residual effect when there was a high Level of Certainty that mitigation would be fully implemented and effective. All instances where the effectiveness of the mitigation was in question resulted in a magnitude rating of Level II.

Aqueous Point Source Emissions

For Project infrastructure and activities that generate point-source emissions with the potential to affect a specific receiving waterbody, the residual effects assessment focused on those particular locations, where adequate baseline data were available.

For point source mine contact water discharges, source terms of runoff water quality were obtained from geochemical testing (AMEC, 2012b) to compare effluent water quality to MDMER criteria, and to evaluate the resultant water quality in receiving waters compared to CCME PAL Guidelines. As a mitigation measure to maximize mixing, and to minimize changes in the natural flow regimes, discharges of mine contact waters will be carried out following the natural hydrograph. The Camp Lake tributary at MR-12 and the

Mary River are gauged during the open water season, which will allow for real-time monitoring of flows and regulation of releases.

A mass balance approach was used, mixing annualized discharge flows with the annualized receiving flow at the nearest downstream location inhabited by fish. The mass balance model is shown below:

$$C_{Res} = \frac{(C_D \times Q_D) + (C_R \times Q_R)}{Q_{Res}}$$

Where:

C_D = indicator concentration in discharge (mg/L)
Q_D = volume of effluent discharged annually (m^3/year)
C_R = indicator concentration in receiving waterbody (mg/L)
Q_R = volume of water in the receiving waterbody annually (m^3/year)
C_{Res} = resulting (mixed) indicator concentration (mg/L)
Q_{Res} = volume of resulting (mixed) waterbody annually (m^3/year)

The model assumes near-instantaneous mixing in riverine environments due to the discharge to receiving flow ratio, and no modification of indicators due to precipitation, speciation, attenuation or degradation.

Modelling was carried out using both mean and 90th percentile baseline concentrations, and under both mean and low flow (7Q10) conditions.

Mixing Assumptions

While the water quality model used above assumes instantaneous mixing, in reality Initial Dilution Zones (IDZs) will exist at each discharge. The specifics for each discharge location are discussed below.

- West Waste Rock Stormwater Pond – Stormwater will be discharged to a natural drainage (L1) that is fishless until about 100 m before the drainage discharges into a main tributary of Camp Lake (tributary L0). The receiving water is the lower reach of L0 below the falls that provide the fish barrier. Stormwater will be mixed with the natural waters in the drainage L1, and although discharge flows are greater than natural flows, it is expected that this mixing will effectively occur over the approximate 1.5 km length to where the water flows over the falls and subsequently into tributary L0, receiving further dilution.
- East Waste Rock Stormwater Pond – Stormwater will be discharged to a natural drainage (F0) that is fishless until the F0 drainage discharges into the Mary River. Stormwater will be mixed with the natural waters in the drainage F0, and although discharge flows are similar to the natural flows, it is expected that this mixing will effectively occur over the approximate 2,500 m section to where the water flows over the falls. F0 then discharges into the Mary River at a point where the flows are highly turbulent, and therefore further mixing is expected to be nearly instantaneous.
- ROM Stockpile Stormwater Pond and Ore Stockpile Stormwater Pond –These discharges will be directly to the Mary River, but at distinct locations separated by approximately 1,500 m of river. IDZs

will exist downstream of each discharge. Because of the volume and turbulent nature of flows in the Mary River, the IDZs will be confined to 20 to 30 m in length.

Source Terms – Waste Rock

Mine contact water from the Waste Rock Stockpiles at the Mine Site will be collected in stormwater ponds prior to discharge. Stormwater runoff water quality (source terms) from Waste Rock Stockpiles were derived by preparing a mass loading model using laboratory derived reaction data and the anticipated site conditions. The ponds will be designed with holding capacities that act to moderate water quality. During mining, when the waste rock pile is under development, stormwater will require retention to settle out solids. The water quality modelling by AMEC (2012a) suggests that if suspended solids are properly managed, the quality of discharge will meet MDMER requirements. While water treatment is not expected to be required, treatment options will be available as a contingency measure. As a conservative measure, maximum waste rock runoff quality estimates were used in the assessment.

For a number of parameters sampled in the humidity cell tests, metals were measured at or below the analytical method detection limit (MDL) for a large proportion of samples. Generally the MDLs are high relative to the selected water quality objectives (CCME PAL or SSWQOs). For these parameters, the values assigned were set at one-half the MDL (AMEC, 2012a). The 90th percentile calculated source term was influenced by predicted water quality results based largely on the non-detect results in the humidity cells for the following metals: mercury (Hg), selenium (Se), copper (Cu), arsenic (As), cadmium (Cd), chromium (Cr), silver (Ag) and thallium (Tl). Consequently, the modelled water quality for these parameters is highly conservative.

A similar issue with detection limits was identified in the baseline water quality dataset. The majority of sample results for several metals were reported as non-detect (measured below the MDL). In the baseline dataset, non-detect samples were conservatively set at the MDL. This contributed to overly conservative modelling results; i.e., when the majority of results were reported at the detection limit, the calculated values were close to or even exceeded the Water Quality Objective (WQO).

Two notable parameters, mercury and selenium, were calculated to exceed the respective WQO because of the high proportion of non-detects in both the baseline receiving waters and in the humidity cell testing.

	Mercury	**Selenium**
WQO (CCME PAL) (mg/L)	0.000026	0.001
90th Percentile Baseline Concentration (mg/L)	0.0001	0.0001
% of Detects in Baseline (Measured above MDL)	2 %	2 %
Calculated Source Term (mg/L) (west discharge / east discharge)	0.004 / 0.003	0.047 / 0.038
Humidity cell testing MDL (mgl/L)	0.001	0.001

As a consequence mercury and selenium are predicted to reach Level II magnitude in the assessments.

During the technical review of the DEIS, the Qikiqtani Inuit Association expressed concern over the potential for nitrates to be elevated in the waste rock stormwater runoff, due to the quantities of ammonium nitrate fuel oil (ANFO) explosives that will be used in mining.

Ammonia releases have been associated with the use of certain explosives at mining and quarrying operations. The use of ammonium nitrate and fuel oil (ANFO) explosive could cause elevated nitrates in waste rock and mine run-off. Ammonia can occur as un-ionized (NH_3) or ionized (NH^{4+}) ammonium ion species. Total ammonia is a measure of both un-ionized and ammonium ion species. The un-ionized is more toxic to aquatic life than the ionized species. Consequently, mining companies have taken a number of initiatives to address this issue. For example, Diavik Diamond Mines Inc has investigated the use, loss and mitigation measures to address nitrate losses, and as a result, has developed and implemented at its site several iterations of an Ammonia Management Plan (Diavik Diamond Mines: Ammonia Management Plan).

Annual explosive use for blasting waste rock and ore is estimated to range from 15,700 tonnes to 18,200 tonnes per annum depending on the year. FEIS Volume 3, Appendix 3B, Attachment 8, Section 2.6 states that the emulsion:AN ratio used for the Project is 70:30. The use of emulsion improves the bulk strength of the explosive and allows efficient rock breakage. The emulsion product also reduces ANFO solubility. Modeling by other companies concludes that ammonia releases can be reduced if proper controls are not implemented. The Explosives Management Plan (FEIS Volume 3, Appendix 3B, attachment 8) and FEIS Volume 10 Section 4.3.3 outline the mitigation measures that will be taken to control the nitrate concentrations entering the receiving environment.

Commercial ammonia reduction technologies, if required, include biological treatment, air stripping, ion exchange, reverse osmosis and breakpoint chlorination. Non-commercial technologies that may have future applications include aerated lagoons, constructed wetlands, land treatment and natural treatment in ponds. (Table 5, Annex C of the Diavik Diamond Mines Ammonia Management Plans), describes for each technology an ammonia reduction estimate, the environmental effect, an evaluation of technology feasibility, capital cost and operating time frames.

<u>Source Terms –Pit Water Quality</u>

Preliminary estimates of pit water quality were made using a similar mass loading approach to that for the waste rock drainage quality (AMEC 2012b). Equilibrated estimates of pit water quality are presented in Table H.4. It is expected that the effluent quality during mine operations will meet MDMER requirements for metals. It is possible that, during the latter portion of the mine, pH may decrease below the lower limit of the MDMER (pH 6.0). The estimated water quality derived for the pit drainage includes allowance for acidic drainage from exposed potentially acid generating (PAG) rock toward the end of mine life. The quantity of this exposed rock and the data used in deriving this drainage quality is the subject of additional study.

It has therefore been assumed that pH adjustment of the pit water will be required in the second half of mine life and into post-Closure. During Operations, pH adjustment will most likely be carried out inside the pit before the water is pumped to the East Waste Rock Pond. Again, humidity cell testing is expected to over-estimate the runoff quality. These modelling results are very conservative and will be reviewed once data are available from recently initiated neutralizing potential-depleted humidity cell testing. This will improve confidence in drainage water quality and pH.

Although the pit water quality source term for the latter part of mine life is beyond the MDMER range for pH and may require minor pH adjustment, the source terms (assuming no treatment) have been applied in the water quality modelling as a conservative measure.

The EEM program under MDMER is specifically designed for this type of situation and is a well designed monitoring tool. It is a tiered program, meaning that the results of monitoring are used in the design of subsequent monitoring, and results also serve to identify the need for corrective action (Dumaresq *et al*. 2002).

<u>Source Terms – Ore Runoff</u>

Mine contact water from the ROM stockpile and the main ore stockpile at the Mine Site will be collected in stormwater ponds prior to discharge to the Mary River. Source terms were derived by calculating the 90th percentile concentrations from sampling carried out by Baffinland in 2010 from lysimeters installed in an ore stockpile generated at the site during the bulk sampling program in 2008. No runoff has been collected since then due to especially dry conditions during the 2011 field season. The runoff data, while limited, are considered conservative in that they represent runoff collected after the stockpile had been sitting dormant for two years; in reality the turnover in the ore stockpiles will be rapid and therefore the contact time between water and the ore will be limited. It has also been identified that non-representative manganese-rich ore may be a component of the lysimeter samples, since this ore was used in construction of the crusher pads where the lysimeters were located. Therefore, lysimeter results may be influenced by drainage from atypical ore.

Runoff from the ore stockpiles is not expected to require treatment beyond settlement of suspended solids in the stormwater pond. Nevertheless, treatment has been identified as a potential contingency measure that can be implemented if monitoring program results indicate that the water quality does not meet discharge criteria. More detail on contingency treatment options for mine contact water is provided in Life-of-Mine Waste Rock Management Plan (BAF-PH1-830-P16-0031).

Table H.4: Predicted Pit Water Quality

Parameters	MDMER Limits	Year 6	Year 10	Year 15	Year 21
pH	6 – 9.5	6.5	6.5	5.1	4.2
Sulphate (mg/L)		77	80	88	158
Arsenic (mg/L)	0.5	0.006	0.006	0.006	0.007
Copper (mg/L)	0.3	0.007	0.008	0.016	0.074
Lead (mg/L)	0.2	0.0005	0.0005	0.0007	0.0022
Nickel (mg/L)	0.5	0.004	0.005	0.018	0.11
Zinc (mg/L)	0.5	0.030	0.031	0.035	0.062
Aluminum (mg/L)		0.24	0.24	0.77	4.2
Antimony (mg/L)		0.007	0.007	0.007	0.008
Boron (mg/L)		0.060	0.062	0.067	0.11
Cadmium (mg/L)		0.00005	0.00005	0.00006	0.00016
Chromium (mg/L)		0.007	0.007	0.008	0.019
Cobalt (mg/L)		0.002	0.002	0.008	0.053
Iron (mg/L)		<0.002	<0.002	0.031	0.22
Manganese (mg/L)		0.0001	0.0001	0.10	0.57
Mercury (mg/L)		0.0013	0.0014	0.0014	0.0016
Molybdenum (mg/L)		0.023	0.024	0.024	0.027
Selenium (mg/L)		0.015	0.016	0.016	0.022
Silver (mg/L)		0.0002	0.0002	0.0002	0.0008
Thallium (mg/L)		0.0007	0.0007	0.0007	0.0009
Vanadium (mg/L)		0.0024	0.0025	0.0025	0.0029
Barium (mg/L)		0.022	0.023	0.024	0.034
Sodium (mg/L)		1.0	1.0	1.1	1.8
Potassium (mg/L)		29.2	30.1	30.2	34.9
Calcium (mg/L)		36.0	37.2	37.4	43.4
Magnesium (mg/L)		20.2	20.8	22.9	40.0

Notes:
1. Equilibrated concentrations, which assume equilibrium with amorphous $Al(OH)_3$, ferrihydrite and manganite where estimated concentrations exceed saturation indices for those phases.

Significance Determination

The potential to result in significant adverse environmental effects was determined for each residual effect, based on professional judgment of the combination of residual effect ratings for each potential effect and taking into account the environmental context and the Level of Confidence associated with each rating.

Residual Effects Assessment

This Section presents potential effects, mitigation measures and the residual effects assessment for two categories:

- Aqueous Non-Point Source Emissions;
- Aqueous Point Source Emissions.

Aqueous Non-Point Source Emissions

Potential effects on surface water and sediment quality associated with aqueous non-point source emissions (key issues) identified in Table H.2 are described below. These emissions are common where activities take place near water bodies and may affect watercourses throughout the Project area. Locations of infrastructure and activities are described for each LSA.

Table H.5 summarizes the ratings assigned to the significance criteria of residual effects associated with each effect discussed below.

Prediction Confidence

The significance rating and confidence level assigned to the predictions of significance for aqueous non-point source discharge effects to water and sediment quality are summarized in Table H.5.

Ground Preparation and Earthworks - Impact Statement SWSQ-1

Impact Statement SWSQ-1: Project-related ground preparation and earthworks may result in changes to surface water and sediment quality in the five freshwater aquatic LSAs.

Ground preparation and earthworks are essential prerequisites during the Construction and Closure phase in all five freshwater LSAs. The areas requiring earthworks notably include the following:

- Developing each of the key areas (Milne Port, Mine Site and Steensby Port) including the construction and reclamation of buildings, laydown areas, access roads and other site infrastructure;
- Minor improvements to the roadbed of the Milne Inlet Tote Road; and
- Railway construction, including the construction access road.

Typical ground preparation activities include vegetation removal and stripping, resulting in ground surface conditions that are prone to potential erosion and liberation of potential contaminants of concern; this may have an effect on surface water quality through changes in pH or the introduction of TSS, petroleum hydrocarbons and/or nutrients. Left unmitigated, direct effects may be observed in surface water quality. By implementing standard best management practices (BMPs) during ground preparation activities, water quality effects can be avoided or reduced to the point where only incidental, minor to moderate adverse short-term effects are anticipated. As required, the following mitigation measures will be applied:

- Minimize the footprint of disturbance;

- Schedule ground preparation to maintain adequate ground cover during periods of expected rainfall;
- Install and maintain water management features, designed to segregate and prevent co-mingling of offsite water and onsite water;
- Install and maintain adequately designed erosion control features;
- Install and maintain adequately designed sediment transport control features;
- Capture and treat potentially contaminated site run-off to applicable water quality standards prior to discharging to the receiving environment; and
- Erosion control measures.

Following the ground preparation activities, earthworks (earth moving, excavation, grading, cut/fill and backfilling) are required for development of components during Construction and reclamation of components during Closure.

The disturbance, exposure, transportation and relocation of earth materials can potentially affect surface water quality in receiving bodies adjacent to these work areas. Left unmitigated, direct effects may be observed in surface water quality including changes in pH, introduction of TSS, petroleum hydrocarbons, and/or nutrients. By implementing standard BMPs described above, water quality impacts can be avoided or reduced to the point where only minor to moderate short-term adverse effects are anticipated.

In the event that existing contamination is suspected or encountered during earthwork activities, the Hazardous Materials and Hazardous Waste Management Plan (BAF-PH1-830-P16-0011) will be used as a guideline for containment, testing, removal, treatment and disposal of contaminated media.

Soil spoils will be re-used nearby as general fill (if suitable), stored for reclamation purposes and/or disposed of in roadside borrows. Borrows will be contoured to provide stable side slopes and restore natural drainage.

Temporary roads will be decommissioned and restored through scarification as soon as practical to reduce the risk of potential effects of erosion and sediment transport. Culverts and bridges will be removed to restore pre-disturbance drainage patterns.

The railway alignment and train-related infrastructure are described and illustrated in FEIS Volume 3. Completion of the rail line will incorporate ground preparation and earthworks, a temporary access road, rail bed construction and rail sleeper installation. The entire rail line consists of new construction through previously unaltered landscape; therefore, potential effects on water and sediment quality are anticipated.

Rail line construction activities with the potential to affect surface water and sediment quality include culvert installation, bridge construction, infilling of right-of-way through watercourses (encroachment), rail bed construction, grading, and water management.

Standard BMPs will be employed to address potential effects during Construction and Closure. The rail bed, rail line and associated features will be designed and installed so as to avoid contamination of surface waters.

Specifically, all structures will be designed, constructed and operated in compliance with *Fisheries Act* authorizations designed to protect water quality as an integral component of fish habitat. Adherence to the conditions of the *Fisheries Act* Authorizations and standard BMPs are anticipated to result in minor adverse residual effects.

Table H.5: Effects Assessment Summary - Aqueous Non-Point Source Emissions

Effect		Residual Effect Evaluation Criteria					Significance
Effect	**Direction & Nature of Effect**	**Magnitude / Complexity**	**Geographical Extent**	**Frequency**	**Duration**	**Reversibility**	**Rated Significance of Residual Effect**
SWSQ-1 Ground preparation & earthworks	**Negative** Water quality (pH, TSS, metals, nutrients and hydrocarbons)	**Level II:** Effect is expected to result in a change greater than threshold value(s)	**Level I:** confined to the LSA	**Level I:** infrequent	**Level II:** will occur for the operation phase (life of the Project)	**Level I:** effect is reversible after activity is complete	Not Significant
SWSQ-2 Site Water Management	**Negative** Water quality (pH, TSS, metals, nutrients and hydrocarbons)	**Level II:** Effect is expected to result in a change greater than threshold value(s)	**Level I:** confined to the LSA	**Level I:** infrequent	**Level I:** will occur mainly during the construction phase	**Level II:** effect is partially reversible with cost/effort	Not Significant
SWSQ-3 Laydown Areas	**Negative** Water quality (pH, TSS, metals, nutrients and hydrocarbons)	**Level II:** Effect is expected to result in a change greater than threshold value(s)	**Level I:** confined to the LSA	**Level I:** infrequent	**Level I:** will occur mainly during the construction phase	**Level I:** effect is reversible after activity is complete	Not Significant
SWSQ-4 Explosives	**Negative** Water quality (pH, TSS, metals, nutrients and hydrocarbons)	**Level II:** Effect is expected to result in a change greater than threshold value(s)	**Level I:** confined to the LSA	**Level I:** infrequent	**Level II:** will occur for the operation phase (life of the Project)	**Level I:** effect is reversible after activity is complete	Not Significant
SWSQ-5 Quarries and Borrow Areas	**Negative** Water quality (pH, TSS, metals, nutrients and hydrocarbons)	**Level II:** Effect is expected to result in a change greater than threshold value(s)	**Level I:** confined to the LSA	**Level I:** infrequent	**Level I:** will occur mainly during the construction phase	**Level I:** effect is reversible after activity is complete	Not Significant

Effect		Residual Effect Evaluation Criteria					Significance
Effect	**Direction & Nature of Effect**	**Magnitude / Complexity**	**Geographical Extent**	**Frequency**	**Duration**	**Reversibility**	**Rated Significance of Residual Effect**
SWSQ-7 Camps and Fuel Management	**Negative** Water quality (pH, TSS, metals, nutrients and hydrocarbons)	**Level I:** Effect is expected to be less than threshold values	**Level I:** confined to the LSA	**Level II:** will occur intermittently	**Level II:** will occur for the operation phase (life of the Project)	**Level II:** effect is partially reversible with cost/effort	Not Significant
SWSQ-8 Water Use and Management	**Negative** Water quality (pH, TSS, metals, nutrients and hydrocarbons)	**Level I:** Effect is expected to be less than threshold values	**Level I:** confined to the LSA	**Level III:** continuous	**Level II:** will occur for the operation phase (life of the Project)	**Level I:** effect is reversible after activity is complete	Not Significant
SWSQ-9 Airstrips and Airstrip Use	**Negative** TSS and Petroleum Hydrocarbons	**Level II:** Effect is expected to result in a change greater than threshold value(s)	**Level I:** confined to the LSA	**Level I:** infrequent	**Level III:** will occur beyond the life of the Project	**Level I:** effect is reversible after activity is complete	Not Significant

Table H.6: Significance of Residual Effects from Non-Point Source Discharges

Key Issue	Significance of Predicted Residual Environmental Effect		Likelihood (1)	
	Significance Rating	Level of Confidence	Probability	Certainty
SWSQ-1: Project-related ground preparation and earthworks, including road and railway construction/closure	N	2	N/A	N/A
SWSQ-2: Project-related site water management	N	2	N/A	N/A
SWSQ-3: Project-related laydown areas	N	1	N/A	N/A
SWSQ-4: Project-related explosives manufacture, storage, and use	N	2	N/A	N/A
SWSQ-5: Quarries and borrow sources	N	2	N/A	N/A
SWSQ-7: Camps, fuel storage and waste management	N	2	N/A	N/A
SWSQ-8: Water use and management	N	2	N/A	N/A
SWSQ-9: Airstrips and airstrip use	N	2	N/A	N/A

KEY:
Significance Rating: S= Significant, N = Not Significant, P = Positive
Level of Confidence : 1= Low; 2= Medium; 3=High
(1) Likelihood - only applicable to significant effects
Probability: 1= Unlikely; 2= Moderate; 3=Likely
Certainty: : 1= Low; 2= Medium; 3=High

Materials from borrow sources have undergone representative geochemical testing, which has indicated that non-reactive material is available throughout the alignment for rail bed construction. The use of non-reactive rock avoids the potential for acid generation and metals leaching that could affect surface water and sediment quality. Imported materials used in rail bed construction will be screened for other obvious contaminants that could affect nearby watercourses. In the event that existing contamination is suspected or encountered during earthwork activities, the Project's Hazardous Materials and Hazardous Waste Management Plan (BAF-PH1-830-P16-0011) will be used as a guideline for containment, testing, removal, treatment and disposal of contaminated media.

The rail sleepers will be hewn from raw wood and will not have any preservatives such as creosote or zinc chloride. One of the factors in the selection of raw wood for rail sleepers was to remove the potential for adverse water quality effects. No negative adverse effects are expected from materials leaching from the raw wood rail sleepers.

Residual Effects Rating

Magnitude

Based on a qualitative assessment, there is a potential for minor to moderate water quality effects associated with ground preparation and earthworks activities, including road and railway construction and reclamation. Generally, the mitigation measures described above are expected to prevent contact of sediment-laden water with natural surface waterbodies in the LSA. Mitigation measures may, however, have limitations, especially considering the extreme climatic conditions: the effectiveness of the installation and performance of sediment transport mitigation (e.g. silt fences) in frozen ground conditions, challenges in providing adequate ground cover, and challenges in completing earthworks in areas of permafrost.

Given the potential limitations of mitigation measures, it is anticipated that TSS loading could occasionally exceed the CCME threshold of +5 mg/L relative to baseline conditions. These effects are most likely to coincide with freshet conditions, which in themselves result in elevated TSS and have the potential to mitigate the magnitude of the potential effect through added capacity to buffer these inputs. Environmental construction monitoring is expected to be successful in identifying potential effects as they arise, and adaptive management will improve the performance of mitigation measures and thereby avoid exceedance of the CCME PAL guidelines.

In the event that existing (pre-Project) contaminated media are identified on any of the Project sites, appropriate measures will be taken to collect, treat and dispose of the material without increasing the footprint of the contamination and/or creating new pathways for contaminant transport. Currently, there are no known instances of existing contamination located in the Project area. Negligible to minor effects may be anticipated with any existing contaminated media identified during ground preparation and earthworks activities.

Based on the potential for water quality to occasionally exceed the identified thresholds, the effect was rated at Level II.

Environmental monitoring, ongoing water quality monitoring and adaptive management are expected to limit the magnitude of potential TSS related effects.

Extent

The extent of residual water and sediment quality effects associated with ground preparation and earthworks will be limited to the LSA where the infrastructure is located. Environmental construction monitoring will identify effects and where necessary, mitigation will limit the extent of the effect. The extent is rated as Level I.

Frequency

Considering the temporal relation between freshet and/or extreme weather conditions and residual water and sediment quality effects, it is anticipated that these effects will be limited to summer months when construction activities are scheduled and when freshet and the majority of rain events occur. Frequency is rated as Level I.

Duration

While ground disturbance and road and railway construction will be concentrated in the Construction phase, these facilities will require ongoing maintenance throughout the duration of the Project. The duration has been rated as Level II.

Reversibility

The potential effects are anticipated to be fully reversible, once the roads have been decommissioned and rehabilitated and natural drainage has been restored. The effect is rated as Level I.

Significance – SWSQ-1 – Project-related ground preparation and earthworks, including road and railway construction/reclamation

Based on the ratings described above, ground disturbance and earthworks activities are not expected to result in significant adverse environmental effects on the water and sediment quality VEC. The residual effect is ranked as *Not Significant* (Table H.5). The Level of Confidence associated with the significance ranking is Medium due to the combined qualitative and semi-quantitative nature of the assessment (Table H.6).

<u>Site Water Management – Impact Statement SWSQ-2</u>

Impact Statement SWSQ-2: Project-related site water management may result in changes to surface water and sediment quality in the five freshwater aquatic LSAs.

Management of storm water, process water and site runoff from engineered surfaces will be required throughout the five freshwater LSAs during all Project phases. The areas requiring site water management are identified in FEIS Table 3.2.1, Major Project Components, Volume 3. The approach to site water management is provided in the Surface Water and Aquatic Ecosystem Management Plan (BAF-PH1-830-P16-0026).

All stormwater sources have the potential to affect surface water quality through the alteration of Ph and/ or introduction of TSS, petroleum hydrocarbons, metals and nutrients. By implementing standard BMPs such as the Land Development Guidelines for the Protection of Aquatic Habitat (DFO, 1993), adverse effects can be avoided or reduced. The following mitigation measures will be used to manage the effects of water management on surface water quality:

- Minimize the footprint of disturbance;
- Install and maintain water management features, designed to segregate and prevent co-mingling of offsite water and onsite water.
- Install and maintain adequately designed erosion control features;
- Install and maintain adequately designed sediment transport control features;
- Where required, locate infrastructure on competent bedrock or provide ground conditions that limit permeability and transport into the active layer; and
- Capture and treat contaminated site run-off prior to discharging to the receiving environment.

Residual Effects Rating

Magnitude

Preliminary site observations coupled with experience gained from existing operations in the Project area indicate that untreated site water can typically be managed in a way that prevents contact with natural surface waterbodies and water contained in the active layer. The underlying bedrock and permafrost conditions will act as a relatively impermeable barrier to migration of potential contaminants into groundwater.

All potentially affected stormwater sources will be collected, contained and treated to applicable water quality criteria prior to discharge. Environmental construction monitoring will focus on receiving waterbodies that have relatively soft water, i.e., sensitive to increased metal toxicity (upstream of the deposits, Mary Lake and tributaries, Camp Lake, Sheardown Lake, Ravn River and Cockburn Lake) and watercourses that are sensitive to nutrient inputs.

Based on the anticipated success of controlling stormwater and treating it to applicable discharge standards, only minor to moderate water effects are anticipated. The magnitude is rated as Level II.

Extent

Based on the scale of the surface areas where site water is being collected, the extent of residual water and sediment quality effects associated with Project-related site water management may extend beyond the LSA where the source is located, but is not anticipated to extend to the RSA scale. Environmental construction monitoring will identify residual water and sediment quality effects and where necessary, mitigation efforts will limit the extent of the effect. A Level I extent rating was assigned.

Frequency

Considering the temporal relation between freshet and/or extreme weather conditions and residual water and sediment quality effects, it is anticipated that these effects occur during summer months when construction activities are scheduled. A Level I frequency rating was assigned.

Duration

Residual water and sediment quality effects associated with site water management are expected during the Construction and Operation phases of the Project and are anticipated to coincide with the timing of freshet, when any potential effect would be expected to be diluted by high flow conditions resulting in key indicator concentrations indistinguishable from baseline. A Level I duration rating was assigned.

Reversibility

Residual surface water and sediment quality effects associated with site water management are anticipated to be partially reversible. The majority of Project areas where site water management is required will be returned to the pre-disturbed state during Closure phase. Following rehabilitation, key indicators are generally expected to return to baseline conditions through removal of the contaminant source. A Level II reversibility rating was assigned.

Significance – SWSQ-2 – Project-related Site Water Management

Based on these ratings, site water management infrastructure and site water discharge are not expected to result in significant adverse environmental effects on the water and sediment quality VEC in the five freshwater LSAs. The residual effect is ranked as *Not Significant* (Table H.5). The Level of Confidence associated with the significance ranking is Medium (Table H.6). While the assessment is qualitative, there is a high Level of Confidence in the effectiveness of mitigation measures.

Laydown Areas - Impact Statement SWSQ-3

Impact Statement SWSQ-3: Project-related laydown areas may result in changes to surface water and sediment quality in the five freshwater aquatic LSAs.

Laydown areas are temporary sites used for the storage of equipment and construction materials during the Construction and Closure phase. Requirements are dictated by equipment needs, the sequence of construction/closure activities, and the timing of material shipments. These factors will be optimized to reduce the number of anticipated laydown areas, and to minimize their anticipated footprints. The two main considerations are sediment and erosion control, and introduction of hazardous substances, leading to discharge of sediment-laden or contaminated water into the receiving environment.

Left unmitigated, direct effects may be observed through the introduction of TSS and metals. By implementing standard BMPs during development and use, water quality effects can be avoided or minimized to the point where only minor to moderate adverse effects are anticipated. In addition to the mitigation measures described in the ground preparation section, the following mitigation measures will be employed in laydown areas, as required:

- Siting of laydown areas over competent bedrock or impermeable ground layers;

- Placement and grading of clean, free draining material to promote a workable lay down area environment;
- Installation of adequate storm water management infrastructure to restrict runoff from overland flow or seepage through the active layer into receiving waterbodies; and
- Appropriate handling and storage of hazardous materials.

Residual Effects Rating

Magnitude

Based on a qualitative assessment, that minor to moderate water quality effects may be associated with Project-related laydown areas and activities. The mitigation measures described above, while they are expected to prevent contact of sediment-laden or contaminated water with natural surface waterbodies may have limitations associated with their implementation and effectiveness.

Given these limitations, TSS loading could occasionally exceed the CCME threshold of +5 mg/L relative to baseline conditions. These effects are most likely to coincide with freshet conditions, which have the potential to mitigate the magnitude of the potential effect through added capacity to buffer these inputs. Environmental construction monitoring will identify potential effects as they arise and adaptive management will reduce the risk of exceeding the CCME PAL guidelines.

Potentially hazardous materials will be stored in appropriate containment in designated locations away from water bodies, to reduce the potential for loss of hazardous materials to the aquatic environment.

Based on the potential for changes in water quality occasionally to exceed the identified thresholds, a Level II magnitude rating was assigned.

Extent

The extent of residual water and sediment quality effects associated with Project-related laydown areas will be limited to the LSA in which they are located. Environmental construction monitoring will identify effects and, where necessary, mitigation efforts preclude or limit the extent of the effect. A Level I extent rating was assigned.

Frequency

Considering the temporal relation between freshet and/or extreme weather conditions and residual water and sediment quality effects that these effects would be limited to summer months when construction activities are scheduled and when freshet and the majority of rain events in the Project area occur. A Level I frequency rating was assigned.

Duration

Residual water and sediment quality effects associated with laydown areas are only expected to occur during Construction and Closure. Potential effects are anticipated to coincide with the timing of freshet, when any potential effect would be expected to be diluted by high flow conditions resulting in key indicator concentrations indistinguishable from baseline. A Level I duration rating was assigned.

Reversibility

Residual surface water and sediment quality effects associated with Project-related laydown areas are anticipated to be fully reversible. Following the closure and rehabilitation, key indicators are generally expected to return to baseline conditions through removal of the contaminant source. A Level I reversibility rating was assigned.

Significance – SWSQ-3 – Project-related Laydown Areas

Based on these ratings, laydown areas are not expected to result in significant adverse environmental effects on the water and sediment quality VEC in the five freshwater LSAs. The residual effect is ranked as *Not Significant* (Table H.5). The Level of Confidence is Low due to the qualitative nature of the assessment and potential limitations related to mitigation measures (Table H.6).

Explosives Manufacture, Explosives Magazine, and Explosives Use - Impact Statement SWSQ-4

Impact Statement SWSQ-4: Project-related explosives manufacture, magazine, and use may result in changes to surface water and sediment quality in the five freshwater aquatic LSAs. Explosives transportation, storage and handling have the potential to affect surface water quality in receiving environments during the Construction, Operation and Closure phases.

Explosives will be used throughout the Project footprint area during Closure to operate quarries, make rock cuts and access aggregate. During early construction and late closure, packaged explosives and ANFO will be delivered to specific areas of use. Packaged explosives will be stored in magazine areas, which will comply with the set-back requirements of NRCan.

Permanent bulk explosives factories will be established at the Mine Site and Steensby Port as early as possible to manufacture explosives from ammonium nitrate. These will be used if possible during early closure.

Explosives (primarily ANFO) manufacture, transportation, storage and handling may result in the introduction of nitrogenous and petroleum hydrocarbon based components into surface water. Certain nitrogenous compounds can be toxic to aquatic life, depending on the form (e.g. nitrate, nitrite, or ammonia) and relative concentration. Elevated nitrogen concentrations can also result in the eutrophication of receiving waters where phosphorus is not limiting.

The following mitigation will be used to manage potential effects on surface water and sediment quality:

- Explosives will be stored in explosives magazines positioned in accordance with the *Nunavut Mine Health and Safety Act* and Regulations. Detonators and explosives will be stored in separate magazines, and inventory will be strictly controlled by designated supervisors.
- Prefabricated magazines will be positioned and appropriately bermed to store explosives between unloading and distribution.
- If bulk mixing plants are available, ammonia nitrate (AN) will be delivered in bulk and transported by truck to the permanent storage facilities.

By implementing standard BMPs identified for explosives transportation, storage, and handling, water quality effects can be avoided or reduced to the point where only minor adverse effects are anticipated.

The mining pit will be mostly dry throughout the year; consequently ammonia or residual nitrogen is not expected to escape to the aquatic environment. During the freshet and summer months, any residual explosives washed away by precipitation will report to the waste rock pile; runoff will be channelled to a sedimentation pond, and discharge will be monitored for compliance with MDMER water quality limits.

The interaction between explosives use and water quality can be a challenge. The primary forms of mitigation to avoid contamination by nitrogen and petroleum hydrocarbons include use of appropriate weights of explosives to achieve desired blasting results, use of blast guards to prevent 'fly-away', and adequate water management features that will prevent co-mingling of contact and noncontact water. The primary area of use of explosives during Construction and Closure are quarries and borrow sources for aggregate production and are generally sited in competent ground conditions, away from sensitive receiving waterbodies, to minimize the potential for adverse effects. As an additional measure, collection sumps can be constructed to capture and treat potentially contaminated contact water prior to discharge.

<u>Residual Effects Rating</u>

Magnitude

Based on a qualitative assessment, minor to moderate water quality effects may be associated with explosives manufacture, transportation, magazine and use. Due to the potentially serious nature of health and safety effects, mitigation will be tightly controlled and intently managed. The permanent bulk explosives factories, ANFO mixing plants, ammonium nitrate storage facilities, and truck wash facilities will be constructed to contain any solid explosives and contact water for appropriate treatment. It is not anticipated that nitrogenous and petroleum hydrocarbon residues originating from these sources will exceed applicable CCME thresholds. Residual effects on water quality and sediment quality are expected to be negligible to minor.

The majority of blasting during the Operation phase will be confined to the open pit where water containing elevated levels of nitrogenous and petroleum hydrocarbon residues can be collected and treated prior to discharge (described in Section 3.4.1.6).

During Construction and Closure, nitrogenous and petroleum hydrocarbon residues are likely to be released due to blasting and wastage (minimal with pre-packaged ANFO) at quarry locations and other required sites. For these other scenarios, restricting blasting during freshet, volatilization by sunlight and attenuation by vegetation and soil and containment of contact water (where possible) are expected to limit potential effects. Even with the implementation of mitigation measures, it is possible that ammonia, nitrates, nitrites and petroleum hydrocarbon residues originating from blasting activities in less confined locations may occasionally exceed their respective CCME thresholds. These effects would likely coincide with the snow melt when accumulated nitrogen and petroleum hydrocarbon residues are released during the thaw and freshet conditions. High flow conditions will moderate the magnitude of the potential effect.

Nutrient characteristics of the receiving streams and lakes are summarized in FEIS Tables 7-3.5 and 7-3.7. The findings indicate that all of the freshwater receiving environments are relatively sensitive to nutrient inputs; therefore, environmental monitoring coupled with adaptive management will limit the magnitude of residual effects.

A Level II magnitude rating was assigned.

Extent

The extent of residual water and sediment quality effects associated with Project-related explosives manufacture, transportation, magazine and use will be limited to the LSA in which it is located. Environmental monitoring will identify residual water and sediment quality effects and where necessary, mitigation efforts will limit the extent of the effect. A Level I extent rating was assigned.

Frequency

Considering the temporal relation between freshet and/or extreme weather conditions and residual water and sediment quality effects, it is anticipated that these effects would occur during summer months when construction activities are scheduled and when freshet and the majority of rain events occur. A Level I frequency rating was assigned.

Duration

Explosives manufacture, transportation, storage and use will be required during the Construction, Operation and Closure phases. Considering that the most likely uncontrolled contribution of nitrogen to the aquatic environment would come from blasting in unconfined areas along the Milne Inlet Tote Road or Railway Alignment, it is likely the source would not persist beyond the Construction phase. Nitrogen introduced in the form of ammonium would likely be assimilated into biomass rapidly, resulting in a relatively short duration of effect. Since the nitrogen source will be removed after Construction, and given the anticipated rapid assimilation of ammonium, a Level II duration rating was assigned.

Reversibility

The potential effects are anticipated to be fully reversible once blasting activities have ceased. This assumes that residual nutrient levels will be attenuated through nitrification/denitrification and that the conclusion of blasting activities will terminate the nitrogen source. A Level I reversibility rating was assigned.

Significance – SWSQ-4 – Explosives Manufacture, Storage and Use

Based on the ratings described above, explosives manufacture, storage and use are not expected to result in significant adverse environmental effects on the water and sediment quality VEC. The residual effect is ranked as *Not Significant* (Table H.5). The Level of Confidence is Medium (Table H.6). Despite the qualitative nature of the assessment, there is a High Level of Confidence in the effectiveness of the identified mitigation measures.

<u>Quarries and Borrow Sources - Impact Statement SWSQ-5</u>

Impact Statement SWSQ-5: Project-related quarries and borrow sources may result in changes to surface water and sediment quality in the five freshwater aquatic LSAs.

Quarries and borrow sources required for rock, fill and aggregate during construction and closure are identified on FEIS Figures 3.2.1 through 3.2.9 in Volume 3. The primary concern is the potential for ML/ARD and sediment generated at these locations to affect water quality when released into the natural environment.

As a mitigation measure, materials from identified quarries and borrow sources have undergone representative geochemical testing, which has indicated that the material is non-reactive (FEIS Volume 6). Additional testing will be completed to ensure that sources used during Construction and Closure consist of non-reactive material.

Quarries and borrow sources are generally sited in competent ground conditions away from sensitive receiving waterbodies to avoid the potential for adverse effects. As an additional measure, collection sumps will capture and treat affected contact water to applicable water quality standards prior to discharge. As stated in the Borrow Pit and Quarry Management Plan (BAF-PH1-830-P16-0004) Baffinland will strive to avoid quarry site that have the potential for ML/ARD. A detailed ML/ARD testing protocol for potential quarry sites is presented in the Borrow Pit and Quarry Management Plan. Based on the results of the representative geochemical testing, it is not anticipated that treatment will be required to address ML/ARD issues.

Residual Effects Rating

Magnitude

A semi-quantitative assessment of magnitude was based on representative geochemical testing of materials from quarries and borrows sources, which indicated that the sampled materials are non-reactive (FEIS, Volume 6). The use of non-reactive materials makes it likely that run-off from quarries and borrow sources will meet the CCME thresholds for pH and metals (ML/ARD). FEIS Tables 7-3.5 and 7-3.7, which summarize acid sensitivity of the receiving streams and lakes, indicate that none of the streams or lakes is particularly sensitive to acidic inputs.

Nitrogenous and petroleum hydrocarbon residues originating from blasting activities, as well as sediment-laden water, will be confined to the water management infrastructure within each quarry and borrow site. While mitigation measures will prevent contact of storm water with natural surface waterbodies, they may have limitations associated with their implementation and effectiveness. Given these limitations, it is anticipated that uncontrolled discharges of water from quarries and borrow sources may occasionally exceed applicable CCME thresholds. These exceedances would likely coincide with freshet conditions during snow melt; this will mitigate the potential effect through dilution.

Environmental construction monitoring will be comprehensive, with an emphasis on those receiving bodies that have relatively soft water quality, a condition that can result in increased susceptibility to metals uptake.

A Level II magnitude rating was assigned.

Extent

The extent of residual water and sediment quality effects associated with quarry or borrow sources will be limited to the LSA in which they are located. The relative insensitivity of watercourses to acidic inputs suggests a relatively high potential to buffer through elevated levels of calcium carbonates that are present. Environmental monitoring will identify effects and, where necessary, mitigation efforts will limit their extent. A Level I extent rating was assigned.

Frequency

Considering the temporal relation between freshet and/or extreme weather conditions and residual water and sediment quality effects, these effects will be limited to summer months when construction/closure activities are scheduled and when freshet and the majority of rain events occur. A Level I frequency rating was assigned.

Duration

Quarries and borrow sources will be required during the Construction and Closure phase. Potential effects are anticipated to coincide with the timing of freshet, when any potential effect will be diluted by high flow conditions, resulting in key indicator concentrations indistinguishable from baseline. A Level I duration rating was assigned.

Reversibility

The potential effects associated with quarry or borrow sources are anticipated to be fully reversible once blasting is completed and these locations have been closed and rehabilitated. A Level I reversibility rating was assigned.

Significance – SWSQ-5 – Quarries and Borrow Sources

Based on the ratings described above, the residual effect is ranked as *Not Significant* (Table H.5). The Level of Confidence associated with the significance ranking is Medium due to the semi-quantitative nature of the assessment (Table H.6).

Camps, Fuel Storage and Waste Management – Impact Statement SWSQ-7

Impact Statement SWSQ-7: Project-related camps, fuel storage and waste management may result in changes to surface water and sediment quality in the five freshwater aquatic LSAs.

Temporary and permanent camps will be located throughout the Project area as described and illustrated in FEIS Volume 3. The potential effects include changes in water and sediment quality due to withdrawal, waste management, fuel storage, and discharge of sewage.

In order to protect water quality, the following management actions have been adopted at waste management facilities:

- Incineration of non-hazardous combustible wastes;
- Landfilling of inert non-combustible wastes;
- Temporary storage and off-site shipping of hazardous and recyclable waste materials; and
- On-site treatment for hydrocarbon-impacted materials (soil, water, ice, and snow).

Diesel, gasoline and aviation fuel will be delivered to temporary camp locations via tanker trucks and will be stored in double-walled fuel tanks located on foundations equipped with impermeable bermed liners and bedding materials. The storage site will be far enough removed from receiving watercourses to reduce the potential for water quality effects.

Fuel will be delivered to the camps at Milne Port, the Mine Site and Steensby Port via marine vessels and tanker trucks and will be stored in large volume double-walled tanks located on foundations equipped with impermeable bermed liners and bedding materials. Within the bermed fuel storage areas, any fuel-contact water will be collected in engineered drainage and sumps, treated to applicable water quality standards, and then discharged if it does not exceed the CCME thresholds for TSS, oil and grease, or petroleum hydrocarbons.

Residual Effects Rating

Magnitude

Effects associated with fuel storage and use and waste management were all assessed qualitatively. Mitigation measures described above will prevent the discharge of fuel contact water that exceeds CCME thresholds for TSS, oil and grease, or petroleum hydrocarbons.

Waste management mitigation as described above will limit any potentially adverse effects to a negligible to minor magnitude.

A Level I magnitude rating was assigned.

Extent

The extent of the potential effect is likely to be limited to watercourses located in the LSA in which a camp is situated. A Level I extent rating was assigned.

Frequency

The frequency of potential effects will be periodic and limited to summer months when the majority of precipitation falls in the Project Area. A Level II frequency rating was assigned.

Duration

Camps, fuel storage and waste management will be required during Construction and Operation; therefore, a Level II duration rating was assigned.

Reversibility

The potential effects are anticipated to be partially reversible once this infrastructure is decommissioned and rehabilitated. A Level II reversibility rating was assigned.

Significance – SWSQ-7 – Camps, Fuel Storage and Waste Management

Based on these ratings, construction and operation of camps, fuel storage and waste management are not expected to result in significant adverse environmental effects on the water and sediment quality VEC. The residual effect is ranked as *Not Significant* (Table H.5). The Level of Confidence is Medium (Table H.6). While the assessment is qualitative in nature, there is a High Level of Confidence in the effectiveness of mitigation measures.

Water Use and Management - Impact Statement SWSQ-8

Impact Statement SWSQ-8: Project-related water use and management may result in changes to surface water and sediment quality in the five freshwater aquatic LSAs.

Water withdrawal will support a number of Project-related activities (FEIS Tables 7-2.5, 7-2.6, 7-2.9 and 7-2.10). Withdrawal from these sources has the potential for indirect effects on surface water quality by reducing the total volume of water in the system at that location.

Various Project-related water uses have the potential to affect water and sediment quality when process water is released back into the freshwater environment, including:

- Aggregate washing;
- Concrete manufacture;
- Concrete curing;
- Truck wash; and
- Equipment/floor wash-down.

Water for aggregate washing will be pumped from the potable water source and stored in a designated washing area. The main consideration with aggregate wash water is the potential for it to contain a high TSS concentration. Wash water will be reused and recycled to the extent possible, and solids will be settled out prior to discharge.

Water used for concrete manufacture and curing will be pumped from the potable water source and stored at the batch plant. Volumetric trucks will be used for remote concrete pours, and standard BMPs will be put in place to ensure that untreated contact water is not discharged. The main consideration with concrete contact water is the potential to contain elevated TSS and pH, which may affect water quality in the environment. Concrete contact water will be treated through settlement and with pH adjustment (e.g. carbon dioxide sparging) prior to discharge.

Truck wash facilities will be constructed with water management features designed to segregate and prevent co-mingling of offsite and onsite water. A drain system and sump will capture and treat potentially contaminated water to applicable quality standards prior to discharge.

Snow, ice, soil or water that has been contaminated by petroleum hydrocarbons has the potential to impair water quality. Any such materials will be transported to lined, bermed treatment landfarm facilities, and materials that have been in contact with oil will be transported to the same locations for treatment in oil/water treatment facilities in the maintenance shops. Contaminated snow will be placed into cells in the landfarms; after thawing it will be treated and discharged. Discharges will not be directed into the freshwater environment; therefore, only minor adverse effects are anticipated from incidental occurrences.

Residual Effects Rating

Magnitude

Negligible to minor magnitude residual water quality effects may be associated with water abstraction (FEIS Tables 7-2.5, 7-2.6, 7-2.9 and 7-2.10). Water used for other activities (e.g., aggregate washing, concrete manufacture, concrete curing, and dust suppression for the quarry crusher) will be managed to ensure the discharges meet applicable CCME water quality guidelines. Negligible to minor water and sediment quality effects are anticipated.

Potential effects of contaminated by petroleum hydrocarbons were assessed qualitatively. Based on the mitigation described above, it is anticipated that treated contact water discharges will meet applicable CCME water quality guidelines and only negligible to minor adverse effects are expected.

A Level I magnitude rating was assigned.

Extent

The extent of the potential effect is likely to be limited to watercourses from which the abstraction or water use is occurring. A Level I extent rating was assigned.

Frequency

The frequency of the potential effect will be year round, while seasonal discharge of treated contact water will occur during freshet. A Level III frequency rating was assigned.

Duration

Effects are anticipated to last through the Construction, Operation and Closure phases; therefore, a Level II duration rating was assigned.

Reversibility

The potential effects are anticipated to be fully reversible, once water withdrawal and treated contact water discharge are discontinued. A Level I reversibility rating was assigned.

Significance – SWSQ-8 – Water Use and Management

Based on these ratings, water use and management are not expected to result in significant adverse environmental effects on the water and sediment quality VEC. The residual effect is ranked as *Not Significant* (Table H.5). The Level of Confidence is Medium (Table H.6). While aspects of the assessment are qualitative, there is a High Level of Confidence in the effectiveness of mitigation measures.

Airstrips and Airstrip Use - Impact Statement SWSQ-9

Impact Statement SWSQ-9: Project-related airstrips and airstrip use may result in changes to surface water and sediment quality in the five freshwater aquatic LSAs.

The airstrip and related infrastructure are described in FEIS Volume 3. Its construction, operation and closure have the potential to affect surface water quality in adjacent water bodies. The primary concern during Closure stems from erosion and sediment transport during ground preparation and earthworks. Mitigation measures are summarized in the sections above.

The primary concern stems from the possibility of contaminating nearby water bodies with runoff from the surface of the airstrip, including de-icing agents such as propylene glycol. De-icing by a portable discharge unit will be carried out in a defined area to the side of the runway using propylene glycol. A synthetic organic polymer (EK 35) will be used as a dust suppressant on the airstrips as needed.

Water management features will be installed and maintained to prevent co-mingling of offsite water with potentially affected onsite water. Any potentially contaminated water will be treated to applicable quality standards prior their discharge.

<u>Residual Effects Rating</u>

Magnitude

As a result of the crowned configuration of the airstrip, surface run-off will be directed to drainage collection structures around the perimeter. Mitigation measures will prevent contact of sediment-laden water with natural surface waterbodies; however, mitigation measures may have limitations associated with their implementation and effectiveness. Given these limitations, it is anticipated that TSS loading could occasionally exceed the CCME threshold of +5 mg/L relative to baseline conditions. These exceedances would likely coincide with freshet conditions during snow melt, which is likely to dilute and mitigate any potential effects.

Use of propylene glycol is anticipated to result in negligible to minor water quality effects as collection and treatment will to ensure that the CCME interim guideline is not exceeded.

The synthetic organic polymer EK 35 is not an identified substance under CCME PAL; therefore, it is recommended that potential effects be assessed through routine water quality monitoring.

Based on the potential for infrequent exceedances of applicable CCME thresholds, a Level II magnitude rating was assigned.

Extent

The extent of the potential effect is likely to be limited to waterbodies adjacent to the airstrips. A Level I extent rating was assigned.

Frequency

The frequency of potential effects will be limited to summer months, when the majority of precipitation falls in the Project Area. A Level I frequency rating was assigned.

Duration

Airstrips and airstrip use will be required during Construction, Operations and Closure. Potential effects are anticipated to coincide with the timing of freshet, when high flows will act to reduce concentrations and render them indistinguishable from baseline. A Level III duration rating was assigned.

Reversibility

The potential effects are anticipated to be fully reversible once the infrastructure is decommissioned and rehabilitated and de-icing and dust suppression ceases. A Level I reversibility rating was assigned.

Significance – SWSQ-9 – Airstrips and Airstrip Use

Based on these ratings, airstrips and airstrip use are not expected to result in significant adverse environmental effects on the water and sediment quality VEC. The residual effect is ranked as *Not Significant* (Table H.5). The Level of Confidence is Medium (Table H.6). While the assessment is qualitative, there is a high Level of Confidence in the effectiveness of the identified mitigation measures.

Aqueous Point Source Emissions

Potential effects on surface water and sediment quality associated with aqueous point source emissions (key issues) identified in Table H.2 are described below. These emissions are from a single, identifiable, localized source and affect a specific receiving waterbody. Locations of infrastructure and activities involving each aqueous point source emission are presented by LSA.

Table H.7 summarizes the ratings assigned to the significance criteria of residual effects associated with each effect discussed below.

<u>Prediction Confidence</u>

The confidence level assigned to the predictions of significance for aqueous non-point source discharge effects to water and sediment quality are summarized in Table H.8.

<u>Milne Port LSA</u>

All aqueous point source emissions from the Milne Port LSA are directed into Milne Inlet (marine environment) via surface release through a combination of constructed/natural drainage to areas that have no identified sensitive receptors (i.e., fish and/or fish habitat). Due to the absence of sensitive secondary receptors, an assessment of freshwater effects was not completed. The assessment of residual effects associated with emissions into the marine environment, where secondary receptors are located, is addressed in FEIS Volume 8.

<u>Milne Inlet Tote Road LSA</u>

No aqueous point source emissions into the freshwater receiving environment are located in the Milne Inlet Tote Road LSA.

Table H.7: Effects Assessment Summary - Aqueous Point-Source Discharges

Effect		Residual Effect Evaluation Criteria					Significance
Effect	**Direction & Nature of Effect**	**Magnitude / Complexity**	**Geographical Extent**	**Frequency**	**Duration**	**Reversibility**	**Rated Significance of Residual Effect**
SWSQ-10 West Waste Rock Stormwater Discharge to Camp Lake and Tributaries	**Negative** Water quality (pH, TSS, metals, ammonia, nitrite)	**Level II**: Concentrations of indicator(s) predicted to exceed threshold value(s) by an order of magnitude or greater	**Level I:** confined to the LSA	**Level II:** will occur frequently	**Level III:** long-term/permanent	**Level II:** effect is partially reversible (water treatment, if required)	Not Significant
SWSQ-11 Waste Rock and Ore Stormwater Discharge to Mary River	**Negative** Water quality (pH, TSS, metals, ammonia, nitrite)	**Level I**: concentrations of indicator(s) predicted to be above but within an order of magnitude of threshold value(s)	**Level I:** confined to the LSA	**Level II:** will occur frequently	**Level II:** will occur for the Operation phase (life of the Project)	**Level II:** effect is partially reversible (water treatment, if required)	Not Significant
SWSQ-12 Exploration Drilling Runoff to Mary River	**Negative** Water quality (pH, TSS, chlorides)	**Level I**: concentrations of indicator(s) predicted to be above but within an order of magnitude of threshold value(s)	**Level I:** confined to the LSA	**Level II:** will occur frequently	**Level II:** will occur for the Operation phase (life of the Project)	**Level I:** effect is reversible after activity is complete	Not Significant
SWSQ-13 Pit Lake and Waste Rock Discharges to Mary River in Post-closure	**Negative** Water quality (pH, TSS, metals)	**Level I**: concentrations of indicator(s) predicted to be above but within an order of magnitude of threshold value(s)	**Level I:** confined to the LSA	**Level II:** will occur frequently	**Level III:** long-term/permanent	**Level II:** effect is partially reversible (water treatment, if required)	Not Significant

Effect		Residual Effect Evaluation Criteria					Significance
Effect	**Direction & Nature of Effect**	**Magnitude / Complexity**	**Geographical Extent**	**Frequency**	**Duration**	**Reversibility**	**Rated Significance of Residual Effect**
SWSQ-14 Exploration Camp WWTF Effluent Discharge to Sheardown Lake	**Negative** Water quality (pH, TSS, BOD, nutrients, ammonia)	**Level I:** Effect is expected to be less than threshold values	**Level I:** confined to the LSA	**Level II:** will occur frequently	**Level II:** will occur for the Operation phase (life of the Project)	**Level I:** effect is reversible after activity is complete	Not Significant
SWSQ-15 Mine Site WWTF Effluent Discharge to Mary River	**Negative** Water quality (pH, TSS, BOD, nutrients, ammonia)	**Level I:** Effect is expected to be less than threshold values	**Level I:** confined to the LSA	**Level II:** will occur frequently	**Level II:** will occur for the Operation phase (life of the Project)	**Level I:** effect is reversible after activity is complete	Not Significant

Table H.8 Significance of Residual Effects from Point Source Discharges

Key Issue	Significance of Predicted Residual Environmental Effect		Likelihood (1)	
	Significance Rating	Level of Confidence	Probability	Certainty
SWSQ-10 West Waste Rock Stormwater Discharge to Camp Lake and Tributaries	N	3	N/A	N/A
SWSQ-11 Waste Rock and Ore Stormwater Discharge to Mary River	N	3	N/A	N/A
SWSQ-12 Exploration Drilling Runoff to Mary River	N	2	N/A	N/A
SWSQ-13 Pit Lake and Waste Rock Discharges to Mary River in Post-closure	N	2	N/A	N/A
SWSQ-14 Exploration Camp WWTF Effluent Discharge to Sheardown Lake	N	2	N/A	N/A
SWSQ-15 Mine Site Camp WWTF Effluent Discharge to Mary River	N	2	N/A	N/A
KEY: Significance Rating: S= Significant, N = Not Significant, P = Positive Level of Confidence : 1= Low; 2= Medium; 3=High (1) Likelihood - only applicable to significant effects Probability: 1= Unlikely; 2= Moderate; 3=Likely Certainty: : 1= Low; 2= Medium; 3=High				

Mine Site LSA

Impact Statements SWSQ-10 to SWSQ-13: Project-related discharges of mine contact water may result in impaired surface water and sediment quality in the Mine Site LSA.

Management of storm water and process water that has been in contact with the iron ore (mine contact water) is required at the Mine Site. Plans and drawings illustrating proposed site water management infrastructure for mine contact water are provided in the Surface Water and Aquatic Ecosystem Management Plan (BAF-PH1-830-P16-0026). The following sources have been identified for inclusion in the aqueous point source emissions assessment because they involve mine contact water that will be discharged into the freshwater environment:

- Waste Rock Stockpile runoff to Camp Lake and Tributaries (SWSQ-10);
- Waste rock and ore stockpile runoff to Mary River (SWSQ-11);
- Exploration drilling runoff (SWSQ-12); and

- Pit lake water and waste rock discharges to Mary River in post-closure (SWSQ-13).

The development of source terms (runoff water quality estimates) for waste rock, ore and pit water is described above.

Given the variability in runoff flows, the ponds were sized to accommodate the two-year extreme event. Discharge is anticipated to be distributed evenly with the natural flows from approximately mid-June until September.

Details regarding theoretical treatment options are provided in the Life-of-Mine Waste Rock Management Plan (BAF-PH1-830-P16-0031). The main findings suggest that, with sufficient storage and upstream control, any water quality issues that arise can be managed. If the only challenge with the water quality is TSS concentration, this will often be solved using retention time alone. With a buffer pond that has a sufficiently large retention time it is possible to allow particles to settle while discharging - either by gravity or pumping - in a continuous system.

All mine contact water (including that from the ore stockpiles) in the Milne Port and Steensby Port LSAs is discharged to the ocean; their potential effects are assessed in FEIS Volume 8.

Residual effects ratings for the various mine contact water discharges are provided below.

<u>Waste Rock Stormwater Discharge to Camp Lake and Tributaries - Impact Statement SWSQ-10</u>

Runoff discharged from the West Waste Rock Stockpile Pond (Pond 1) has the potential to adversely affect water quality in the tributary of Camp Lake to which stormwater will be discharged, and downstream into Camp Lake.

Contact water (runoff) from the Waste Rock Stockpile will be settled in the west pond (Pond 1) prior to discharge to tributary L1, which in turn reports to tributary L0 and subsequently to Camp Lake. The arrangement of the stockpile, the sedimentation pond and the receiving environment are illustrated in Life-of-Mine Waste Rock Management Plan. It is predicted, based on waste rock seepage modelling, that runoff from the stockpile will meet MDMER requirements (Life-of-Mine Waste Rock Management Plan (BAF-PH1-830-P16-0031)).

Background water quality was measured in the open-water seasons (June to September) of 2006, 2007, 2008 and 2011. Open-water season means were calculated for key water quality parameters at sampling locations L0-01, L1-02 and L1-08. Water quality sampling included analysis of routine water quality parameters identified in the Baseline Water and Sediment Quality Report in FEIS Appendix 7B-1. Background mean and 90th percentile baseline concentrations were applied to the modelling.

Mean and low flow rates (or annual volumes) were obtained from hydrological surveys conducted over five years (2006, 2007, 2008, 2010 and 2011).

A mass balance approach was applied using the methodology described above to estimate water quality in the receiving waters under mean flow conditions and by discharging runoff following the natural hydrograph. Resultant water quality in Camp Lake tributary L1 (at the location of falls which prevent the upstream passage of fish), downstream where L1 reports to tributary L0 and then at Camp Lake is presented in Table H.9. The same analysis during the 10-year dry year is presented in Table H.10.

Residual Effects Rating

Magnitude

The mass balance modelling indicates that several parameters will have Level II magnitude effects to water quality under both mean and low flow conditions at the nearest downstream location inhabited by fish at L0, and in Camp Lake (Hazard Quotient - HQ of >1 and <10). An HQ >10 and <100 was applied for mercury using 90th percentile baseline concentrations. All other parameters are at Level I or lower.

As mentioned above, each of the metals showing an HQ >1 (a Level I effect) or HQ >10 (a Level II effect) is identified in the humidity cell testing as having >50 % non-detects, and half the detection limits were assumed for non-detect results. Consequently, the derived source terms for these metals are substantially based on the MDLs. Most of these same parameters (including arsenic, cadmium, chromium, mercury, selenium and silver, as well as other metals that do not trigger a Level I effect) have measured baseline concentrations that are mostly non-detect, and therefore the calculated mean or 90th percentile concentrations are substantially based on MDLs. On this basis, the assignment of a Level II magnitude rating for water and sediment quality effects arising from discharge of stormwater from the west waste rock pond to the Camp Lake tributaries and Camp Lake is considered to be highly conservative. Baffinland is exploring options for re-testing or additional testing to obtain a dataset of more precise measurements for these parameters.

Aquatic Effects Monitoring, Environmental Effects Monitoring and routine water quality monitoring are expected to identify potential effects as they arise, and adaptive management will reduce the risk of exceeding the predicted effects level.

Duration

Discharge of mine contact water from the West Waste Rock Pond into the lower reach of Camp Lake tributary L1 will be required during the Operation, Closure and post-closure phases of the Project; a Level III duration rating was assigned.

Frequency

The frequency of the potential effect will be annual, limited to the period between June and September. A Level II frequency rating was assigned.

Extent

The extent of the potential effect is expected to be limited to the Mine Site freshwater LSA and to reach negligible levels where Camp Lake discharges into Mary Lake. A Level I extent rating was assigned.

Reversibility

The potential effects are anticipated to be partially reversible. A Level II reversibility rating was assigned.

Significance – SWSQ-10 – West Waste Rock Stormwater Discharge to Camp Lake and Tributaries

Based on these ratings, discharge of mine contact water from the West Waste Rock Sedimentation Pond into the tributary of Camp Lake is not expected to result in an adverse environmental effect on water and sediment quality in the Mine Site LSA. The residual effect is ranked as *Not Significant* (Table H.7). The Level of Confidence (Table H.8) is High due to the quantitative nature and conservative assumptions of the assessment. Additionally the EEM requirements of MDMER provide assurance that effects will be detected and necessary corrective actions implemented.

Table H.9: Predicted Water Quality in Camp Lake Tributaries and Camp Lake Under Mean Flow Conditions

Parameter	Units	Baseline Water Quality (L0-01, L1-02, L1-08)			Baseline Water Quality Camp Lake	Receiving Water Quality Objectives (Note 5)	Discharge Scenario		WATER QUALITY IN THE RECEIVING WATERS									
									CAMP LAKE TRIB L1 BEFORE DISCHARGE TO TRIB L0				MOUTH OF TRIB L0 AT OUTLET TO CAMP LAKE				CAMP LAKE	
							Flows Used		Discharge Equalized to Mean Summer Flow Discharge Volume = 843,000 m^3/yr Mean Baseline Flows in L1 = 790,807 m^3/yr				Discharge Equalized to Summer Flow - Additional Dilution in L0 Discharge Flows = 1,633,807 m^3/yr Mean Baseline Flows in L0 (MR-10) at outlet to lake = 976,453 m^3/yr				Assume Instantaneous Mixing within lake = 27,511,100 m^3 Discharge Flows into Camp Lake (MR-10 Outlet Flows + Discharge Volume) = 2,610,260 m^3/yr	
		Mean Concentration	90th Percentile Concentration	% Detects	Mean Concentration		Baseline Concentrations		Mean	HQ	90th Percentile	HQ	Mean	HQ	90th Percentile	HQ	Mean (Lake) 90th Percentile (Streams)	HQ
							MDMER	West Waste Rock Pile Source Terms										
pH		7.84	8.38		7.61	6.5 - 9.0	-	6.9	7.35	-	7.62	-	7.54	-	7.90	-	7.64	-
Hardness	mg/L $CaCO_3$	74.11	121.00		57.69	-	-	-	-	-	-	-	-	-	-	-	-	-
Aluminum	mg/L	0.0190	0.0390	82%	0.0095	0.94	-	0.12	0.071	0.1	0.081	0.1	0.052	0.05	0.065	0.07	0.0143	0.02
Antimony	mg/L	-	0.0004	0%	0.00010	-	-	0.0031	-	-	0.0018	-	-	-	0.0013	-	0.00020	-
Arsenic	mg/L	-	0.0050	6%	0.00018	0.005	0.50	0.0025	-	-	0.0037	0.7	-	-	0.0042	0.8	0.00053	0.1
Barium	mg/L	0.0093	0.0119	59%	0.00565	-	-	0.064	0.038	-	0.039	-	0.027	-	0.029	-	0.0076	-
Beryllium	mg/L	-	0.0050	0%	0.00050	0.0053	-	-	-	-	-	-	-	-	-	-	-	-
Boron	mg/L	-	0.0320	10%	0.01000	1.5	-	0.025	-	-	0.028	0.02	-	-	0.030	0.02	0.012	0.01
Cadmium	mg/L	-	0.00010	10%	0.000023	0.000029	-	0.000020	-	-	0.00006	2.0	-	-	0.00007	2.6	0.00003	0.9
Chromium	mg/L	-	0.0010	10%	0.00055	0.0047	-	0.0029	-	-	0.0020	0.4	-	-	0.0016	0.3	0.00064	0.1
Cobalt	mg/L	-	0.0003	4%	0.00011	-	-	0.00079	-	-	0.00055	-	-	-	0.00046	-	0.00014	-
Copper	mg/L	0.0015	0.0020	94%	0.00207	0.0047	0.30	0.0031	0.0023	0.5	0.0026	0.5	0.0020	0.4	0.0024	0.5	0.0021	0.4
Iron	mg/L	0.0471	0.0610	67%	0.03152	1.2	-	<0.002	0.023	0.02	0.030	0.03	0.032	0.03	0.042	0.03	0.032	0.03
Lead	mg/L	0.0002	0.0007	18%	0.000171	0.001	0.20	0.00020	0.0002	0.2	0.00044	0.4	0.0002	0.2	0.001	0.5	0.0002	0.2
Manganese	mg/L	0.0063	0.0100	51%	0.002289	-	-	0.00004	0.0031	-	0.0049	-	0.004	-	0.0068	-	0.002678	-
Mercury	mg/L	-	0.00010	2%	0.000040	0.000026	-	0.00057	-	-	0.00034	13	-	-	0.00025	9.7	0.000058	2.2
Molybdenum	mg/L	0.0027	0.0050	46%	0.000620	0.073	-	0.010	0.0065	0.1	0.0076	0.1	0.0051	0.07	0.0066	0.09	0.0011	0.02
Nickel	mg/L	0.0030	0.0050	32%	0.00109	0.083	0.50	0.0019	0.0024	0.03	0.0034	0.04	0.0026	0.03	0.0040	0.05	0.0013	0.02
Selenium	mg/L	-	0.0050	2%	0.00100	0.001	-	0.0077	-	-	0.0064	6	-	-	0.0059	5.87	0.0014	1.4
Silver	mg/L	-	0.0001	4%	0.000017	0.0001	-	0.000064	-	-	0.00008	0.8	-	-	0.00009	0.9	0.000023	0.2
Thallium	mg/L	-	0.0002	0%	0.00010	0.0008	-	0.00029	-	-	0.00025	0.3	-	-	0.00023	0.3	0.00011	0.1
Uranium	mg/L	0.0016	0.0027	100%	0.000402	0.015	-	-	-	-	-	-	-	-	-	-	-	-
Vanadium	mg/L	-	0.0010	2%	0.00100	0.006	-	0.0010	-	-	0.0010	0.2	-	-	0.0010	0.2	0.0010	0.2
Zinc	mg/L	0.0020	0.0030	25%	0.00247	0.03	0.50	0.013	0.008	0.3	0.008	0.3	0.006	0.2	0.006	0.2	0.00280	0.1

NOTES:

1. MODEL ASSUMES COMPLETE NEAR INSTANTANEOUS MIXING OF EFFLUENT AND RECEIVING WATER.
2. NO MEAN CONCENTRATION CALCULATED WHERE THE MAJORITY OF SAMPLING RESULTS WERE BELOW THE METHOD DETECTION LIMIT
3. EFFLUENT SOURCE TERMS PROVIDED BY AMEC (JANUARY, 2012).

Parameter	Units	Baseline Water Quality (L0-01, L1-02, L1-08)			Baseline Water Quality Camp Lake	Receiving Water Quality Objectives (Note 5)	Discharge Scenario		WATER QUALITY IN THE RECEIVING WATERS: CAMP LAKE TRIB L1 BEFORE DISCHARGE TO TRIB L0				MOUTH OF TRIB L0 AT OUTLET TO CAMP LAKE				CAMP LAKE	
							Flows Used		Discharge Equalized to Mean Summer Flow Discharge Volume = 843,000 m^3/yr Mean Baseline Flows in L1 = 790,807 m^3/yr				Discharge Equalized to Summer Flow - Additional Dilution in L0 Discharge Flows = 1,633,807 m^3/yr Mean Baseline Flows in L0 (MR-10) at outlet to lake = 976,453 m^3/yr				Assume Instantaneous Mixing within lake = 27,511,100 m^3 Discharge Flows into Camp Lake (MR-10 Outlet Flows + Discharge Volume) = 2,610,260 m^3/yr	
		Mean Concentration	90th Percentile Concentration	% Detects	Mean Concentration		Baseline Concentrations		Mean	HQ	90th Percentile	HQ	Mean	HQ	90th Percentile	HQ	Mean (Lake) 90th Percentile (Streams)	HQ
							MDMER	West Waste Rock Pile Source Terms										

4. EFFLUENT SOURCE TERM OF 0.001 USED IN CALCULATIONS FOR IRON
5. RECEIVING WATER QUALITY OBJECTIVES OBTAINED FROM CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT (CCME) CANADIAN WATER QUALITY GUIDELINES FOR THE PROECTION OF AQUATIC LIFE (PAL) (2003), CONTINUOUS CONCENTRATION (CHRONIC) NATIONAL RECOMMENDED WATER QUALITY CRITERIA (UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (2006)), BRITISH COLUMBIA MINISTRY OF ENVIRONMENT APPROVED AND WORKING WATER QUALITY GUIDELINES OR SUTER THRESHOLDS, AS APPLICABLE.
6. IN ORDER TO ESTIMATE EFFLUENT SOURCE TERMS, HALF THE METHOD DETECTION LIMIT OF A PARAMETER WAS ADOPTED WHERE MORE THAN HALF OF THE RESULTS FOR THAT PARAMETER WERE NON-DETECT (I.E. LESS THAN THE MDL). THESE EFFLUENT SOURCE TERMS ARE HIGHLIGHTED IN BLUE.
7. RESULTS WITH AN HQ GREATER THAN 1 ARE HIGHLIGHTED IN ORANGE, TO FOCUS DISCUSSION IN THE EFFECTS ASSESSMENT.

Table H.10: Predicted Water Quality in Camp Lake Tributaries and Camp Lake In A Dry Year

Parameter	Units	Baseline Water Quality (L0-01, L1-02, L1-08)			Baseline Water Quality Camp Lake	Receiving Water Quality Objectives (Note 5)	Discharge Scenario		WATER QUALITY IN THE RECEIVING WATERS: CAMP LAKE TRIB L1 BEFORE DISCHARGE TO TRIB L0				MOUTH OF TRIB L0 AT OUTLET TO CAMP LAKE				CAMP LAKE	
							Flows Used		Discharge Equalized to 10-Year Low Flow Discharge Volume = 354,060 m^3/yr 10-Year Low Baseline Flows in L1 = 332,139 m^3/yr				Discharge Equalized to 10-Year Low Flow - Additional Dilution in L0 Discharge Flows = 686,199 m^3/yr 10-Year Low Baseline Flows in L0 (MR-10) at outlet to lake = 410,110 m^3/yr				Assume Instantaneous Mixing within lake = 27,511,100 m^3 Discharge Flows into Camp Lake (MR-10 Outlet Flows + Discharge Volume) = 1,096,309 m^3/yr	
		Mean Concentration	90th Percentile Concentration	% Detects	Mean Concentration		Baseline Concentrations		Mean	HQ	90th Percentile	HQ	Mean	HQ	90th Percentile	HQ	Mean (Lake) 90th Percentile (Streams)	HQ
							MDMER	West Waste Rock Pile Source Terms										
pH		7.84	8.38		7.61	6.5 - 9.0	-	6.9	7.35	-	7.62	-	7.54	-	7.90	-	7.62	-
Hardness	mg/L $CaCO_3$	74.11	121.00		57.69	-	-	-	-	-	-	-	-	-	-	-	-	-
Aluminum	mg/L	0.0190	0.0390	82%	0.0095	0.94	-	0.286	0.157	0.2	0.166	0.2	0.105	0.11	0.119	0.13	0.0137	0.01
Antimony	mg/L	-	0.0004	0%	0.00010	-	-	0.007	-	-	0.004	-	-	-	0.003	-	0.0002	-
Arsenic	mg/L	-	0.0050	6%	0.00018	0.005	0.50	0.006	-	-	0.0055	1.1	-	-	0.0053	1.06	0.00038	0.08
Barium	mg/L	0.0093	0.0119	59%	0.00565	-	-	0.152	0.083	-	0.084	-	0.056	-	0.057	-	0.0076	-
Beryllium	mg/L	-	0.0050	0%	0.00050	0.0053	-	-	-	-	-	-	-	-	-	-	-	-
Boron	mg/L	-	0.0320	10%	0.01000	1.5	-	0.060	-	-	0.046	0.03	-	-	0.041	0.03	0.0112	0.01
Cadmium	mg/L	-	0.00010	10%	0.000023	0.000029	-	0.00005	-	-	0.00007	2.5	-	-	0.00008	2.9	0.00003	0.87
Chromium	mg/L	-	0.0010	10%	0.00055	0.0047	-	0.007	-	-	0.0040	0.9	-	-	0.0029	0.62	0.00064	0.14

Parameter	Units	Baseline Water Quality (L0-01, L1-02, L1-08)			Baseline Water Quality Camp Lake	Receiving Water Quality Objectives (Note 5)	Discharge Scenario		WATER QUALITY IN THE RECEIVING WATERS: CAMP LAKE TRIB L1 BEFORE DISCHARGE TO TRIB L0				MOUTH OF TRIB L0 AT OUTLET TO CAMP LAKE				CAMP LAKE	
							Flows Used		Discharge Equalized to 10-Year Low Flow Discharge Volume = 354,060 m³/yr 10-Year Low Baseline Flows in L1 = 332,139 m³/yr				Discharge Equalized to 10-Year Low Flow - Additional Dilution in L0 Discharge Flows = 686,199 m³/yr 10-Year Low Baseline Flows in L0 (MR-10) at outlet to lake = 410,110 m³/yr				Assume Instantaneous Mixing within lake = 27,511,100 m³ Discharge Flows into Camp Lake (MR-10 Outlet Flows + Discharge Volume) = 1,096,309 m³/yr	
		Mean Concentration	90th Percentile Concentration	% Detects	Mean Concentration		Baseline Concentrations		Mean	HQ	90th Percentile	HQ	Mean	HQ	90th Percentile	HQ	Mean (Lake) 90th Percentile (Streams)	HQ
							MDMER	West Waste Rock Pile Source Terms										
Cobalt	mg/L	-	0.0003	4%	0.00011	-	-	0.0019	-	-	0.0011	-	-	-	0.0008	-	0.00014	-
Copper	mg/L	0.0015	0.0020	94%	0.00207	0.0047	0.30	0.007	0.0045	1.0	0.0048	1.0	0.0034	0.7	0.0037	0.8	0.00213	0.5
Iron	mg/L	0.0471	0.0610	67%	0.03152	1.2	-	0.002	0.024	0.02	0.031	0.03	0.033	0.03	0.042	0.0351	0.032	0.03
Lead	mg/L	0.0002	0.0007	18%	0.000171	0.001	0.20	0.0005	0.0003	0.3	0.0006	0.6	0.0003	0.3	0.0006	0.6	0.00019	0.2
Manganese	mg/L	0.0063	0.0100	51%	0.002289	-	-	0.00010	0.0031	-	0.0049	-	0.0043	-	0.0068	-	0.0025	-
Mercury	mg/L	-	0.00010	2%	0.000040	0.000026	-	0.001	-	-	0.00075	29	-	-	0.00051	19.46	0.000058	2.23
Molybdenum	mg/L	0.0027	0.0050	46%	0.000620	0.073	-	0.024	0.014	0.2	0.015	0.2	0.010	0.13	0.011	0.15	0.0010	0.01
Nickel	mg/L	0.0030	0.0050	32%	0.00109	0.083	0.50	0.005	0.004	0.05	0.005	0.06	0.003	0.04	0.005	0.06	0.00123	0.01
Selenium	mg/L	-	0.0050	2%	0.00100	0.001	-	0.018	-	-	0.0119	12	-	-	0.0093	9.31	0.0013	1.32
Silver	mg/L	-	0.0001	4%	0.000017	0.0001	-	0.0002	-	-	0.00013	1.3	-	-	0.00012	1.2	0.00002	0.21
Thallium	mg/L	-	0.0002	0%	0.00010	0.0008	-	0.001	-	-	0.00045	0.6	-	-	0.00036	0.448	0.00011	0.14
Uranium	mg/L	0.0016	0.0027	100%	0.000402	0.015	-	-	-	-	-	-	-	-	-	-	-	-
Vanadium	mg/L	-	0.0010	2%	0.00100	0.006	-	0.002	-	-	0.0017	0.3	-	-	0.0014	0.24	0.0010	0.17
Zinc	mg/L	0.0020	0.0030	25%	0.00247	0.03	0.50	0.031	0.017	0.6	0.017	0.6	0.011	0.4	0.012	0.4	0.0028	0.1

NOTES:

1. MODEL ASSUMES COMPLETE NEAR INSTANTANEOUS MIXING OF EFFLUENT AND RECEIVING WATER.
2. NO MEAN CONCENTRATION CALCULATED WHERE THE MAJORITY OF SAMPLING RESULTS WERE BELOW THE METHOD DETECTION LIMIT.
3. EFFLUENT SOURCE TERMS PROVIDED BY AMEC (JANUARY, 2012).
4. EFFLUENT SOURCE TERM OF 0.001 USED IN CALCULATIONS FOR IRON.
5. RECEIVING WATER QUALITY OBJECTIVES OBTAINED FROM CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT (CCME) CANADIAN WATER QUALITY GUIDELINES FOR THE PROECTION OF AQUATIC LIFE (PAL) (2003), CONTINUOUS CONCENTRATION (CHRONIC) NATIONAL RECOMMENDED WATER QUALITY CRITERIA (UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (2006)), BRITISH COLUMBIA MINISTRY OF ENVIRONMENT APPROVED AND WORKING WATER QUALITY GUIDELINES OR SUTER THRESHOLDS, AS APPLICABLE.
6. IN ORDER TO ESTIMATE EFFLUENT SOURCE TERMS, HALF THE METHOD DETECTION LIMIT OF A PARAMETER WAS ADOPTED WHERE MORE THAN HALF OF THE RESULTS FOR THAT PARAMETER WERE NON-DETECT (I.E. LESS THAN THE MDL). THESE EFFLUENT SOURCE TERMS ARE HIGHLIGHTED IN BLUE.
7. RESULTS WITH AN HQ GREATER THAN 1 ARE HIGHLIGHTED IN ORANGE, TO FOCUS DISCUSSION IN THE EFFECTS ASSESSMENT.

Waste Rock and Ore Stormwater Discharge to the Mary River - Impact Statement SWSQ-11

Runoff discharged from the East Pond (Pond 2), containing both Waste Rock Stockpile runoff and pit water, has the potential to adversely affect water quality in the Mary River.

A mass balance approach similar to that used for the West Waste Rock Pond (SWSQ-10) was applied using the methodology described above to estimate water quality in the receiving waters under mean flow conditions and by discharging effluent following the natural hydrograph. Resultant water quality in the Mary River following discharge of the East Pond is presented in Table H.11, and the same analysis during the 10-year dry year is presented in Table H.12.

Residual Effects Rating

Magnitude

The mass balance modelling indicates that Level I magnitude effects to water quality will occur under both mean and low flow conditions (all indicator parameters <10x the applicable WQO) in the Mary River at each of the locations modelled:

- In the Mary River at MR-12 where tributary F0 containing the east pond discharge reports to the Mary River, under mean flow conditions (Table H.11) and the 10-year dry condition (Table H.12); and
- At the point of mixing of the discharge of stormwater from the main ore stockpiles, including the ROM stormwater discharge, under mean flow conditions (Table H.13) and the 10-year dry condition (Table H.14).

Fish habitat is present at the outlet of MR-12 (tributary F0), for which the resultant water quality in Mary River is shown on the far right of Tables H.11 and H.12. At this location, Level I water quality effects may be experienced based on an HQ >1 for mercury, selenium and silver (under mean flow conditions). Copper and chromium are added under the dry year condition. As discussed in the assessment of discharges from East Waste Rock Pond, the calculated baseline concentrations and source terms used in the modelling are from datasets where these parameters were predominantly non-detect. As such, a Level I magnitude rating is highly conservative.

Farther downstream, the ROM and main ore stockpiles will discharge into the Mary River. The resultant water quality in the Mary River considering these discharges as well as the east waste rock pond discharge discussed above is presented in Tables H.13 and H.14. Mercury, selenium and silver (under mean flow and low flow conditions), have a calculated HQ >1, suggesting a Level I magnitude effect with the same qualifiers as described above.

The resultant water quality downstream in Mary Lake was approximated considering discharges from the west stormwater pond via Camp Lake and the multiple discharges to Mary River, which also report to Mary Lake. Based on the average lake volume of 169,000,000 ^{m3}, HQs of 4, 1 and 1 were calculated for mercury, selenium and silver, respectively. Given that the modelling inputs (both baseline and source terms) for each of these parameters are based on MDLs, it is anticipated that the HQ values will be below 1, achieving a negligible effect on water quality in Mary Lake.

Duration

While the temporary ore stockpiles will to discharge stormwater during the Operations phase only, a Level II duration rating is assigned to this effect. The east waste rock pond and pit will continue to discharge runoff in the long term; however the post-closure effects of this is assessed separately in SWSQ-13.

Frequency

The frequency of the potential effect will be annual, limited to the period between June and September when discharge is proposed. A Level II frequency rating was assigned.

Extent

The extent of the potential effect is expected to reach negligible levels where the Mary River discharges into Mary Lake, so, given that the effect is expected to be limited to the Mine Site freshwater LSA, a Level I extent rating was assigned.

Reversibility

The potential effects associated with the discharge of mine contact water from the Waste Rock Stockpile into the Mary River system are anticipated to be partially reversible. A Level II reversibility rating was assigned.

Significance – SWSQ-11 – Waste Rock and Ore Stormwater Discharge to the Mary River

Based on these ratings, discharge of mine contact water from the Waste Rock Stockpile, ROM stockpile and Main Ore Stockpile into the Mary River is not expected to result in an adverse environmental effect on water and sediment quality in the Mine Site LSA. The residual effect is ranked as *Not Significant* (Table H.7). The Level of Confidence is High due to the quantitative and conservative nature of the assessment.

Table H.11: Predicted Water Quality in the Mary River Under Mean Flow Conditions (East Discharge)

Parameter	Units	Baseline Water Quality in Trib F0 (F0-01, F0-05)			Baseline Water Quality in Mary River (E0-01, E0-03, E0-10)			Receiving Water Quality Objectives (Note 5)	Discharge Scenario			COMBINED EFFLUENT DISCHARGE FROM THE EAST WASTE ROCK POND	WATER QUALITY IN THE RECEIVING WATERS							
													WATER QUALITY IN TRIB F0 - CATCHMENT MR-12 (U/S OF FISH HABITAT)				WATER QUALITY IN MARY RIVER AT MR-12 OUTLET (FISH HABITAT)			
									Flows Used			Mean Volume of Effluent from East Pond = 370,138 m³/yr Mean Volume of Effluent from Open Pit = 224,978 m³/yr	Mean Volume of Effluent Discharged from East Pond and Open Pit = 595,116 m³/yr Mean Volume to mix at MR-12 = 4,152,146 m³/yr				Mean Volume of Effluent Discharged from Tributary, East Pond and Open Pit = 4,747,262 m³/yr Mean Volume to mix in Mary River = 78,185,678 m³/yr			
		Mean Concentration	90th Percentile Concentration	% Detects	Mean Concentration	90th Percentile Concentration	% Detects		Baseline Concentrations			Mean	Mean	HQ	90th Percentile	HQ	Mean	HQ	90th Percentile	HQ
									MDMER	Pit Water Source Terms (Year 21)	East Waste Rock Source Terms									
pH		8.01	8.31		7.83	8.20		6.5 - 9.0	-	4.20	6.9	5.88	7.74	-	8.01	-	7.83	-	8.19	-
Hardness	mg/L CaCO₃	84	133		58	105		-	-	-	-	-	-	-	-	-	-	-	-	-
Aluminum	mg/L	0.020	0.042	81%	0.191	0.394	100%	0.94	-	4.2	0.095	1.65	0.22	0.2	0.24	0.3	0.19	0.2	0.39	0.4
Antimony	mg/L	-	0.0004	0%	-	0.0001	2%	-	-	0.008	0.0025	0.0046	-	-	0.001	-	-	-	0.00015	-
Arsenic	mg/L	-	0.0010	4%	-	0.0010	8%	0.005	0.50	0.007	0.0020	0.0039	-	-	0.001	0.3	-	-	0.00102	0.2
Barium	mg/L	0.00945	0.01068	47%	0.01011	0.01319	57%	-	-	0.0340	0.051	0.045	0.014	-	0.015	-	0.010	-	0.013	-
Beryllium	mg/L	-	0.0050	0%	-	0.0005	0%	0.0053	-	-	-	-	-	-	-	-	-	-	-	-
Boron	mg/L	-	0.010	2%	-	0.010	6%	1.5	-	0.11	0.020	0.054	-	-	0.016	0.01	-	-	0.010	0.01
Cadmium	mg/L	-	0.0000200	0%	-	0.00002	8%	0.000029	-	0.00016	0.000016	0.00007	-	-	0.000026	0.9	-	-	0.000020	0.7
Chromium	mg/L	0.0010	0.0010	8%	0.0018	0.0020	27%	0.0047	-	0.019	0.0023	0.0086	0.0020	0.4	0.0020	0.4	0.0018	0.4	0.0020	0.4
Cobalt	mg/L	0.0002	0.0003	4%	0.0002	0.0002	20%	-	-	0.053	0.00063	0.020	0.0027	-	0.0028	-	0.00035	-	0.00035	-
Copper	mg/L	-	0.0009	38%	0.0012	0.0018	64%	0.0047	0.30	0.074	0.0025	0.030	-	-	0.0045	1.0	-	-	0.0020	0.4
Iron	mg/L	0.04	0.05	19%	0.18	0.36	86%	1.2	-	0.22	<0.002	0.084	0.045	0.04	0.054	0.05	0.17	0.1	0.34	0.3
Lead	mg/L	0.00016	0.00020	13%	0.00029	0.00087	35%	0.001	0.20	0.0022	0.00016	0.0009	0.00026	0.3	0.00029	0.3	0.00029	0.3	0.00084	0.8
Manganese	mg/L	0.00260	0.01000	32%	0.00386	0.01000	48%	-	-	0.57	0.00004	0.22	0.029	-	0.036	-	0.0053	-	0.011	-
Mercury	mg/L	-	0.00010	0%	-	0.00010	2%	0.000026	-	0.0016	0.00045	0.0009	-	-	0.00020	8	-	-	0.00011	4.1
Molybdenum	mg/L	0.00306	0.00500	38%	0.00288	0.00500	46%	0.073	-	0.027	0.0078	0.015	0.0046	0.06	0.0063	0.09	0.0030	0.04	0.0051	0.07
Nickel	mg/L	0.0032	0.0050	10%	0.0031	0.0050	92%	0.083	0.50	0.11	0.0015	0.043	0.0081	0.1	0.010	0.1	0.0034	0.04	0.0053	0.06
Selenium	mg/L	-	0.001	0%	-	0.001	0%	0.001	-	0.022	0.0051	0.011	-	-	0.0023	2.3	-	-	0.0011	1.1
Silver	mg/L	-	0.00010	4%	-	0.00010	10%	0.0001	-	0.0008	0.000051	0.00033	-	-	0.00013	1.3	-	-	0.00010	1.0
Thallium	mg/L	-	0.0001	0%	-	0.0001	0%	0.0008	-	0.0009	0.00023	0.00048	-	-	0.00015	0.185	-	-	0.00010	0.1
Uranium	mg/L	0.00213	0.00299	100%	0.00252	0.00468	98%	0.015	-	-	-	-	-	-	-	-	-	-	-	-
Vanadium	mg/L	-	0.001	0%	0.001	0.001	11%	0.006	-	0.0029	0.00083	0.0016	-	-	0.0011	0.179	-	-	0.0010	0.2
Zinc	mg/L	-	0.009	8%	0.003	0.006	25%	0.03	0.50	0.062	0.010	0.030	-	-	0.012	0.386	-	-	0.0063	0.2

NOTES:
1. MODEL ASSUMES COMPLETE NEAR INSTANTANEOUS MIXING OF EFFLUENT AND RECEIVING WATER.
2. NO MEAN CONCENTRATION CALCULATED WHERE THE MAJORITY OF SAMPLING RESULTS WERE BELOW THE METHOD DETECTION LIMIT.
3. EFFLUENT SOURCE TERMS PROVIDED BY AMEC (JANUARY, 2012).
4. EFFLUENT SOURCE TERM OF 0.001 USED IN CALCULATIONS FOR IRON.

Parameter	Units	Baseline Water Quality in Trib F0 (F0-01, F0-05)			Baseline Water Quality in Mary River (E0-01, E0-03, E0-10)			Receiving Water Quality Objectives (Note 5)	Discharge Scenario			COMBINED EFFLUENT DISCHARGE FROM THE EAST WASTE ROCK POND	WATER QUALITY IN THE RECEIVING WATERS: WATER QUALITY IN TRIB F0 - CATCHMENT MR-12 (U/S OF FISH HABITAT)				WATER QUALITY IN THE RECEIVING WATERS: WATER QUALITY IN MARY RIVER AT MR-12 OUTLET (FISH HABITAT)			
									Flows Used			Mean Volume of Effluent from East Pond = 370,138 m^3/yr Mean Volume of Effluent from Open Pit = 224,978 m^3/yr	Mean Volume of Effluent Discharged from East Pond and Open Pit = 595,116 m^3/yr Mean Volume to mix at MR-12 = 4,152,146 m^3/yr				Mean Volume of Effluent Discharged from Tributary, East Pond and Open Pit = 4,747,262 m^3/yr Mean Volume to mix in Mary River = 78,185,678 m^3/yr			
		Mean Concentration	90th Percentile Concentration	% Detects	Mean Concentration	90th Percentile Concentration	% Detects		Baseline Concentrations			Mean	Mean	HQ	90th Percentile	HQ	Mean	HQ	90th Percentile	HQ
									MDMER	Pit Water Source Terms (Year 21)	East Waste Rock Source Terms									

5. RECEIVING WATER QUALITY OBJECTIVES OBTAINED FROM CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT (CCME) CANADIAN WATER QUALITY GUIDELINES FOR THE PROECTION OF AQUATIC LIFE (PAL) (2003), CONTINUOUS CONCENTRATION (CHRONIC) NATIONAL RECOMMENDED WATER QUALITY CRITERIA (UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (2006)), BRITISH COLUMBIA MINISTRY OF ENVIRONMENT APPROVED AND WORKING WATER QUALITY GUIDELINES OR SUTER THRESHOLDS, AS APPLICABLE.
6. IN ORDER TO ESTIMATE EFFLUENT SOURCE TERMS, HALF THE METHOD DETECTION LIMIT OF A PARAMETER WAS ADOPTED WHERE MORE THAN HALF OF THE RESULTS FOR THAT PARAMETER WERE NON-DETECT (I.E. LESS THAN THE MDL). THESE EFFLUENT SOURCE TERMS ARE HIGHLIGHTED IN BLUE.
7. RESULTS WITH AN HQ GREATER THAN 1 ARE HIGHLIGHTED IN ORANGE, TO FOCUS DISCUSSION IN THE EFFECTS ASSESSMENT.

Table H.12: Predicted Water Quality in the Mary River Under 10-Year Dry Conditions (East Discharge)

Parameter	Units	Baseline Quality in Trib F0 (F0-01, F0-05)			Baseline Quality in Mary River (E0-01, E0-03, E0-10)			Receiving Water Quality Objectives (Note 5)	MDMER (Mean Monthly)	Discharge Scenario		COMBINED EFFLUENT DISCHARGE FROM THE EAST WASTE ROCK POND	WATER QUALITY IN RECEIVING WATERS: WATER QUALITY IN TRIB F0 - CATCHMENT MR-12 (U/S OF FISH HABITAT)				WATER QUALITY IN RECEIVING WATERS: WATER QUALITY IN MARY RIVER AT MR-12 OUTLET (FISH HABITAT)			
										Flows Used		10-Year Low Flow Volume of Effluent from East Pond = 244,291 m^3/yr -10-Year Low Flow Volume of Effluent from Open Pit = 148,485 m^3/yr	10-Year Low Flow Volume of Effluent Discharged from East Pond and Open Pit = 392,777 m^3/yr 10-Year Low Flow Volume to mix at MR-12 = 2,740,417 m^3/yr				10-Year Low Flow Volume of Effluent Discharged from Tributary, East Pond and Open Pit = 3,133,194 m^3/yr 10-Year Low Flow Volume to mix in Mary River = 53,166,261 m^3/yr			
		Mean Concentration	90th Percentile Concentration	% Detects	Mean Concentration	90th Percentile Concentration	% Detects			Baseline Concentrations			Mean	HQ	90th Percentile	HQ	Mean	HQ	90th Percentile	HQ
										Pit Water Source Terms (Year 21)	East Waste Rock Source Terms									
pH	0	8.01	8.31		7.83	8.20		6.5 - 9.0	-	4.20	6.9	5.88	7.74	-	8.01	-	7.83	-	8.19	-
Hardness	mg/L $CaCO_3$	84	133		58	105		-	-	-	-	-	-	-	-	-	-	-	-	-
Aluminum	mg/L	0.020	0.042	81%	0.191	0.394	100%	0.94	-	6.4	0.144	2.50	0.33	0.4	0.35	0.4	0.20	0.2	0.39	0.4
Antimony	mg/L	-	0.0004	0%	-	0.0001	2%	-	-	0.012	0.004	0.01	-	-	0.0012	-	-	-	0.00016	-
Arsenic	mg/L	-	0.0010	4%	-	0.0010	8%	0.005	0.50	0.011	0.003	0.006	-	-	0.002	0.3	-	-	0.001	0.2
Barium	mg/L	0.00945	0.01068	47%	0.01011	0.01319	57%	-	-	0.0515	0.077	0.07	0.01673	-	0.018	-	0.010	-	0.013	-
Beryllium	mg/L	-	0.0050	0%	-	0.0005	0%	0.0053	-	-	-	-	-	-	-	-	-	-	-	-
Boron	mg/L	-	0.010	2%	-	0.010	6%	1.5	-	0.17	0.030	0.082	-	-	0.019	0.01	-	-	0.011	0.01
Cadmium	mg/L	-	0.0000200	0%	-	0.00002	8%	0.000029	-	0.00024	0.00002	0.0001	-	-	0.00003	1.1	-	-	0.00002	0.7

Parameter	Units	Baseline Quality in Trib F0 (F0-01, F0-05)			Baseline Quality in Mary River (E0-01, E0-03, E0-10)			Receiving Water Quality Objectives (Note 5)	MDMER (Mean Monthly)	Discharge Scenario		COMBINED EFFLUENT DISCHARGE FROM THE EAST WASTE ROCK POND	WATER QUALITY IN RECEIVING WATERS							
													WATER QUALITY IN TRIB F0 - CATCHMENT MR-12 (U/S OF FISH HABITAT)				WATER QUALITY IN MARY RIVER AT MR-12 OUTLET (FISH HABITAT)			
										Flows Used		10-Year Low Flow Volume of Effluent from East Pond = 244,291 m^3/yr -10-Year Low Flow Volume of Effluent from Open Pit = 148,485 m^3/yr	10-Year Low Flow Volume of Effluent Discharged from East Pond and Open Pit = 392,777 m^3/yr 10-Year Low Flow Volume to mix at MR-12 = 2,740,417 m^3/yr				10-Year Low Flow Volume of Effluent Discharged from Tributary, East Pond and Open Pit = 3,133,194 m^3/yr 10-Year Low Flow Volume to mix in Mary River = 53,166,261 m^3/yr			
		Mean Concentration	90th Percentile Concentration	% Detects	Mean Concentration	90th Percentile Concentration	% Detects			Baseline Concentrations			Mean	HQ	90th Percentile	HQ	Mean	HQ	90th Percentile	HQ
										Pit Water Source Terms (Year 21)	East Waste Rock Source Terms									
Chromium	mg/L	0.0010	0.0010	8%	0.0018	0.0020	27%	0.0047	-	0.029	0.003	0.013	0.003	0.5	0.003	0.5	0.0018	0.4	0.0020	0.4
Cobalt	mg/L	0.0002	0.0003	4%	0.0002	0.0002	20%	-	-	0.080	0.0010	0.031	0.004	-	0.004	-	0.0004	-	0.0004	-
Copper	mg/L	-	0.0009	38%	0.0012	0.0018	64%	0.0047	0.30	0.112	0.004	0.045	-	-	0.006	1.4	-	-	0.0021	0.4
Iron	mg/L	0.04	0.05	19%	0.18	0.36	86%	1.2	-	0.33	0.002	0.13	0.051	0.04	0.060	0.05	0.17	0.1	0.34	0.3
Lead	mg/L	0.00016	0.00020	13%	0.00029	0.00087	35%	0.001	0.20	0.0033	0.0002	0.001	0.0003	0.3	0.0004	0.4	0.00029	0.3	0.00084	0.8
Manganese	mg/L	0.00260	0.01000	32%	0.00386	0.01000	48%	-	-	0.86	0.00006	0.33	0.043	-	0.050	-	0.006	-	0.01221	-
Mercury	mg/L	-	0.00010	0%	-	0.00010	2%	0.000026	-	0.0024	0.001	0.001	-	-	0.0003	9.8	-	-	0.00011	4.2
Molybdenum	mg/L	0.00306	0.00500	38%	0.00288	0.00500	46%	0.073	-	0.041	0.012	0.023	0.006	0.08	0.007	0.1	0.0030	0.04	0.0051	0.07
Nickel	mg/L	0.0032	0.0050	10%	0.0031	0.0050	92%	0.083	0.50	0.17	0.002	0.064	0.011	0.1	0.012	0.1	0.004	0.04	0.0054	0.07
Selenium	mg/L	-	0.001	0%	-	0.001	0%	0.001	-	0.033	0.008	0.02	-	-	0.003	3.1	-	-	0.0011	1.1
Silver	mg/L	-	0.00010	4%	-	0.00010	10%	0.0001	-	0.0012	0.0001	0.001	-	-	0.0002	1.5	-	-	0.00010	1.0
Thallium	mg/L	-	0.0001	0%	-	0.0001	0%	0.0008	-	0.0014	0.0003	0.001	-	-	0.0002	0.2	-	-	0.00010	0.1
Uranium	mg/L	0.00213	0.00299	100%	0.00252	0.00468	98%	0.015	-	-	-	-	-	-	-	-	-	-	-	-
Vanadium	mg/L	-	0.001	0%	0.001	0.001	11%	0.006	-	0.0044	0.001	0.002	-	-	0.001	0.2	-	-	0.0010	0.2
Zinc	mg/L	-	0.009	8%	0.003	0.006	25%	0.03	0.50	0.094	0.015	0.045	-	-	0.014	0.5	-	-	0.0064	0.2

NOTES

1. MODEL ASSUMES COMPLETE NEAR INSTANTANEOUS MIXING OF EFFLUENT AND RECEIVING WATER.
2. NO MEAN CONCENTRATION CALCULATED WHERE THE MAJORITY OF SAMPLING RESULTS WERE BELOW THE METHOD DETECTION LIMIT.
3. EFFLUENT SOURCE TERMS PROVIDED BY AMEC (JANUARY, 2012).
4. EFFLUENT SOURCE TERM OF 0.001 USED IN CALCULATIONS FOR IRON.
5. RECEIVING WATER QUALITY OBJECTIVES OBTAINED FROM CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT (CCME) CANADIAN WATER QUALITY GUIDELINES FOR THE PROECTION OF AQUATIC LIFE (PAL) (2003), CONTINUOUS CONCENTRATION (CHRONIC) NATIONAL RECOMMENDED WATER QUALITY CRITERIA (UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (2006)), BRITISH COLUMBIA MINISTRY OF ENVIRONMENT APPROVED AND WORKING WATER QUALITY GUIDELINES OR SUTER THRESHOLDS, AS APPLICABLE.
6. IN ORDER TO ESTIMATE EFFLUENT SOURCE TERMS, HALF THE METHOD DETECTION LIMIT OF A PARAMETER WAS ADOPTED WHERE MORE THAN HALF OF THE RESULTS FOR THAT PARAMETER WERE NON-DETECT (I.E. LESS THAN THE MDL). THESE EFFLUENT SOURCE TERMS ARE HIGHLIGHTED IN BLUE.
7. RESULTS WITH AN HQ GREATER THAN 1 ARE HIGHLIGHTED IN ORANGE, TO FOCUS DISCUSSION IN THE EFFECTS ASSESSMENT

Table H.13: Predicted Water Quality in the Mary River Under Mean Flow Conditions (All Discharges)

Parameter	Units	Baseline Quality in Mary River (E0-01, E0-03, E0-10)			Receiving Water Quality Objectives (Note 5)	MDMER	Discharge Scenario						WATER QUALITY IN MARY RIVER AFTER EAST POND DISCHARGE (FROM TABLE 7-3.18)		WATER QUALITY IN MARY RIVER AFTER ROM AND MAIN STOCKPILE DISCHARGE			
							Flows Used						Mean Volume of Effluent Discharged from Tributary, East Pond and Open Pit = 4,747,262 m^3/yr Mean Volume to mix in Mary River = 78,185,678 m3/yr		Mean Volume after Discharge of Tributary, East Pond, Open Pit and Mary River Upstream of MR-12 = 82,932,940 m^3/yr Mean Volume of ROM Pond = 18,203 m^3/yr Mean Volume of Effluent from Main Ore Stockpiles = 143,489 m^3/yr Total Ore Effluent = 161,692 m^3/yr Additional Dilution in Mary River = 5,333,330 m^3/yr			
		Mean Concentration	90th Percentile Concentration	% Detects			Ore Runoff (Based on Lysimeter Monitoring Results of Bulk Sample Ore Stockpile)						Mean Baseline	90th Percentile Baseline	Mean Baseline	HQ	90th Percentile Baseline	HQ
							Lump Ore Total Metals (2010-09-07)	Lump Ore Total Metals (2010-09-19)	Fine Ore Total Metals (2010-09-07)	Fine Ore Total Metals (2010-09-19)	Mean Ore Stockpile Source Terms	95th Percentile Ore Stockpile Source Terms						
pH	0	7.83	8.20		6.– - 9.0	-	5.76	5.93	6.68	6.48	6.21	6.65	7.8	8.2	7.8	-	8.2	-
Hardness	mg/L $CaCO_3$	58	105		-	-												
Aluminum	mg/L	0.191	0.394	81%	0.94	-	0.127	<0.015	<0.02	<0.06	0.044	0.112	0.19	0.39	0.19	0.2	0.39	0.4
Antimony	mg/L	-	0.0001	0%	-	-	<0.0005	<0.0005	<0.002	<0.002	0.001	0.001	-	0.00015	-	-	0.00015	-
Arsenic	mg/L	-	0.0010	4%	0.005	0.50	<0.0005	<0.0005	<0.002	<0.002	0.001	0.001	-	0.0010	-	-	0.0010	0.2
Barium	mg/L	0.01011	0.01319	47%	-	-	0.0236	0.0251	0.0213	0.0115	0.020	0.025	0.010	0.013	0.010	-	0.013	-
Beryllium	mg/L	-	0.0005	0%	0.0053	-	<0.0025	<0.0025	<0.01	<0.01	0.003	0.005	-	-	-	-	-	-
Boron	mg/L	-	0.010	2%	1.5	-	0.16	0.16	0.21	0.31	0.210	0.295	-	0.010	-	-	0.011	0.007
Cadmium	mg/L	0.00003	0.00010	0%	0.000029	-	0.000203	0.000198	<0.0002	0.00057	0.00027	0.00051	-	0.00002	-	-	0.00003	0.9
Chromium	mg/L	0.0018	0.0020	8%	0.0047	-	<0.0025	<0.0025	<0.01	<0.01	0.003	0.0050	0.0018	0.0020	0.0018	0.4	0.0020	0.4
Cobalt	mg/L	0.0002	0.0002	4%	-	-	0.09740	0.1080	0.0462	0.1400	0.098	0.1352	0.0003	0.0004	0.00058	-	0.00059	-
Copper	mg/L	0.0012	0.0018	38%	0.0047	0.30	0.00183	<0.0025	<0.002	<0.01	0.002	0.0045	-	0.0020	-	-	0.0019	0.4
Iron	mg/L	0.18	0.36	19%	1.2	-	0.825	0.031	0.041	0.082	0.24	0.714	0.17	0.34	0.17	0.1	0.34	0.3
Lead	mg/L	0.00029	0.00087	13%	0.001	0.20	<0.0003	0.001	<0.001	<0.001	0.0005	0.0009	0.00029	0.00084	0.00029	0.3	0.00084	0.8
Manganese	mg/L	0.00386	0.01000	32%	-	-	18.4	21.5	65.5	112	54.4	105.0	0.005	0.01147	0.197	-	0.203	-
Mercury	mg/L	-	0.00010	0%	0.000026	-	<0.00001	0.00004	<0.00001	<0.00001	0.00001	0.00003	-	0.00011	-	-	0.00011	4.0
Molybdenum	mg/L	0.00288	0.00500	38%	0.073	-	<0.00025	<0.00025	<0.001	0.0012	0.0005	0.001	0.0030	0.0051	0.0030	0.04	0.0051	0.1
Nickel	mg/L	0.0031	0.0050	10%	0.083	0.50	0.0977	0.107	0.035	0.113	0.088	0.112	0.0034	0.0053	0.0036	0.04	0.005	0.1
Selenium	mg/L	-	**0.001**	0%	0.001	-	<0.005	0.0051	<0.02	<0.02	0.007	0.010	-	0.0011	-	-	0.0011	1.1
Silver	mg/L	-	0.00010	4%	0.0001	-	<0.00005	<0.00005	<0.0002	<0.0002	0.00006	0.00010	-	0.00010	-	-	0.00010	1.0
Thallium	mg/L	-	0.0001	0%	0.0008	-	<0.0005	<0.0005	<0.002	<0.002	0.001	0.001	-	0.00010	-	-	0.00010	0.1
Uranium	mg/L	0.00252	0.00468	100%	0.015	-	0.00010	<0.00005	<0.0002	<0.0002	0.00008	0.00010	-	-	-	-	-	-
Vanadium	mg/L	0.001	0.001	0%	0.006	-	<0.005	<0.005	<0.02	<0.02	0.006	0.010	-	0.0010	-	-	0.0010	0.2
Zinc	mg/L	0.003	0.006	8%	0.03	0.50	<0.005	<0.015	<0.02	<0.06	0.013	0.027	-	0.0063	-	-	0.0063	0.2

NOTES
1. MODEL ASSUMES COMPLETE NEAR INSTANTANEOUS MIXING OF EFFLUENT AND RECEIVING WATER

Parameter	Units	Baseline Quality in Mary River (E0-01, E0-03, E0-10)			Receiving Water Quality Objectives (Note 5)	MDMER	Discharge Scenario						WATER QUALITY IN MARY RIVER AFTER EAST POND DISCHARGE (FROM TABLE 7-3.18)		WATER QUALITY IN MARY RIVER AFTER ROM AND MAIN STOCKPILE DISCHARGE			
							Flows Used						Mean Volume of Effluent Discharged from Tributary, East Pond and Open Pit = 4,747,262 m^3/yr Mean Volume to mix in Mary River = 78,185,678 m3/yr		Mean Volume after Discharge of Tributary, East Pond, Open Pit and Mary River Upstream of MR-12 = 82,932,940 m^3/yr Mean Volume of ROM Pond = 18,203 m^3/yr Mean Volume of Effluent from Main Ore Stockpiles = 143,489 m^3/yr Total Ore Effluent = 161,692 m^3/yr Additional Dilution in Mary River = 5,333,330 m^3/yr			
		Mean Concentration	90th Percentile Concentration	% Detects			Ore Runoff (Based on Lysimeter Monitoring Results of Bulk Sample Ore Stockpile)						Mean Baseline	90th Percentile Baseline	Mean Baseline	HQ	90th Percentile Baseline	HQ
							Lump Ore Total Metals (2010-09-07)	Lump Ore Total Metals (2010-09-19)	Fine Ore Total Metals (2010-09-07)	Fine Ore Total Metals (2010-09-19)	Mean Ore Stockpile Source Terms	95th Percentile Ore Stockpile Source Terms						

2. NO MEAN CONCENTRATION CALCULATED WHERE THE MAJORITY OF SAMPLING RESULTS WERE BELOW THE METHOD DETECTION LIMIT
3. EFFLUENT SOURCE TERMS PROVIDED BY AMEC (JANUARY, 2012).
4. EFFLUENT SOURCE TERM OF 0.001 USED IN CALCULATIONS FOR IRON.
5. RECEIVING WATER QUALITY OBJECTIVES OBTAINED FROM CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT (CCME) CANADIAN WATER QUALITY GUIDELINES FOR THE PROECTION OF AQUATIC LIFE (PAL) (2003), CONTINUOUS CONCENTRATION (CHRONIC) NATIONAL RECOMMENDED WATER QUALITY CRITERIA (UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (2006)), BRITISH COLUMBIA MINISTRY OF ENVIRONMENT APPROVED AND WORKING WATER QUALITY GUIDELINES OR SUTER THRESHOLDS, AS APPLICABLE. IN ORDER TO ESTIMATE EFFLUENT SOURCE TERMS, HALF THE METHOD DETECTION LIMIT OF A PARAMETER WAS ADOPTED WHERE MORE THAN HALF OF THE RESULTS FOR THAT PARAMETER WERE NON
6. DETECT (I.E. LESS THAN THE MDL). THESE EFFLUENT SOURCE TERMS ARE HIGHLIGHTED IN BLUE
7. RESULTS WITH AN HQ GREATER THAN 1 ARE HIGHLIGHTED IN ORANGE, TO FOCUS DISCUSSION IN THE EFFECTS ASSESSMENT

Table H.14: Predicted Water Quality in the Mary River Under 10-Year Dry Conditions (All Discharges)

Parameter	Units	Baseline Quality in Mary River (E0-01, E0-03, E0-10)			Receiving Water Quality Objectives (Note 5)	MDMER	Discharge Scenario						WATER QUALITY IN MARY RIVER AFTER EAST POND DISCHARGE (TABLE 7-3.19)		WATER QUALITY IN MARY RIVER AFTER ROM AND MAIN STOCKPILE DISCHARGE			
							Flows Used						10-Year Low Flow Volume of Effluent Discharged from Tributary, East Pond and Open Pit = 3,133,194 m3/yr 10-Year Low Flow Volume to mix in Mary River = 53,166,261 m3/yr		10-Year Low Flow Volume after Discharge of Tributary, East Pond, Open Pit and Mary River Upstream of MR-12 = 56,299,454 m^3/yr 10-Year Low Flow Volume of ROM Pond = 12,378 m^3/yr 10-Year Low Flow Volume of Effluent from Main Ore Stockpiles = 97,573 m^3/yr Total Ore Effluent = 109,951 m^3/yr Additional Dilution in Mary River = 3,626,664 m^3/yr			
		Mean Concentration	90th Percentile Concentration	% Detects			Ore Runoff (Based on Lysimeter Monitoring Results of Bulk Sample Ore Stockpile)						Mean Baseline	90th Percentile Baseline	Mean Baseline	HQ	90th Percentile Baseline	HQ
							Lump Ore Total Metals (2010-09-07)	Lump Ore Total Metals (2010-09-19)	Fine Ore Total Metals (2010-09-07)	Fine Ore Total Metals (2010-09-19)	95th Percentile Ore Stockpile For Mean Flows Source Terms	Ore Stockpile Source Terms (Dry Year)						
pH	0	7.83	8.20		6.– - 9.0	-	5.76	5.93	6.68	6.48	6.65	6.65	7.83	8.01	7.82	-	8.0	-
Hardness	mg/L $CaCO_3$	58	105		-	-												
Aluminum	mg/L	0.191	0.394	81%	0.94	-	0.127	<0.015	<0.02	<0.06	0.112	0.170	0.20	0.39	0.20	0.2	0.39	0.4
Antimony	mg/L	-	0.0001	0%	-	-	<0.0005	<0.0005	<0.002	<0.002	0.001	0.002	-	0.000162	-	-	0.00016	-

Parameter	Units	Baseline Quality in Mary River (E0-01, E0-03, E0-10)			Receiving Water Quality Objectives (Note 5)	MDMER	Discharge Scenario – Flows Used – Ore Runoff (Based on Lysimeter Monitoring Results of Bulk Sample Ore Stockpile)						WATER QUALITY IN MARY RIVER AFTER EAST POND DISCHARGE (TABLE 7-3.19) – 10-Year Low Flow Volume of Effluent Discharged from Tributary, East Pond and Open Pit = 3,133,194 m3/yr; 10-Year Low Flow Volume to mix in Mary River = 53,166,261 m3/yr		WATER QUALITY IN MARY RIVER AFTER ROM AND MAIN STOCKPILE DISCHARGE – 10-Year Low Flow Volume after Discharge of Tributary, East Pond, Open Pit and Mary River Upstream of MR-12 = 56,299,454 m³/yr; 10-Year Low Flow Volume of ROM Pond = 12,378 m³/yr; 10-Year Low Flow Volume of Effluent from Main Ore Stockpiles = 97,573 m³/yr; Total Ore Effluent = 109,951 m³/yr; Additional Dilution in Mary River = 3,626,664 m³/yr			
		Mean Concentration	90th Percentile Concentration	% Detects			Lump Ore Total Metals (2010-09-07)	Lump Ore Total Metals (2010-09-19)	Fine Ore Total Metals (2010-09-07)	Fine Ore Total Metals (2010-09-19)	95th Percentile Ore Stockpile For Mean Flows Source Terms	Ore Stockpile Source Terms (Dry Year)	Mean Baseline	90th Percentile Baseline	Mean Baseline	HQ	90th Percentile Baseline	HQ
Arsenic	mg/L	-	0.0010	4%	0.005	0.50	<0.0005	<0.0005	<0.002	<0.002	0.001	0.002	-	0.00103	-	-	0.00103	0.2
Barium	mg/L	0.01011	0.01319	47%	-	-	0.0236	0.0251	0.0213	0.0115	0.025	0.038	0.010	0.013	0.011	-	0.013	-
Beryllium	mg/L	-	0.0005	0%	0.0053	-	<0.0025	<0.0025	<0.01	<0.01	0.005	0.008	-	-	-	-	-	-
Boron	mg/L	-	0.010	2%	1.5	-	0.16	0.16	0.21	0.31	0.295	0.447	-	0.011	-	-	0.011	0.008
Cadmium	mg/L	0.00003	0.00010	0%	0.000029	-	0.000203	0.000198	<0.0002	0.00057	0.00051	0.00078	-	0.000021	-	-	0.000027	0.9
Chromium	mg/L	0.0018	0.0020	8%	0.0047	-	<0.0025	<0.0025	<0.01	<0.01	0.0050	0.008	0.0018	0.0020	0.0018	0.4	0.0020	0.4
Cobalt	mg/L	0.0002	0.0002	4%	-	-	0.09740	0.1080	0.0462	0.1400	0.1352	0.205	0.0004	0.0004	0.0008	-	0.0008	-
Copper	mg/L	0.0012	0.0018	38%	0.0047	0.30	0.00183	<0.0025	<0.002	<0.01	0.0045	0.007	-	0.0021	-	-	0.0020	0.4
Iron	mg/L	0.18	0.36	19%	1.2	-	0.825	0.031	0.041	0.082	0.714	1.08	0.17	0.34	0.17	0.1	0.35	0.3
Lead	mg/L	0.00029	0.00087	13%	0.001	0.20	<0.0003	0.001	<0.001	<0.001	0.0009	0.001	0.00029	0.00084	0.0003	0.3	0.00084	0.8
Manganese	mg/L	0.00386	0.01000	32%	-	-	18.4	21.5	65.5	112	105.0	159.1	0.006	0.012	0.30	-	0.30	-
Mercury	mg/L	-	0.00010	0%	0.000026	-	<0.00001	0.00004	<0.00001	<0.00001	0.00003	0.00005	-	0.00011	-	-	0.00011	4.2
Molybdenum	mg/L	0.00288	0.00500	38%	0.073	-	<0.00025	<0.00025	<0.001	0.0012	0.001	0.0017	0.0030	0.0051	0.0030	0.04	0.0051	0.1
Nickel	mg/L	0.0031	0.0050	10%	0.083	0.50	0.0977	0.107	0.035	0.113	0.112	0.170	0.004	0.0054	0.0038	0.05	0.0057	0.1
Selenium	mg/L	**-**	**0.001**	0%	0.001	-	<0.005	0.0051	<0.02	<0.02	0.010	0.015	-	0.0011	-	-	0.0011	1.1
Silver	mg/L	-	0.00010	4%	0.0001	-	<0.00005	<0.00005	<0.0002	<0.0002	0.0001	0.0002	-	0.00010	-	-	0.00010	1.0
Thallium	mg/L	-	0.0001	0%	0.0008	-	<0.0005	<0.0005	<0.002	<0.002	0.001	0.002	-	0.00010	-	-	0.00011	0.1
Uranium	mg/L	0.00252	0.00468	100%	0.015	-	0.00010	<0.00005	<0.0002	<0.0002	0.0001	0.0002	-	-	-	-	-	-
Vanadium	mg/L	0.001	0.001	0%	0.006	-	<0.005	<0.005	<0.02	<0.02	0.010	0.015	-	0.0010	-	-	0.0010	0.2
Zinc	mg/L	0.003	0.006	8%	0.03	0.50	<0.005	<0.015	<0.02	<0.06	0.027	0.041	-	0.0064	-	-	0.0065	0.2

NOTES:
1. MODEL ASSUMES COMPLETE NEAR INSTANTANEOUS MIXING OF EFFLUENT AND RECEIVING WATER.
2. NO MEAN CONCENTRATION CALCULATED WHERE THE MAJORITY OF SAMPLING RESULTS WERE BELOW THE METHOD DETECTION LIMIT.
3. EFFLUENT SOURCE TERMS PROVIDED BY AMEC (JANUARY, 2012).
4. EFFLUENT SOURCE TERM OF 0.001 USED IN CALCULATIONS FOR IRON.
5. RECEIVING WATER QUALITY OBJECTIVES OBTAINED FROM CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT (CCME) CANADIAN WATER QUALITY GUIDELINES FOR THE PROECTION OF AQUATIC LIFE (PAL) (2003), CONTINUOUS CONCENTRATION (CHRONIC) NATIONAL RECOMMENDED WATER QUALITY CRITERIA (UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (2006)), BRITISH COLUMBIA MINISTRY OF ENVIRONMENT APPROVED AND WORKING WATER QUALITY GUIDELINES OR SUTER THRESHOLDS, AS APPLICABLE.
6. IN ORDER TO ESTIMATE EFFLUENT SOURCE TERMS, HALF THE METHOD DETECTION LIMIT OF A PARAMETER WAS ADOPTED WHERE MORE THAN HALF OF THE RESULTS FOR THAT PARAMETER WERE NON-DETECT (I.E. LESS THAN THE MDL). THESE EFFLUENT SOURCE TERMS ARE HIGHLIGHTED IN BLUE.

Pit Lake Water and Waste Rock Discharges to Mary River in Post-Closure – Impact Statement SWSQ-13

At the end of mining, the open pit will gradually fill with water from precipitation; time is estimated at 85 to 147 years, depending on annual precipitation, evaporation and other factors (Knight Piésold, 2008).

During the years that the pit is filling, runoff will continue to discharge to tributary F0 and the Mary River from the East Waste Rock Pond.

AMEC (2012b) developed water quality estimates for pit water for the final year of mining (Year 21), which were applied in a water quality model under the assumption that, once the pit has filled, in each subsequent (post-Closure) year all precipitation into the open pit will accumulate and spill over the southern edge facing the Mary River, behaving like a spillway, and that water will be released during the open water period according to the natural hydrograph.

Based on pit water quality for Year 21 of mining, it is possible the water will have A pH of around 4.2, which is outside of thE pH range of the MDMER (6.0 to 9.0). Adjustment oF pH will be carried out periodically through post-closure using either batch lime treatment or in-line treatment, drawing down the pit lake periodically. As mentioned in above, the mass loading modelling carried out is based on conservative assumptions and Baffinland is continuing to study the geochemistry of waste rock and ore to further refine predictions, management plans, and post-closure strategies.

Residual Effects Ratings

Magnitude

The estimated water quality in the Mary River from pit water and waste rock stormwater discharges, assuming no treatment to adjusT pH of pit water, is presented in Table H.15. The mass balance modelling indicates that Level I magnitude effects to water quality will occur under low flow conditions, with a calculated HQ between 1 and 10 for mercury, selenium and silver. It is noted that an HQ >10 was calculated for mercury within the F0 tributary, upstream of fish; however, since the assessment of water and sediment quality is based on fish as the receptor, the effects assessment considers the resultant water quality at fish habitat within the Mary River, where all parameters have an HQ value less than 10.

Duration

The effects associated with the discharge of pit water and waste rock runoff into the Mary River are permanent; Level III duration. The waste rock seepage will run off into the Mary River starting in the first year post-closure, whereas the pit water is not expected to discharge to the Mary River until the pit fills, after 80 years or more.

Frequency

The frequency of the potential effect will be annual, limited to the period between June and September when discharge is proposed. A Level II frequency rating was assigned.

Extent

The extent of the potential effect is likely to be limited to the Mine Site freshwater LSA; a Level I extent rating was assigned.

Reversibility

The effects associated with the discharge of pit water and waste rock runoff into the Mary River is partially reversible. A Level II reversibility rating was assigned.

Significance – SWSQ-13 – Pit Lake Water and Waste Rock Discharges to Mary River in Post-Closure

Based on these ratings, discharge of pit water and stormwater from the East Waste Rock Sedimentation Pond into the Mary River is not expected to result in an adverse environmental effect on water and sediment quality in the Mine Site LSA. The residual effect is ranked as *Not Significant* (Table H.7). The Level of Confidence (Table H.8) is Medium, due to the assumptions made in the mass loading models and the consequently highly conservative nature of the effect prediction.

Table H.15: Predicted Water Quality in the Mary River During Post-Closure Due to Discharges of Pit Water and Waste Rock Stormwater Under 10-Year Low Flow Conditions

Parameter	Units	Baseline Quality in Trib F0 (F0-01, F0-05)			Baseline Quality in Mary River (E0-01, E0-03, E0-10)			Receiving Water Quality Objectives (Note 5)	MDMER (Mean Monthly)	Discharge Scenario			COMBINED EFFLUENT DISCHARGE FROM THE EAST WASTE ROCK POND	WATER QUALITY IN RECEIVING WATERS: WATER QUALITY IN TRIB MR-12 (U/S OF FISH HABITAT)				WATER QUALITY IN RECEIVING WATERS: WATER QUALITY IN MARY RIVER AT MR-12 (FISH HABITAT)			
										Flows Used			10-Year Low Flow Volume of Effluent from East Pond = 244,291 m³/yr 10-Year Low Flow Volume of Effluent from Open Pit = 296,971 m³/yr	10-Year Low Flow Volume of Effluent Discharged from East Pond and Open Pit = 541,262 m³/yr 10-Year Low Flow Volume to mix at MR-12 = 2,740,417 m³/yr				10-Year Low Flow Volume of Effluent Discharged from Tributary, East Pond & Open Pit = 3,281,679 m³/yr 10-Year Low Flow Volume to mix in Mary River = 53,166,261 m³/yr			
		Mean Concentration	90th Percentile Concentration	% Detects	Mean Concentration	90th Percentile Concentration	% Detects			Baseline Concentrations			Mean	Mean	HQ	90th Percentile	HQ	Mean	HQ	90th Percentile	HQ
										Pit Water Source Terms (Year 21)	East Waste Rock Source Term (Mean Flows)	East Waste Rock Source Terms (Dry Year)									
pH	0	8.01	8.31		7.83	8.20		6.5 - 9.0	-	4.20	6.9	6.9	5.42	7.58	-	7.83	-	7.82	-	8.18	-
Hardness	mg/L CaCO₃	84	133		58	105		-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chloride	mg/L	5.7	18.6		8.3	17.0		120	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Suspended Solids	mg/L	-	2		3	6		15	15.00	-	-	-	-	-	-	-	-	-	-	-	-
Total Alkalinity	mg/L CaCO₃	74	108		47	81		-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia	mg/L	0.06	0.11		0.05	0.07		-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate	mg/L	0.1	0.1		-	0.1		13	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrite	mg/L	0.011	0.017		0.010	0.014		0.06	-	-	-	-	-	-	-	-	-	-	-	-	-
Sulphate	mg/L	2	4		3	5		-	-	239	26	39	149	26	-	28	-	4	-	6	-
Total Phosphorous	mg/L	0.013	0.030		0.013	0.026		-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aluminum	mg/L	0.020	0.042	81%	0.191	0.394	100%	0.94	-	6.4	0.095	0.144	3.56	0.60	0.6	0.62	0.7	0.21	0.229	0.41	0.4
Antimony	mg/L	-	0.0004	0%	-	0.0001	2%	-	-	0.012	0.003	0.004	0.01	-	-	0.0017	-	-	-	0.00019	-
Arsenic	mg/L	-	0.0010	4%	-	0.0010	8%	0.005	0.50	0.011	0.002	0.003	0.007	-	-	0.0020	0.4	-	-	0.00106	0.2
Barium	mg/L	0.00945	0.01068	47%	0.01011	0.01319	57%	-	-	0.0515	0.051	0.077	0.06	0.01831	-	0.019	-	0.011	-	0.014	-
Beryllium	mg/L	-	0.0050	0%	-	0.0005	0%	0.0053	-	-	-	-	-	-	-	-	-	-	-	-	-
Boron	mg/L	-	0.010	2%	-	0.010	6%	1.5	-	0.17	0.020	0.030	0.105	-	-	0.026	0.02	-	-	0.011	0.01
Cadmium	mg/L	-	0.0000200	0%	-	0.00002	8%	0.000029	-	0.00024	0.00002	0.00002	0.0001	-	-	0.000040	1.4	-	-	0.000021	0.7
Chromium	mg/L	0.0010	0.0010	8%	0.0018	0.0020	27%	0.0047	-	0.029	0.002	0.003	0.017	0.004	0.8	0.0037	0.8	0.0019	0.406	0.0021	0.4
Cobalt	mg/L	0.0002	0.0003	4%	0.0002	0.0002	20%	-	-	0.080	0.0006	0.0010	0.044	0.008	-	0.0076	-	0.0006	-	0.00063	-
Copper	mg/L	-	0.0009	38%	0.0012	0.0018	64%	0.0047	0.30	0.112	0.003	0.004	0.063	-	-	0.011	2.4	-	-	0.0023	0.5
Iron	mg/L	0.04	0.05	19%	0.18	0.36	86%	1.2	-	0.33	0.001	0.002	0.18	0.064	0.1	0.072	0.06	0.17	0.144	0.34	0.3
Lead	mg/L	0.00016	0.00020	13%	0.00029	0.00087	35%	0.001	0.20	0.0033	0.0002	0.0002	0.002	0.0005	0.5	0.00049	0.5	0.00030	0.299	0.00085	0.8
Manganese	mg/L	0.00260	0.01000	32%	0.00386	0.01000	48%	-	-	0.86	0.00004	0.00006	0.47	0.080	-	0.087	-	0.008	-	0.01445	-

Parameter	Units	Baseline Quality in Trib F0 (F0-01, F0-05)			Baseline Quality in Mary River (E0-01, E0-03, E0-10)			Receiving Water Quality Objectives (Note 5)	MDMER (Mean Monthly)	Discharge Scenario			COMBINED EFFLUENT DISCHARGE FROM THE EAST WASTE ROCK POND	WATER QUALITY IN RECEIVING WATERS							
														WATER QUALITY IN TRIB MR-12 (U/S OF FISH HABITAT)				WATER QUALITY IN MARY RIVER AT MR-12 (FISH HABITAT)			
										Flows Used			10-Year Low Flow Volume of Effluent from East Pond = 244,291 m^3/yr 10-Year Low Flow Volume of Effluent from Open Pit = 296,971 m^3/yr	10-Year Low Flow Volume of Effluent Discharged from East Pond and Open Pit = 541,262 m^3/yr 10-Year Low Flow Volume to mix at MR-12 = 2,740,417 m^3/yr				10-Year Low Flow Volume of Effluent Discharged from Tributary, East Pond & Open Pit = 3,281,679 m^3/yr 10-Year Low Flow Volume to mix in Mary River = 53,166,261 m^3/yr			
		Mean Concentration	90th Percentile Concentration	% Detects	Mean Concentration	90th Percentile Concentration	% Detects			Baseline Concentrations			Mean	Mean	HQ	90th Percentile	HQ	Mean	HQ	90th Percentile	HQ
										Pit Water Source Terms (Year 21)	East Waste Rock Source Term (Mean Flows)	East Waste Rock Source Terms (Dry Year)									
Mercury	mg/L	-	0.00010	0%	-	0.00010	2%	0.000026	-	0.0024	0.00045	0.00068	0.002	-	-	0.00035	13.6	-	-	0.00011	4.4
Molybdenum	mg/L	0.00306	0.00500	38%	0.00288	0.00500	46%	0.073	-	0.041	0.008	0.012	0.028	0.007	0.1	0.0088	0.12	0.0031	0.043	0.0052	0.07
Nickel	mg/L	0.0032	0.0050	10%	0.0031	0.0050	92%	0.083	0.50	0.17	0.002	0.002	0.092	0.018	0.2	0.019	0.2	0.004	0.048	0.0058	0.07
Selenium	mg/L	-	0.001	0%	-	0.001	0%	0.001	-	0.033	0.005	0.008	0.02	-	-	0.0044	4.4	-	-	0.0012	1.2
Silver	mg/L	-	0.00010	4%	-	0.00010	10%	0.0001	-	0.0012	0.0001	0.0001	0.001	-	-	0.00020	2.0	-	-	0.00011	1.1
Thallium	mg/L	-	0.0001	0%	-	0.0001	0%	0.0008	-	0.0014	0.0002	0.0003	0.001	-	-	0.00023	0.3	-	-	0.00011	0.1
Uranium	mg/L	0.00213	0.00299	100%	0.00252	0.00468	98%	0.015	-	-	-	-	-	-	-	-	-	-	-	-	-
Vanadium	mg/L	-	0.001	0%	0.001	0.001	11%	0.006	-	0.0044	0.001	0.001	0.003	-	-	0.0013	0.2	-	-	0.0010	0.2
Zinc	mg/L	-	0.009	8%	0.003	0.006	25%	0.03	0.50	0.094	0.010	0.015	0.058	-	-	0.017	0.6	-	-	0.0066	0.2

NOTES:
1. MODEL ASSUMES COMPLETE NEAR INSTANTANEOUS MIXING OF EFFLUENT AND RECEIVING WATER.
2. NO MEAN CONCENTRATION CALCULATED WHERE THE MAJORITY OF SAMPLING RESULTS WERE BELOW THE METHOD DETECTION LIMIT.
3. EFFLUENT SOURCE TERMS PROVIDED BY AMEC (JANUARY, 2012).
4. EFFLUENT SOURCE TERM OF 0.001 USED IN CALCULATIONS FOR IRON.
5. RECEIVING WATER QUALITY OBJECTIVES OBTAINED FROM CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT (CCME) CANADIAN WATER QUALITY GUIDELINES FOR THE PROECTION OF AQUATIC LIFE (PAL) (2003), CONTINUOUS CONCENTRATION (CHRONIC) NATIONAL RECOMMENDED WATER QUALITY CRITERIA (UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (2006)), BRITISH COLUMBIA MINISTRY OF ENVIRONMENT APPROVED AND WORKING WATER QUALITY GUIDELINES OR SUTER THRESHOLDS, AS APPLICABLE.
6. IN ORDER TO ESTIMATE EFFLUENT SOURCE TERMS, HALF THE METHOD DETECTION LIMIT OF A PARAMETER WAS ADOPTED WHERE MORE THAN HALF OF THE RESULTS FOR THAT PARAMETER WERE NON-DETECT (I.E. LESS THAN THE MDL). THESE EFFLUENT SOURCE TERMS ARE HIGHLIGHTED IN BLUE.
7. RESULTS WITH AN HQ GREATER THAN 1 ARE HIGHLIGHTED IN ORANGE, TO FOCUS DISCUSSION IN THE EFFECTS ASSESSMENT.

References

1. AMEC 2012c. Interim Mine Rock ML/ARD Report, Mary River Project, January 2012.
2. AMEC. 2012a. Interim Waste Rock Stockpile Seepage Quality Model Report, Mary River Project. January 2012.
3. AMEC. 2012b. Interim Open Pit Water Quality Model Technical Memorandum, Mary River Project. January 2012.